AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between City of Sandpoint, Idaho ("Owner") and Apollo, Inc. ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

The project can be summarized to Installation of two owner-furnished screw presses; removal of existing belt presses, associated access platform and stairs; modifications to existing digested sludge, utility water, and polymer piping; installation of associated mechanical systems; electrical upgrades, structural modifications including roof replacement and new lift hatch; and HVAC improvements within the dewatering building.

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: City of Sandpoint –WWTP Screw Press Upgrade

ARTICLE 3—ENGINEER

3.01 The Owner will assume all duties and responsibilities of Engineer, and have rights and authority assigned to Engineer in the Contract.

3.02 The project has been designed by the Owner's consultant Stantec.

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Dates*

A. The Work will be substantially complete on or before **April 23, 2027**, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before **May 7, 2027**.

4.05 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and

difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $1,000.00 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $500.00 for each day that expires after such time until the Work is completed and ready for final payment.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the 30th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. 95 percent of the value of the Work completed (with the balance being retainage).

b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

A. All amounts not paid when due will bear interest at the rate of 6% percent per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

A. The Contract Documents consist of all of the following:

1. This Agreement.
2. Bonds:
    a. Performance bond (together with power of attorney).
    b. Payment bond (together with power of attorney).
3. Standard General Conditions, EJCDC C-700 (2018 Edition).
4. Supplementary Conditions.
5. Specifications (not attached but incorporated by reference) consisting of the Idaho Standards for Public Works Construction (ISPWC – 2020 Edition), excluding Division 100.
6. Technical Specifications
7. Drawings consisting of 41 sheets with each sheet bearing the following general title **WWTP Screw Press Upgrade.**
8. Addenda (numbers 1 to 3, inclusive).
9. Contractor's Bid
10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.
    e. Warranty Bond, if any.

11. In the event of inconsistency between the Contract Documents, the Contract Documents shall be interpreted in accordance with the listed priorities set forth in this provision, i.e, requirements of item 1 shall supersede all lower ranked items.

B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.

2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Contractor has carefully studied the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the drawings.

5. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

6. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

7. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

8. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of

discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

9. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

10. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

11. The Contractor is an appropriately licensed public works contractor per Idaho Code Section 54-1902.

12. Contractor shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring the Contractor's compliance with any Laws or Regulations.

8.02 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

B. This is to certify that Contractor and its agents is not owned or operated by the government of China, nor will it be owned or operated by the government of China during the duration of any and all contracts entered into with the Owner.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on July 02, 2026 (which is the Effective Date of the Contract).

Owner:	Contractor:
City of Sandpoint *(typed or printed name of organization)*	Apollo, Inc. *(typed or printed name of organization)*
By: _____ *(individual's signature)*	By: _____ *(individual's signature)*
Date: July 01, 2026 *(date signed)*	Date: _____ *(date signed)*
Name: Jeremy Grimm *(typed or printed)*	Name: _____ *(typed or printed)*
Title: Mayor *(typed or printed)*	Title: _____ *(typed or printed)* *(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*
Attest: _____ *(individual's signature)*	Attest: _____ *(individual's signature)*
Title: Meri Jane Bohn, City Clerk *(typed or printed)*	Title: _____ *(typed or printed)*
Address for giving notices:	Address for giving notices:
City of Sandpoint, City Clerk	1133 W. Columbia Avenue
1123 Lake Street	Kennewick, Washington 99336
Sandpoint, Idaho 83864	
Designated Representative:	Designated Representative:
Name: Holly Ellis *(typed or printed)*	Name: _____ *(typed or printed)*
Title: Public Works Director *(typed or printed)*	Title: _____ *(typed or printed)*
Address:	Address:
City of Sandpoint	
1123 Lake Street	
Sandpoint, Idaho 83864	
Phone: (208) 946-2087	Phone: _____
Email: hellis@sandpointidaho.gov	Email: _____
*(If **[Type of Entity]** is a corporation, attach evidence of authority to sign. If **[Type of Entity]** is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)*	License No.: PWC-C-14034 *(where applicable)*
	State: Idaho

PERFORMANCE BOND

Contractor	**Surety**
Name: **Apollo, Inc** Address *(principal place of business)*: **1133 W. Columbia Drive** **Kennewick, Washington 99336**	Name: Address *(principal place of business)*:
Owner	**Contract**
Name: City of Sandpoint Mailing address *(principal place of business)*: 1123 Lake St. Sandpoint, Idaho 83864	Description *(name and location)*: **A26-3257-1 WWTP Screw Press Upgrade** Contract Price: $2,729,575.00 Effective Date of Contract: July 02, 2026

Bond

Bond Amount:

Date of Bond:

(~~Date of Bond cannot be earlier than~~ Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:

    3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;

    3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

    3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

    5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

    5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

    5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

    5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

   7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

   7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

   7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

    14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

    14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

    14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

    14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

16. Modifications to this Bond are as follows: **None**

PAYMENT BOND

Contractor	**Surety**
Name: **Apollo, Inc** Address *(principal place of business)*: **1133 W. Columbia Drive** **Kennewick, Washington 99336**	Name: Address *(principal place of business)*:
Owner	**Contract**
Name: **City of Sandpoint** Mailing address *(principal place of business)*: **1123 Lake St.** **Sandpoint, ID 83864**	Description *(name and location)*: **A26-3257-1 –WWTP Screw Press Upgrade** Contract Price: $2,729,575.00 Effective Date of Contract: July 02, 2026

Bond

Bond Amount:

Date of Bond:

(~~Date of Bond cannot be earlier than~~ Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____	_____
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

    5.1. Claimants who do not have a direct contract with the Contractor

        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2. Pay or arrange for payment of any undisputed amounts.

    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

    16.1. *Claim*—A written statement by the Claimant including at a minimum:

        16.1.1. The name of the Claimant;

        16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

18. Modifications to this Bond are as follows: **None**

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

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requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

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recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

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33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

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43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. *Unit Price Work*—Work to be paid for on the basis of unit prices.

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

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1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. A Preliminary Schedules: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. A preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

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2. A preliminary Schedule of Submittals; and. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work

2.04 Preconstruction Conference; Designation of Authorized Representatives

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Owner, Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the

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recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective

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to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as

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possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

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4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or

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adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

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ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

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B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

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4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

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Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

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3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

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of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

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Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

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Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

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L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

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4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

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Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

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6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

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2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

    a. will certify that the proposed substitute item will:

        1) perform adequately the functions and achieve the results called for by the general design;

        2) be similar in substance to the item specified; and

        3) be suited to the same use as the item specified.

    b. will state:

        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

        3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

    c. will identify:

        1) all variations of the proposed substitute item from the item specified; and

        2) available engineering, sales, maintenance, repair, and replacement services.

    d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

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7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

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7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

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I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

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3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

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document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

   a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

   b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

   c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

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d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

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9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

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D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

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E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

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B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

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9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

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ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

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E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

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ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or
2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
    a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
    b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
    c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
    d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
    e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
    f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

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11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

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Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

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and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

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2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

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consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

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thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

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D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

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losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

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or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

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establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

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b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

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submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

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significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

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d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

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appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;

2. correct such defective Work;

3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

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attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

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provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

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18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

SC-1.01 Delete Paragraph 1.01.A.46.c in its entirety and replace with the following:

46.c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

SC-1.01 Add the following immediately after Paragraph 1.01.A.50:

51. *Special Provisions* - The part of the Contract that amends or supplements the Specifications.

52. *Request for Information* – A written request for information or clarification, requiring a written response to Owner, Engineer, or Contractor, initiated by Owner, Engineer, or Contractor.

53. *Owner Furnished Equipment (OFE)* - Equipment and related services procured by Owner prior to Contract award and assigned to Contractor for incorporation into the Work.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:

A. Owner shall furnish to Contractor **[1]** electronic copy of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully signed counterpart of the Agreement). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

2.03 *Before Starting Construction*

SC-2.03 Delete Paragraph 2.03.A.1 in its entirety and replace with the following:

1. A detailed Progress Schedule in Gantt Chart format or similar used to plan, coordinate, and control the progress of construction and shall include the following:

a. provide for orderly, timely, and efficient prosecution of the Work;

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b. contain sufficient detail to enable both the Contractor and the Engineer to plan,

coordinate, and control their respective Contract responsibilities

c. sufficient detail for each Schedule of Value activity, at a minimum, and indicate the durations, dates for starting and completing the various stages of the Work, and including subcontractor work; and,

d. durations and relationships of required submittals, major material procurement lead times, permitting, traffic control, and any utility coordination.

2.05 *Acceptance of Schedules*

SC-2.05 Delete Paragraph 2.05.A in its entirety and replace with the following:

A. No Work on Site shall begin until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times and meets the requirements of the Contract. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 3 days to revise and resubmit the schedule.

SC-2.05 Add the following immediately after Paragraph 2.05.A:

B. Acceptance of the Progress Schedule will provide an overall baseline for progressing the Work and be supplemented with a "look-ahead" Work schedule each week to the Engineer. The "look-ahead" Project Work schedule will be presented in a bar chart that shows at least three weeks of activity including the week the bar chart is issued with the largest time scale unit of 1 calendar day (smaller scales may be used) representing each activity that will be done including the location/limits of the Work. The first "look-ahead" schedule will be provided within one week after acceptance of the Progress Schedule.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

SC-3.01 Delete Paragraph 3.01.C in its entirety.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.05 *Delays in Contractor's Progress*

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SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.

b. The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.

6. *Owner-Furnished Equipment*

a. Delays attributable solely to late delivery, defects, or supplier-related issues of Owner-Furnished Equipment, not caused by Contractor, shall be considered excusable delays. Contractor shall not be subject to liquidated damages for such delays, provided timely notice is given.

ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.02 *Use of Site and Other Areas*

SC-5.02 Delete Paragraph 5.02.A.2 and insert the following paragraph in its place:

A. 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, defend, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

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5.03 *Subsurface and Physical Conditions*

SC-5.03 Delete Paragraph 5.03A in its entirety and replace with the following:

A. *Reports and Drawings*: No reports or drawings related to explorations and tests of subsurface conditions or existing physical conditions at or adjacent to the Site are known by Owner.

5.04 *Differing Subsurface or Physical Conditions*

SC-5.04 Delete Paragraph 5.04.A in its entirety and replace with the following:

A. Notice by Contractor: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

5.06 *Hazardous Environmental Conditions*

SC-5.06 Delete Paragraph 5.06A and 5.06B in its entirety and replace with the following:

A. *Reports and Drawings:* No reports or drawings related to Hazardous Environmental Conditions at the Site are known by Owner.

B. Not used.

SC-5.06 Delete Paragraph 5.06.J and insert the following paragraph in its place:

To the fullest extent permitted by Laws and Regulations, Contractor shall defend, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for Whom Contractor is responsible. Nothing in Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

ARTICLE 6—BONDS AND INSURANCE

6.02 *Insurance—General Provisions*

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker's

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compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.D:

1. All certificates of insurance shall name as additionally insured:

    a. Owner: City of Sandpoint

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

D. *Workers' Compensation and Employer's Liability:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions). All insurance policies shall contain a Waiver of Subrogation coverage or endorsements.

Workers' Compensation and Related Policies	**Policy limits of not less than:**
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory

F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
2. damages insured by reasonably available personal injury liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.
    a. Such insurance must be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

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2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
4. Underground, explosion, and collapse coverage.
5. Personal injury coverage.
6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
8. All policies shall contain waiver of subrogation coverage or endorsements.

H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).
6. Any limitation or exclusion based on the nature of Contractor's work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	**Policy limits of not less than:**
General Aggregate	$2,000,000.00
Products—Completed Operations Aggregate	$2,000,000.00
Personal and Advertising Injury	$1,000,000.00
Bodily Injury and Property Damage—Each Occurrence	$1,000,000.00

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J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	**Policy limits of not less than:**
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$1,000,000.00

K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	**Policy limits of not less than:**
Each Occurrence	$2,000,000.00
General Aggregate	$2,000,000.00

L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein.

M. *Contractor's Pollution Liability Insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

Contractor's Pollution Liability	**Policy limits of not less than:**
General Aggregate	$1,000,000.00

N. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

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Contractor's Professional Liability	Policy limits of not less than:
Each Claim	$500,000.00
Annual Aggregate	$1,000,000.00

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Delete Paragraphs 6.04.B and 6.04.C in their entirety and add the following immediately after Paragraph 6.04.E:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

    a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.

    b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.

2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).

4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

5. extend to cover damage or loss to insured property while in transit.

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6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.
7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.
8. include performance/hot testing and start-up, if applicable.
9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.
10 include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds."

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

SC-7.03 Delete Paragraph 7.03.C in its entirety, and insert the following:

C. Contractor may perform the Work at the Site only between the hours of 7AM and 5PM, Monday thru Friday unless otherwise authorized by the Owner in writing.

D. Contractor shall perform the Work in a manner that maintains continuous operation of the wastewater treatment plant.

E. Contractor shall comply with all operational constraints, outage requirements, and sequencing requirements identified in the Specifications.

F. All temporary systems, bypass systems, night work, weekend work, and overtime required to maintain operations shall be included in the Contract Price.

7.09 *Permits*

SC-7.09 Add the following immediately after Paragraph 7.09.A:

B. Contractor and any subcontractors shall obtain a City of Sandpoint Business License prior to mobilization.

7.10 *Taxes*

SC-7.10 Add the following paragraph immediately after Paragraph 7.10.A:

B. In the event of the Contractor's default on the payment of taxes, excises, and license fees as set forth in Idaho Code 63-1503, the Owner shall have the authority to withhold from any payment due the Contractor under this contract, the estimated amount of such accrued and accruing taxes, excises, and license fees for the benefit of all taxing authorities to which said Contractor is liable.

C. Contractor shall be responsible for payment of all applicable sales and use taxes associated with Owner-furnished equipment assigned to Contractor, including any taxes due as a result of transfer of ownership or incorporation into the Work.

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D. The Contract Price includes all such taxes, including those related to Owner-furnished equipment assigned to the Contractor. No separate or additional payment will be made for sales or use taxes except as specifically provided in the Contract Documents.
E. No overhead, profit, or other markups shall be applied to sales or use taxes.

7.11 *Laws and Regulations*

SC-7.11 Add the following paragraph immediately after Paragraph 7.11.C:

D. While not intended to be inclusive of all Laws or Regulations for which Contractor may be responsible under paragraph 6.09, the following Laws or Regulations are included as mandated by statute or for the convenience of the Contractor;

1. **Idaho Code Section 63-1501. Definitions.** As used in this act, the following terms shall have the following meanings:

   "Contracting units" shall include the state or any officer or department thereof, the counties or other subdivisions of the state, and all municipal and quasi-municipal corporations therein.

   "Contractor" shall mean any person, firm, co-partnership, association, or corporation, foreign or domestic, entering into a contract for the construction, erection, repair, or improvement of any kind or character of public works in this state.

   "Taxes" shall mean all taxes, assessments, excises, and license fees authorized to be levied, assessed, and collected under the laws of this state, other than taxes on real property.

   "Taxing unit" shall mean the state or any officer or department thereof, the counties or other subdivisions of the state, and all municipal and quasi-municipal corporations therein authorized by law to assess, levy and collect taxes.

2. **Idaho Code Section 63-1502. Conditions precedent to contract for public works.** Before entering into a contract for the construction of any public works in this state, the contracting unit shall require as conditions precedent that the contractor be authorized to do business in this state and that he furnish satisfactory evidence that he has paid or secured to the satisfaction of the respective taxing units all taxes for which he or his property is liable then due or delinquent.

3. **Idaho Code Section 63-1503. Contractor for public works to pay or secure taxes—Agreement.** Every contract for the construction of public works by a contracting unit of this state shall contain substantially the following provisions:

   The Contractor, in consideration of securing the business of erecting or constructing public works in this state, recognizing that the business in which he is engaged is of a transitory character, and that in the pursuit thereof, his property used therein may be without the state when taxes, excises, or license fees to which he is liable become payable, agrees:

   a. To pay promptly when due all taxes (other than on real property), excises and license fees due to the state, its subdivisions, and municipal and quasi-municipal corporations therein accrued or accruing during the term of this contract, whether or not the same shall be payable at the end of such term;

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b. That if the said taxes, excises, and license fees are not payable at the end of said term, but liability for the payment thereof exists, even though the same constitute liens upon his property, to secure the same to the satisfaction of the respective officers charged with the collection thereof; and

c. That in the event of his default in the payment or securing of such taxes, excises, and license fees, to consent that the department, officer, board, or taxing unit entering into this contract may withhold from any payment due him hereunder the estimated amount of such accrued and accruing taxes, excises, and license fees for the benefit of all taxing units to which said contractor is liable.

4. **Idaho Code Section 44-1002** requires the following: The Contractor must employ ninety-five percent (95%) bona fide Idaho residents as employees on any job under any such contract except where under such contracts fifty (50) or less persons are employed, the Contractor may employ ten percent (10%) nonresidents, provided, however, in all cases employers must give preference to the employment of bona fide residents in the performance of said work, and no contract shall be let to any person, firm, association, or corporation refusing to execute an agreement with the above mentioned provisions in it; provided, that, in contracts involving the expenditure of federal aid funds this act shall not be enforced in such a manner as to conflict with or be contrary to the federal statutes prescribing a labor preference to honorably discharged soldiers, sailors, and marines, prohibiting as unlawful any other preference or discrimination among citizens of the United States.

5. **Idaho Code Chapter 19 of Title 54** requires proper licensing of Public Works Contractors.

7.13 *Safety and Protection*

SC-7.13 Add the following paragraph immediately following Paragraph J.

K. Contractor shall be responsible for all costs, penalties, damages, and claims resulting from violations of permit requirements caused by Contractor's operations.

L. Owner may take corrective action to maintain compliance, and such costs may be deducted from payments due Contractor.

7.18 *Indemnification*

SC-7.18 Delete Paragraph 7.18.A in its entirety and insert the following paragraph in its place:

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property)other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity

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directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

7.20 *Assignment of Owner-Furnished Equipment Purchase Orders*

SC-7.20 Add the following Paragraph immediately after Paragraph 7.19:

A. Owner shall assign to Contractor certain purchase orders for Owner-Furnished Equipment (OFE) identified in the Contract Documents.

B. Upon execution of the Agreement or as otherwise directed by Owner, Contractor shall accept assignment of such purchase orders and assume responsibility for coordination, payment, delivery, storage, installation, and integration of the OFE into the Work.

C. Contractor shall be responsible for all obligations of the purchaser under the assigned purchase orders from the date of assignment forward, including payment to the supplier.

D. Owner shall remain responsible for obligations incurred prior to the effective date of assignment.

E. Assignment shall not relieve Contractor of responsibility for providing a complete and functional system.

ARTICLE 8—OTHER WORK AT THE SITE

No Supplementary Conditions in this Article.

ARTICLE 9—OWNER'S RESPONSIBILITIES

No Supplementary Conditions in this Article.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.02 *Visits to Site.*

SC-10.02 Delete Paragraphs 10.02 in its entirety.

10.03 *Resident Project Representative.*

SC-10.03 Delete Paragraphs 10.03 in its entirety.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

SC-11.01 Delete Paragraph 11.01.C in its entirety and insert the following in its place:

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by CWE's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of CWE.

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ARTICLE 12—CLAIMS

No Supplementary Conditions in this Article.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

No Supplementary Conditions in this Article.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

No Supplementary Conditions in this Article.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

No Supplementary Conditions in this Article.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

No Supplementary Conditions in this Article.

ARTICLE 18—MISCELLANEOUS

18.07 *Controlling Law*

SC-18.07 Delete Paragraph 18.07 in its entirety and insert the following paragraph in its place:

This Contract is to be governed by the law of the State of Idaho. The jurisdiction/venue for any action arising out of performance of this Contract, or interpretation of its terms and conditions, shall be in the District Court in the First Judicial District of the State of Idaho, Bonner County. In any action to enforce the terms and conditions of this Contract, the prevailing party may recover its reasonable attorney fees.

Add the following Article 19 – Prosecution of the Work, immediately following Article 18 - Miscellaneous.

ARTICLE 19—PROSECUTION OF THE WORK

SC-19.01 *General*

A. From the time of commencement of the Work to the time of Final Acceptance the Contractor shall: provide adequate Materials, Equipment, labor, and supervision to perform and complete the Work; perform the Work as vigorously and as continuously as conditions permit, and according to a Project Work schedule that ensures completion within the Contract Time or the adjusted Contract Time; not voluntarily suspend or slow down

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operations without prior written approval from the Engineer; and not resume suspended Work without the Engineer's written authorization.

SC-19.02 *Cost Reduction Proposals*

B. The Contractor may submit written proposals to the Engineer that modify Plans, Specifications, or other Contract Documents for the sole purpose of reducing the total cost of construction. Unless otherwise agreed to in writing, a proposal that is solely or primarily a proposal to reduce estimated quantities or delete Work, is not eligible for consideration as a cost reduction proposal.

C. Proposal Requirements - The Engineer will not adopt a cost reduction proposal that impairs essential functions or characteristics of the Project, including, but not limited to, service life, economy of operation, ease of maintenance, designed appearance, or design and safety standards.

To conserve time and funds, the Contractor may first submit a written request for a feasibility review by the Engineer. The request should contain a description of the proposal together with a rough estimate of anticipated dollar and time savings. The Engineer will, within a reasonable time, advise the Contractor in writing whether or not the proposal would be considered by the Engineer, should the Contractor elect to submit a detailed cost reduction proposal.

D. A detailed cost reduction proposal shall include without limitation the following information:

1. A description of existing Contract requirements for performing the Work and the proposed change;
2. The Contract items of Work affected by the proposed change, including any quantity variation caused by the proposed change;
3. Pay Items affected by the proposed change including any quantity variations;
4. A detailed cost estimate for performing the Work under the existing Contract and under the proposed change.

Costs of re-design, which are incurred after the Engineer has accepted the proposal, shall be included in the cost of proposed work; and a date by which the Engineer must accept the proposal in order to accept the proposed change without impacting the Contract Time or cost reduction amount.

E. Continuing to Perform Work - The Contractor shall continue to perform the Work according to Contract requirements until the Engineer issues a Change Order incorporating the cost reduction proposal. If the Engineer fails to issue a Change Order by the date specified in the proposal, the proposal shall be deemed rejected.

F. Consideration of Proposal - The Engineer is not obligated to consider any cost reduction proposal. The Engineer will not be liable to the Contractor for failure to accept or act upon any cost reduction proposal submitted. The Engineer will determine in its sole discretion whether to accept a cost reduction proposal as well as the estimated net savings in construction costs from the adoption of all or any part of the proposal. In determining the estimated net savings, the Engineer may disregard the Schedule of Items. The Engineer will

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establish prices that represent a fair measure of the value of Work to be performed or to be deleted as a result of the cost reduction proposal.

G. Sharing Investigation Costs - As a condition for considering a Contractor's cost reduction proposal, the Engineer reserves the right to require the Contractor to share in the Engineer's costs of investigating the proposal. If the Engineer exercises this right, the Contractor shall provide written acceptance of the condition to the Engineer. Such acceptance will authorize the Engineer to deduct its share of investigation costs from payments due or that may become due to the Contractor under the Contract.

H. Acceptance of Proposal Requirements - If the Contractor's cost reduction proposal is accepted in whole or in part, acceptance will be made by a Change Order. The Contractor's cost of preparing the cost reduction proposal and the Engineer's costs of investigating the proposal, including any portion paid by the Contractor, will be excluded from determination of the estimated net savings in construction costs. Costs of re-design, which are incurred after the Engineer has accepted the proposal, will be included in the cost of the Work attributable to cost reduction measures. If the Engineer accepts the cost reduction proposal, the Change Order that authorizes the cost reduction measures will also address any Contract Time adjustment.

SC-19.03 *Force Account Work*

The Materials, Equipment and labor rates and procedures established in this Section apply to Extra Work ordered by the Engineer to be performed as Force Account Work.

A. Extra Work on a Force Account Basis - Before ordering Force Account Work, the Engineer will discuss the proposed work with the Contractor, and will seek the Contractor's comments and advice concerning the formulation of Force Account Work specifications. The Engineer is not bound by the Contractor's comments and advice, and has final authority to: determine and direct the Materials, Equipment and labor to be used on the approved Force Account Work and to determine the time of the Contractor's performance of the ordered Force Account Work.

B. If the Engineer orders the performance of Extra Work as Force Account Work, the Engineer will record, on a daily basis, the Materials, Equipment, labor, and Special Services used for the Force Account Work during that day. The Engineer and the Contractor shall sign the record daily to indicate agreement on the Materials, Equipment, labor, and Special Services used for the Force Account Work performed on that day.

C. The Owner will not be responsible for additional costs that are a direct or indirect result of the Contractor's inefficient means and methods or that reasonably could have been avoided if the Materials, Equipment, labor or services had been obtained at a more commercially reasonable cost.

D. Payment for Force Account Work shall be negotiated and agreed upon by Change Order.

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Sandpoint WWTP Screw Press Upgrade

Volume 1: Technical Specifications



January 23, 2026

Prepared for:
City of Sandpoint, Idaho

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VOLUME 1 TECHNICAL SPECIFICATIONS

Sandpoint WWTP Screw Press Upgrade

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SECTION 01 10 00 – SUMMARY OF WORK

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Work to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the Owner.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of this Contract comprises the construction of new screw presses to replace the existing belt presses in the existing dewatering building which includes:

1. Variable Frequency Drive added to existing Sludge Pump No. 2.

2. Modifications to the existing digested sludge piping, utility water piping, and polymer piping on the second level of the dewatering building.

3. Installation of two new screw presses.

4. Installation of new air compressors to support screw presses.

5. Demolition of existing belt presses, belt press access platform and stairs.

6. Demolition existing digested sludge piping, utility water piping, and polymer piping on the second level of the dewatering building.

7. Upgrades to the existing HVAC equipment.

8. Replacement of the existing roof and roof hatches.

B. The Work is located at the Owner's wastewater treatment plant, approximately 1/4-mile south of the intersection of Elm Street and Ontario Street, in the town of Sandpoint, Idaho.

1.04 CONTRACT METHOD

A. The Work hereunder will be constructed under a single lump sum contract.

1.05 WORK BY OTHERS

A. Where two or more contracts are being performed at one time on the same Site or adjacent land in such manner that work under one contract may interfere with work under another, the Owner will determine the sequence and order of the Work in either or both contracts. When the Site of one contract is the necessary or convenient means of access for performance of work under another, the Owner may grant privilege of access or other reasonable privilege to the contractor so desiring, to the extent, amount, and in manner and at time that the Owner may determine. No Owner determination of method or time or sequence or order of the work or access privilege shall be the basis for a claim for delay or damage except under provisions of the General Conditions for temporary suspensions of the work. The Contractor shall conduct its operations so as to cause a minimum of interference with the work of such other contractors and shall cooperate fully with such contractors to allow continued safe access to their respective portions of the Site, as required to perform work under their respective contracts.

B. Interference With Work On Utilities**:** The Contractor shall cooperate fully with all utility forces of the Owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the Work, and shall schedule the Work so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.06 WORK SEQUENCE

A. The Contractor's attention is directed to the fact that during the period of January 1 through March 31, no interruption in the process can be accommodated, and the Contractor shall so schedule its construction operations that no interference with the operation of the plant will occur during this critical period.

B. Access to the site is limited to the hours of 7:00 am to 5:00 pm.

1.07 CONTRACTOR USE OF SITE

A. The Contractor's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

1.08 OUTAGE PLAN AND REQUESTS

A. Unless the Contract Documents indicate otherwise, the Contractor shall not remove from service, de-energize, or modify settings for any existing operating tank pipeline, valve, channel, equipment, structure, road, or any other facility without permission from the Engineer.

B. Where the Work requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, the Contractor shall submit a detailed outage plan and schedule for the Engineer’s approval a minimum of two weeks in advance of the time that such outage is planned.

C. A completed System Outage Request form (blank furnished by the Engineer) shall accompany each outage plan. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of the Contract Documents.

D. The Engineer shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.

E. The Contractor shall provide written confirmation of the shutdown date and time two working days prior to the actual shutdown.

F. Refence Section 01 14 00 – Construction Constraints for allowable outage durations.

1.09 OWNER USE OF THE SITE

A. The Owner may utilize all or part of the existing facilities during the entire period of construction for the conduct of the Owner's normal operations. The Contractor shall cooperate and coordinate with the Owner to facilitate the Owner's operations and to minimize interference with the Contractor's operations at the same time. In any event, the Owner shall be allowed access to the Site during the period of construction.

1.10 PROJECT MEETINGS

A. Pre-Bid Meeting

1. Prior to submitting a bid for the Project, the Contractor will be required to visit the site to understand the existing conditions to provide the most accurate bid price.

B. Preconstruction Conference

1. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by the Contractor’s Project Manager, its superintendent, and its subcontractors as the Contractor deems appropriate. Other attendees will be:

a. Engineer and the Resident Project Representative.

b. Representatives of Owner.

c. Governmental representatives as appropriate.

d. Others as requested by Contractor, Owner, or Engineer.

e. The Contractor shall bring the preconstruction conference submittals in accordance with Section 01 33 00 – Submittal Procedures.

2. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, the Contractor should be prepared to discuss all of the items listed below.

a. Status of Contractor's insurance and bonds.

b. Contractor's tentative schedules.

c. Transmittal, review, and distribution of Contractor's submittals.

d. Processing applications for payment.

e. Maintaining record documents.

f. Critical work sequencing.

g. Field decisions and Change Orders.

h. Use of Site, office and storage areas, security, housekeeping, and Owner's needs.

i. Major equipment deliveries and priorities.

j. Contractor's assignments for safety and first aid.

k. Daily Report Form which the Engineer will furnish.

l. Submittal Transmittal Form which the Engineer will furnish.

3. The Engineer will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

4. The Contractor and its subcontractors should plan on the conference taking no less than 0.5 a working day. The first day will cover the items listed in paragraphs 2 and 3, and the following day(s) will be spent reviewing the Drawings and Specifications, in extensive detail, with the Engineer and the Owner.

C. Progress Meetings

1. The Engineer will schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by Contractor or as required by progress of the Work. The Contractor, Engineer, and all subcontractors active on the Site shall attend each meeting. Contractor may at its discretion request attendance by representatives of its suppliers, manufacturers, and other subcontractors.

2. The Engineer will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the Contractor shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 00 – CONSTRUCTION RESTRAINTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Work shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the operation and maintenance of existing facilities.

B. The Contractor shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules required

1.02 EXISTING PLANT

A. The Work shall be executed while the existing WWTP plant is in operation. Operation of the existing plant shall not be jeopardized, nor shall the efficiency of wastewater treatment be reduced as a result of the execution of the Work.

B. Unless indicated otherwise, temporary pumping, piping, power, lighting, controls, instrumentation, alarms, security devices, and safety devices shall be provided by the Contractor whenever its activity or interruption due to its activity, affects the existing facility.

C. The construction constraints in this Section do not include every item affecting the completion of the Work but are intended to describe the sequence of critical events necessary to minimize disruption to the ongoing treatment plant processes and to ensure compliance with NPDES Permit requirements and maintaining general plant operations. It shall be understood and agreed by the Contractor that the critical events described are not inclusive and that additional items of Work not included may be required to minimize disruption and ensure compliance. Deviation from or modification of these suggested sequences is permitted if techniques and methods known to the Contractor will result in reducing disruption to the facility operation and maintaining treatment efficiency, and if deviation is approved in advance by the Engineer.

1.03 OPERATION OF PLANT EQUIPMENT

A. Operational functions or shutdown of the existing plant required to facilitate Contractor's operation will be done by the Owner's personnel only.

B. The plant operation and maintenance personnel will cooperate in every way that is practical in order to facilitate Contractor's operation. However, certain shutdown and connections will only be permissible at times other than normal working hours such as nights or weekends, unless otherwise allowed by the Owner. No additional payment will be made to the Contractor for any night, weekend, or holiday premium or overtime payments.

C. If it becomes necessary for the proper operation or maintenance of portions of the plant, the Owner may require the Contractor to reschedule an approved shutdown. The Contractor shall then reschedule its operations so there shall be no conflict with necessary operations or maintenance of the plant. The Contractor shall, within 2 Days, furnish the Engineer a revised outage request and a plan for rescheduling the shutdown in accordance with the requirements of the construction schedule.

1.04 BYPASSING

A. Bypassing of untreated or partially treated sewage to surface waters or drainage courses is prohibited during construction. In the event accidental bypassing is caused by the Contractor's operations, the Owner shall immediately be entitled to employ others to stop the bypassing and costs incurred therefore will be deducted from the Contractor's construction progress payments.

1.05 COMPLIANCE WITH NPDES PERMIT

A. The plant is operating under the terms of an NPDES permit issued by the US EPA. The NPDES permit specifies the water quality limits that the plant must meet prior to discharging its effluent. A copy of the NPDES permit is available for review by the Contractor. In scheduling and performing the Work, the Contractor shall not, directly or indirectly, prevent the plant from achieving the discharge requirements. Penalties imposed on the Owner as a result of any discharge violation caused by the actions of the Contractor or its employees, or subcontractors shall be borne in full by the Contractor, including fines, legal fees, and other expenses to the Owner resulting directly or indirectly from such discharge violations. The Owner may recover such sums by deductions from the construction progress payments.

B. The Contractor shall take necessary precautions to ensure that no damage occurs to the plant facilities, including piping, utilities, roads, and structures, that are to remain in operation and are not to be modified or replaced. Any temporary facilities, materials, equipment, and labor required for the plant to continue to meet the terms of the NPDES permit during construction shall be provided by the Contractor as part of the Work. At the completion of work, such temporary facilities, materials, and equipment shall be removed from the Site as part of the Work.

1.06 OUTAGE REQUESTS

A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary outage or bypass of existing treatment processes or facilities. In such cases, the Contractor shall coordinate Work with the Engineer as described below. The Contractor shall submit a detailed outage plan and time schedule for construction activities which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment, structure, road, or other facilities from service.

B. The outage plans shall be submitted to the Engineer for acceptance a minimum of 2 weeks in advance of the time that such outages are required. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of this Section. The outage plan shall describe the Contractor's method for preventing bypassing of other treatment units; the length of time required to complete the operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the Contractor shall provide in order to ensure proper operation of associated treatment units. Costs for preparing and implementing the outage plans shall be the responsibility of the Contractor as part of the Work.

C. The Contractor shall not begin an alteration affecting existing facilities until specific written approval has been granted by the Engineer in each case.

D. The Engineer will coordinate the Contractor's planned procedure with the treatment facility personnel. The Engineer has the authority to modify any proposed shutdown procedures if such procedures would adversely impact the plant operations.

E. The Engineer shall be notified in writing at least one week in advance of the required outage if the schedule for performing the Work has changed or if revisions to the outage plan are required. The Contractor shall provide written confirmation of the shutdown date and time 2 Days prior to the actual shutdown.

1.07 TEMPORARY CONNECTIONS

A. Making connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall be completed as quickly as possible and with as little delay as possible and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.

B. The cost of any temporary facilities and night, weekend, or holiday activity and overtime payments required during process interruptions shall be included in the Work.

C. Temporary facilities and piping shall be located to minimize interference with Contractor's construction facilities and Owner's operation and maintenance of the wastewater treatment plant. Unless otherwise indicated, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline. Piping materials shall be suitable for the material being conveyed and be as required in the Contract Specifications.

D. When temporary electrical power, controls, instrumentation, or alarms are required for routine continuous operations of existing or new equipment, the Contractor shall provide the necessary equipment and appurtenances. Prior to installing said equipment and appurtenances, Contractor shall furnish a submittal on the proposed components and installation for Engineer's review and approval.

E. A plan showing the size and location of the temporary facilities and piping shall be submitted to the Engineer at the same time as the outage plan required under this Section. Costs for design, provision, operation, and removal of temporary facilities and piping shall be part of the Work.

1.08 CONSTRUCTION SEQUENCING

A. Construction activities shall be scheduled and sequenced to ensure continuous operation of the existing treatment facilities. The Contractor's scheduling shall develop construction sequencing so that the Work will not adversely impact treatment. The Contractor shall be responsible for development of the construction sequencing. In implementing the construction sequencing, the Contractor shall maintain the existing facilities in service until new facilities are constructed and are operational to supplement the existing capacity. When new facilities are operational, the existing facilities may be taken out of service. The following general guidelines shall be used by the Contractor in planning the sequence of construction.

1. Safe working conditions for personnel shall be maintained during rehabilitation, modification, and demolition Work. The foregoing includes at least proper trench excavation, the provision of temporary equipment guards, supports, warning signs, walkways, covers over openings, handrailing, and protection of electrical equipment and power supply.

2. Temporary facilities shall be constructed in accordance with applicable codes and regulations to operate safely and properly.

3. Valves to be temporarily shut off during the Work shall be tagged as such and shall be wired shut with a crimped lead seal and padlocked.

4. Electrical and mechanical equipment shall be similarly shut down.

B. The Construction Sequence will be as follows:

1. The roof shall not be replaced during the winter months, starting from November 1 to March 31. The roof replacement shall be coordinated with the timing of the screw press upgrades.

2. The Owner furnished screw presses are expected to be onsite no later than July 1, 2026.

3. Only one existing dewatering belt press will be taken offline and demolished at a time. Contractor is responsible for the disposal of demolished material.

4. Once one of the existing belt presses is demolished, one new screw press will be installed and connected into the system. Start-up of the screw press will be completed in accordance with Section 01 75 00 – Equipment Testing and Plant Start-up.

5. The screw press must be successfully operated for a maximum of 30 days prior to the second belt press being decommissioned with less time required as approved and determined by the City.

6. Following the successful operation of the first screw press, the second belt press will be taken offline and demolished. The second screw press will then be installed and connected into the system. The start-up of the second screw press will be completed in accordance with Section 01 75 00 – Equipment Testing and Plant Start-up.

1.09 PERMITS

A. The Contractor shall abide by the conditions of permits and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the Work by the Owner.

1.10 SCHEDULE CONSTRAINTS

A. General: It is the Contractor's responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall Work.

B. The listing of schedule constraints below does not mean that every constraint or special condition has been identified. The list does not substitute for the Contractor's coordination and planning for completion of the Work within the Contract Times.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 16 00 – OWNER-FURNISHED EQUIPMENT

PART 1 -- GENERAL

1.01 THE SUMMARY

A. This section covers Owner pre-purchased equipment. The Owner has pre-purchased equipment and installation services for the project. Copies of the purchase order, proposal documents for supply is included as part of these specifications (See appendix A). The purchase order will be assigned to the Contractor upon award of the Contract. The Contractor is required to include the cost of the Owner pre-purchased equipment plus applicable sales tax in its Bid.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 25 00	Measurement and Payment

1.03 RESPONSIBILITY OF THE CONTRACTOR

A. Following the award of the contract. and upon assignment by the Owner of the purchase order for the Owner pre-purchased equipment and installation services to the Contractor, the Contractor shall assume ownership of the purchase order. The Contractor shall coordinate with the supplier, shall submit necessary shop drawings and submittals to the Owner, shall make all installations, provide field services and shall perform startup and testing through the supplier/installer. Refer to the attached Appendix A for manufacturer services required as a part of the purchase order. The Contractor shall maintain responsibility for a complete working system for the Owner pre-purchased equipment, the same as if the Contractor had purchased the equipment and installation services following award of the contract.

1.04 INSURANCE

A. The Contractor shall include in his insurance coverage for the Work under this Contract, sufficient coverage to protect the Owner pre-purchased equipment against all losses until final acceptance of the Work by the Owner. The Owner shall be named as co-insureds for this equipment.

1.05 PAYMENT

A. Payment to the Contractor for the Owner-ordered equipment shall be defined in Section 01 25 00 - Measurement and Payment and as listed on the Bid Schedule.

B. Payment to the Contractor for installation of the Owner pre-purchased equipment and other work in this section shall be included in the lump sum bid price as defined in Section 01 25 00 - Measurement and Payment.

C. Payment by the Contractor to the Supplier shall be made as specified in Appendix A.

PART 2 -- PRODUCTS

2.01 CONTRACTOR - SUPPLIED EQUIPMENT AND MATERIALS

A. Except for equipment specifically identified as "Owner pre-purchased", all other materials required to complete the Work shall be provided by the Contractor. Such materials to be provided by the Contractor include, but are not limited to connecting piping, valves, and flanges, bolts, nuts, gaskets, hangers, and supports, motor starters and wiring, piping accessories, specialties, finish painting, expendable materials, all as necessary to provide complete and properly functioning mechanical systems.

B. All materials provided by the Contractor are subject to approval by the Engineer prior to their installation into the Work. The Contractor shall submit submittals for all materials and components it proposes to furnish, and also shall include such data as necessary to allow the Engineer to determine their fitness for the Work.

PART 3 -- EXECUTION

3.01 EXECUTION

A. All work shall be in conformance with the manufacturer's recommended procedures, instructions, and shop drawings, as approved by the Engineer. The Contractor (through the Owner's supplier/installer) shall receive, transport to its place of installation, unload, inspect, and maintain an inventory on all Owner pre-purchased equipment and materials.

3.02 STORAGE ANO PROTECTION

A. Following delivery of Owner pre-purchased equipment, and until final acceptance of the completed work, the Contractor (through the Owner's supplier Installer) shall protect and maintain the equipment in a condition that will prevent damage in accordance with the Engineer manufacturer's instructions. Equipment subject to damage by the elements shall be placed in an approved temporary storage building prior to installation. The Contractor shall replace equipment items that become corroded, damaged, or deteriorated prior to final acceptance of work.

3.03 INSTALLATION

A. The Contractor (through the Owner's supplier/installer) shall provide all supervision, labor, tools, construction equipment, incidental materials, and the necessary services required to complete the installation and testing of the Owner pre-purchased equipment

B. Mechanical, electrical and all other work required to connect to the Owner pre-purchased equipment shall conform to the applicable standards, final certified shop drawings, Specifications, and the Drawings including these Contract Documents.

3.04 FIELD TESTING

A. Following installation, a functional (or run) test on all Owner pre-purchased equipment shall be performed by the Contractor in the presence of the Engineer. The Contractor shall prepare all Owner pre-purchased equipment for startup and testing, including all cleanup, lubrication and equipment tolerance adjusting. He shall furnish all incidental materials required for this preparation.

B. Prior to commissioning, all equipment shall be performance tested under actual or approved simulated operating conditions and in accordance with the construction contract documents. Such testing shall be performed by the Contractor and scheduled in cooperation with the Engineer and the manufacturer's representative.

3.05 CERTIFICATE OF PROPER INSTALLATION

A. OWNER PRE-PURCHASED EQUIPMENT - Following the successful performance test, and prior to acceptance of work, the authorized representative of the manufacturer of Owner pre-purchased equipment shall provide the Owner and the Contractor with a written certificate of proper installation. Such certificate shall indicate the date of test, that the equipment has been properly installed, that proper electrical connections have been made, and that the equipment is operating in accordance with the specified performance requirements.

PART 4 -- PRE-PURCHASED EQUIPMENT

4.01 DOCUMENTS

A. Purchase order executed by the Owner is attached in Appendix A.

B. The Supplier's proposal is attached in Appendix A.

C. Proposal documents and technical specifications of Owner pre-purchased equipment are attached in Appendix A.

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Wherever submittals are required by the Contract Documents, submit them to the Engineer.

B. Within 7 Days after the date of commencement as stated in the Notice to Proceed, submit the following items for review:

1. Submittal Schedule

a. Submit a preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("or equal") submittals listed in the Bid.

b. Allow time for resubmittals.

1.02 SHOP DRAWINGS

A. Wherever called for in the Contract Documents or where required by the Engineer, furnish one copy plus one reproducible copy of each Shop Drawing submittal.

B. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items.

C. Whenever the Manufacturer is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the Project is located, unless otherwise indicated.

D. Transmittal Form

1. Shop Drawing submittals shall be accompanied by the Engineer's standard submittal transmittal form, a reproducible copy of which is available from the Engineer.

2. A submittal without the form, or where applicable items on the form have not been completed, will be returned for resubmittal.

E. Organization

1. Use a single submittal transmittal form for each technical specification Section or item or class of material or equipment for which a submittal is required.

2. A single submittal covering multiple Sections will not be accepted, unless the primary specification references other Sections for components: For example, if a pump Section references other Sections for the motor, shop-applied protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted, whereas a single submittal covering vertical turbine pumps and horizontal split-case pumps would not be accepted.

3. On the transmittal form, index the components of the submittal.

4. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.

5. Unless otherwise indicated, match terminology and equipment names and numbers used in the submittals with those used in the Contract Documents.

F. Format

1. Submittals shall be submitted as a PDF document.

2. Number every page in a submittal in sequence.

3. Where product data from a Manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports.

4. Present a sufficient level of detail for assessment of compliance with the Contract Documents.

5. Before accepting the number system option in the following Subparagraph, the Specifier should verify that the document tracking system to be used in the field office will function under an alphanumeric system. If not, select the second optional wording for compatibility.

6. Numbering

a. Assign to each submittal a unique number.

b. Number the submittals sequentially, with the submittal numbers clearly noted on the transmittal.

1) Assign original submittals a numeric submittal number followed by a decimal point and a numeric digit in order to distinguish between the original submittal and each resubmittal: For example, if submittal "25.1" requires a resubmittal, the first resubmittal will bear the designation "25.2" and the second resubmittal will bear the designation "25.3," and so on.

G. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.

H. Engineer's Review

1. Except as otherwise indicated, the Engineer will return prints of each submittal to the Manufacturer with comments noted thereon, within 30 Days following receipt by the Engineer.

2. It is considered reasonable that the Manufacturer shall make a complete and acceptable submittal to the Engineer by the first resubmittal on an item.

3. The Owner reserves the right to withhold monies due to the Manufacturer to cover additional costs of the Engineer's review beyond the first resubmittal.

4. The Engineer's maximum review period for each submittal or resubmittal will be 30 Days; thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 90 Days.

I. If a submittal is returned to the Manufacturer marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required.

J. If a submittal is returned marked "MAKE CORRECTIONS NOTED," the Manufacturer shall make the corrections on the submittal, but formal revision and resubmission will not be required.

K. Resubmittals

1. If a submittal is returned marked "AMEND-RESUBMIT," the Manufacturer shall revise the submittal and resubmit the required number of copies.

2. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.

L. Rejected Submittals

1. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request.

M. The fabrication of an item may commence only after the Engineer has reviewed the pertinent submittals and returned copies to the Manufacturer marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

N. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.

O. Review by Manufacturer

1. Submittals shall be carefully reviewed by an authorized representative of the Manufacturer prior to submission to the Engineer.

2. Each submittal shall be dated and signed by the Manufacturer as being correct and in strict conformance with the Contract Documents.

3. In the case of Shop Drawings, each sheet shall be dated and signed.

4. Any deviations from the Contract Documents shall be noted on the transmittal sheet.

5. The Engineer will only review submittals that have been verified by the Manufacturer.

6. Non-verified submittals will be returned to the Manufacturer without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Manufacturer.

P. Conformance

1. Corrections or comments made on the Manufacturer's Shop Drawings during review shall not relieve the Manufacturer from compliance with Contract Drawings and Specifications.

2. A lack of comments made on the Manufacturer's Shop Drawings during review shall not relieve the Manufacturer from compliance with Contract Drawings and Specifications.

3. Review is for conformance to the design concept and general compliance with the Contract Documents only.

4. The Manufacturer shall be responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating Work with the trades, and satisfactory and safe performance of the Work.

1.03 SAMPLES

A. Quantity

1. The Manufacturer shall submit the number of samples indicated by the Specifications.

2. If the number is not indicated, submit not less than 3 samples.

3. Where the quantity of each sample is not indicated, submit such quantity as necessary for proper examination and testing by the methods indicated.

B. Identification and Distribution

1. Individually and indelibly label or tag each sample, indicating the salient physical characteristics and the manufacturer's name.

2. Upon acceptance by the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Manufacturer, one set of samples will be retained by the Engineer, and one set shall remain at the Site in the Engineer's field office until completion of the Work.

C. Selection

1. Unless otherwise indicated, the Engineer will select colors and textures from the Manufacturer's standard colors and standard materials, products, or equipment lines.

2. If certain samples represent non-standard colors, materials, products, or equipment lines that will require an increase in Contract Times or Price, the Manufacturer shall clearly state so on the transmittal page of the submittal.

D. The Manufacturer shall schedule sample submittals such that:

1. Sample submittals for color and texture selection are complete so the Engineer has 45 Days to assemble color panels and select color- and texture-dependent products and materials without delay to the construction schedule; and,

2. After the Engineer selects colors and textures, the Manufacturer has sufficient time to provide the products or materials without delay to the construction schedule.

3. The Contract Times will not be extended for the Manufacturer's failure to allow enough review and approval or selection time, failure to submit complete samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.04 TECHNICAL MANUAL

A. The Manufacturer shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the Technical Manual.

B. The manual shall be written such that it can be used and understood by the Owner's operation and maintenance staff.

C. The Specifier must consider whether the organization of information in the manuals is appropriate for the scope of the Work. If possible during customization, discuss the manual organization with Owner staff and O&M manual specialists.

D. Categories

1. The Technical Manual shall be subdivided first by Specification Section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

a. Category 1 - Equipment Summary

1) Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.

2) Form: The Engineer will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the Work. The Manufacturer shall fill in the relevant information on the form and include it in Part 1.

b. Category 2 - Operational Procedures

1) Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:

a) Installation

b) Adjustment

c) Startup

d) Location of controls, special tools, equipment required, or related instrumentation needed for operation

e) Operation procedures

f) Load changes

g) Calibration

h) Shutdown

i) Troubleshooting

j) Disassembly

k) Reassembly

l) Realignment

m) Testing to determine performance efficiency

n) Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices

o) List of all electrical relay settings including alarm and contact settings

c. Category 3 - Preventive Maintenance Procedures

1) Procedures: Preventive maintenance procedures shall include Manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.

2) Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

d. Category 4 - Parts List

1) Parts List: A complete parts list shall be furnished, including a generic description and Manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

2) Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

e. Category 5 - Wiring Diagrams

1) Diagrams: Category 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

f. Category 6 - Shop Drawings

1) Drawings: This category includes approved shop or fabrication drawings with Engineer comments and corrections incorporated, complete with dimensions.

g. Category 7 - Safety

1) Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

h. Category 8 - Documentation:

1) Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

E. Format

1. Bind each Technical Manual in standard size 3-ring hardcover binders, labeled on the spine and cover with Project name, Owner's project number, Specification Section number, equipment name, and equipment identification number

2. Each Binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.

3. Documents in binders shall be 3-hole punched, with no text punched out, and pages larger than 8-1/2 by 11 shall be folded to 8-1/2 by 11 size.

4. Provide an electronic file with each final set of Technical Manuals, as follows:

a. Project-specific files created in the latest version of Microsoft Word;

b. Adobe Acrobat portable document format (PDF) or other software required by the Specifications; or,

c. Manufacturer literature in Adobe Acrobat portable document format (PDF).

F. Review Process

1. Furnish one electronic draft Technical Manuals for each Specification Section that requires a manual.

2. The Engineer will retain one copy, will forward one copy to the Owner, and will return one copy to the Manufacturer with review comments.

3. Incorporate comments into the draft and submit one hard copy and one electronic version of the final manual for acceptance.

G. Schedule

1. Submittal and Corrections

a. The Work under this Contract involves start-up and commissioning of equipment in multiple areas of the facility at independent times within the Project Schedule.

b. The manuals shall be completed for each piece of equipment prior to placing equipment into service.

c. Except as otherwise indicated, submit the manuals for review in final form a minimum of 30 Days prior to pre-commissioning and commissioning for each piece of equipment.

d. Discrepancies found by the Engineer shall be corrected within 30 Days from the Date of written notification by the Engineer.

1.05 SPARE PARTS LIST

A. General

1. Furnish to the Engineer one set of spare parts information for mechanical, electrical, and instrumentation equipment.

2. The spare parts list shall include those spare parts that each Manufacturer recommends to be maintained by the Owner in inventory.

B. Sources and Pricing

1. The spare parts list shall include a current list price of each spare part.

2. Each Manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts, to assist the Owner in ordering.

C. Format

1. Cross-reference the spare parts lists to the equipment numbers designated in the Contract Documents.

1.06 QUALITY CONTROL (QC) SUBMITTALS

A. Quality control submittals are defined as those required by the Specifications to present documentary evidence to the Engineer that the Manufacturer has satisfied certain requirements of the Contract Documents.

B. Unless otherwise indicated, QC submittals shall be submitted:

1. Before delivery and unloading, for the following types of submittals:

a. Manufacturers' installation instructions

b. Manufacturers' and Installers' experience qualifications

c. Ready mix concrete delivery tickets

d. Design calculations

e. Affidavits and manufacturers' certification of compliance with indicated product requirements

f. Laboratory analysis results

g. Factory test reports

2. Within 30 Days of the event documented for the following types of submittals:

a. Manufacturers' field representative certification of proper installation

b. Field measurement

c. Field test reports

d. Receipt of permit

e. Receipt of regulatory approval

C. The Engineer will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

D. Retain the following article only if our CM forms will be used.

1.07 INFORMATIONAL SUBMITTALS

A. Informational submittals formalize the flow of information between the Manufacturer and the Engineer.

B. Electronic forms shall be obtained from the Engineer for such purpose.

C. The following forms may be used, but the list is not necessarily inclusive:

1. CM - 302 Request for Clarification
2. CM - 306 Manufacturer's Submittal Transmittal Form
3. CM - 307 Memorandum of Delay
4. CM - 1003 Request for Payment for Material on Hand
5. CM - 1004 Request for Adjustment of Retainage
6. CM - 1005 Consent of Surety for Reduction of Partial Release of Retainage
7. CM - 1006 Consent of Surety for Final Payment
8. CM - 1007 Affidavit of Payment
9. CM - 1102 Initiator Change Order Request
10. CM - 1106 Deviation Request
11. CM - 1110 Substitution Request Form
12. CM - 1301 Partial Waiver of Lien
13. CM - 1302 Final Waiver of Lien

D. CM - 1303 Affidavit of Release of Lien

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 17 – STRUCTURAL DESIGN, SUPPORT AND ANCHORAGE

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide calculations and details for structural, nonstructural and non-building structures components, supports, and anchorages as required by the Contract Documents and the 2018 IBC. This includes Components that are in or supported by a structure, Components that are outside of a structure and are permanently connected to the mechanical or electrical systems or Components that are part of the egress system of a structure. The Contractor shall furnish and install all such structural and non-structural components, supports, and anchorages in accordance with the calculations and details.

B. Where a conflict exists between the requirements of the Contract Documents and the 2018 IBC, the more stringent requirement shall apply.

1. Exemptions to this requirement that are permitted by the 2018 IBC, ASCE 7, or any other applicable Building Code or Reference Document, shall not apply unless the exemption is explicitly listed within this Specification Section.

C. Design parameters used to determine Seismic and Wind design forces shall be as listed herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
03 60 00	Grouting
04 05 19.16	Masonry Anchors
05 50 00	Metal Fabrications
05 05 19	Post Installed Concrete Anchors

B. The edition of the standards applicable to the Work shall be those editions referenced by the 2025 California Building Code (CBC). If the standard is not referenced by the CBC, nor a CBC-referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

IBC	2018 International Building Code
American Society of Civil Engineers (ASCE)	
ASCE 7-16	Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
American Concrete Institute (ACI)	
ACI 318	Building Code Requirements for Structural Concrete (2019 edition)
OSHPD	California Office of Statewide Health Planning and Development's Seismic Preapproval

The Masonry Society (TMS)	
TMS 402	Building Code for Masonry Structures (2016 edition)
TMS 602	Specification for Masonry Structures (2016 edition)

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

1. Calculations and Details

2. Calculations and details are considered a Deferred Submittal as defined in the IBC.

3. Calculations and details shall be complete, accurate, and in accordance with the requirements of the CBC and ASCE 7 and shall be signed and sealed by a Civil or Structural Professional Engineer registered in the State of California.

4. Calculations shall be clear and concise and show equipment and other non-structural component anchorage forces and the capacities of the anchorage elements proposed by the Contractor. The calculations shall substantiate a complete load path from the component or equipment being anchored into the supporting structure or foundation.

5. The calculations and details shall demonstrate a complete lateral and vertical load path and shall clearly indicate all forces imposed on the supporting structure.

6. Calculations and details are required for all Non-Structural components, supports, anchorages, and attachments.

   a. Non-Structural components shall include all architectural, mechanical, and electrical components, equipment, distribution systems (i.e. piping, conduit, ducting, other), light poles, flag poles, antenna poles, freestanding walls, solid signs, facilities, and all other similar or related appurtenances necessary to produce the complete architectural, mechanical, and electrical systems.

      1) Where the architectural, mechanical or electrical components or equipment has a weight of four hundred pounds (400 lbs) or more. See ASCE 7 section 13.2, 13.3, 13.4 and 13.5.

      2) Where the architectural, mechanical or electrical components or equipment has a weight of less than four hundred pounds (400 lbs) and a center of mass located four feet (4’-0”) or more above the adjacent floor level see ASCE 7 section 13.2, 13.3, 13.4 and 13.6.

      3) Where architectural, mechanical or electrical equipment has a weight of twenty pounds (20 lbs) or less or, in the case of a distributed system that has a weight of five pounds per feet (5 lbs/ft) or less, seismic anchorage need not be considered. Where multiple distributed systems are supported off of the same system their combined weight must be used in determining if design is required for the support system. See ASCE 7 section 13.2, 13.3, 13.4, 13.5 and 13.6.

1. In addition to the requirements of item 6 above, provide seismic design for support systems, internal connections and packaged components as called for below:

a. Seismic design of Premanufactured Modular Mechanical and Electrical Systems (i.e. Electrical Switch Boards, Motor Control Centers, Standby Generators and Skid Mounter Systems with an Enclosure), where the Premanufactured Mechanical and Electrical Modules are six feet (6'-0") or taller and that contain or support mechanical and electrical components shall be designed in accordance with ASCE 7-22 Chapter 15 'Nonbuilding Structures Similar to Buildings'. Nonstructural components contained or supported within the modular systems shall be designed in accordance with ASCE 7-16 Chapter 13. Provide design that includes details and calculations signed and sealed by a Civil or Structural engineer registered in the State of California.

b. If Premanufactured Modular Mechanical and Electrical Systems (i.e. Electrical Switch Boards, Motor Control Centers, Standby Generators and Skid Mounter Systems with an Enclosure) is 'Prequalified' in accordance with ASCE 7-22 Chapter 13 section 13.2.3, it is exempt from the requirements of Section 7 above. Manufacturer shall provide seismic qualification based on a nationally recognized testing standard procedure, such as ICC-ES AC 156. Seismic qualification by experience data based on nationally recognized procedures is also acceptable. Seismic pre-approval from OSHPD will also satisfy this requirement. Certification must be provided for either listed option. Certification must show seismic capacities are equal to or exceed the seismic demands that are project specific.

c. If Premanufactured Modular Mechanical and Electrical Systems (i.e. Electrical Switch Boards, Motor Control Centers, Standby Generators and Skid Mounter Systems with an Enclosure) has 'Experience Data' in accordance with ASCE 7-22 Chapter 13 section 13.2.7, it is exempt from the requirements of Section 7.a and 7.b.

d. Section 7 shall not apply to Skid-Mounted Equipment without an enclosure (i.e. pumps), and single large components, such as air handlers, cooling towers, chillers and boilers.

2. When the Contract Documents require the Contractor to design structures or structural components, provide Calculations and Construction Documents specifications, drawings and details) for those structures and structural components, and their supports, anchorages, and attachments, are required. See ASCE 7-22 Chapter 13 section 13.2.8.

3. Calculations shall use the load cases as required by ASCE 7-16, including the factors ρ and Ω where it is required by the load combination.

4. When computer generated calculations and analyses are included as part (or as the whole) of the calculations, the calculations shall include, but not be limited to, the following: version of computer program used, derivations of all input parameters; clear indication of the applicable load combinations and building code equations; diagrams of all members, geometry, loads, forces, reactions and deflections, for all components and connections; and output results demonstrating all stress, force, deflection and other Contract Document and building code requirements have been satisfied.

5. In accordance with the CBC, ASCE 7 and ACI 350 internal elements in a water bearing structures, such as equipment and accessories that are attached to the structure, shall be designed for the lateral loads due to sloshing liquid in addition to the inertial forces. Derivations of sloshing loads must be provided in the calculations.

6. Typical Details may have been provided for supporting mechanical equipment, electrical equipment and distributed systems (i.e. piping, conduit, ducting, other) as well as for stairs, ladders, and other miscellaneous items in the construction documents. These Typical Details are to be used for a minimum standard for style, size, and materials and shall be used as a guide for the contractor in designing the specific item or system utilized on the project. Design for these systems shall be provided in the submittal. The design shall include details and calculations signed and sealed by a Civil or Structural engineer registered in the State of California.

7. Do not use more than 60 percent of the Dead Load (D) for resisting overturning due to seismic forces. Do not use tank content for resisting overturning due to seismic forces.

8. Refer to Part 2 below for additional requirements.

1.04 SEISMIC DESIGN CRITERIA

A. Design Requirements

1. Design Parameters:

a. Risk Category: III.

b. Seismic Design Category: C.

c. Mapped MCE_R, 5% damped spectral response acceleration parameter at short periods: S_S = 0.0.335.

d. Mapped MCE_R, 5% damped spectral response acceleration parameter at a period of 1-second: S_1 = 0.113.

e. Site Class: D.

f. Design, 5% damped spectral response acceleration parameter at short periods: S_{DS} =0.342.

g. Design, 5% damped spectral response acceleration parameter at a period of 1-second: S_{D1} = 0.178.

h. Long period transition period: T_L = 6 seconds

i. Response modification coefficient, R: In accordance with ASCE 7, Tables 12.2-1, and 12.14-1.

j. Seismic Importance Factor, I:1.25.

k. Component resonance ductility factor, In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.

l. Component strength factor, R_{po}: In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.

m. Component importance factor, I_p:

n. I_p = 1.25, unless noted otherwise herein.

1) I_p = 1.50 if any of the following conditions apply:

a) The component is required to function for life-safety purposes after an earthquake, including fire sprinkler systems and egress stairways.

b) The component conveys, supports, or otherwise contains toxic, highly toxic, explosive, or hazardous substances.

1.05 WIND DESIGN CRITERIA

A. Design Requirements

1. Design Parameters:

a. Risk Category: III.

b. Basic 3-second Wind Gust Speed: 110 miles per hour.

c. Exposure Category: D.

d. Topographic Factor, K_{zt}: 1.0.

1.06 SNOW DESIGN

A. Design Requirements

1. Design Parameters:

a. Ground Snow Load = 56 psf.

b. Risk Category: III.

c. Importance Factor I_p = 1.10.

d. C_e Exposure Factor as determined from Table 7.3-1.

e. C_s slop factor as determined from Fig. 7.4-1.

f. C_t Thermal Factor as determined from Table 7.3-2.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Non-Structural Component Supports and Anchors

1. Unless otherwise indicated, non-structural component supports, anchors, and restrainers shall be adequately designed for all applicable static, dynamic, operational, seismic and wind loads.

a. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches of the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel or engineered framing support systems. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

b. All equipment and all other non-structural components shall be supported and anchored in place by methods that satisfy the building code and the Contract Documents.

c. All equipment and all other non-structural components shall be supported and anchored in place by methods that satisfy the manufacturer's applicable seismic certification requirements.

2. Component attachments shall be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

B. Non-Building Structures

1. Non-Building Structures shall be designed in accordance with ASCE 7 Chapter 15.

2. Non-Building Structures, foundations, supports, anchors, and restrainers shall be adequately designed for all applicable static, dynamic, operational, seismic and wind loads.

3. Friction shall not be used to resist sliding due to seismic forces, except as indicated below:

a. Friction may be used to resist sliding of Welded or Bolted Steel Tanks designed in accordance with AWWA D100 or AWWA D103, respectively, when specifically permitted by that Standard.

C. Anchors – General

1. Use anchor bolts, bolts, or welded studs for anchors for resisting seismic forces. Anchor bolts used to resist seismic forces shall have a standard hex bolt head. Do not use anchor bolts fabricated from rod stock with an L or J shape.

2. Anchor bolts shall be in accordance with Section 05 50 00 – Metal Fabrication.

3. Adhesives and epoxies for post-installed anchors in concrete or masonry shall be in accordance with Section 05 05 19 19 - Post Installed Concrete Anchors or Section 04 05 19.16 - Masonry Anchors, respectively.

4. Grouts for anchor bolts shall be in accordance with Section 03 60 00 - Grouting.

5. The Contractor shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the calculations and details.

6. When anchors are embedded into existing Concrete or Masonry, the anchors can not damage existing reinforcing. Contractor shall x-ray Concrete or Masonry for reinforcing locations. If reinforcing is encountered while drilling for anchorage, stop

drilling immediately, patch hole where drilling occurred and move anchor to a location where existing reinforcing doesn't occur.

7. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all applicable load combinations, including seismic and wind loads.

    a. The design of anchors resisting seismic forces shall satisfy the ductility requirements stated in the IBC, ASCE 7,ACI 318 and TMS 402.

8. Reduction factors associated with edge distance, embed length, grout and base plate thickness, and bolt spacing shall all be considered and based on the actual dimensions of the concrete or masonry that resists the anchorage forces.

9. Where anchorage is required into or through equipment pads, the following requirements shall apply unless otherwise approved by the Engineer:

    a. For tensile forces, the embed length and associated concrete failure zone shall be provided entirely within the structural slab. No portion of the equipment pad may be considered as effective in resisting tensile forces.

    b. For shear forces, the edge distance and associated concrete failure zone shall be provided entirely within the equipment pad. No portion of the structural slab may be considered as effective in resisting shear forces.

10. Anchor bolt details shall include required bolt diameter, embed, spacing, and edge distances.

11. Where additional reinforcement is required to satisfy anchorage requirements, such reinforcement shall be included in the anchorage details, and shall be furnished and installed by the Contractor.

D. Mechanical and Electrical Equipment Foundations

1. Equipment foundations are indicated on Drawings. The Contractor, through the equipment manufacturer, shall verify the size and weight of the equipment foundation to ensure compatibility with equipment.

2. Equipment foundation dimensions shall be coordinated with the equipment base geometry and the edge distance and embed requirements of the equipment anchorage calculations.

E. Mechanical and Electrical Equipment (Housekeeping) Pads

1. General

    a. Equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on concrete equipment pads, unless otherwise indicated. The top surface of the equipment pads shall be level, unless otherwise indicated, or otherwise required by the equipment manufacturer.

    b. Equipment pads shall be sized to accommodate the bearing and anchorage requirements of the equipment, subject to the constraints listed below.

c. Final geometry of the equipment pads shall not result in a condition that violates applicable building code provisions, including but not limited to the provisions of the National Electric Code.

2. Mechanical Equipment Pads

a. Mechanical equipment pad heights shall be coordinated with process equipment and piping elevation requirements. Where no such elevation constraints exist, the equipment pad height shall be as shown on the drawings, or as indicated below when no specific height is provided.

1) Equipment pads for mechanical equipment shall be 5 inches tall (minimum) at the front of the equipment, with #4 reinforcing steel at 12-inches each way (minimum).

b. Mechanical equipment pads shall extend not more than 2 inches beyond the front, back, and sides of the equipment, except as indicated below, unless otherwise shown on the drawings.

1) Where necessary to meet seismic or wind anchorage requirements, the pads may be extended beyond the 2 inch limit indicated above. The pads shall extend not more than 6 inches beyond the front, back, and sides of the equipment.

3. Electrical Equipment Pads

a. Electrical equipment pads shall be the same as mechanical equipment pads, described in part 2.02.E.2.

b. Electrical equipment pads shall extend not more than 2 inches beyond the front, back, and sides of the equipment, except as indicated below, unless otherwise shown on the drawings.

c. Where necessary to meet seismic anchorage requirements, the anchors must be extended through the equipment pad into the slab or matt foundation below the pad. The pad 'height' shall not be used to resist seismic forces.

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 29 – CONCRETE SAW-CUTTING AND CORE-DRILLING

PART 1 -- GENERAL

1.01 DESCRIPTION

A. The work of this section consists of saw cutting and/or core drilling new openings in existing concrete.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
03 30 00	Cast-In-Place Concrete

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 03 33 00.

B. Submit drawings and commentary showing and describing the proposed cutting procedures and proposed equipment for each type of cut.

1. Description of proposed work, and products to be used.

2. Alternatives to cutting and patching.

3. Date and time work will be executed.

PART 2 -- PRODUCTS

A. Not Used

PART 3 -- EXECUTION

3.01 SAFETY REGULATIONS

A. Comply with all applicable safety regulations including the requirements of OSHA.

B. Provide equipment in good and safe working order, adequate to perform the work.

C. Provide necessary scaffolding, lighting, access, debris removal equipment and devices, and appropriate safety measures.

3.02 CONCRETE CUTTING

A. Perform concrete cutting as shown on the drawings and as specified herein and in accordance with the approved submittals.

B. Openings shall be cut to the dimensions shown on the drawings and shall not be over-cut. In straight-cut openings, the face opposite the saw shall be chipped to achieve the opening dimension.

3.03 PATCHING

A. Where existing reinforcing bars are cut at new opening, burn back the reinforcing bars a minimum of 1-inch below adjacent concrete.

B. Patch the resulting void at existing reinforcing bars and the surface of chipped opening surfaces with an approved epoxy grout in accordance with Section 03 60 00 – Grouting, to achieve a smooth, uniform surface.

C. Coat the patch exposed surfaces per Section 09 96 00.

3.04 DISPOSAL

A. Remove cut material and dispose offsite in a safe and orderly manner. Do not allow debris to accumulate on the site exposed to view.

B. Inside structures, cuttings, chippings and patching grout droppings must be removed completely. No debris shall be washed into the plant's sediment drain system.

C. Upon completion of the work of this section, the surfaces of all structures shall be clean and free of cuttings, slurry and debris.

END OF SECTION

SECTION 01 75 00 – EQUIPMENT TESTING AND PLANT STARTUP

PART 1 - GENERAL

1.1 THE SUMMARY

A. The new dewating system startup is prerequisite to satisfactory completion of the contract requirements and shall be completed within the Contract Times.

B. Conduct all test, check out, startup, and related requirements indicated in the Contract Documents and provide documentation of same to the Engineer prior to requesting Substantial Completion from the Engineer. Where manufacturer onsite inspections are required before startup, the manufacturer shall furnish a written statement that the installation and check out is complete and proper and that the item(s) are ready for startup.

C. Startup of a treatment plant and facilities within is a highly complex operation requiring the combined expertise of the Contractor, Subcontractors, the Engineer, Manufacturer and the Owner. The Contractor shall be responsible for coordinating all parties for a successful startup: the Manufacturer, Engineer and Owner shall be available for technical and operational advice prior to and during startup.

D. General requirements for startup activities are included in this Section. More specific requirements may also be included in other portions of the Contract Documents.

E. Temporary facilities may be necessary. If so, Contractor shall design, provide, operate, and later decommission them.

1.2 DEFINITIONS

A. Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.

B. Pre-commissioning is the systematic demonstration through testing and extended operation that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function. Pre-commissioning involves balancing, adjustments, calibration, loop checks, and loop validation. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the Engineer. Pre-commissioning of all portions of the work shall be successfully completed prior to starting Commissioning.

C. Commissioning is the verification that the complete work functions on an extended basis in full conformance with the Contract requirements.

1.3 SUBMITTALS

A. Startup Plan: Not less than 60 Days prior to startup, the Manufacturer shall submit for review a detailed Startup Plan related to the Dewatering Screw Press. The Manufacturer shall revise the Plan as necessary based on review comments. The Maunfacture's Plan shall include:

1. Schedules for manufacturers' equipment certifications.

2. Schedules for submitting final Technical Manuals.

3. Schedule for training the Owner's personnel.

4. Description of temporary facilities, if necessary, and schedule for installation and decommissioning them.

5. Detailed schedule of operations to achieve successful pre-commissioning and commissioning.

6. Checklists and data forms for Dewatering Screw Press.

7. Address coordination with the Owner's staff.

8. Designate a representative of the Manufacturer who has the authority to act in matters relating to startup and has experience in testing Dewatering Screw Press. The Plan shall also designate the roles and responsibilities of the Contractor that may be involved in startup activities.

9. Safety, startup, and testing procedures and proposed inspection and certification forms and records.

10. The Contractor shall be responsible for:

    a. The Interconnection of new to existing facilities

    b. Date and time frame of proposed shutdown or interconnection, including sequence of events and activities to be conducted.

    c. A detailed description of sequences and activities for the planned shutdown and interconnection.

    d. Staff, equipment, and materials that will be at the Site before commencing the shutdown.

    e. Other provisions so that interconnection, testing, and startup will be completed within the planned time.

11. The Contractor shall be responsible for hydrostatic testing of water-holding structures and pipelines and other potable water equipment. Schedule and plan shall indicate source of water, testing and disinfection sequence, disinfection procedures, and the disposal of the water following disinfection.

B. System Outage Requests: Request for shutdown of existing systems as necessary to test or start up new facilities.

C. Records and Documentation

1. Where required by the specifications, submit equipment installation certifications under those Sections.

2. Records of startup as indicated below.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MALFUNCTIONS

A. During the extended operational demonstrations, all components, subsystems, systems, and equipment must properly run continuously 24 hours per day at rates indicated by the Engineer throughout the test period. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired by the Contractor and the test restarted at time zero with no credit given for the operating time before the failure or malfunction. Malfunctions satisfying all three of the following conditions will allow the demonstration period to resume at the elapsed time when the malfunction started:

1. Malfunction did not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment.

2. Malfunction was corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations.

3. Malfunction was corrected within one hour of the time the malfunction was detected (the one hour period includes the time required to locate the cause of the malfunction, beginning upon Contractor’s notification from the Engineer that a malfunction has occurred and ending when the item is corrected and the system is successfully placed back into operation).

B. The Contractor shall arrange for manufacturer's representatives to visit the Site as often as necessary to correct malfunctions.

3.2 PREREQUISITES

A. Pre-commissioning and commissioning activities shall be scheduled by the Contractor. The seven day demonstrations and the eight day demonstration shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the Owner's calendar.

B. The following shall be completed before pre-commissioning begins.

1. All Technical Manual information required by the Contract Documents has been submitted and approved.

2. Safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents are provided. Devices and equipment shall be fully functional, adjusted, and tested.

3. Manufacturer's certifications of proper installation have been accepted.

4. Leakage tests, electrical tests, and adjustments have been completed.

5. The Engineer has approved the Startup Plan.

6. Temporary facilities are functional, adjusted, and ready for use.

7. Individual instrumentation loops (analog, status, alarm, and control) have been verified functionally.

8. Pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and other control devices to the settings determined by the Engineer or the equipment manufacturer have been adjusted for accuracy.

9. Individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls have been verified.

3.3 GENERAL

A. Supplies

1. The Contractor shall furnish:

a. Fuel

b. Oil and grease

c. Other necessary materials not listed for the Owner to furnish

2. The Owner will furnish:

a. Polymer

b. Water

c. Power

B. Startup Records: The Contractor shall maintain the following during testing and startup and submit originals to Engineer:

1. Lubrication and service records for each mechanical and electrical equipment item

2. Hours of daily operation for each mechanical and electrical equipment item

3. Equipment alignment and vibration measurement records

4. Logs of electrical measurements and tests

5. Instrumentation calibration and testing logs

6. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms

7. Factory and field equipment settings

8. Log of problems encountered and remedial action taken

9. Other records, logs, and checklists as required by the Contract Documents

3.4 PRE-COMMISSIONING

A. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.

B. Subject to the malfunction criteria above, each system shall be demonstrated for a continuous, seven day, 24 hour/day period. If any system malfunctions, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

C. The Contractor shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.

D. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup Plan. Completion of systems shall be documented by a report.

E. The Contractor shall demonstrate utility, chemical feed, safety equipment, and other support systems before whole process systems.

F. Furnish the Engineer at least 10 Days written notice confirming the start of pre-commissioning. The Owner's staff will observe pre-commissioning.

3.5 COMMISSIONING

A. The Contractor shall start up the new dewatering system and operate it without malfunction for a continuous eight day, 24 hour/day period. The Engineer will determine the operational parameters.

B. Defects that appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons that interrupt the test may, at the judgement of the Engineer, be cause for extending the demonstration an equal amount of time.

C. Commissioning shall not begin until leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, and system tests have been completed to the satisfaction of the Engineer.

D. The Owner will furnish certified treatment plant operators during the startup period to comply with Idaho Department of Environmental Quality requirements. Certified operators will be under the direct supervision of and be responsible to the Contractor. The Contractor shall furnish continuous, 24 hour staffing at the facility.

E. During commissioning, the Contractor shall:

1. Lubricate and maintain equipment in accordance with the manufacturers' recommendations.

2. Clean or replace strainers, screens, and filter elements.

END OF SECTION

SECTION 01 78 36 – WARRANTIES

PART 1 -- GENERAL

1.01 REQUIREMENTS INCLUDED

A. Preparing and submitting of warranties and bonds.

1.02 FORM OF SUBMITTALS

A. Electronic PDFs.

B. Label cover of each binder with typed or printed title "WARRANTIES AND BONDS", with title of Project; name, address and telephone number of Manufacturer; and name of responsible principal.

C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Contract Documents, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

D. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.03 PREPARATION OF SUBMITTALS

A. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers within 10 days after completion of the applicable item of work. Except for items put into use with Owner’s permission leave date of beginning of time of warranty open until the date of substantial completion is determined. All warranty coverage shall be extended directly to the benefit of the Owner.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

1.04 TIME OF SUBMITTALS

A. For equipment or component parts of equipment put into service during construction with Owner’s permission, submit documents within 10 days after acceptance.

B. Make other submittals within 10 days after date of substantial completion, prior to final application for payment.

C. For items of Work when acceptance is delayed beyond date of substantial completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00 - OWNER STAFF TRAINING

PART 1 - GENERAL

1.1 THE SUMMARY

A. The Manufacturer shall furnish all labor, materials, equipment, and incidentals necessary to train Owner's personnel on the dewatering screw press equipment, products, and systems furnished under this Contract and outlined in Section 46 76 27 – Dewatering Screw Press. Owner training is a prerequisite to satisfactory completion of the Contract requirements and shall be completed within the Contract Time.

B. The minimum onsite training requirements for various plant components are described in various sections of the specifications.

C. Except where otherwise indicated, all costs for training shall be the responsibility of the Manufacturer.

1.2 SUBMITTALS

A. Training Schedule: Schedule for training the Owner's personnel shall be submitted with the detailed Testing and Startup Plan required by Section 01 75 00 – Equipment Testing and Plant Startup.

B. Resumes of instructors.

C. The training lesson plan and materials shall be submitted to the Engineer for review at less than three weeks prior to the provision of training.

D. Approved operation and maintenance manuals shall be available at least 30 days prior to the scheduled date for the individual training session.

E. Training classes shall be scheduled a minimum of four weeks in advance of the date of the first class to allow Owner staffing arrangements to take place. The Manufacturer shall schedule training classes within the period 8:00 a.m. to 5:00 p.m. Monday through Friday.

F. Training classes shall be organized in conjunction with the Startup Systems, as defined in Section 01 75 00 – Testing and Plant Startup. Each training class shall consist of a classroom portion and a field tour portion. Each training class shall include:

1. Safety to be conducted by the plant safety officer.

2. Overview of the startup system, conducted by the Engineer.

3. Training on each item of equipment within the startup system, conducted by the Equipment Manufacturer's representative.

4. Training on the mechanical piping system within the startup system, conducted by the Contractor's mechanical superintendent.

5. Training on the power distribution system within the startup system, conducted by the Contractor's electrical superintendent.

6. Training on the instrumentation and control systems within the startup system, conducted by the Manufacturer's representative

G. Class Agenda: A class agenda shall be prepared by the Contractor, with equipment specific agenda items provided by the Manufacturer and submitted to the Engineer with the training schedule. The agenda shall include a listing of subjects to be discussed, time estimated for each subject, a list of documentation to be used and provided to support training, the proposed route of the field tours, and the instructor(s) name and qualifications. Agendas shall include an allocation of time for all components of the training session, including time for Owner staff to ask questions and discuss the subject matter. The Owner may request that particular subjects are emphasized and the agenda shall be adjusted to accommodate these requests. Copies of the agenda shall be distributed to each student at the beginning of each training class.

H. Within 10 days after the completion of each training session, the Contractor shall submit the following:

1. A sign-in sheet of all personnel that attended the training session.

2. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

3. A flash drive or other digital transfer as acceptable to the Owner containing the above information and a video of the training.

1.3 INSTRUCTOR QUALIFICATIONS

A. Instructors shall be completely knowledgeable in the products and systems for which they are providing training, and shall be experienced in conducting classes. Sales representatives are not considered qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.

B. Instructor shall have at least two years of experience in providing training certified by the Manufacturer.

C. If, in the opinion of the Owner, the Instructor did not provide the adequate training, such training shall be rescheduled and repeated with a suitable instructor at the Contractor's expense.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where specified, the Contractor, with support of the Manufacturer, shall conduct training sessions for the Owner's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this Contract.

2.2 TRAINING AIDS

A. Each instructor is encouraged to use audio-visual devices, P&IDs, models, charts, or other means to effectively increase the transfer of knowledge. The instructor conducting the training shall furnish all such equipment (televisions, CD/DVD recorder/player, projectors, screens easels, etc.), models, and charts for each class. It shall be the responsibility of the instructor to confirm in advance that the classroom will be appropriate for the types of audio-visual equipment to be employed.

2.3 LOCATION

A. Training sessions and field training shall take place at the Project Site, unless otherwise specified by the Owner.

2.4 FORMAT AND CONTENT

A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

1. Familiarization

   a. Review catalog, parts lists, drawings, etc., which have been previously provided for the Owner's files and operation and maintenance manuals.

   b. Inspection on how the equipment has been installed. Demonstrate the operation of the unit and describe how all parts of the equipment meet the requirement of the Specifications.

   c. Answer questions.

2. Safety

   a. Using material previously provided, review safety features of the equipment.

   b. Discuss proper precautions when working around equipment.

3. Operation

   a. Using material previously provided, review reference literature.

   b. Explain all modes of operation (including emergency).

   c. Check out Owner's personnel on proper use of the equipment.

4. Preventive Maintenance

   a. Using material previously provided, review preventive maintenance (PM) lists including:

      1) Reference material.

      2) Daily, weekly, monthly, quarterly, semiannual, and annual PM activities.

b. Demonstrate how to perform Preventive Maintenance procedures.

c. Demonstrate to the Owner's personnel what to look for as indicators of potential equipment problems.

5. Corrective Maintenance

a. Identify possible problems.

b. Demonstrate how to perform repairs. Point out special problems.

c. Open up equipment and demonstrate O&M procedures, where practical.

6. Parts

a. Demonstrate the use of previously provided parts list and order parts.

b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.

7. Local Representatives

a. Identify local vendors where to order parts: name, address, telephone.

b. Service problems:

1) Identify contacts local contacts.

2) Identify emergency contacts.

8. Operation and Maintenance Manuals

a. Review any other material submitted.

b. Update material, as required.

PART 3 - EXECUTION

3.1 GENERAL

A. The objective of the training included under this Section shall be to convey the knowledge needed by the Owner operations, maintenance, and engineering staff to safely operate, maintain, and repair the equipment and systems furnished under this Contract.

B. Owner personnel who will participate in this training have existing full-time work assignments and this training is an additional assigned work task. Owner’s staff work schedules regularly shift, as the plant is operated on an around-the-clock basis.

C. Training shall be tailored to suit the skills and job classifications of the personnel attending the classes e.g., plant manager, plant operator, maintenance technical, electrician, etc.

D. Minimum onsite training requirements for plant components are described in various sections of the Specifications. For the purpose of the times given in individual Specification sections, a workday is defined as an eight hour day at the site, excluding travel time.

E. Training shall be scheduled as a separate trip from equipment inspection, startup, and field adjustment. Training shall not be done until the manufacturer certifies that the equipment is operable as specified.

F. Specific Training Objectives: The training shall include a review of the equipment and drives, including internal parts, as prepared at the factory. The training shall include safety, removal, inspection, cleaning, operation and maintenance of the equipment such as startup, normal operation and shutdown procedures, step-by-step troubleshooting procedures with all necessary test equipment, and emergency or abnormal operation procedures. Training shall include preventive maintenance and long-term maintenance procedures, special tools necessary, and a discussion of recommended spare parts.

3.2 TRAINING CLASSES

A. Number of Classes on Each Subject: A minimum of two classes on identical subject matter shall be conducted, unless otherwise indicated. The purpose of having two classes on each subject is to accommodate the attendance of as many Owner personnel working different shifts as possible.

B. A maximum of one class per day shall be held on consecutive days unless otherwise approved by the Owner. Multiple classes may be scheduled if the class duration is shorter than 4 hours. Times shall be scheduled at the discretion of the Owner.

C. Class Length: Each class shall be subdivided into 2 to 6 hour modules, or as appropriate for the subject matter being discussed.

D. Number of Students: It is estimated that 5 to 10 persons will attend each training class. The Owner will determine the actual number of students. Provide training materials for all attendees.

E. Cancellation of Classes: If a class must be canceled because the equipment is not ready for operation, etc. the Contractor shall notify the Manufacturer and Owner at least one week in advance. The Contractor shall coordinate with the Manufacturer and Owner to reschedule the training.

3.3 TRAINING AIDS

A. Training Aids: Each instructor is encouraged to use audio-visual devices, P&IDs, models, charts, etc. to increase the transfer of knowledge. The Contractor shall provide all such equipment (televisions, videocassette recorder/player, projectors, screens, easels, models, charts, etc.) for each class. It shall be the responsibility of the Contractor to confirm in advance that the training room set-up will be appropriate for the types of audiovisual equipment to be employed.

B. Classroom Documentation: If training is being completed on equipment, systems, or products for which a Technical Manual is required, the draft Technical Manual shall have been returned by the Engineer with a status of “No Exceptions Taken” or “Make Corrections Noted” before the training class is scheduled. The approved Technical

Manual shall be used during the classroom instruction. Supplemental documentation handouts shall be provided by the organization conducting the training as required to the support instruction.

3.4 DOCUMENTATION OF TRAINING

A. The Contractor shall record the entire detailed training course in proper operation and maintenance and provide the video to the Owner. The recording shall be organized by each segment of the training session and be presented in a table of contents style with selectable segments of the session. The video shall become the exclusive property of the Owner. The Owner reserves the right to video, photograph, audio record, and otherwise document any or all training classes provided under this Work.

B. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.

1. As a minimum, classroom equipment training for operations personnel will include:

a. Identify and discuss safety items and procedures.

b. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.

c. Purpose and plant function of the equipment.

d. A working knowledge of the operating theory of the equipment.

e. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

g. Operator detection, without test instruments, of specific equipment trouble symptoms.

h. Required equipment exercise procedures and intervals.

i. Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.

2. As a minimum, hands-on equipment training for operations personnel will include:

a. Identify and review safety items and perform safety procedures.

b. Identify location of equipment and review the purpose.

c. Identifying piping and flow options.

d. Identifying valves and their purpose.

e. Identifying instrumentation:

f. Location of primary element.

g. Location of instrument readout.

h. Discuss purpose, basic operation, calibration, maintenance, troubleshooting, repair, and information interpretation.

i. Discuss, demonstrate, and perform standard operating procedures and round checks.

j. Discuss and perform the preventative maintenance activities.

k. Discuss and perform start-up and shutdown procedures.

l. Perform the required equipment exercise procedures.

m. Perform routine disassembly and assembly of equipment if applicable.

END OF SECTION

SECTION 03 11 00 – CONCRETE FORMING

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall furnish concrete formwork, bracing, shoring, and supports for cast-in-place concrete and shall design and construct falsework, all in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The edition of the standards applicable to the Work shall be those editions referenced by the 2018 International Building Code (IBC. If the standard is not referenced by the IBC, nor an IBC Referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

B. Reference Specifications

01 33 00	Contractor Submittals
03 30 00	Cast-in-Place-Concrete

C. Reference Standards

American Concrete Institute (ACI)	
ACI 117	Standard Tolerances for Concrete Construction and Materials.
National Institute of Standards and Technology (NIST)	
Voluntary Product Standard PS 20	American Softwood Lumber Standard.
Voluntary Product Standard PS 1	Structural Plywood

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Manufacturer’s information demonstrating compliance with requirements for the following:

1. Form ties and related accessories, including taper tie plugs, if taper ties are used.

2. Form gaskets.

3. Form release agent, including NSF/ANSI 61 certification if not using mineral oil.

4. Manufacturer's design information on formwork:

a. Form materials, and locations for use.

1.04 QUALITY ASSURANCE

A. Tolerances: The variation from required lines or grade shall not exceed 1/4-in. in 10-ft, non-cumulative, and there shall be no offsets or visible waviness in the finished surface. Other tolerances shall be within the tolerances of ACI 117.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Except as otherwise expressly accepted by the Engineer, lumber brought on the Site for use as forms, shoring, or bracing shall be new material. Forms shall be smooth surface forms and shall be of the following materials:

Walls	Steel, fiberglass, or plywood panel
Columns	Steel, plywood, or fiberglass
Roof and floor	Plywood
All other Work	Steel panels, fiberglass, plywood or tongue and groove lumber

B. Form materials that may remain or leave residues on or in the concrete shall be certified as compliant with NSF 61.

C. Water-based form release agent shall be Clean Strip J1EF by Dayton Superior, or equal.

2.02 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with Voluntary Product Standard PS 20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork, shall conform to the requirements of Voluntary Product Standard PS 1 – Exterior Plywood for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall accomplish such results. Wood forms for surfaces to be painted shall conform to the requirements of Voluntary Product Standard PS 1 – Exterior Plywood for Concrete Forms, Class I, Medium Density Overlaid (MDO) Grade.

4. Steel leave in place forms shall not be used.

B. Unless otherwise indicated, exterior corners (exterior and interior) in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf minimum. The minimum design load for combined dead and live loads shall be 100 psf.

2.03 FORM TIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form tie fasteners having a circular cross-section shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops that tightly fit the form tie so that they cannot be moved from mid-point of the tie. Form ties shall be ST-4 Hex Head Snaptie by MeadowBurke, A3 Snap-Ties by Dayton Superior, or equal.

B. Removable taper ties may be used when approved by the Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. Use HD-9 Taper-Tie by MeadowBurke, D9 Taper-Tie by Dayton Superior, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

A. Notify Engineer 48 hours prior to placement of concrete. Concrete shall not be placed until Engineer has reviewed and approved the placement of all reinforcing steel.

B. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of forms, and any forms that are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

C. Concrete forms shall conform to the shape, lines, and dimensions of members required, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

D. Forms shall be removed unless approved otherwise by the Engineer.

3.02 FORM DESIGN

A. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the Engineer. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03 30 00 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the Engineer.

3.03 CONSTRUCTION

A. Vertical Surfaces: Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. Construction Joints: Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties that cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls that are dry on both sides. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout that shall match the color and texture of the surrounding wall surface.

3.04 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on exposed concrete surfaces Exposed concrete surfaces are defined as surfaces which are permanently exposed to view In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.05 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. All supporting forms or shoring shall remain in place for a minimum of 10 days or until members have acquired the 28-days compressive strength to support their weight and imposed loads safely, see Section 03 30 00 for the 28 Day Strength. 03 30 00. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained the 28 Day strength and has been in place for a minimum of 10 Days.

3.06 MAINTENANCE OF FORMS

A. Forms shall be maintained in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the Contractor shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.07 FALSEWORK

A. The Contractor shall be responsible for the design, engineering, construction, maintenance, and safety of falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the Cal OSHA and OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements herein.

B. Falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

C. Falsework shall be placed upon a solid footing, safe against undermining, and be protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

END OF SECTION

SECTION 03 21 00 – REINFORCEMENT BARS

PART 1 -- GENERAL

1.01 SUMMARY

A. Provide reinforcement steel and appurtenant Work, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
03 60 00	Grouting

B. Reference Standards

1. The edition of the standards applicable to the Work shall be those editions referenced by the 2018 International Building Code (IBC). If the standard is not referenced by the IBC, nor an IBC-referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

American Concrete Institute (ACI)	
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 318	Building Code Requirements for Structural Concrete
ASTM International (ASTM)	
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706	Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 775	Epoxy - Coated Reinforcing Steel Bars
ASTM A 1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
American Welding Society (AWS)	
AWS D1.4	Structural Welding Code – Reinforcing Steel
Concrete Reinforcing Steel Institute (CRSI)	
CRSI	Manual of Standard Practice
International Code Council (ICC)	
IBC	2018 International Building Code

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings

1. Furnish shop bending diagrams, placing lists, and drawings of reinforcement steel prior to fabrication.

2. Diagrams

    a. The shop bending diagrams shall show the actual lengths of bars to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface.

    b. Include bar placement diagrams that clearly indicate the dimensions of each bar splice.

3. Reinforcement

    a. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt by the Contractor of the Notice to Proceed.

    b. Said details of reinforcement steel for fabrication and erection shall conform to the CRSI Manual of Standard Practice, and the indicated requirements.

    c. Mill certificates, including reinforcing steel yield and tensile strength test data.

4. Mechanical Couplers

    a. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit the following items:

        1) manufacturer's literature containing instructions and recommendations for installation for each type of coupler used;

        2) certified test reports that verify the load capacity of each type and size of coupler used; and

        3) Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

5. Welding

    a. If reinforcement steel is to be spliced by welding at any location, submit mill test reports containing the information necessary for determination of the carbon equivalent per AWS D1.4.

    b. Submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.

    c. If reinforcement steel is spliced by welding at any location, submit certifications of procedure qualifications for each welding procedure and certification of welder qualifications, for each welding procedure and for each welder performing on the Work.

1.04 QUALITY ASSURANCE

A. Materials Testing

1. If requested by the Engineer, furnish samples from each heat of reinforcement steel in a quantity adequate for testing.

2. Costs of initial tests will be paid by the Owner.

3. Costs of additional tests if material fails initial tests shall be the Contractor's responsibility.

B. Welding

1. Welder qualifications and procedure qualifications shall be as indicated in AWS D1.4.

2. If requested by the Engineer, furnish samples of each type of welded splice in a quantity and of dimensions adequate for testing.

3. At the discretion of the Engineer, radiographic testing of direct butt-welded splices will be performed.

4. Provide assistance necessary to facilitate testing.

5. Repair welds that fail to meet AWS D1.4.

6. The costs of testing will be paid by the Owner, but the costs of tests that show failure to meet requirements shall be the Contractor's responsibility.

PART 2 -- PRODUCTS

2.01 MATERIAL REQUIREMENTS

A. Materials that may remain or leave residues on or within the concrete shall be certified as compliant with NSF/ANSI 61.

2.02 REINFORCEMENT STEEL

A. Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Deformed Bar Reinforcement

For Seismic Design Categories A, B, or C, use the following paragraphs.

a. Deformed bar reinforcement shall conform to ASTM A615 for Grade 60 reinforcement, unless otherwise indicated.

b. Welded Reinforcement

1) Deformed bar reinforcement that is welded shall conform to ASTM A706 for Grade 60 reinforcement, unless otherwise indicated.

2) The carbon equivalent in reinforcing that is welded shall not exceed 0.55 percent.

2. Spiral Reinforcement

a. Spiral reinforcement shall conform to one of the following:

1) ASTM A615 deformed bars.

2) ASTM A706 deformed bars.

b. Welded Reinforcement

1) Spiral reinforcement that is welded shall conform to ASTM A706, unless otherwise indicated.

2) The carbon equivalent in spiral reinforcing that is welded shall not exceed 0.55 percent

3. Welded Wire Reinforcement

a. Welded wire reinforcement shall conform to ASTM A1064 and the indicated Details.

b. Welded wire reinforcement with longitudinal wire of W4 size wire and smaller shall be in flat sheets or in rolls with a core diameter of not less than 10-inches.

c. Welded wire reinforcement with longitudinal wires larger than W4 size shall be in flat sheets only.

B. Accessories

1. Accessories shall include necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement.

2. Bar Supports

a. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice, including special requirements for supporting epoxy-coated reinforcing bars.

b. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating that extends at least 1/2 inch from the concrete surface.

c. Plastic shall be gray in color.

3. Concrete Blocks

a. Concrete blocks (dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as required for the concrete in which they are located.

b. Wire ties shall be embedded in concrete block bar supports.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where indicated and where approved by the Engineer.

B. The couplers shall develop a tensile strength and compressive strength that exceeds 125 percent of the specified yield strength of the reinforcement bars being spliced at each splice and shall develop the specified tensile strength of the reinforcement bars being spliced at each splice.

C. Multi-Component Couplers

1. Where the type of coupler used is composed of more than one component, components required for a complete splice shall be provided.

2. This shall apply to mechanical splices, including those splices intended for future connections.

D. Connection

1. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection.

2. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

E. Couplers shall be Lenton Form Saver by Erico Products, Dowel Bar Splicer System by Dayton/Richmond, or equal.

2.04 WELDED SPLICES

A. Welded splices shall be provided where indicated and where approved by the Engineer.

B. Welded splices of reinforcement steel shall develop a tensile strength that exceeds 125 percent of the specified yield strength of the reinforcement bars that are connected.

C. Materials as required to conform the welded splices to AWS D1.4 shall be provided.

2.05 EPOXY GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled.

B. Epoxy grout shall be in conformance with the requirements of Section 03 60 00-Grouting.

PART 3 -- EXECUTION

3.01 GENERAL

A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the Building Code and the indicated supplementary requirements.

3.02 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 318 and the CRSI Manual of Standard Practice, except as modified by the Drawings.

2. Bars shall be bent cold.

3. Bars shall be bent in accordance with the requirements of ACI 318.

4. Fabricate reinforcement bars for structures in accordance with accepted bending diagrams, placing lists, and placing drawings.

B. Fabricating Tolerances

1. Bars used for concrete reinforcement shall conform to the following fabricating tolerances:

a. Sheared Length: plus and minus one inch

b. Depth of Truss Bars: plus zero, minus 1/2 inch

c. Stirrups, Ties and Spirals: plus and minus 1/2 inch

d. Other Bends: plus and minus one inch

3.03 PLACEMENT

A. Reinforcement steel shall be accurately positioned as indicated and shall be supported and wired together to prevent displacement using annealed iron wire ties or suitable clips at intersections.

B. Reinforcement steel shall be supported by concrete, plastic or metal support spacers, or metal hangers that are sufficiently strong and rigid to prevent any displacement of the reinforcement steel.

C. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous.

D. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks.

E. For concrete over formwork, provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

F. Limitations on the use of bar support materials shall be as follows.

1. Concrete Dobies

a. permitted at any location except where architectural finish is required

b. required for slabs on grade and surfaces in contact with or above ozonated process water

2. Wire bar supports will be permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.

3. Plastic bar supports will be permitted at every location except on-grade.

G. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

H. Bars additional to those indicated that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional expense to the Owner.

I. Except where in conflict with the Building Code, unless otherwise indicated, reinforcement placing tolerances shall be within the limits indicated in ACI 318.

J. Moving Bars

1. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items.

2. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the Engineer.

K. Welded Wire Reinforcement

1. Welded wire reinforcement placed over horizontal forms shall be supported on slab bolsters.

2. Slab bolsters shall be spaced not more than 30-inch on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.

3. Welded wire reinforcement placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.

4. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

L. Storage and Handling

1. Epoxy-coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating.

2. Non-abrasive slings made of nylon and similar materials shall be used.

3. Specially coated bar supports shall be used.

4. Chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.

M. Accessory Spacing

1. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars.

2. When used to space the reinforcing bars from wall forms, the forms and bars shall be located such that there is no deflection of the accessory when the forms are tightened into position.

3.04 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars, nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.05 SPLICING

A. General

1. Reinforcement bar splices shall only be used at indicated locations.

2. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as reviewed and accepted by the Engineer.

3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318 for a Class B splice.

2. Welded Wire Reinforcement

a. Laps of welded wire reinforcement shall be in accordance with ACI 318.

b. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet.

c. Wires shall be staggered and tied in such a manner that they cannot slip.

3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. Bending or Straightening

1. Reinforcement shall not be straightened or re-bent in a manner which will injure the material.

2. Bars shall be bent or straight as indicated.

3. Do not use bends different from the bends indicated.

4. Bars shall be bent cold, unless otherwise permitted by the Engineer.

5. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the Engineer.

D. Couplers

1. Couplers that are located at a joint face shall be of a type that can be set either flush or recessed from the face as indicated.

2. The couplers shall be sealed during concrete placement to completely eliminate concrete, or cement paste from entering.

3. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface.

4. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.

5. Threaded couplers shall be plugged.

E. Unless indicated otherwise, mechanical coupler spacing, and capacity shall match the spacing and capacity of the reinforcing indicated for the adjacent section.

3.06 CLEANING AND PROTECTION

A. Reinforcement steel shall always be protected from conditions conducive to corrosion until concrete has been placed around it.

B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

C. Where there is delay in depositing concrete, the reinforcement shall be re-inspected and, if necessary, re-cleaned.

3.07 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. The hole preparation shall be per the manufacture’s recommendations and product evaluation report.

2. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling, and the location of holes shall be adjusted to avoid drilling through or nicking any existing reinforcing bars. Final hole locations shall be as reviewed and accepted by the Engineer.

3. The hole shall be cleaned per manufacture’s recommendations and evaluation report.

B. Embedment

1. Drilling depth, product application and dowel insertion shall be per the manufacture’s recommendations and product evaluation report.

END OF SECTION

SECTION 03 30 00 – CAST IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 SUMMARY

A. Provide cast-in-place concrete, as indicated in accordance with the Contract Documents.

B. The following types of concrete are covered in this Section:

1. Structural Concrete

a. Regular Mix: Use for roof slabs, floor slabs, columns, walls, pavements, and other concrete items not indicated otherwise in the Contract Documents.

b. Thick Section Mix: This type of concrete may be used for 24-inch and thicker sections at the Contractor's option.

c. Congested Section Mix: Use where indicated or at the Contractor’s option, if approved in advance by the Engineer.

d. Pea Gravel Mix: Required at the bottom 6 inches of walls with waterstops.

C. The term "hydraulic structure" shall mean environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, other fluids, or gases.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
03 11 00	Concrete Forming
03 21 00	Reinforcement Bars
03 60 00	Grouting

B. Reference Standards

1. The edition of the standards applicable to the Work shall be those editions referenced by the 2018 International Building Code (IBC). If the standard is not referenced by the IBC, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

American Concrete Institute (ACI)	
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete

ASTM International (ASTM)	
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C127	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
ASTM C128	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C156	Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete
ASTM C157	Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM D1227	Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing

ASTM D2419	Standard Test Methods for Sand Equivalent Value of Soils and Fine Aggregate
ASTM E1643	Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00– Submittal Procedures

B. Mix Designs

1. Prior to beginning the Work and within 14 Days of the Notice to Proceed, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete.

2. Mix designs shall be checked through trial batch and laboratory testing by an independent testing laboratory acceptable to the Engineer.

3. Costs related to trial batch and related laboratory testing shall be Contractor's responsibility as part of the Work.

4. Since laboratory trial batches require 35 calendar days to complete, the Contractor shall test a minimum of 2 mix designs for each class of concrete.

C. Delivery Tickets

1. Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete.

2. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amount of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix.

3. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

D. Test Data: Test data relating to the cement, aggregate, and admixtures shall be less than 6 months old.

E. Furnish the following submittals in accordance with ACI 301:

1. mill tests for cement

2. admixture certification, including chloride ion content

3. aggregate gradation test results and certification

4. materials and methods for curing

1.04 CONCRETE CONFERENCE

A. The Engineer will chair a meeting to review the detailed requirements of the Contractor's proposed concrete design mixes and to determine the procedures for producing proper concrete construction no later than 14 Days after the Notice to Proceed.

B. Parties involved in the concrete Work shall attend the conference, including the following at a minimum:

1. Contractor's representative

2. testing laboratory representative

3. concrete subcontractor

4. reinforcing steel subcontractor and detailer

5. concrete supplier

6. admixture manufacturer's representative

C. The conference shall be held at a time and place proposed by the Contractor and accepted by the Engineer.

D. The conference shall be held at least 5 Days after acceptance.

1.05 QUALITY ASSURANCE

A. General

1. Tests on component materials and for compressive strength and shrinkage of concrete shall be performed as indicated.

2. Tests for determining slump shall be in accordance with ASTM C143.

3. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C33.

4. The cost of trial batch laboratory tests on cement, aggregates, and concrete shall be the Contractor's responsibility.

5. The cost of laboratory tests on field-placed cement, aggregates, and concrete and the cost of Special Inspections required by Code will be the Owner’s responsibility.

6. The Contractor shall be responsible for the cost of any tests and investigations of Work that is determined to be Defective Work.

7. The testing laboratory shall meet or exceed ASTM C1077.

8. Concrete for testing shall be furnished by the Contractor, and the Contractor shall assist the Engineer in obtaining samples and disposal and cleanup of excess material.

B. Inspections

1. Continuous inspection by a special inspector approved by the Engineer will be required where necessary to conform with Code requirements.

2. Costs of the special inspector shall be paid by the Owner.

3. Inspection reports shall be submitted to the Engineer.

4. The special inspector shall observe the following for conformance to the Contract Documents:

   a. the preparation and taking of required test specimens; and,

   b. placement of concrete, except sitework concrete fully supported on earth.

C. Field Compression Tests

1. Test reports shall be sent to the Engineer with copies to the Contractor.

2. Concrete which fails to meet strength, slump, air or shrinkage requirements may be rejected by the Engineer before, during, or after placement.

3. One set of four concrete test cylinders shall be taken for every 50 cubic yards or fraction thereof of each concrete mix design placed each day. The Engineer has the option to direct the required test specimens to be taken as he deems necessary to insure the concrete meets the specification.

4. Specimens shall be taken, cured, and tested for compressive strength in accordance with ASTM C31, ASTM C39, and ASTM C172, respectively.

5. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.

6. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens.

7. These tests shall be considered a part of the normal compression tests for the project.

D. Determine the concrete slump by ASTM C143 with each strength test sampling and as required to establish consistency.

E. Determine air content of the concrete using ASTM C231 to verify the percentage of air in the concrete immediately prior to depositing in the forms.

F. Construction Tolerances

1. Where tolerances are not shown elsewhere, permissible deviations from established lines, grades, and dimensions are listed below:

2. Variation from the Plumb

a. In the lines and surfaces of columns, piers, walls and in any other vertical members: in 10 feet, ¼-inch; in any story or 20 feet maximum, 3/8 inch; in 40 feet or more, ¾-inch.

b. For exposed corners and other conspicuous lines: in any bay or 20 feet maximum, ¼-inch; in 40 feet or more, ½-inch.

3. Variation from the Level or from the Grades Shown

a. In floors, ceilings, and beam soffits: in 10 feet, ¼-inch; in any bay or 20 feet maximum, 3/8 inch; in 40 feet or more, ¾-inch; in floors to receive tile, maximum of 1/8" in 10 feet.

b. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: in any bay or 20 feet maximum, ¼-inch; in 40 feet or more, ½-inch.

4. Variation of the linear building lines from established position in plan and related position of columns, walls and partitions: In any bay or 20 feet maximum, ½-inch; in 40 feet or more, 1 inch.

5. Variation in tank, channel or structural lines in 10 feet, ¼-inch; in 20 feet, 3/8 inch; in 40 feet or more, ½-inch.

6. Variation in the sizes and locations of sleeves, floor openings and wall openings: ¼-inch.

7. Variation in cross sectional dimensions of columns, beams and piers, and in the thickness of slabs and walls: minus, ¼-inch; plus, 3/8-inch.

8. Footings

a. Variation in Dimensions in Plan: Minus, ½-inch; plus, 2 inch.

b. Misplacement or Eccentricity: 2 percent of the footing width in the direction of misplacement but not more than 2 inches.

c. Misplacement or Eccentricity of Footings Supporting Masonry Or Concrete: ½-inch.

d. Reduction in Thickness: Minus 5 percent of specified thickness.

9. Variation in Steps

a. In a Flight of Stairs: rise, 1/8 inch; tread, ¼-inch.

b. In Consecutive Steps: rise, 1/16 inch; tread, 1/8 inch.

10. Variation from established lines and grades in sidewalks, plazas, outdoor concrete slabs, curb and gutter sections: in 10 feet, ¼-inch; in 1 foot, 1/8-inch.

G. Where tolerances are not met, the Owner's Representative may require removal and replacement at no cost to the Owner.

PART 2 -- PRODUCTS

2.01 CONCRETE MATERIALS

A. General

1. Concrete materials in contact with potable water shall be classified as acceptable for potable water use in accordance with NSF/ANSI 61 as required by the authority having jurisdiction. Not all products listed herein are for use in contact with potable water.

2. Cement for concrete that will contact potable water shall not be obtained from kilns that burn metal rich hazardous waste fuel.

3. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage.

4. Cement reclaimed from cleaning bags or leaking containers shall not be used.

5. Cement shall be used in the sequence of receipt of shipments.

Materials and storage of materials shall comply with ACI 301, as applicable.

B. Materials for concrete shall conform to the following requirements:

1. Cement

a. Cement shall be standard brand Portland cement conforming to ASTM C150, for Type II Modified/Type V.

b. A minimum of 85 percent of cement by weight shall pass a 325 screen.

c. A single brand of cement shall be used throughout the Work, and prior to its use, the brand shall be accepted by the Engineer.

d. The cement shall be suitably protected from exposure to moisture until used.

e. Cement that has become lumpy shall not be used.

f. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling.

g. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the Engineer, if requested, regarding compliance with the Specifications.

2. Water

a. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities.

b. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.

c. Agricultural water shall not be used.

3. Aggregates

a) Aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, and shall conform to ASTM C33.

b) The maximum size of coarse aggregate shall be as indicated, and the substitution of lightweight sand for fine aggregate will not be permitted.

c) Coarse Aggregates

1) Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof.

2) The coarse aggregates shall be prepared and handled in 2 or more size groups for combined aggregates, with a maximum size greater than 3/4 inch.

3) When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined (also refer to the Article below entitled "Trial Batch and Laboratory Tests").

b. Fine Aggregates

1) Fine aggregates shall be natural sand or a combination of natural and manufactured sand that is hard and durable.

2) When tested in accordance with ASTM D2419, the sand equivalency shall not be less than 75 percent for an average of 3 samples, nor less than 70 percent for an individual test.

3) The gradation of fine aggregate shall conform to ASTM C33 when tested in accordance with ASTM C136 for the fineness modulus of the sand used, including the optional grading in Section 6.2.

4) The fineness modulus of sand used shall not be greater than 3.1.

5) When tested in accordance with ASTM C33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

c. Combined Aggregates

1) Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce concrete that has optimum workability and consolidation characteristics.

2) Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.

3) When tested in accordance with ASTM C33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions or 10.5 percent after 100 revolutions.

d. When tested in accordance with ASTM C33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

e. When tested in accordance with ASTM C33, the loss resulting after 5 cycles of the soundness test shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate when using sodium sulfate.

4. Ready-mixed concrete shall conform to the requirements of ASTM C94.

5. Admixtures

a. Admixtures shall be compatible and shall be furnished by a single manufacturer capable of providing qualified field service representation.

b. Admixtures shall be used in accordance with manufacturer's recommendations.

c. If the use of an admixture is producing an inferior end result, the Contractor shall discontinue use of the admixture.

d. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

e. Air Content

1) An air-entraining agent meeting the requirements of ASTM C260 shall be used.

2) The Owner reserves the right, at any time, to sample and test the air-entraining agent.

3) The air-entraining agent shall be added to the batch in a portion of the mixing water.

4) The solution shall be batched by means of a mechanical batcher capable of accurate measurement.

5) Air content shall be tested at the point of placement.

6) The air entraining agent shall be Micro-Air by Master Builders; Daravair by W.R. Grace; Sika AEA-15 by Sika Corporation; or equal

f. Water-Reducing Admixtures

1) A water reducing agent such as Pozzolith, WRDA, or equal shall be used in all concrete. The admixture shall conform to ASTM C494, Type A. Proportioning and mixing shall be as recommended by the manufacturer.

2) Concrete shall not contain more than one water-reducing admixture, unless it can be demonstrated that the proposed mix will meet the indicated drying shrinkage requirements.

3) Flyash

a) Fly ash shall conform to ASTM C618, Class F or N, except that the loss on ignition shall be limited to 1%. The Contractor may at his option substitute up to 15 percent by weight of fly ash for the cementitious material required herein except where high early strength is specified or where the use of fly ash is prohibited.

2.02 CURING MATERIALS

A. Sheet Materials: ASTM C171, 4 mil polyethylene film or waterproof paper.

B. Spray Applied Membrane Forming Liquids: Meet or exceed requirements of ASTM C309, Type 1-D, Class B, except that the loss of water, when tested, shall be not more than 0.15 kilograms per square meter in 24 hours, nor more than 0.45 kilograms per square meter in 72 hours. Shall be a water-base, resin cure with fugitive dye, meeting California Air Regulation Board requirements. Products by Burke, W.R. Meadows, Inc., or equal. Material shall only be allowed on concrete not scheduled to be coated.

C. Concrete Curing Blanket

1. Polyethylene Sheets

a. Polyethylene sheets for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils.

b. The loss of moisture when determined in accordance with ASTM C156 shall not exceed 0.055 grams per square centimeter of surface.

2. Polyethylene-Coated Burlap

a. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, with white opaque polyethylene film impregnated or extruded into one side of the burlap.

b. The burlap shall weigh not less than 9 ounces per square yard.

c. The loss of moisture, when determined in accordance with ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.

2.03 FLOOR HARDENER

A. Liqui-Hard by W.R. Meadows; Lapidolith by Sonneborn Building Products, Division of Contech, Inc., Minneapolis, Minnesota, or equal. Hardener shall be compatible with curing method used.

2.04 NON-WATERSTOP JOINT MATERIALS

2.05 MISCELLANEOUS MATERIALS

A. Bonding Agents

1. Bonding agents shall be epoxy adhesives.

2. Bonding agents for bonding freshly-mixed, plastic concrete to hardened concrete shall be:

a. Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corporation;

b. MasterEmaco ADH 326 by BASF/Master Builders;

c. BurkEpoxy MV by Edoco;

d. or equal.

3. Bonding agents for bonding hardened concrete or masonry to steel shall be:

a. Sikadur 31 Hi-Mod Gel by Sika Corporation;

b. BurkEpoxy NS by Edoco;

c. Concresive Paste (LPL) by MBT/Degussa Building Systems;

d. or equal.

B. Vapor Retarder

1. The vapor retarder shall be a plastic sheet meeting the Class A permeance and strength requirements of ASTM E1745. The minimum thickness shall be 10 mils.

2. The vapor retarder shall be Griffolyn Type-65 G by Reef Industries, Inc., or equal.

C. Colorant for duct bank concrete shall be an integral red oxide coloring pigment used in the proportion of 8 pounds per cubic yard of concrete.

2.06 CONCRETE DESIGN REQUIREMENTS

A. General

1. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated.

2. The exact proportions in which these materials are to be used for different parts of the Work shall be determined during the trial batches.

3. In general, the mix shall be designed to produce a concrete capable of being deposited to obtain maximum density and minimum shrinkage, and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface.

4. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items.

5. The proportions shall be changed whenever necessary or desirable to meet the required results, and such changes shall be subject to review by the Engineer.

Fine Aggregate	
Fineness Modulus	**Percent (maximum)**
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

6. For other concrete, the maximum percentage of fine aggregate of total aggregate by weight shall not exceed 50 percent.

B. Duct Bank Concrete

1. Duct bank concrete shall contain an integral red-oxide coloring pigment.

2. The concrete shall be dyed red throughout.

3. Using a surface treatment to color duct banks will not be accepted.

C. Water/Cement Ratio

1. The indicated water/cement ratio is for a saturated-surface dry condition of aggregate.

2. Throughout every Day, the added batch water shall be adjusted for the total free water in the aggregates, which shall be determined as follows:

   a. The total moisture content of all aggregate shall be calculated by ASTM C566.

   b. Subtract the moisture absorbed by the coarse aggregate, calculated by ASTM C127.

   c. Subtract the moisture absorbed by the fine aggregate, calculated by ASTM C128.

D. Concrete Property Tables

1. The maximum cement contents, the maximum W/C Ratios and the maximum Water Contents given in the Concrete Property Tables below are intended to minimize drying shrinkage and heat of hydration of the concrete.

2. It is understood that the indicated maximum cement contents and maximum water contents may require additional water reducing agent for the workability required by the Contractor's methods, and may not result in the least costly concrete mix for the required concrete strength.

Type of Use	Concrete Class	Maximum Aggregate Size (inches)	Minimum Compression Strength at 28 Days (psi)	Slump (inches)	Max. Water Cementitious Ratio (by weight)	Entrained Air Required (%)
STRUCTURAL CONCRETE:						
Interior and Exterior Concrete	1	1 ½	4000	3 max	0.45	3 ± 1-½

NOTE: The Contractor is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the Contractor's construction methods and aggregates. The Contractor shall be responsible for providing concrete with the required workability and strength.

E. Concrete Class:

1. Class 1 concrete shall contain a minimum of 675 pounds of cementitious material per cubic yard.

F. Concrete Compressive Strength:

1. Whenever the 28-day compressive strength shown on the plans is 5000 pounds per square inch or greater, the concrete shall be considered to be designated by compressive strength.

2. When the concrete is designated by compressive strength the mix proportions shall be determined and concrete shall be furnished which contains not less than 675 pounds and not more than 800 pounds of cementitious material per cubic yard of concrete and which conforms to the strengths shown on the plans or as specified.

3. Batch proportions shall be adjusted as necessary to produce concrete having the specified cement factor.

G. Duct Bank Concrete

1. Duct bank concrete shall contain an integral red-oxide coloring pigment, the concrete shall be dyed red throughout. Using a surface treatment to color duct banks will not be accepted.

2.07 TRIAL BATCH AND LABORATORY TESTS

A. Prepare and submit proposed mix designs along with trial batch test results with a minimum of three test cylinders or a series of production compression tests with a minimum of 20 sets of test data within the last year. All test results shall be signed by a laboratory currently certified by CCRL and actively participating in their sample proficiency program verifying that the components and final products meet the requirements of ACI MCP and these specifications. Mix designs shall include fine, coarse, and combined aggregate gradations.

B. Provide certificates that the cement used complies with ASTM C150 and these specifications.

C. Provide certificate of compliance from the manufacturer of the concrete admixtures with these specifications.

D. Submit concrete drying shrinkage test data along with mix design submittals for concrete with required 28 day compressive strength of 4000 psi and above. Test shall comply with ASTM C157 as modified by SEAOC. The maximum limit for drying shrinkage shall be 0.045% for mix design and 0.058% for field cast after 28 days of drying after the wet cure period.

E.

PART 3 -- EXECUTION

3.01 SAFETY REGULATIONS

A. Comply with all applicable safety regulations requirements of OSHA.

3.02 READY-MIXED CONCRETE

A. General

1. All concrete shall be machine mixed at the site, or delivered to the site by transit mixers under conditions approved by the Engineer.

2. Provide delivery tickets for ready-mix concrete or weighmaster certificates per ASTM C94, including cement weights, aggregate size, the amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both the coarse and fine aggregates.

3. No concrete shall be placed in the work after it has started to set. No concrete can be placed more than one hour after it has been mixed.

4. If transit mix is used, the rate of delivery, haul time, mixing time and hopper capacity shall be such that all mixed concrete delivered shall be placed in the forms within one hour from the time of introduction of cement and water to the mixer. All concrete shall be kept continuously agitated until discharged in the hopper at the job site.

5. Trucks rejected based on time limit or required test(s) failure shall not return with new concrete to the jobsite within three hours unless approved by the Engineer.

3.03 CONCRETE HANDLING AND PLACEMENT

A. Excavations and Formwork

1. Excavations shall be kept free from water while concrete is being placed, cured and finished therein. Fresh concrete shall be protected at all times from running water.

2. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 14 days before the contiguous unit or units are placed.

3. Before placing concrete, all form work shall be cleaned of dirt and construction debris, water-drained, reinforcement securely and properly fastened in its correct position, forms at construction joints re-tightened, all ducts, sleeves, hangers, pipes, conduits, bolts, wires, etc., installed.

4. No concrete shall be placed before the forms and all work that is to be embedded have been set and observed by the Engineer.

5. See Section 03 11 00-Concrete Forming for additional information.

B. Concrete Placement

1. Notify Engineer 48 hours prior to placement of concrete. Concrete shall not be placed until Engineer has reviewed and approved the placement of all reinforcing.

2. The working schedule and schedule of placement shall be as shown on the plans and worked out in conjunction with the Engineer. The schedule shall be worked out prior to commencement of work, and shall be rigidly adhered to.

3. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the separation or loss of the materials. The concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. Use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

4. Concrete shall be placed and consolidated by methods that will not cause segregation of the aggregates and will result in a dense homogeneous concrete which is free of voids and rock pockets. All concrete shall be used while fresh and before it has taken an initial set. Retempering any partially hardened concrete with additional water will not be permitted.

5. Surfaces on which concrete is to be placed shall be dampened with water immediately before placing concrete.

6. Concrete shall not be deposited on frozen or ice-coated ground nor on ice-coated forms, reinforcing steel, embedded items or construction joints.

7. Where pavement or surfacing is to be placed around or adjacent to manholes or drainage inlets which will be located within traffic lanes, such structures shall not be constructed to final grade until after the pavement or surfacing has been placed around these locations.

8. Where a schedule for placing concrete is shown on the plans no deviation will be permitted there from unless approved in writing by the Engineer.

9. Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete, will not be permitted.

10. Except for concrete used in cast in place piles, fresh concrete shall not be permitted to fall from a height greater than 4 feet without the use of adjustable length pipes, tubes or double belting placed to prevent segregation of the concrete. Double belting shall not be used unless the thickness of the member is less than 16 inches.

11. In vertical sections, concrete shall be deposited continuously in horizontal layers of 24 inches maximum depth so as to maintain a horizontal plastic surface until the completion of the unit. No concrete shall be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section.

12. Concrete for horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections is no longer plastic and has been in place at least two hours.

13. In all slabs, concrete shall be deposited in a continuous or monolithic operation to the full thickness of the slab. Each batch shall be dumped against previously placed concrete and not away from it, and shall not be dumped in separate piles and then worked together.

14. The concrete in each integral part of the structure shall be placed continuously, and work will not be allowed to commence on any such part unless sufficiently inspected and approved material for the concrete is on hand, and forces and equipment are sufficient to complete the part without interruption in the placing of the concrete.

C. Concrete Vibrating

1. Consolidate concrete by means of high frequency internal vibrators within 15 minutes after it is deposited in the forms. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The vibrating shall be done with care and in such manner that displacement of reinforcement, ducts, and embedded items is avoided.

2. All concrete shall be consolidated by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness.

3. Internal vibrators used shall be the largest size and the most powerful that can be properly used in the work, as described in Table 5.1.4 of ACI 309. They shall be operated by competent workmen. Use of vibrators to transport concrete within forms shall not be allowed. The vibrator shall be inserted vertically at uniform spacing over the entire area of the placement. The distance between insertions shall generally be about 1½ times the radius of action, or such that the area visibly affected by the vibrator overlaps the adjacent just vibrated area by a few inches. In slabs, the vibrator shall be sloped toward the horizontal as necessary to operate in a fully embedded position.

4. The vibrator shall penetrate rapidly to the bottom of the layer, and at least 6 inches into the preceding layer if there is such. At each insertion, the vibrator shall be held stationary for a time sufficient to consolidate the concrete but not cause segregation, generally from 5 to 15 seconds. The vibrator shall then be withdrawn slowly, at the rate of approximately 3 inches per second.

5. A spare vibrator in good working condition shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

6. The use of external vibrators for consolidating concrete will be permitted when, in the opinion of the Engineer, the concrete is inaccessible for adequate consolidation provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

D. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306 and the following paragraphs.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather (as defined in ACI 306), maintain concrete temperature at not less than 55 degrees F for the first five days after placing, and above 35 degrees F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

4. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

E. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305 and the following paragraphs.

2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F.

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

3.04 CURING AND PROTECTION

A. General: Beginning immediately after placement, protect concrete from drying, excessively hot and cold temperatures and mechanical injury. Keep moisture loss to a minimum until cement has hydrated and concrete is hard. Keep concrete constantly moist during the curing period. Follow color admixture manufacturer's recommendations for integrally colored concrete.

B. Curing

1. Formed Surfaces: Keep forms wet. Cool metal forms exposed to the sun with water. If curing compound is used, apply in accordance with manufacturer's instructions. Curing compound shall not be used on any wall/slab scheduled to be coated.

2. Slabs: Immediately after finishing, apply one of the materials specified in Section 2.22 entitled Curing Materials, but use membrane forming liquid only with Engineer's approval.

3. Duration of Curing: 7 days minimum.

C. Protection

1. In cold weather, maintain the moisture conditions but also, by heating or covering, maintain the temperature of the concrete between 50 degrees F and 70 degrees F for entire curing period.

2. In hot weather take immediate steps to protect newly finished concrete from drying effects of wind and sun, and maintain temperature of the air surrounding the concrete uniform within 5 degrees F in any one hour or 50 degrees F in any 24 hour period.

3. During curing period, protect concrete from mechanical damage, loading, shock and vibration.

3.05 CONSTRUCTION OF CONCRETE FILLETS, TOPPING, AND EQUIPMENT PADS

A. General

1. Concrete fillets, topping and equipment pads shall be placed as soon as possible after completion of the curing period of the tank walls and structural floors. Contact surfaces shall be thoroughly cleaned to the degree recommended by the bonding agent manufacturer

2. Bonding agent shall be accurately and thoroughly mixed and applied at the manufacturer's recommended coverage rate. Mix only the amount which can be used prior to expiration of the pot life. Concrete shall be immediately placed over the fresh surface before setting of the agent. Bonding agent which sets up prior to placing concrete shall be recoated with a fresh coat.

3. Concrete fillets, topping, and equipment pads shall be accurately screeded to the slopes and elevations shown and steel trowel finished. Cure concrete as specified for slabs above. Set equipment anchor bolts in pad to accommodate equipment furnished.

3.06 REPAIRING AND PATCHING

A. General

1. Clean, thoroughly dampen and patch all tie-rod holes and all repairable defects immediately after form removal.

2. All honeycombed and other defective concrete shall be removed to sound concrete with edges perpendicular to the surface. Surface imperfections greater than 3/8 inch in any dimension shall be removed and the affected areas neatly patched. Dampen the area to be patched and an area at least 6 inches wide surrounding it to prevent absorption of water from the patching mortar. Mix patching grout to the consistency of thick cream and brush it well into the surface.

3. Make the patching mortar of the same material and approximately the same proportions as used for the concrete, omitting the coarse aggregate. The resultant mortar shall consist of not more than 1 part cement to 2½ parts sand by damp loose volume.

4. Do not use more mixing water than necessary for handling and placing. Mix the patching mortar in advance and allow to stand with frequent manipulation with a trowel, without adding water, until it has reached the stiffest consistency that will permit placing.

5. After surface water has evaporated from the area to be patched, brush the patching grout well into the surface. When the patching grout begins to lose the water sheen, apply the premixed patching mortar. The mortar shall be thoroughly consolidated into place and struck off to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least 1 hour before finishing it. Keep the patched area damp for 7 days. Do not use metal tools in finishing a patch in a formed wall which will be exposed.

6. Tie Holes: Clean thoroughly by mechanical abrading, dampen, then fill solid with patching mortar. Mortar shall match color of concrete. Fill tie holes prior to finishing.

3.07 REPAIR OF DEFECTS

A. General

1. 1. Do not repair defects until concrete has been reviewed by the Owner's Representative

2. Severe Defects: Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure. Repair by removing the honeycombed and other defective concrete down to sound concrete, make the edges perpendicular to the surface, sandblast the surface, coat the sandblasted surface with an approved epoxy bonding compound, place Non-Shrink Grout see Section 03 60 00-Grouting, match the finish on the adjacent concrete, and cure as specified.

3. Major Defects: If the defects are serious or affect the structural integrity of the structure or if patching does not satisfactorily restore the quality and appearance to the surface, the Engineer may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section at no additional cost to the Owner.

3.08 REPAIR OF CRACKS IN CONCRETE

A. Repair leaking concrete cracks that are 1/10 inch or less in width by epoxy pressure injection.

1. Preparation: Insert and anchor a one-way polyethylene valve or pipe nipple in holes drilled into crack. Position them every 6- to 18-inches on center depending on the width of crack. Maintain a slow, steady pressure rather than a rapid buildup of pressure. When grouting material reaches the next tube, stop off the present position and follow the same procedure on the next position.

2. Upon completion of the epoxy grouting, remove the epoxy gel used to hold the valve or nipple by applying a direct flame to the epoxy and scraping it off. Fill the holes with the same material as used for patching the surface.

3. While the valves or nipples are installed first, the grouting operation shall not commence until after the patch work has been completed and has sufficiently cured.

B. Repair cracks in concrete structures that are wider than 1/10 inch in width by cutting out square edged and uniformly aligned joining 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joining, priming the join, and applying polyurethane join sealant in accordance with this section.

C. If the cracks are serious or affect the structural integrity or function of the element, the Engineer may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section at no additional cost to the Owner.

D. After repairing visible leaks, damp spots or leaking concrete cracks, retest the structure.

3.09 CARE AND REPAIR OF CONCRETE

A. The Contractor shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until Final Acceptance.

B. Particular care shall be exercised in order to prevent the drying shrinkage damage of concrete and to avoid roughening or otherwise damaging the concrete surface.

C. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be removed and replaced with acceptable materials to the satisfaction of the Engineer at no additional cost to the Owner.

END OF SECTION

SECTION 03 60 00 – GROUTING

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide grout, complete and in place, in accordance with the Contract Documents. For concrete repair material and procedures, reference Section 03 01 00 – Maintenance of Concrete.

B. Grout provided as a base support for mechanical and electrical equipment shall conform to manufacturer's requirements and the requirements of this section.

C. The following types of grout are covered in this Section:

1. Neat Cement Grout

2. Non-Shrink Grout

3. High Strength Non-Shrink Grout

4. Non-Shrink Epoxy Grout

5. Topping Grout and Grout Fill

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The edition of the standards applicable to the Work shall be those editions referenced by the 2018 International Building Code (IBC). If the standard is not referenced by the IBC, nor an IBCreferenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

B. Reference Specifications

01 33 00	Submittal Procedures
03 01 00	Maintenance of Concrete
03 30 00	Cast-in-Place Concrete
05 05 19	Post-Installed Concrete Anchors

C. Reference Standards

ASTM International (ASTM)	
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C580	Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete
ASTM C1339	Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
International Concrete Repair Institute (ICRI)	
ICRI 310.2R-2013	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified testing lab reports for tests indicated herein.

2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.

3. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use.

4. Documentation indicating that the grouts contain no chlorides or other chemicals that cause corrosion.

5. Manufacturer’s Safety Data Sheet documenting composition of grouts.

6. Submit manufacturer's written warranty as indicated herein.

1.04 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the Engineer. The specimens will be made by the Engineer or its representative.

2. Compression tests and fabrication of specimens for cement based non-shrink grout will be performed in accordance with ASTM C1107 at intervals during construction selected by the Engineer.

3. Compression tests and fabrication of specimens for topping grout and grout fill will be performed in accordance with Section 03 30 00 - Cast-in-Place Concrete at intervals during construction selected by the Engineer.

4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579, Method B, at intervals during construction selected by the Engineer. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.

5. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the Work.

6. The Contractor shall assist the Engineer in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 30 00- Cast-in-Place Concrete unless indicated otherwise.

C. Pre-Installation Demonstration and Training

1. Non-Shrink Grouts

a. The grout manufacturer shall give a demonstration and training session for the cement based and epoxy non-shrink grouts to be used on the project before any installation of grout is allowed.

b. Training session shall use a minimum of 5 bags of cement-based non-shrink grout mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. Six cubes for testing at 1, 3, and 28 Days shall be made. The remaining grout shall be placed, and curing may be initiated on actual project placements such as baseplates to provide on-the-job training for the Contractor and Engineer. The Contractor employees who will be doing the grouting shall participate in this training and demonstration session. The training session shall include methods for curing the grout.

c. The Contractor shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the Engineer.

1.05 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty

1. Furnish one year warranty for Work provided under this section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 -- PRODUCTS

2.01 APPLICATION

A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension.	Non-Shrink
Column base plates (greater than 2 story or larger than 16-inches in the least dimension)	High Strength Non-Shrink
Under precast concrete elements	High Strength Non-Shrink
Storage tanks and other non-motorized equipment or machinery under 30 horsepower	Non-Shrink
Motorized equipment over 30 horsepower and equipment under 30 horsepower but subject to severe shock loads and high vibrations	Non-Shrink Epoxy
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink
Toppings and grout fill less than 3-inches thick	Topping Grout
Toppings and grout fill greater than 3-inches thick	Non-Shrink Epoxy Grout and Structural Concrete per 03 30 00- Cast-in-Place Concrete
Anchor bolts, anchor rods and reinforcing steel required to be set in epoxy or adhesive.	Post Installed Anchors in Concrete per Section 05 05 19- Post-Installed Concrete Anchors
Repair of holes and defects in concrete members.	Concrete Repair and Rehabilitation per Section 03 01 00- Maintenance of Concrete

2.02 NEAT CEMENT GROUT

A. Neat cement grout shall be composed of one 94 pound bag of cement and 5 gallons minimum to 6 gallons maximum of clean water to obtain the desired consistency.

B. Cement material and water shall be as indicated in 03 30 - Cast-in-Place Concrete.

2.03 NON-SHRINK GROUTS

A. General

1. All non-shrink grout shall be cement based unless otherwise noted.

2. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

3. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each non-shrink grout shall be as recommended by the manufacturer for the particular application.

4. The manufacturer's product information shall state the acceptability of the non-shrink grout for the intended purpose and location.

5. Grout shall not contain chlorides or additives that may contribute to corrosion.

6. Grout placed in continuously wet environments or in exterior conditions shall not contain gypsum or calcium salt.

7. All cement-based non-shrink grout shall have the following general properties:

   a. Meet the requirements of ASTM C1107.

   b. Have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827. The grout when tested shall not bleed or segregate at maximum allowed water.

   c. No shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.

   d. A minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C882.

8. Environmental and ambient conditions shall be a factor in the selection of non-shrink grout. If a non-shrink grout is to be used in a high temperature environment or freeze/thaw environment, the manufacturer's product information shall state the acceptability for each environmental condition.

9. Grout shall be suitable for use in freeze/thaw environments.

B. Non-Shrink Grout

1. Non-Shrink Grout shall have a minimum 28 Day compressive strength of 5000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. Non-Shrink Grout shall be Five Star Grout by Five Star Products, Inc., Fluid Grout 100 by Five Star Products, Inc., Sikagrout 212 by Sika Corporation, or approved equal.

C. High Strength Non-Shrink Grout

1. High Strength Non-Shrink Grout shall have a minimum 28-Day compressive strength of 10,000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. High Strength Non-Shrink Grout shall be High Strength Grout by Five Star Products, Inc., Sikagrout 428 FS by Sika Corporation, or approved equal.

2.04 NON-SHRINK EPOXY GROUT

A. Non-shrink epoxy grout shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, method B.

B. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents.

C. The manufacturer’s product information shall state the acceptability of the epoxy grout for the intended purpose and location.

D. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

E. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable.

F. Non-shrink epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested in accordance with ASTM C531.

G. The effective bearing area shall be a minimum of 85 percent effective bearing area (EBA) in accordance with ASTM C1339, for bearing area and flow.

H. The chemical formulation of the non-shrink epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.

I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:

1. Minimum bond strength to concrete of 3000 psi per ASTM C882 modified.

2. Minimum bond strength to steel of 1700 psi per ASTM C882 modified.

3. Minimum flexural strength of 2500 psi per ASTM C580.

4. Minimum tensile strength of 2000 psi per ASTM C307.

J. Non-shrink epoxy grout shall be DP Epoxy Grout by Five Star Products, Inc., MasterFlow 648 by BASF/Master Builders, Sikadur 42 Grout-Pak by Sika Corporation, or approved equal.

2.05 TOPPING GROUT AND GROUT FILL

A. Topping grout and grout fill for built-up surfaces of tanks, channels, and basin bottoms shall.be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated. Materials and procedures indicated for structural concrete in Section 03 30 00- Cast-in-Place Concrete, shall apply unless indicated otherwise

B. Topping grout used in clarifiers, or where the fill thickness is 3 inches or greater shall contain fiber reinforcing, unless otherwise shown on the Contract Documents. Fiber reinforcing shall be 100 percent virgin polypropylene fibrillated fibers specifically manufactured in a blended gradation for use as concrete secondary reinforcement. Fibers shall be added at a rate of 1.5 pounds per cubic yard of concrete. Fibers shall conform to ASTM C1116.

C. For topping grout and grout fill thickness greater than 3-inches, ready-mix concrete may be used, where indicated on the drawings, with the following requirements:

1. Strength: Minimum compressive strength of topping grout and grout fill at 28 days shall be 4000 psi.

2. Minimum of 658 pounds of cement per cubic yard with a Maximum slump shall be four (4) inches.

3. Coarse aggregate shall be 3/8-inch pea gravel. Grading shall be set forth in Section 90 of the Standard Specifications

D. Topping grout and grout fill shall contain air-entraining agent per Section 03 30 00- Cast-in-Place Concrete.

2.06 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03 30 00 - Cast-in-Place Concrete and as recommended by the manufacturer of prepackaged grouts.

2.07 CONSISTENCY

A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.08 MEASUREMENT OF INGREDIENTS

A. Measurements shall be made accurately by volume using containers. Shovel measurements are not allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Grout shall be stored in accordance with manufacturer's recommendations.

3.02 GENERAL

A. Contractor shall arrange for the manufacturer of prepackaged grouts to provide on-site technical assistance within 72 hours of request, as part of the Work.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the Engineer.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement based grout shall be in accordance with Section 03 30 00- Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.03 GROUTING PROCEDURES

A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted by the Contractor for acceptance by the Engineer.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Topping Grout and Grout Fill

1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping grout or grout fill.

2. To ensure bonding to the base slab, the base slab shall have a roughened surface to a ¼-inch amplitude. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per ICRI 310.2R-2013 prior to placing topping grout and grout fill. No topping grout shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied.

3. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. The minimum thickness of grout topping and grout fill shall be one-inch. Where the finished surface of grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

5. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

6. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

7. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Engineer, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.04 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 04 05 19.16 – MASONRY ANCHORS

PART 1 -- GENERAL

1.01 SUMMARY

A. Provide post-installed anchors and appurtenances, complete and in place, as indicated in accordance with the Contract documents.

B. Unless otherwise indicated, drilled masonry anchors shall be adhesive anchors.

C. Section Includes:

1. Adhesive anchors

2. Expansion anchors

3. Screw anchors

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Definitions

1. Epoxy anchors are considered adhesive anchors.

2. Expansion anchors, screw anchors, and undercut anchors are considered mechanical anchors.

B. Reference Specifications

01 33 00	Submittal Procedures
01 33 17	Structural Design, Support and Anchorage
03 21 00	Reinforcement Bars
03 30 00	Cast-in-Place-Concrete
05 50 00	Metal Fabrications

C. Reference Standards

1. The edition of the standards applicable to the Work shall be the edition referenced by the 2018 International Building Code (IBC). If the standard is not referenced by the IBC, nor an IBC-referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

American Concrete Institute (ACI)	
ACI 530	Building Code Requirements for Masonry Structures (TMS 402/ACI 530-ASCE 5).
ACI 530.1	Specification for Masonry Structures (TMS 602/ACI 530.1/ASCE 6).
American Society of Civil Engineers (ASCE)	
ASCE 7	ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures

ASCE 41	ASCE/SEI 41 - Seismic Evaluation and Retrofit of Existing Buildings
ASTM International (ASTM)	
ASTM E 3121	Standard Test Methods for Field Testing of Anchors in Concrete or Masonry
International Code Council (ICC)	
IBC	International Building Code
ICC ES AC01	Acceptance Criteria for Expansion Anchors in Masonry Elements
ICC ES AC58	Acceptance Criteria for Adhesive Anchors in Masonry Elements
ICC ES AC106	Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements
NSF International (NSF)	
NSF/ANSI 61	Drinking Water System Components – Health Effects

1.03 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit the following:

1. Product data and technical information

2. Safety Data Sheets (SDS) for adhesives

3. Manufacturer's literature containing installation instructions and appropriate uses for each type of post-installed anchor and location of use

4. Current International Code Council Evaluation Service (ICC-ES) or International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES) Evaluation Reports

5. Certification for each installer demonstrating that they have been qualified in accordance with the Quality Assurance requirements below

C. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

D. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be completed and submitted in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

E. For existing structures, the anchor is designed in accordance with ASCE 41.

1.04 QUALITY ASSURANCE

A. Special inspection for all post-installed anchor installations shall be provided:

1. As recommended or required by the ICC-ES or IAPMO-UES report.

2. As required by the enforceable building code.

3. As otherwise indicated in the Contract Documents.

B. The most stringent of the above requirements shall be used. The cost of Special Inspection of post-installed anchors shall be paid for by the owner.

C. Before installing adhesive anchors in the work, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading if required.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

D. Before installing mechanical anchors in the work, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, and torqueing.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

E. Defective anchors noted by the Special Inspector shall be replaced and re-installed by the contractor without any additional compensation.

F. Masonry anchors must have an ICC-ES and/or IAPMO-UES report, and the report will provide special inspection and testing information, if required. Anchor products without an ICC-ES and/or IAPMO-UES report are not allowed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer’s or distributor’s packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer’s recommendations to prevent damage or deterioration.

C. Anchoring adhesives shall be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

1.06 SITE CONDITIONS

A. Post-installed anchors shall be installed in grout filled, concrete masonry having the minimum age required by the ICC-ES or IAPMO-UES report, or manufacturer’s instructions, at the time of anchor installation.

B. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed. Anchors, nuts, and washers in the locations listed below shall be fabricated from type 316 stainless steel:

1. buried locations

2. submerged locations

3. locations subject to seasonal or occasional flooding

4. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

5. chemical handling areas

6. inside trenches, containment walls, and curbed areas

7. locations indicated or designated by the Engineer to be provided with stainless steel anchors.

PART 2 -- PRODUCTS

2.01 ADHESIVE ANCHORS

A. General

1. Only Adhesive anchors can be used on the project.

2. The adhesive anchor system shall consist of: 1) adhesive product; and 2) threaded rod or reinforcing bar insert. The complete system shall be compatible as required by the adhesive manufacturer.

3. Adhesives shall be injectable, two-component, cartridge-type systems dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

4. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the adhesive anchor for the intended purpose and location.

5. Adhesive anchors shall be permitted when regular ambient temperatures are consistent with manufacturer’s recommendation for long and short term temperatures.

6. Adhesive anchors shall not be used where anchors are subject to vibration or fire.

7. Adhesive anchors shall not be used in overhead applications unless specifically called out on the Contract Documents.

8. Adhesive shall have a current NSF/ANSI 61 listing.

9. Adhesive shall be capable of being used in submerged applications once cured.

B. Adhesive Anchors in Grout Filled Concrete Masonry Units

1. Threaded rod inserts shall meet the requirements of Section 05 50 00 – Metal Fabrications.

2. Adhesive anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and shall have been tested and qualified for performance in grout-filled and hollow (ungrouted) concrete masonry units in accordance with ICC-ES AC58.

3. Adhesive anchors for masonry shall be AC100+ Gold by DeWalt/Powers Fasteners, HIT-HY 270 by HiltiSET-3G by Simpson Strong-Tie, or equal.

4.

PART 3 -- EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Post-installed anchors shall be installed in strict accordance with the manufacturer's instructions, the ICC-ES or IAPMO-UES report, and project specific design requirements indicated on the Contract Documents or in the design calculations provided by the contractor.

B. Where holes are drilled in masonry, holes shall be accurately drilled and vertically aligned, and the holes shall be cleaned in accordance with the manufacturer’s recommendations.

C. Acceptable installation and performance temperature ranges shall be verified with manufacturer’s literature prior to installation. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.

D. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

E. The contractor shall locate existing items and identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

F. Core drilling of holes is not allowed.

G. Identification of reinforcing steel and/or embedded items, relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the Work and shall be provided at no additional cost to the Owner.

H. All abandoned drilled holes shall be repaired in accordance with Section - Maintenance of Concrete at no additional cost to the Owner.

END OF SECTION

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 -- GENERAL

1.01 SUMMARY

A. Provide miscellaneous metalwork and appurtenances, complete and in place, as indicated in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Referenced Specifications

01 33 00	Submittal Procedures
03 60 00	Grouting
05 05 19	Post Installed Concrete Anchors
09 96 00	High-Performance Coatings

B. References herein to "Building Code" shall mean the 2018 International Building Code (IBC). The edition of the standards applicable to the Work shall be those editions referenced by the CBC. If the standard is not referenced by the IBC, nor an IBC-referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of award of this contract.

Aluminum Association (AA)	
AA DAF-45	Designation System for Aluminum Finishes
American Association of State Highway and Transportation Officials (AASHTO)	
AASHTO	LRFD Bridge Design Specifications
American Institute of Steel Construction (AISC)	
AISC	Steel Construction Manual
AISC	Detailing for Steel Construction
American Iron and Steel Institute (AISI)	
AISI S100	North American Specification for the Design of Cold - Formed Steel Structural Members
ASTM International (ASTM)	
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

ASTM A194	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780	Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A992	Standard Specification for Structural Steel Shapes
ASTM A1085	Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM C478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C497	Standard Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile
ASTM D4101	Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F3125	Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength
American Welding Society (AWS)	
AWS B1.5	Standard for the Qualification of Welding Inspectors
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.3	Structural Welding Code - Sheet Steel
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D1.8	Structural Welding Code-Seismic Supplement
AWS QC1	Qualification and Certification of Welding Inspectors
California Building Code (CBC)	
CBC	2022 California Building Code
Military Specification (MIL)	
MIL-G-18015 A (3)	(Ships) Aluminum Planks. (6063-T6)
MIL-PRF-907F	Antiseize Thread Compound, High Temperature
National Association of Architectural Metal Manufacturers (NAAMM)	
NAAMM MBG531	Metal Bar Grating Manual
NAAMM MBG532	Heavy Duty Metal Bar Grating Manual

Steel Deck Institute (SDI)	
SDI RD	Standard for Steel Roof Deck
SDI NC	Standard for Noncomposite Steel Floor Deck
SDI QA/QC	Standard for Quality Control and Quality Assurance for Installation of Steel Deck
United States Department of Labor - Occupational Safety and Health Administration (OSHA)	
OSHA 1910.23(d)	Fixed Ladders
OSHA 1910.29	Fall Protection Systems And Falling Object Protection-Criteria and Practices

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings

1. Materials list of items proposed to be provided under this Section.

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements

3. Shop Drawings shall conform to AISC Detailing for Steel Construction, and shall show all holes, material grades, and location of parts/pieces in the completed Work.

4. Shop Drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and interface of the work of this Section with the work of adjacent trades, and diagrams for the sequence of erection.

B. Anchor Submittals

1. For post installed anchors in concrete, refer to Section 05 05 19 – Post Installed Concrete Anchors.

2. For cast-in-place anchors, complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be signed and stamped by a Professional Engineer registered in the state in which the project is located.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Weld procedures and welder qualifications shall be available in the Contractor’s field office for review.

C. Welding Special Inspection shall be performed by the Owner in accordance with the enforceable Building Code.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Steel

Rolled W and WT shapes	ASTM A992
Shapes, Plates, Bars	ASTM A36 unless indicated otherwise
Steel plates to be bent or cold-formed	ASTM A283, grade C
Steel pipe	ASTM A120, schedule 40, black finish unless otherwise noted
Steel tubing (hot-formed, welded, or seamless)	ASTM A501.
HSS	ASTM A500 Grade B ASTM A1085
Steel bars and bar-size shapes	ASTM A306, grade 65, or ASTM A36
Cold-finished steel bars	ASTM A108
Cold-rolled carbon steel sheets	ASTM A336
Galvanized carbon steel sheets	ASTM A526, with G90 zinc coating in accordance with ASTM A525
Stainless steel bars, plates, structural shapes	ASTM A276, Type 304
Stainless steel sheets	AISI type 302 or 304, 24 gauge, with Number 4 finish
Aluminum plates, shapes, and bars	6061-T6 or 6063-T6 alloy, mill finish unless otherwise specified
Grey iron castings	ASTM A48, Class 50B, or better
Malleable iron castings	ASTM A47
Concrete inserts:	Threaded or wedge type galvanized ferrous castings of malleable iron complying with ASTM A27. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.

2.02 FABRICATION

A. Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of size, thickness, and type in accordance with this Section.

B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item.

D. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.

E. Properly mark and match-mark materials for field assembly and for identification as to location for which intended.

F. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

G. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations.

H. Provide finish surfaces of members exposed in the final structure free from markings, burrs, and other defects.

2.03 CASTINGS

A. All castings shall be sound and free from shrinkage crack, blow holes, and other defects. All fins and burnt sand must be removed. Excessive porosity and spongy surfaces will constitute causes for rejection. The Engineer shall be final judge as to whether the defects present are sufficient to cause rejection.

B. No welding or patching of defects in castings will be permitted unless authorized by the Engineer. Any such welding or patching done without the Engineer's consent shall be cause for rejection.

C. All castings shall be true to form and dimensions shown on the Drawings. After inspection and prior to shipping, all machined surfaces shall be coated with a blue rust inhibitive lacquer, or other approved material which can be easily removed, unless otherwise specified.

D. The dimensions of the finished castings shall not be less than the specified dimensions. Castings shall not be more than seven and one-half (7-1/2) percent overweight. Large castings shall be suspended and hammered over their entire area. No cracks, flaws, or other defects shall appear after such hammering.

E. Castings shall be provided with adequate continuous fillets cast in place in all re-entrant angles. The radius of curvature of the exposed surface of a fillet shall define the size of the fillet. The size of fillets shall not be less than one-half (1/2) of the thickness of the thinnest adjoined member nor less than one-half (1/2) inch.

F. Iron castings shall be dipped or painted with asphalt which will form a tough, tenacious, non-scaling coating which does not have a tendency to become brittle when cold or sticky when hot.

G. The covers and seats shall be machined so that the cover sits evenly and firmly in the frame.

2.04 CONNECTIONS

A. Provide bolts and washers of types and sizes required for completion of field erection.

B. Welded Construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welded work.

C. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.05 FASTENERS

A. General:

1. For exterior use and where built into exterior walls, provide zinc-coated fasteners, for damp locations provide stainless steel fasteners.
2. Provide fasteners of type, grade, and class required for the particular use.

B. Comply with the following standards as pertinent:

1. Bolts and Nuts: Provide hexagon-head regular type complying with ASTM A307, Grade A (Steel); ASTM A320 and A194, Grade B8 (Stainless Steel).
2. Lag bolts: Provide square-head type complying with Fed. Spec. FF-B-561.
3. Machine Screws: Provide cadmium plated steel type complying with Fed. Spec. FF-S-111; except use stainless steel for damp locations or with aluminum.
4. Washers:
   a. Plain washers: Comply with Fed Spec FF-W-92, round, carbon steel.
   b. Lock washers: Comply with Fed. Spec FF-W-84, helical spring type carbon steel.
5. Toggle bolts: Provide type, class, and style needed but complying with Fed. Spec. FF-B-588.
6. Anchorage devices: Provide expansion shield complying with Fed Spec FF-S-325.

2.06 HOLES FOR OTHER WORK

A. Provide holes required for securing other work to metalwork and for passage of other work as shown on the approved Shop Drawings.

B. Provide threaded nuts welded to framing and other specialty items as shown, to receive other work.

C. Cut, drill, or punch holes perpendicular to metal surfaces.

D. Do not flame cut holes or enlarge holes by burning.

E. Drill holes in bearing plates.

2.07 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

2.08 GALVANIZING

A. Shall be double hot-dip processed after fabrication, ASTM A123, A153, A386, and A525. Double dip shall be required, if necessary, to achieve required coating weight.

B. For repair of galvanizing, use galvaloy stick applied as recommended by the manufacturer.

2.09 SHOP PRIMING AND FINISHES

C. General:

1. Shop prime un-galvanized steel work, except those members or portions of members to be embedded in concrete or mortar.

2. Paint embedded steel which is partially exposed on the exposed portions, and the initial 2" of embedded areas only.

D. Surface Preparation:

1. After inspection and before shipping, clean steelwork to be painted.

2. Remove loose rust, loose mill scale, and spatter, slag, and flux deposits.

3. Prepare steel in accordance Section 09900. If not specified, prepare steel in accordance with Steel Structures Painting Council SP-3, "Power Tool Cleaning."

E. Primer Painting:

1. Immediately after surface preparation, apply structural steel primer paint in accordance with Section 09900 and the manufacturer's recommendations and at a rate to provide a uniform dry film thickness.

2. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.

3. The Contractor shall be responsible for providing the required coating system per Section 09900. The Contractor shall remove shop coatings not in conformance with Section 09900. Additionally, the Contractor shall prepare any shop applied coating, which, while meeting the requirements of Section 09900, requires additional surface preparation in order to obtain a mechanical bond between coatings.

F. All stainless-steel parts, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence ensures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection. All field welds shall be cleaned and passivated to remove iron (and prevent corrosion) in accordance with ASTM A380.

PART 3 -- EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.03 INSTALLATION

G. General:

1. Set work accurately into position, plumb, level, true, and free from rack.
2. Anchor firmly into position.
3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc-welding for appearance and quality of weld and for methods to be used in correcting welding work.
4. Grind exposed welds smooth, and touch-up shop prime coats.
5. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or screwed field connections.
6. Dissimilar Materials: Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint conforming to MIL-C-18480 or to TT-V-51 or a coat of zinc chromate primer conforming to TT-P-645 to prevent galvanic or corrosive action.
7. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. All bolts, anchors, supports, braces, connection and other items necessary for completion of the miscellaneous metalwork shall be provided.

END OF SECTION

SECTION 05 05 19 – POST-INSTALLED CONCRETE ANCHORS

PART 1 -- GENERAL

1.01 SUMMARY

A. Use anchor bolts, bolts, or welded studs for anchors for resisting seismic forces. Anchor bolts used to resist seismic forces shall have a standard hex bolt head. Do not use anchor bolts fabricated from rod stock with an L or J shape. Do not use concrete anchors, flush shells, adhesive anchors, powder actuated fasteners, or other types of anchors unless indicated on the Drawings or accepted in writing by the Engineer.

B. Provide post-installed anchors and appurtenances, complete and in place, as indicated in accordance with the Contract documents.

C. Unless otherwise indicated, drilled concrete anchors shall be adhesive anchors.

D. Section Includes:

1. Adhesive anchors

2. Expansion anchors

3. Screw anchors

4. Undercut anchors (dynamic loading)

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Definitions

1. Epoxy anchors are considered to be adhesive anchors.

2. Expansion anchors, screw anchors, and undercut anchors are considered to be mechanical anchors.

B. Reference Specifications

01 33 00	Submittal Procedures
01 33 17	Structural Design, Support and Anchorage
03 01 00	Maintenance of Concrete
03 21 00	Reinforcement Bars
03 30 00	Cast-in-Place Concrete
05 50 00	Metal Fabrications

C. Reference Standards

1. The edition of the standards applicable to the Work shall be the edition referenced by the 2018 International Building Code (IBC). If the standard is not referenced by the IBC, nor an IBC-referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.

American Concrete Institute (ACI)	
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 355.2	Qualification of Post Installed Mechanical Anchors in Concrete and Commentary
ACI 355.4	Qualification for Post-Installed Adhesive Anchors in Concrete and Commentary
American Society of Civil Engineers (ASCE)	
ASCE 7	ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures
ASCE 41	ASCE/SEI 41 - Seismic Evaluation and Retrofit of Existing Buildings
International Code Council (ICC)	
IBC	International Building Code
ICC ES AC193	Mechanical Anchors in Concrete Elements
ICC ES AC308	Post Installed Adhesive Anchors in Concrete Elements

1.03 SUBMITTALS

A. Furnish submittals in accordance with Section01 33 00– Submittal Procedures.

B. Submit the following:

1. Product data and technical information

2. Safety Data Sheets (SDS) for adhesives

3. Manufacturer’s literature containing installation instructions and appropriate uses for each type of post-installed anchor and location of use

4. Current International Code Council Evaluation Service (ICC-ES) or International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES) Evaluation Reports

5. Certification for each installer demonstrating that they have been qualified in accordance with the Quality Assurance requirements below

C. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

D. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be completed and submitted in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

1. Where adhesive anchors are used for structural applications (such as dowels between new and existing concrete) and an embedment depth is not shown on the contract documents, the anchor shall be installed in accordance with Method 1 or Method 2 below:

    a. Method 1: The minimum depth of embedment shall be greater than or equal to the development length (l_d) determined in accordance with ACI 318 for a cast in place reinforcing bar of the same diameter and grade, unless it can be shown by calculation that the anchor spacing and edge distance is sufficient to develop the tensile strength of the anchor in a lesser depth of embedment.

    b. Method 2: Adhesive anchors in concrete that cannot develop the tensile capacity of the steel element may be used to transfer forces, provided that:

        1) For new structures, the anchor is designed in accordance with ACI 318 and whichever is more stringent.

1.04 QUALITY ASSURANCE

A. Special inspection for all post-installed anchor installations shall be provided:

    1. As recommended or required by the ICC-ES or IAPMO-UES report.

    2. As required by the enforceable building code.

    3. As otherwise indicated in the Contract Documents.

B. The most stringent of the above requirements shall be used. The cost of Special Inspection of post-installed anchors shall be paid for by the Owner.

C. Before installing adhesive anchors in the Work, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

    1. Certification by an applicable certification program per ACI 318-19 section 26.7.1(l).

    2. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading if required.

    3. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

D. Before installing mechanical anchors in the Work, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

    1. Hole drilling procedure, hole preparation and cleaning techniques, and torquing.

    2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

E. Defective anchors noted by the Special Inspector shall be replaced and re-installed by the Contractor without any additional compensation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

C. Anchoring adhesives shall be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

1.06 SITE CONDITIONS

A. Post-installed anchors shall be installed in concrete having a minimum age of 21 days at time of anchor installation.

B. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed. Anchors, nuts, and washers in the locations listed below shall be fabricated from type 316 stainless steel:

1. buried locations

2. submerged locations

3. locations subject to seasonal or occasional flooding

4. inside hydraulic structures below the top of the structure

5. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

6. chemical handling areas

7. inside trenches, containment walls, and curbed areas

8. locations indicated or designated by the Engineer to be provided with stainless steel anchors.

PART 2 -- PRODUCTS

2.01 ADHESIVE ANCHORS

A. General

1. The adhesive anchor system shall consist of: 1) adhesive product; and 2) threaded rod or reinforcing bar insert. The complete system shall be compatible as required by the adhesive manufacturer.

2. Adhesives shall be injectable, two-component, cartridge-type systems dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the adhesive anchor for the intended purpose and location.

4. Adhesive anchors shall be permitted when regular ambient temperatures are consistent with manufacturer's recommendation for long and short term temperatures.

5. Adhesive anchors shall not be used where anchors are subject to vibration or fire.

6. Adhesive anchors shall not be used in overhead applications, unless specifically called out on the construction documents.

7. Where required, adhesive shall be capable of being used in submerged applications once cured.

B. Adhesive Anchors in Concrete

1. Threaded rod inserts shall meet the requirements of Section 05 50 00 - Metal Fabrications.

2. Reinforcing dowel inserts shall meet the material requirements of Section 03 21 00– Reinforcement Bars and Section 03 30 00 – Cast-in-Place Concrete.

3. Adhesive for use in concrete adhesive anchors shall be certified for use in resisting seismic loads in cracked concrete applications in accordance with ICC-ES AC308.

4. Where not detailed on the drawings, adhesive anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC308.

5. Adhesive anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ICC-ES AC308 and ACI 355.4. Adhesive anchors to be used for structures, nonbuilding structures and/or nonstructural components assigned to Seismic Design Categories C through F shall have been tested and qualified for earthquake loading performance in cracked and uncracked concrete in accordance with ICC-ES AC308 and ACI 355.4.

6. Adhesive anchors for concrete shall HIT-RE 500 V3 by Hilti or SET-3G by Simpson Strong-Tie, or equal.

2.02 EXPANSION ANCHORS

A. General

1. Expansion anchors are post-installed torque-controlled mechanical expansion anchors used to resist structural loads.

2. Expansion anchors shall be an imperial sized, threaded stud with an integral cone expander, expansion clip, nut and washer.

3. Lead caulking anchors will not be permitted.

4. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

5. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the expansion anchor for the intended purpose and location.

6. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Expansion Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318, which requires post-installed mechanical anchors to be qualified according to ACI 355.2.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ICC-ES AC193 and ACI 355.2. Anchors to be used for structures, nonbuilding structures and/or nonstructural components assigned to Seismic Design Categories C through F shall have been tested and qualified for earthquake loading performance in cracked and uncracked concrete in accordance with ICC-ES AC193 and ACI 355.2.

3. Expansion anchors shall be Strong-Bolt 2 by Simpson Strong-Tie,Kwik-Bolt TZ by Hilti, or equal.

2.03 SCREW ANCHORS

A. General

1. Screw anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

2. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the screw anchor for the intended purpose and location.

3. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Screw Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ICC-ES AC193.

3. Screw anchors for concrete shall be Titen HD by Simpson Strong-Tie,Kwik HUS-EZ (KH-EZ) by Hilti, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Post-installed anchors shall be installed in strict accordance with the manufacturer's instructions, the ICC-ES or IAPMO-UES report, and project specific design requirements indicated on the Contract Documents or in the design calculations provided by the Contractor.

B. Where holes are drilled in concrete, holes shall be accurately drilled and vertically aligned, and the holes shall be cleaned in accordance with the manufacturer's recommendations.

C. Post-installed anchors shall not be installed until the concrete has reached the required age of 21 days or per manufacturer's requirements, whichever is longer.

D. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.

E. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

F. The Contractor shall locate existing items and identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

G. Core drilling of holes is not allowed.

H. Bending of and welding to post installed anchors is not allowed.

I. Identification of reinforcing steel and/or embedded items, relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the Work and shall be provided at no additional cost to the Owner.

END OF SECTION

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall construct rough carpentry and appurtenant Work, complete and in place, in accordance with the Contract Documents.

B. The Work shall include, at least the following items:

1. Rooftop equipment bases and support curbs.

2. Wood blocking, cants, and nailers.

3. Plywood backing panels.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures

B. Reference Standards

American Wood Protection Association (AWPA)	
AWPA U1	Use Category System: User Specification for Treated Wood
AWPA M4	Standard for the Care of Preservative-Treated Wood Products
ASTM International (ASTM)	
ASTM D2898	Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM D3201	Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Based Products
ASTM D5664	Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire- Retardant Treated Lumber
ASTM D6841	Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire-Retardant-Treated Lumber
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
Forest Stewardship Council (FSC)	
FSC STD-01-001	FSC Principles and Criteria for Forest Stewardship

1.03 CONTRACTOR SUBMITTALS

A. Furnish the following in accordance with Section 01 33 00- Contractor Submittals.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 -- PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Certified Wood: Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. In DOC PS 20, dressed sizes of green lumber are larger than dry lumber.

3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

4. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.03 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 ft beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.04 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

2. Nailers.

3. Rooftop equipment bases and support curbs.

4. Cants.

B. For items of dimension lumber size, provide No. 1 or Better grade lumber and any of the following species:

1. Douglas Fir-Larch

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Douglas Fir-Larch No. 1 or Better.

D. For blocking not used for attachment of other construction, Douglas Fir-Larch No. 1 or Better.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.05 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than ¾-in nominal thickness.

PART 3 -- EXECUTION

3.01 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Install plywood backing panels by fastening to substrate with corrosion resistant fasteners; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

C. Do not splice structural members between supports unless otherwise indicated.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16-in o.c.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96-in o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96-in o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-in nominal actual thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 ft o.c.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Use inorganic boron for items that are continuously protected from liquid water.

I. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.02 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 07 52 00 - MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 -- GENERAL

1.1 SECTION INCLUDES

A. Torch Applied 2-Ply Asphalt Roofing

B. Accessories.

C. Edge Treatment and Roof Penetration Flashings.

1.2 REFERENCES

A. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.

B. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

C. ASTM D 312 - Standard Specification for Asphalt used in Roofing.

D. ASTM D 4601 Standard Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing.

E. ASTM D 5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.

F. ASTM D 6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

G. ASTM D 6163 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.

H. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings

I. Factory Mutual Research (FM): Roof Assembly Classifications.

J. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

K. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

L. Underwriters Laboratories, Inc. (UL): Fire Hazard Classifications.

M. Intertek/Warnock Hersey (WH): Fire Hazard Classifications.

N. ANSI-SPRI ES-1 Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.

O. ASCE 7, Minimum Design Loads for Buildings and Other Structures

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Exterior Fire Test Exposure: Roof system shall achieve a UL, FM or WH Class rating for roof slopes indicated on the Drawings as follows:

1. Factory Mutual Class A Rating.

2. Underwriters Laboratory Class A Rating.

3. Intertek/Warnock Hersey Class A Rating.

C. Design Requirements:

1. Uniform Wind Uplift Load Capacity

a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.

1) Design Code: ASCE 7, Method 2 for Components and Cladding.

2) Importance Category:

a) III.

3) Importance Factor of:

a) 1.25

4) Wind Speed: 115 mph

5) Exposure Category:

a) D

6) Design Roof Height: 28 feet.

7) Minimum Building Width: 37’-4”

8) Roof Pitch: 1/4 :12.Field Verify

9) Roof Area Design Uplift Pressure: Per ASCE 7

2. Snow Load: 56 psf

3. Live Load: Not to exceed original building design.

4. Dead Load:

a. Installation of new roofing materials shall not exceed the dead load capacity of the existing roof structure.

D. Roof system shall have been tested in compliance with the following codes and test requirements:

a. Torch and Mop Membrane Systems Over

1) Concrete Decks N.O.A.

2) Lightweight Concrete Decks N.O.A.

3) Recover Decks N.O.A.

4) Steel Decks N.O.A.

5) Wood Decks N.O.A.

2. Intertek/Warnock Hersey

a. ITS Directory of Listed Products

3. FM Approvals:

a. RoofNav Website

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation instructions.

C. Shop Drawings: Submit shop drawings including installation details of roofing, flashing, fastening, insulation and vapor retarder, including notation of roof slopes and fastening patterns of insulation and base modified bitumen membrane, prior to job start.

D. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE 7 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before Work begins.

E. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

F. Manufacturer's Fire Compliance Certificate: Certify that the roof system furnished is approved by Factory Mutual (FM), Underwriters Laboratories (UL), Warnock Hersey (WH) or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.

G. Closeout Submittals: Provide Manufacturer's maintenance instructions that include recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the Manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.

B. Manufacturer Qualifications: Company specializing in Manufacturing products

specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.

C. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.

D. For torch applications, installer must be NRCA - CERTA trained and must utilize CERTA compliant application methods.

E. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.

F. Manufacturer's Field Supervision: A representative of the roof system Manufacturer must be present two days per week during the roof system installation.

G. Product Certification: Provide Manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

H. Source Limitations: Obtain all components of roof system from a single Manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:

1. Record minutes of the conference and provide copies to all parties present.

2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.

3. Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in Manufacturer's unopened packaging with labels intact until ready for installation.

B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with "breathable" tarpaulins.

C. Stored in accordance with the instructions of the Manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface except store KEE-Stone HP and FB 60 rolls flat on a clean flat surface. No wet or damaged materials will be used in the application.

D. Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50-degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.

F. Adhesive storage shall be between the range of above 50-degree F (10 degree C) and below 80-degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.8 COORDINATION

A. Coordinate Work with installing associated metal flashings as work of this section proceeds.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by Manufacturer for optimum results. Do not install products under environmental conditions outside Manufacturer's absolute limits.

1.10 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due to defective material or workmanship, the Manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition, in accordance with the terms of the Manufacturer's warranty, warranty requirements and limitations.

1. Warranty Period: 30 years from date of acceptance.

B. Installer is to guarantee all work against defects in materials and workmanship for a period indicated following final acceptance of the Work.

1. Warranty Period:

a. 3 years from date of acceptance.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Garland Company, Inc. (The); 3800 E. 91st St., Cleveland, OH 44105. Local Representative: Doug Clark (925) 784-6701 – email:dclark@garlandco.com and Drew Wright (208) 899-5508 – email:dwright@garlandco.com

B. The Products specified are intended and the Standard of Quality for the products required for this project. If other products are proposed the bidder must disclose in the bid the Manufacturer and the products that they intend to use on the Project. If no Manufacturer and products are listed, the bid may be accepted only with the use of products specified.

1. Bidder will not be allowed to change materials after the bid opening date.

2. If alternate products are included in the bid, the products must be equal to or exceed the products specified. Supporting technical data shall be submitted to the Architect/ Owner for approval prior to acceptance.

3. In making a request for substitution, the Bidder/Roofing Contractor represents that it has:

   a. Personally investigated the proposed product or method, and determined that it is equal or superior in all respects to that specified.

   b. Will provide the same guarantee for substitution as for the product and method specified.

   c. Will coordinate installation of accepted substitution in work, making such changes as may be required for work to be completed in all respects.

   d. Will waive all claims for additional cost related to substitution, which consequently become apparent.

   e. Cost data is complete and includes all related cost under his/her contract or other contracts, which may be affected by the substitution.

   f. Will reimburse the Owner for all redesign cost by the Architect for accommodation of the substitution.

4. Architect/ Owner reserves the right to act as the final authority on the acceptance or rejection of any or all bids, proposed alternate roofing systems or materials that have met ALL specified requirement criteria.

5. Failure to submit substitution package, or any portion thereof requested, will result in immediate disqualification and consideration for that particular contractor's request for Manufacturer substitution.

2.2 TORCH APPLIED 2-PLY ASPHALT ROOFING

A. Nailable Base Sheet: One ply fastened to the deck per wind uplift calculations.

   1. HPR Premium Glasbase:

B. Base (Ply) Sheet:

   1. HPR Torch Base:

C. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with interplay adhesive.

   1. StressPly IV Plus:

D. Intumescent primer for wood components at perimeters, flashings and penetrations:

   1. Pro-Stop FR:

E. Flashing Base Ply:

1. SA Base IV

F. Flashing Cap (Ply) Sheet:

1. StressPly IV Plus UV Mineral:

G. Surfacing:

1. Aggregate/Flood Coat:

a. Green-Lock Plus Membrane Adhesive

b. Immediately embed 3/8” aggregate at a rate of 400lbs per square.

2.3 ACCESSORIES:

A. Roof Insulation Cover Board: Provide GP Gypsum DensDeck Prime,

B. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless-steel nails shall be used with aluminum; and stainless-steel nails shall be used with stainless steel, Fasteners shall be self-clinching type of penetrating type as recommended by the deck Manufacturer. Fasten nails and fasteners flush-driven through flat metal discs not less than 1 inch (25 mm) diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than 1 inch (25 mm) diameter are used.

C. Light Weight Concrete Fasteners: Zonolite per fastener Manufacturer approval and confirmed pull test.

D. Insulation Adhesive: Insul-Lock HR applied in a ribbon pattern per Manufacturers wind uplift calculations.

E. Urethane Sealant Hybrid - Tuff-Stuff MS: One-part, non-sag sealant as approved and furnished by the membrane Manufacturer for moving joints.

1. Tensile Strength, ASTM D 412: 225 psi

2. Elongation, ASTM D 412: 450-550%

3. Hardness, Shore A ASTM C 920: 25-35

4. Adhesion-in-Peel, ASTM C 92: 30 pli

2.4 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

A. Pre-Manufactured Edge Metal Finishes:

1. Exposed and unexposed surfaces for mill finish flashing, fascia, and coping cap, as shipped from the mill.

2. Exposed surfaces for coated panels:

a. Steel Finishes: fluorocarbon finish. Epoxy primer baked both sides, .2-.25 mils thickness as approved by finish coat Manufacturer. Weathering finish as referred by National Coil Coaters Association

(NCCA). Provided with the following properties.

1) Pencil Hardness: ASTM D3363, HB-H / NCCA II-2.

2) Bend: ASTM D-4145, O-T / NCCA II-19.

3) Cross-Hatch Adhesion: ASTM D3359, no loss of adhesion.

4) Gloss (60 deg. angle): ASTM D523, 25+/-5%

5) Reverse Bend: ASTM D2794, no cracking or loss of adhesion.

6) Nominal Thickness: ASTM D1005.

a) Primer: 0.2 mils.

b) Topcoat: 0.7 mils min.

c) Clear Coat 0.3 mils.

7) Color: Provide as specified. (Subject to minimum quantities)

B. Flashing Boot - Rubbertite Flashing Boot: Neoprene pipe boot for sealing single or multiple pipe penetrations adhered in approved adhesives as recommended and furnished by the membrane Manufacturer.

C. Vents and Breathers: Heavy gauge aluminum and fully insulated vent that allows moisture and air to escape but not enter the roof system as recommended and furnished by the membrane Manufacturer.

D. Pitch pans, Rain Collar 24 gauge stainless or 20oz (567gram) copper. All joints should be welded/soldered watertight. See details for design.

E. Drain Flashings should be 4lb (1.8kg) sheet lead formed and rolled.

F. Plumbing stacks should be 4lb (1.8kg) sheet lead formed and rolled.

G. Liquid Flashing - Tuff-Flash Plus LO: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.

1. Tensile Strength, ASTM D 412: 650 psi.

2. Elongation, ASTM D 412: 325%

3. Density @77 deg. F 8.3 lb/gal typical.

H. Fabricated Flashings:

1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.

I. Manufactured Roof Specialties:

1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.

D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. General: Clean surfaces thoroughly prior to installation.

1. Prepare surfaces using the methods recommended by the Manufacturer for achieving the best result for the substrate under the project conditions.

2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.

3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.

4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.

5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.

6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pull-out capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with cap nails require a minimum pullout capacity of 40 lb. per nail.

7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck Manufacturer.

B. Lightweight Insulating Concrete Deck:

1. Lightweight insulating concrete decks are required to have a minimum thickness of 2 inches (51 mm), a minimum compressive strength of 125 psi (0.86 MPa) and a minimum density of 22 pcf (352 kg/sm).

2. Lightweight insulating concrete decks are acceptable only on slopes up to 1

inch per foot (83 mm/m).

3. Do not attach insulation directly to lightweight concrete decks. Over old, dry decks, additional board insulation may be solidly mopped to an approved mechanically attached anchor sheet (base sheet).

C. Re-Roofing Applications:

1. Remove existing roof flashings from curbs and parapet walls down to the surface of the roof. Remove existing flashings at roof drains and roof penetrations.

2. Remove all wet, deteriorated, blistered or delaminated roofing membrane or insulation and fill in any low spots occurring as a result of removal work to create a smooth, even surface for application of new roof membranes.

3. Install new wood nailers as necessary to accommodate insulation/recovery board or new nailing patterns.

4. When mechanically attached, the fastening pattern for the insulation/recovery board shall be as recommended by the specific product Manufacturer.

5. Re-roofing over coal tar pitch requires a mechanically attached recovery board or insulation and a base sheet prior to the application of roofing system.

6. Existing roof surfaces shall be primed as necessary with asphalt primer meeting ASTM D 41 and allowed to dry prior to installing the roofing system.

D. Insulation:

1. All joints between layers should be staggered when multiple layers of insulation are installed. Insulation greater than 2.5 inches shall be installed in multiple layers.

2. Insulation shall be kept dry at all times. Install only as much insulation as can be covered with the completed roofing membrane before the end of the day's work or prior to onset of inclement weather.

3. Edges shall butt tightly, and all cuts shall fit neatly against adjoining surfaces to provide a smooth overall surface. Gaps of greater than 1/4-inch width shall be filled with insulation.

4. Install tapered insulation around roof drains and penetrations to provide adequate slope for proper drainage.

5. The proposed insulation adhesive shall be compatible with the roof substrate, the proposed bitumen and the requirements of the specific membrane.

3.3 INSTALLATION - GENERAL

A. Install modified bitumen membranes and flashings in accordance with Manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.

B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:

1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.

2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.

C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water

D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.4 INSTALLATION TORCH APPLIED 2-PLY ASPHALT ROOFING

A. Base Ply: Install torch base sheet to a properly prepared substrate. Shingle in proper direction to shed water on each area of roofing. If wood components are present at perimeters, flashings and penetration locations, an intumescent primer must be applied to the wood components prior to the application of the torch applied cap membrane. A self-adhering base sheet, intended for use with torch-applied cap sheets must also be applied around all perimeters, flashings, curbs and penetrations.

1. Lay out the roll in the course to be followed and unroll 6 feet (1.8 m).

2. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.

3. After the major portion of the roll is bonded, re-roll the first 6 feet (1.8 m) and bond it in a similar fashion.

4. Repeat this operation with subsequent rolls with side laps of 4 inches (101 mm) and end laps of 8 inches (203 mm).

5. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a

smooth, tight seal.

6. Extend underlayment 2 inches (50 mm) beyond top edges of cants at wall and projection bases.

7. Install base flashing ply to all perimeter and projections details.

B. Modified Cap (Ply) Sheet: Over torch base sheet underlayment, lay out the roll in the course to be followed and unroll 6 feet (1.8 m). Stagger seams over the torch base sheet seams.

1. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to ensure a proper bond.

2. After the major portion of the roll is bonded, re-roll the first 6 feet (1.8 m) and bond it in a similar fashion.

3. Repeat this operation with subsequent rolls with side laps of 4 inches (101 mm) and end laps of 8 inches (203 mm).

4. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to ensure a smooth, tight seal.

C. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.

D. Wood Blocking, Nailers and Cant Strips:

1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.

2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.

3. Nailer lengths should be spaced with a minimum 1/8-inch gap for expansion and contraction between each length or change of direction.

4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1-49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.

5. All wood blocking, nailers, and cant strips, must be primed with an intumescent primer prior to the application of the base sheet.

E. Wood Component Intumescent Primer: Intumescent primer shall be applied to all wood components within perimeter conditions, flashing and penetrations, such as wood nailers, blocking sheathing, etc.

1. Before and during primer application, the substrates' surfaces shall be dry, clean and free from loose debris, dust, dirt, grease, oil, and all prior coating

materials, such as paint, stains and sealers. The substrate shall not have, nor have been exposed to, treatments, chemicals, coatings, etc. prior to the application of the primer

2. Prior to application of primer, moisture content of the substrate must be verified to less than 16%

3. Apply intumescent at a rate of 1/2 gallon per 100 square feet (200 square feet per gallon)

4. Allow primer to cure prior to application of the base sheet and/or flashing plies.

F. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.

G. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable sealant at the top edge if required.

H. Flashing Base Ply: Seal all curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.

1. Prepare all walls, penetrations, expansion joints, and other surfaces to be flashed with asphalt primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

2. Adhere modified flashing base to the underlying base flashing ply with specified flashing ply adhesive. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.

3. Solidly adhere the entire sheet of flashing membrane to the substrate. Tops of all flashings that are not run up and over curb shall be secured through termination bar 6 inches (152 mm) o.c. and sealed at top.

4. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work.

5. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work. When using mineralized cap sheet all stripping plies type IV felt / VersiPly 40 shall be installed prior to cap sheet installation.

I. Flood Coat/Aggregate:

1. Install after cap sheets and modified flashing, tests, repairs and corrective actions have been completed and approved.

2. Apply flood coat materials in the quantities recommended by the Manufacturer.

3. Uniformly embed aggregate in the flood coat of cold adhesive at a rate

recommended by the Manufacturer.

4. Aggregate must be dry and placed in a manner required to form a compact, embedded overlay. To aid in embedment, lightly roll aggregate.

J. Flashing Cap Ply: Install flashing cap sheets by the same application method used for the base ply.

1. Seal curb, wall, and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.

2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

3. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.

4. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.

5. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.

6. All stripping shall be installed prior to flashing cap sheet installation.

7. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.

8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed or nailed 4 inches o.c. and covered with an acceptable counter flashing.

9. Seal all vertical laps of cap flashing ply with a three-course application of trowel-grade mastic and fiberglass mesh.

3.5 INSTALLATION EDGE TREATMENT AND ROOF PENETRATION FLASHING

A. Roof Edge With Gutter:

1. Inspect the nailer to ensure proper attachment and configuration. Increase slope at metal edge by additional degree of slope in first board.

2. Run one ply over the edge. Assure coverage of all wood nailers. Fasten plies with ring shank nails at 8 inches (203 mm) o.c.

3. Install gutter and strapping.

4. Install continuous cleat and fasten at 6 inches (152 mm) o.c.

5. Install new metal edge hooked to continuous cleat and set in bed of roof cement. Fasten flange to wood nailer every 3 inches (76 mm) o.c. staggered.

6. Prime metal edge at a rate of 100 square feet per gallon and allow to dry. Do not prime for Green-Lock System lightly sand metal to improve bond.

7. Strip in flange with base flashing ply covering entire flange in bitumen with 6 inches (152 mm) onto the field of the roof. Assure ply laps do not coincide with metal laps.

8. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof.

B. Reglet Mounted Counterflashing:

1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Maximum flashing height is 24 inches. Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).

3. Install base flashing ply covering wall set in bitumen with 6 inches (152 mm) on to field of the roof.

4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.

5. Apply butyl tape to wall behind flashing. Secure termination bar through flashing, butyl tape and into wall. Alternatively use caulk to replace the butyl tape.

6. Cut reglet in masonry one joint above flashing.

7. Secure reglet counterflashing with expansion fasteners and caulk reglet opening.

C. Exhaust Fan:

1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in bitumen. Run all plies over cant a minimum of 2 inches (50 mm).

3. Install base flashing ply covering curb with 6 inches (152 mm) on to field of the roof.

4. Install a second ply of modified flashing ply installed over the base flashing ply, 9 inches (228 mm) on to field of the roof. Attach top of membrane to top of wood curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.

5. Install metal exhaust fan over the wood nailers and flashing to act as counterflashing. Fasten per Manufacturer's recommendation.

D. Plumbing Stack:

1. Minimum stack height is 12 inches (609 mm).

2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.

3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4-inch (6 mm) bed of roof cement.

4. Install base flashing ply in bitumen.

5. Install membrane in bitumen.

6. Caulk the intersection of the membrane with elastomeric sealant.

7. Turn sleeve a minimum of 1 inch (25 mm) down inside of stack.

E. Heat Stack:

1. Minimum stack height is 12 inches (609 mm).

2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.

3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4-inch (6 mm) bed of roof cement.

4. Install base flashing ply in bitumen.

5. Install modified membrane in bitumen.

6. Caulk the intersection of the membrane with elastomeric sealant.

7. Install new collar over cape. Weld collar or install stainless steel draw brand.

3.6 CLEANING

A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.

B. Remove asphalt markings from finished surfaces.

C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.7 PROTECTION

A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes, and the like to protect personnel, roofs and structures, vehicles and utilities.

B. Protect exposed surfaces of finished walls with tarps to prevent damage.

C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch (16 mm) thick.

D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.

E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.8 FIELD QUALITY CONTROL

A. Inspection: Provide Manufacturer's field observations a minimum of two times per work week. Provide a final inspection upon completion of the Work.

1. Warranty shall be issued upon Manufacturer's acceptance of the installation.

2. Field observations shall be performed by a Sales Representative employed full-time by the Manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the Manufacturer.

3. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.

4. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

END OF SECTION

SECTION 09 96 00– HIGH-PERFORMANCE COATINGS

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means Dry Film Thickness.

C. The following surfaces shall not be coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.

2. Stainless steel

3. Machined surfaces

4. Grease fittings

5. Glass

6. Equipment nameplates

7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures

B. Reference Standards

ASTM International (ASTM)	
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D3276	Standard Guide for Painting Inspectors (Metal Substrates)

ASTM D4060	Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
American Water Works Association (AWWA)	
AWWA D102	Coating Steel Water-Storage Tanks
ANSI/AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
NACE International (NACE)	
NACE RP0287-02	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
Occupational Safety and Health Administration (OSHA)	
OSHA 29CFR1910.1200	Hazard Communication
Society for Protective Coatings (SSPC)	
SSPC Guide 12	Guide for Illumination of Industrial Painting Projects
SSPC PA 1	Shop, Field, and Maintenance Coating of Metals
SSPC PA Guide 11	Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
SSPC SP 1	Solvent Cleaning
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 5/NACE No. 1	White Metal Blast Cleaning
SSPC SP 6/NACE 3	Commercial Blast Cleaning
SSPC SP 7/NACE 4	Brush-off Blast Cleaning (NACE No. 4)
SSPC SP 10/NACE 2	Near-White Blast Cleaning
SSPC SP 11	Power Tool Cleaning to Bare Metal
SSP SP 13	Surface Preparation of Concrete

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating Work:

1. Materials List: A copy of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.

2. Manufacturer's Information: For each coating system to be used, the following data:

    a. Manufacturer's data sheet for each proposed product

    b. Manufacturer’s statements on the suitability of the proposed products for the intended use. Include in the statement confirmation that the coating manufacturer’s technical engineering representative inspected all existing substrate and/or surfaces with existing coatings and confirmed that the proposed products, application procedures and surface preparation requirements are compatible with the coatings required by this Section.

    c. Technical and performance information that demonstrates compliance with the system performance and material requirements.

    d. Paint manufacturer's instructions and recommendations on surface preparation and application.

    e. Colors available for each product (where applicable).

    f. Compatibility of shop and field applied coatings (where applicable).

    g. Safety Data Sheet for each product proposed.

C. Samples

1. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

2. Two sets of color samples to match each color selected by the Owner from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the Owner.

3. One 5 pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

D. Experience Requirements of the Field Applicator:

1. Submit a project organization chart showing the full name and clear lines of responsibility and duties for all personnel scheduled to perform work (including office managers, quality control supervisor and safety supervisor) on the project.

2. Submit for documentation a statement on company letter head indicating the name of the Quality Control Supervisor (QCS) who has been given written authority by executive management to perform the duties of the QCS position for the project. Include in the statement the date of last successful completion of training to perform the QCS position. Acceptable coating inspection training programs include at a minimum: SSPC (PCI, NBPI, BCI) Level 1, KTA Level 1, GPI (Level 1), NACE (CIP Level 1, Frosio) or equivalent formal in-house inspection training conforming to ASTM D3276.

3. Submit for documentation the set of procedures that have been implemented for conducting and documenting training (as needed) and for qualifying trainees, newly hired craft workers and newly hired experienced workers. Include documentation of annual proficiency evaluation system for all craft workers.

4. Submit for documentation up-to-date experience, training certificates, and licenses for all personnel scheduled to perform work on the project.

5. Submit for documentation a statement on company letter head that key personnel (including but not limited to, project management and QCS) have reviewed the project contract documents and specifications in effect at contract award. Include in the statement confirmation that the project contract documents, and specifications have been distributed to all affected personnel within the organization scheduled to perform work on the project. Include in the statement the procedure for recording receipt and distribution of specifications and contract documents and all changes and revisions to contract documents. Include in the statement the procedures for documenting verbal responses from the Owner for requests for clarification.

6. Submit references of successfully completed projects for industrial coating projects completed within the last 18 calendar months. Acceptable references shall include contact information for owner staff having direct connection with the project, copies of facility owner project performance evaluations, letters of commendation from the owner or prime contractor, statements of final payment, and punch list acceptance.

E. Quality Assurance Plan

1. Submit for review the written project-specific Quality Control Program to be followed. Primary duties and responsibilities of the QCS as outlined in the Quality Control Program shall include but are not limited to the following:

   a. Ensuring that qualified personnel perform the Work on the project.

   b. Ensure that proper inspection forms and recording procedures are used for job quality monitoring (including those required herein).

   c. Ensure correct and properly operating and calibrated equipment is used.

   d. Review and sign off on Daily Inspection Reports (DIRs) on a timely basis (QCS must sign off or authorize review of DIRs by other competent QC personnel).

   e. Ensure that Work is inspected for conformance with the contract requirements, good painting practice, and internal Quality Control (QC) procedures.

   f. Ensure that nonconforming work and rework is properly documented.

g. Develop and/or review Inspection and Test Plans.

h. Conduct and/or review internal audits.

2. Submit for documentation written project-specific procedures for all production processes to be used on the project. The procedures shall include, but are not limited to the following:

a. Standard company or contract specific procedures are available to and used by on-site personnel for verifying that coating and related operations are performed in accordance with contract requirements and industry best practices.

b. Inspection procedures or project specific inspection plans ensuring that all work is properly performed and documented daily during coating operations or documented in accordance with contract requirements, are available to site personnel, and are used to perform in-process inspections of work at key hold points.

c. Abrasive blasting (dry or wet) and related processes

d. Water jetting and related processes

e. Hand and power tool cleaning and related processes

f. Coating mixing and related processes

g. Coating application (e.g., brush, roller, spray, mitt) and related processes

h. Top coating procedures (e.g., conditions when meeting and exceeding recoat windows)

i. Curing process for materials applied

j. Erecting, moving, and tearing down containment

k. Field audits performed on site confirming equipment is in good operating condition

3. Submit for review and documentation Daily Inspection Reports (DIRs) to Engineer on a weekly basis. All DIRs and testing results shall be maintained on file for the duration of the project. DIRs must be signed and dated by the Contractor and formally reviewed by the QCS. DIRs and other daily reports shall record project relevant observations including:

a. Compressed air cleanliness

b. Air temperature (dry and wet bulb)

c. Relative humidity

d. Dew point

e. Substrate surface temperature

f. Abrasive cleanliness

g. Surface preparation cleanliness specified and achieved

h. Surface profile specified and achieved

i. Illumination of work area (foot candles for surface preparation, coating application, and inspection) in accordance with SSPC Guide 12 recommendations or contract requirements.

j. Batch numbers of coatings and thinners

k. Mixing of coatings (in accordance with coating manufacturer's mixing instructions)

l. DFT readings for each applied coating meeting specification requirements.

m. Inspection instruments used (manufacturer, model, and serial number)

n. Storage temperature and storage conditions to include min/max daily, or as required.

1.04 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. Nonconforming work, identified by Contractor QC personnel, Owner, Engineer or Owner's Representative performing QA on behalf of the Owner shall be documented and repaired.

B. Inspection: An inspection may be conducted during the eleventh month following completion of coating Work. The Contractor and a representative of the coating material manufacturer shall attend this inspection. Defective Work shall be repaired in accordance with these specifications and to the satisfaction of the Owner. The Owner may, by written notice to the Contractor, reschedule the inspection to another date within the one-year correction period or may cancel the inspection altogether. The Contractor is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

C. Use the following paragraph if the project contains any steel reservoir or tank lined with System 100 or 105.

1.05 COMPLIANCE WITH VOLATILE ORGANIC COMPOUND (VOC) LIMITS

A. All paint and coating products shall comply with the applicable limits on volatile organic compounds (VOCs) as established by the United States Environmental Protection Agency and by state and local air quality regulating agencies. It shall be the Contractor's responsibility to verify compliance of all paints and coatings.

B. Listed products in this specification are based on a maximum VOC level of 450 g/L. If local limits on VOCs are higher or lower, the Contractor shall propose substitute products that are compliant with local limits and equivalent in performance to the listed product.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Suitability: The Contractor shall use suitable coating materials as recommended by the manufacturer.

B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the Contractor shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

E. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the Engineer. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the Engineer.

F. Substitute or "Or-Equal" Products

1. To establish equality, the Contractor shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

a. Suitability for the intended service

b. Compatibility with other coatings

c. Resistance to chemical attack

d. Minimum and maximum recoat times

e. Minimum and maximum cure time for immersion

f. Abrasion resistance per ASTM D4060 using CS17 Wheel

g. Maximum and minimum dry film thickness per coat

h. Temperature limitations during application and in service

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the Contractor shall provide the Engineer with the names of not less than 10 successful applications and case histories of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the Work, the Contractor shall bear such costs involved as part of the Work.

2.02 INDUSTRIAL COATING SYSTEMS

A. System 1 - Acrylic Polymer

1. Materials

Primer	Manufacturer's recommendation
Finish Coat	1 component water-based acrylic
Type	Pure acrylic emulsion
Demonstrated suitable for	ferrous and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance
VOC Content, max (g/L)	450

2. Application and manufacturers

Prime Coat (DFT = 2 to 4 mils)	**Finish Coat (DFT = 2 to 4 mils)**	**Total System DFT**
PPG Pitt Tech Plus	PPG Pitt Tech Plus	4 to 8 mils
Tnemec Series 115 Unibond	Tnemec Series 1028 Enduratone for Gloss finish (use Series 1029 for Semi-Gloss finish)	4 to 8 mils
Carboline Sanitile 120	Carbocrylic 3359 Series	4 to 8 mils

B. System 2 – **Not Used**

C. System 3 – **Not Used**

D. System 4 - Epoxy/Polyurethane

1. Materials

Primer type	2 component epoxy
VOC Content, max (g/L)	450
Finish type	2 component aliphatic polyurethane
VOC Content, max (g/L)	450

Demonstrated suitable for	ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	**Finish Coat (DFT = 3 - 4 mils)**	**Total System DFT**
Carboline Carboguard 890	Carbothane 134 HG	6 - 9 mils
Tnemec Hi-Build Epoxoline II Series L69	Tnemec Endura-Shield Series 1094 for Gloss finish (use Series 1095 for Semi-Gloss finish)	6 - 9 mils
PPG Amerlock 2/400	Amershield	6 - 9 mils
Sherwin Williams Macropoxy 646	S W Hi-Solids Polyurethane	6 - 9 mils

E. System 5 - Inorganic Zinc/Epoxy/Polyurethane

1. Materials

Prime Coat	Inorganic zinc silicate, water-based, 2 component
Zinc content in dry film	79 percent, minimum
VOC content, max (g/L)	0
Demonstrated suitable for	Ferrous metal, providing superior corrosion, chemical, and abrasion resistance, recommended for use as primer under epoxy
Intermediate Coat	2 component epoxy, high build, recommended by manufacturer for application over inorganic zinc primer
Demonstrated suitable for	Outstanding chemical, corrosion, and abrasion resistance
VOC content, max (g/L)	450
Finish Coat	2 component aliphatic or acrylic polyurethane
Demonstrated suitable for	Superior color and gloss retention, resistance to chemical fumes, severe weathering, and abrasion
VOC content, max (g/L)	450

2. Application and manufacturers

Surface preparation for primer		SSPC SP 10	
Anchor profile for primer		per manufacturer	
Prime Coat (DFT = 3 - 4 mils)	**Intermediate Coat (DFT = 4 - 6 mils)**	**Finish Coat (DFT = 3 - 4 mils)**	**Total System DFT**
PPG- Dimetcote 21-5	PPG Amerlock 2/400	Amershield	10 - 14 mils
Carboguard Carbozinc 11 VOC	Carboline Carboguard 890 Series	Carbothane 134 HG	10 - 14 mils
Tnemec Tneme-Zinc 94H20	Tnemec Series L69	Tnemec Endura-Shield Series 1094 for Gloss finish (use Series 1095 for Semi-Gloss finish)	10 - 14 mils

Sherwin Williams Zinc Clad III HS 100	S W Macropoxy 646	S-W Hi-Solids Polyurethane 250	10 - 14 mils

F. System 6 – **Not Used**

G. System 7 – **Not Used**

H. System 8 - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max (g/L)	450
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max (g/L)	450

2. Application and manufacturers

Prime Coat (DFT = 4 - 5 mils)	**Finish Coat (DFT = 4 - 5 mils)**	**Total System DFT**
PPG- Amerlock 2/400	PPG Amerlock 2/400	8-10 mils
Tnemec Series N69	Tnemec Series N69	8-10 mils
Carboline Carboguard 890 Series	Carboline Carboguard 890 Series	8-10 mils
Sherwin Williams Macropoxy 646	Sherwin Williams Macropoxy 646	8-10 mils

I. System 9 – **Not Used**

J. System 10 - Acrylic, Concrete

1. Materials

Filler-Sealer Type	Epoxy or acrylic masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	as recommended by manufacturer
VOC Content, max (g/L)	450
Finish Type	single component waterborne pure acrylic emulsion, industrial grade, high molecular weight
VOC Content, max (g/L)	450

Demonstrated suitable for	concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Prime Coat (Filler-Sealer)	**Finish Coat (DFT = 5 - 7 mils) (2 or more coats)**	**Total System DFT**
Tnemec EnviroFill Series 130	Tneme-Crete 180 Series	5 - 7 mils plus primer
PPG- Amerlock 400BF and/or Amercoat 965	PPG Pitt-Tech Plus Series	5 - 7 mils plus primer
Carboline Sanitile 500	Carboline - Carbocrylic 3359 DTMC	5 - 7 mils plus primer
Sherwin Williams Pro Industrial Heavy Duty Block Filler	Sherwin Williams Pro Industrial Acrylic	5 - 7 mils plus primer

K. System 11 – **Not used**

L. System 12 – **Not Used**

2.03 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	high build, amine cured epoxy
VOC content, max (g/L)	450
Demonstrated suitable for	steel, long-term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG Novaguard 840	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Carboline Carboguard 891 VOC	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Hi-Build Epoxoline II Series N69 for wastewater	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Sherwin Williams Tank Clad HS	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils

B. System 101 – **Not used**

C. System 102 - Polyamide Epoxy

1. Materials

Type	high build polyamide cure epoxy
VOC content, max (g/L)	450
Demonstrated suitable for	long term immersion in water resistant to corrosion and chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
Tnemec Series 21 Epoxoline	12-18 mils
PPG- Amerlock 2/400	12-18 mils
Carboline - Carboguard 61	12-18 mils
Sherwin Williams Macropoxy 646 PW	12-18 mils

D. System 103 – **Not used**

E. System 104 – **Not used**

F. System 105 – **Not Used**

G. System 107 - Chemical Resistant Sheet Lining:

1. Materials: The Contractor shall use natural rubber, chlorobutyl rubber, ethylene propylene diene monomer (EPDM) rubber, chloroprene polymer (neoprene) rubber, or chlorosulfonated polyethylene (Hypalon) rubber sheet lining materials as indicated. The Shop Drawing submittal shall contain technical information that confirms the suitability of the lining material system for long-term immersion in each chemical to be stored. The service temperatures are expected to be up to 150 deg F.

2. Neoprene sheet lining material shall be synthetic rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16 - inch. The lining material shall be Polymeric Protective Linings BFG 2011 (59688), or equal.

3. Chlorobutyl sheet lining material shall be synthetic rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16-inch. The lining material shall be Polymeric BFG 1051 (60924), or equal.

4. Natural rubber (soft) sheet lining material shall be soft natural rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16-inch. The lining material shall be Polymeric BFG 2004 (83160), or equal.

5. Natural rubber (hard) sheet lining material shall be a hard, natural rubber resistant to oxidizing agents and formulated for autoclave curing. The minimum lining thickness shall be 3/16-inch. The lining material shall be Polymeric BFG 1006 (8631), or equal.

6. EPDM sheet lining material shall be synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution and formulated for autoclave or steam curing under pressure. The lining material shall be Polymeric BFG 1039 (EP156), or equal.

7. Hypalon sheet lining material shall be synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution. The lining material shall be Polymeric BFG 2045 (8706), or equal.

8. Primers, adhesives, activators, accelerators and other necessary materials shall be as required by the sheet material manufacturer.

9. Metal Surface Preparation: Prior to abrasive blast cleaning the base metal shall be prepared as required by the sheet lining material manufacturer's installation instructions. If the instructions differ from these specifications, the highest degree of cleaning and surface preparation shall be provided. Abrasive blast cleaning shall be done in accordance with this Section.

10. Installation of lining materials shall be in accordance with the material manufacturer's written installation instructions. All interior surfaces shall be lined, including all piping, vents, fittings, flange faces, manhole covers, and blind flanges.

11. The lining system shall be holiday tested in accordance with this Section before and after curing.

12. The lining system shall be cured by steam using the time and temperature as required by the material manufacturer.

H. System 108 - Polyurethane, Concrete

1. Materials

Filler-sealer type	epoxy material with portland cement and aggregate
Primer type	Phenolicamine or polyamidoamine epoxy
VOC content, max (g/L)	450
Finish type	aromatic elastomeric polyurethane
Demonstrated suitable for	concrete and concrete block masonry, long term immersion in water and wastewater and service where subject to splash and spill of water and wastewater treatment chemicals
VOC content, max (g/L)	450
Certification requirement, where coating will be in contact with potable water	NSF 61/600

2. Application and manufacturers

Filler-Sealer	Primer DFT = 3 - 7-mils	Finish Coat DFT = 100 - 125-mils, 75 mils for potable water
Carboline – Carbocrete 4010	Carboline -Carboguard 1340 WB (Optional)	Carboline -Reactamine 760
Tnemec MortarClad 218	Tnemec Pota-Pox L140 (potable water) Epoxoprime 201 (wastewater)	Elasto-Shield 406 (max 75 mils for potable water)
PPG-Amercoat 100A	PPG Raven 175	PPG Aquataflex 505
Sherwin Williams Steel Seam FT 910	Sherwin Williams Macropoxy 5000	Sherwin Williams Polycote 115

I. System 109 – Not Used

2.04 SPECIAL COATING SYSTEMS

A. System 200 – **Not Used**

B. System 201 - Rich Portland Cement Mortar: Rich Portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.

C. System 202 – **Not Used**

D. System 203 – **Not Used**

E. System 204 – **Not Used**

F. System 205 - Polyethylene Encasement: Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

G. System 206 – **Not Used.**

H. System 207 – **Not Used.**

I. System 208 - **Not Used.**

J. System 209 – **Not Used**

K. System 210 – **Not Used**

L. System 211 – Novolac Epoxy, Concrete, Aggregate Filled, Secondary Containment, foot traffic

1. Topcoat Material

Type	Novolac epoxy, 60 – 75 mil resin system
Demonstrated suitable for	Chemical storage or feed pump areas subject to foot traffic.

	See Coating System Schedule, Concrete Surfaces of Chemical Secondary Containment in Part 3 for specific chemical applications

2. Application and MANUFACTURERS

   a. TNEMEC

      1) Surface Filler: Series 215, thickness as required to fill bug holes and other imperfections to produce a smooth surface.

      2) Treat all cracks, construction joints, expansion joints and wall slab intersections in accordance with the coating manufacturer's recommendations.

      3) Primer: Series 201 Epoxyprime, 5-6 mils DFT

      4) Base Coat: Series 239C, 25-30 mils DFT

      5) Aggregate Fill, 20/40 mesh silica or garnet aggregate

      6) Top Coat: Series 282 15-20 mils DFT

   b. CARBOLINE

      1) Surface Filler: Semstone 110 blended with fine silica and thixotrope Part D, thickness as required to fill bug holes and other imperfections to produce a smooth surface.

      2) Treat all cracks, construction joints, expansion joints and wall slab intersections in accordance with the coating manufacturer's recommendations, see paragraph 3.10.

      3) Primer: Semstone 110, 5-6 mils DFT or Dudick Primer 67, 3-4 mils DFT

      4) Base Coat: Semstone 145, 25-30 mils DFT or Dudick Protecto-Coat 100XT, 15-20 mils DFT

      5) Aggregate Fill 20/40 mesh silica or garnet aggregate

      6) Top Coat: Semstone 145, 15-20 mils DFT or Dudick Pretecto-Coat 100XT, 15-20 mils DFT

   c. SHERWIN WILLIAMS

      1) Surface Filler: Epoxy Mortar, Duraplate 2300, thickness as required to fill bug holes and other imperfections to produce a smooth surface.

      2) Treat all cracks, construction joints, expansion joints and wall slab intersections in accordance with the coating manufacturer's recommendations, see paragraph 3.10.

      3) Prime: Corobond 100 Epoxy Primer, B58 Series, 5-6 mils DFT

4) Base Coat: Cor Cote E.N. 7000, 25-30 mils DFT

5) Aggregate Fill 20/40 mesh silica or garnet aggregate

6) Top Coat : Cor Cote E.N. 7000, 15-20 mils DFT

d. PPG

1) Prime: Milamar ICO LV

2) Base Coat: Milamar ICO Hi Guard Coating

3) Top Coat: Milamar ICO Hi Guard Coating

M.

N. System 212 – **Not Used**

O. System 213 – **Not Used**

P. System 214 – **Not Used**

PART 3 -- EXECUTION

3.01 MANUFACTURER'S SERVICES

A. The Contractor shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

B. For submerged and severe service coating systems, the Contractor shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 6 hours of on-Site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.02 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating Work.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition.

3.03 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations**:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.

B. Coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.04 PREPARATION FOR COATING

A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The Contractor shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.

B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent Work during blasting operations. Spraying shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any and all damage to adjacent Work or adjoining property occurring from blasting or coating operations.

E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.05 ENVIRONMENTAL REQUIREMENTS

A. No coating work shall be performed under the following conditions:

1. Surface or ambient temperatures exceed the manufacturer’s recommended maximum or minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.

4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

5. Ambient temperature that is expected to drop below 50 deg F or less than 5 deg F above the dew point within 8 hours after application of coating.

3.06 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC SP 5/NACE 1): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC SP 6/NACE 3): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC SP 7/NACE 4): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP 10/NACE 2): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. Power Tool Cleaning to Bare Metal (SSPC 11) When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than 1 mil (25 microns).

9. Surface Preparation of Concrete (SSPC-SP 13/NACE 6): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.07 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. The Shop Painting Facility shall use a minimum blast material mixture of 75 percent grit and 25 percent shot material to achieve the proper surface profile.

C. The Field Coating Applicator shall abrasive blast the shop coated surfaces per SSPC SP 7/NACE 4. The previously shop-painted surfaces shall be abraded prior to the application of the final coats. Special attention shall be given to uncoated steel weld joints, coating holdbacks, and bare metal.

D. Grease, oil, and welding fluxes shall be removed by wiping with MEK or naphtha cleaning or with trisodium phosphate detergent per SSPC SP 1.

E. All sharp edges shall be rounded or chamfered and all burrs, rust, scale, welding slag, and spatter shall be removed and the surface prepared by SSPC SP 2 hand tool cleaning, and SSPC SP 3 power tool cleaning.

F. The Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any blasted surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter ($\mu g/cm^2$). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

G. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate’s surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

H. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

I. The Contractor shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

J. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.

K. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

L. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

M. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

N. If the required abrasive blast cleaning will damage adjacent Work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP 2 or SSPC SP 3 may be used.

O. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP 1 before the abrasive blast cleaning has been started.

P. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.08 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP 7/NACE 4.

B. Any high spots, sharp protrusions, and rough edges, such as the metal drip line, shall be smoothed to avoid paint film gaps in the areas of the high spots. Surfaces shall be hand tool cleaned per SSPC SP 2 and power tool cleaned per SSPC SP 3.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

D. The surfaces of galvanized steel exposed to chemical splashing or within a wastewater head space shall be abraded per SSPC SP 11 or SP 7 prior to coating.

3.09 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

A. General: Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. Abrasive Blast Cleaning: The Contractor shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP 6/NACE 3. Areas of tightly adhering coatings shall be cleaned to SSPC SP 7/NACE 4, with the remaining thickness of existing coating not to exceed 3-mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the Contractor shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.10 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 Days after the concrete or masonry has been placed. All water retaining structures shall be successfully leak tested prior to coating application.

B. At the discretion of the Inspector, the Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter (µg/cm2). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

C. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate’s surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

D. In accordance with ASTM D4262, test to determine the pH of the concrete surface after the surface has been thoroughly blasted and cleaned. If the pH is outside the range recommended by the coating manufacturer, then the surface must be neutralized by removing concrete until the surface pH of 7 or greater is obtained prior to any coating application. One pH test shall be performed every 200 square feet, or less, and at locations determined by the Inspector.

E. The Contractor shall test for capillary moisture in accordance with ASTM D4263. Moisture tests shall be taken every 200 square feet or less and at locations determined by the Inspector. If capillary moisture is present, the coating manufacturer shall be consulted to determine primer requirements and special coating application criteria.

F. For below grade structures with surface areas greater than 2,000 square feet, the Contractor shall install three anhydrous calcium chloride test kits on bare concrete to measure the Moisture Vapor Transmission Rate (MVTR) on a flat horizontal surface. Testing and calculations shall be performed according to ASTM F1869. The MVTR shall be less than 3 lbs per 1,000 square feet per 24 hours. If the MVTR is greater than 3 lbs per 1,000 square feet per 24 hours, the Contractor shall apply a concrete sealant to reduce the MVTR through the concrete. The test kits shall be undisturbed for a minimum of 60 hours.

G. Surface Voids: Bugholes, honeycomb, or other surface voids greater than 1/4 inch in depth or 1/4 inch in diameter shall be filled in with a resurfacing mortar prior to the application of any primer or finish coat.

H. Holes or other joint defects in masonry shall be filled with mortar and repainted. All voids and cracks shall be repaired as specified. Loose or spatter mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.

I. Coating Pipe Penetrations: A 1/4-inch wide by 3/8-inch deep saw cut shall be made around the circumference of the pipe as it penetrates the concrete. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

J. Coating Floor/Wall Joints: A 1/4-inch wide by 3/8-inch deep saw cut shall be made on the vertical and horizontal concrete surfaces around the perimeter of the floor. The saw cut shall be 2 inches from the joint on both sides. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

K. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP 1 before abrasive blast cleaning.

L. New concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, and deteriorated concrete, and to roughen the surface equivalent to 80 Grit sandpaper or ICRI No. 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays Concrete Surface Profile No. 4.

M. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

N. Secondary Containment: Treat cracks, construction joints, expansion joints and inside corners according to the coating manufacturer’s recommendations.

3.11 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP 1 followed by sanding or brush-off blast cleaning SSPC SP 7/NACE 4.

C. Surfaces shall be clean and dry prior to coating application.

3.12 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. The mortar surfaces shall be cured at least 14 Days before surface preparation Work is started.

B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.

C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

3.13 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.

B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.

C. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning all surfaces as necessary in accordance with SSPC SP 1 and SP 2. Damaged shop coating shall be cleaned in accordance with SSPC SP 3, Power Tool Cleaning, and recoated with the primer specified.

D. For every 500 square feet, or less, of steel surface blasted, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other RP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, one replica tape test shall be performed. For each test area, the three replica tape thickness values shall be recorded and must be within 10 percent of the coating manufacturer’s recommended profile. If the surface profile does not meet the manufacturer’s recommended profile, two additional tests will be performed within a 12-inch diameter of the initial test. If the values are not satisfactory, the Contractor shall reblast the affected areas.

E. The interior surfaces of steel water reservoirs, except for Paragraph A surfaces, shall have surface preparation and coating Work performed in the field.

F. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

G. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

H. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated or less time if recommended by the coating manufacturer.

I. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

J. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.14 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA 1 - Paint Application Specification No. 1.

B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The Contractor shall schedule such inspection with the Engineer in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Contractor shall use an independent stripe coat per SSPC PA Guide 11 for these areas. Particular care shall be used to ensure that the specified coverage is secured on the edges and corners of all surfaces.

F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.

2. Concrete surfaces will be in direct sunlight during application or within 3 hours after application.

3. Dust or smoke laden atmosphere.

4. Damp or humid weather.

5. Substrate or air temperature is less than 5 deg F above the dew point.

6. Air temperature is expected to drop below 40 deg F or less than 5 deg F above the dew point within 8 hours after application of coating.

7. Wind conditions are not calm.

I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

K. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.15 CURING OF COATINGS

A. The Contractor shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

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3.16 IDENTIFICATION OF PIPING

A. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per OSHA Occupational Safety and Health Standards 29CFR1910.1200

B. Unburied pipes in structures and in chemical pipe trenches shall be color-code painted. Colors shall be as selected by the Engineer or as indicated.

3.17 SHOP AND FIELD INSPECTION AND TESTING

A. General: The Contractor shall give the Engineer a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

B. Such Work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such Work in its absence.

C. Inspection by the Engineer, or the waiver of inspection of any particular portion of the Work, shall not relieve the Contractor of its responsibility to perform the Work in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the Engineer to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.

E. Inspection Devices: The Contractor shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for the Engineer's use while coating is being done, until final acceptance of such coatings. The Contractor shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the Engineer.

F. Holiday Testing: The Contractor shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.

1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

2. Coatings with thickness of 20-mils or less total DFT: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo or equal, shall be added to the water prior to wetting the detector sponge.

G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. Surface Preparation: Confirm proper surface profile with Testex Press-O-Film replica tape in accordance with NACE RP0287-02.

3.18 COATING SYSTEM SCHEDULE, FERROUS METAL - NOT GALVANIZED

	Item	**Surface Prep.**	**System No.**
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3	(1) Acrylic Polymer
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy

FM-8	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC SP 5/NACE 1	(102) polyamide epoxy
FM-9	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-13	Interior surfaces of all chemical tanks, including tank nozzles, manholes, nozzle necks, flange faces.	White metal blast cleaning SSPC SP 5/NACE 1	(107) chemical-resistant sheet lining

FM-16	Structural steel, miscellaneous metalwork, and supports for roof and face support systems for buildings.	Solvent cleaning SSPC SP 1	(5) Inorganic Zinc/Epoxy/Polyurethane
FM-17	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP 6/NACE 3	(8) epoxy, equipment
FM-19	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plastic).	Removal of dirt, grease, oil	(201) rich portland cement mortar
FM-20	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including factory-coated surfaces.	As specified by reference specification	(205) polyethylene encasement

3.19 COATING SYSTEM SCHEDULE, FERROUS METAL - GALVANIZED: PRETREATMENT COATINGS, BARRIER COATINGS, OR WASHES SHALL BE APPLIED AS RECOMMENDED BY THE COATING MANUFACTURER. ALL GALVANIZED SURFACES SHALL BE COATED.

	Item	**Surface Prep.**	**System No.**
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1	(4) epoxy/ polyurethane
FMG-4	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC SP 1 followed by brush-off grade blast cleaning SSPC SP 7/NACE 4	(100) amine cure epoxy

3.20 COATING SYSTEM SCHEDULE-CONCRETE

	Item	**Surface Prep.**	**System No.**
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.10	(108) polyurethane, concrete

C-3	Floor slab and walls, exposure to chemicals, where indicated.	Per paragraph 3.10	(211) Novolac Epoxy, Concrete

3.21 COATING SYSTEM SCHEDULE-CONCRETE BLOCK MASONRY

	Item	**Surface Prep.**	**System No.**
CBM-1	All surfaces, indoors and outdoors, where indicated.	Per paragraph 3.10	(10) acrylic, concrete

END OF SECTION

SECTION 23 05 00 – COMMON WORKS RESULTS FOR HVAC

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide heating, ventilating, and air conditioning systems and associated equipment complete with supports, mounting frames, ventilators, ductwork, piping, louvers, panels, filters, grilles, electric drive units and controls, mechanical equipment, electrical work, appurtenances, testing, and balancing, as indicated in accordance with the Contract Documents.

B. The equipment shall be installed ready for operation.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
01 33 17	Structural Design, Support and Anchorage
09 96 00	High-Performance Coatings
23 07 13	Duct Insulation
26 00 10	Electrical General Requirements
26 05 10	Low-Voltage Electric Motors
26 05 33	Electrical Raceway Systems
40 05 07	Hangers and Supports for Process Piping
40 05 24	Steel Process Pipe

B. Reference Standards

Air Movement and Control Association International, Inc. (AMCA)	
American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)	
ASHRAE Standard 52-76/ASHRAE 52.1-1992 Standard	Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
American Society of Civil Engineers (ASCE)	
ASCE 7-10	(2010; Errata 2011; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures
American Society of Mechanical Engineers (ASME)	
Institute of Electrical and Electronics Engineers (IEEE)	
National Electrical Manufacturers Association (NEMA)	
National Fire Protection Association (NFPA)	
NFPA 72	(2022) National Fire Alarm and Signaling Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)	

UL 900	(2015) Standard for Air Filter Units

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings

1. Submit complete shop drawings and certificates, test reports, affidavits of compliance, for all equipment, ductwork and piping systems, in accordance with the requirements in Section 01 33 00 – Submittal Procedures, and as indicated in the individual equipment, piping or ductwork Sections.

2. Construction Drawings

a. The HVAC Drawings define the general layout, configuration, routing, size and the general intent of the design. and are not fabrication drawings.

b. The ductwork dimensions provided on the design drawings represent a free area and they are clear inside dimensions. The contractor shall be responsible to account for the loss of free area due acoustical lining, or any internal obstructions, and oversize the ductwork to provide the same free area as the one shown on the design drawings.

c. It shall be the Contactor's responsibility to develop the Shop Drawings required for the construction of the HVAC system.

3. The Shop Drawings shall include all necessary dimensions and details regarding equipment, pipe and ductwork joints, fittings, valves, appurtenances, design calculations, and material lists.

4. The submittals shall include detailed layout, spool, or fabrication drawings which shall show all fittings, and supports as necessary to accommodate the equipment as a complete and functional system.

B. Equipment Numbers

1. Equipment is identified by assigned numbers for reference and location purposes in the Contract Documents.

2. Indicate the appropriate equipment numbers on the Shop Drawings and other submittals.

C. Furnish certified fan curves for each fan.

1.04 WARRANTY

A. Air conditioners, heaters, fans, ventilators, grilles, and the like, that are provided by the Contractor shall carry the manufacturer’s standard warranty.

B. Warranties shall be furnished to the Engineer upon final acceptance of the completed systems by the Owner.

C. Refrigerant compressors shall carry a manufacturer's 5-year warranty.

D. Control System

1. The temperature and equipment control system shall be warranted free from defects in workmanship and material under normal use and service for a period of one year after acceptance by the Engineer.

2. Equipment that proves to be defective in workmanship or material during the warranty period shall be adjusted, repaired, or replaced by the automatic control manufacturer as part of the Contract.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Quality

1. Mechanisms and other parts shall be amply proportioned for the stresses which may occur during operation and for any other stresses which may occur during fabrication and erection.

2. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials, and shall be of the manufacturer's top-line, industrial-commercial grade.

B. Supports

1. Equipment and appurtenances shall be firmly anchored or connected to supporting members.

2. Equipment shall be supported on restrained spring-type vibration isolators.

3. Support as required for the proper installation of the equipment but not forming an integral part of the building structure, shall be provided unless otherwise indicated.

C. Noise and Vibration Control

1. The system shall be free of objectionable vibrations and noise.

2. Provide flexible connections in ducts and piping connections to fans, compressors, and other vibrating equipment.

2.02 MOTORS

A. Motors provided with the equipment shall conform to the latest IEEE and NEMA requirements for mechanical and electrical characteristics, including service factors.

B. Motors shall be in conformance with the requirements of Section 26 05 10–Low-Voltage Electric Motors.

C. Each motor shall bear the manufacturer’s nameplate with complete motor data.

D. Each motor shall be of ample size and construction to continuously carry the loads which might be imposed by the equipment throughout the full range of operation of the equipment.

E. The maximum motor loading shall be less than or equal to the nameplate horsepower rating, exclusive of the service factor.

2.03 ELECTRICAL WORK

A. The Work of this section shall include:

1. Provide controls, sensors and control panels relating to the HVAC systems, including starters, thermostats, motorized dampers, louver operators and other equipment as indicated.

2. Provide control wiring of 120-volt and less as indicated in this Section and in conformance the requirements of Division 26 – Electrical

B. The Work of Division 26 shall include:

1. Provide local power disconnects where required.

2. Provide circuit breakers, starters in motor control centers, and 120-, 208-, 240- and 480-volt power feeders from the starters and circuit breakers to the HVAC equipment, as indicated.

C. Enclosures shall be of the same NEMA class as the electrical equipment in the same area.

D. Low-voltage control wiring shall be in accordance with the National Electric Code.

E. Conduit shall be in conformance with the requirements of Section 26 05 33 – Electrical Raceway Systems.

2.04 DUCT SMOKE DETECTORS

A. Products

1. Furnish and install all duct smoke detectors whether shown on the drawings or required by code. If the project includes an existing fire alarm panel all signals from the duct smoke detectors shall be transmitted to the existing fire alarm panel. If the project does not include an existing fire alarm panel, and a new fire alarm panel is not required for any other reason, signals from the duct smoke detectors shall be transmitted to the HVAC automatic temperature control panel.

2. Make-up Air Handling Unit and Fans

a. Provide duct smoke detectors on both the intake and the discharge of Make-up Air Handling Unit , and fans as required by code.

b. The detector shall shut off the respective air handling unit or fan upon the detection of smoke.

3. Smoke detectors shall operate on the photoelectric principle and shall respond to a predetermined smoke density regardless of the rate of combustion, the distance between the detector and fire source, the combustible material, the temperature or velocity of the smoke, and whether the fire is in a confined or open area.

4. The detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory-set alarm point.

5. The smoke detectors shall be capable of operating at a humidity range of 10 to 90 percent RH.

6. The smoke detectors shall operate from a 24-VDC power source, and shall be Simplex, 4098 Series, ADT; Pyrotronics; or equal.

B. Refer to the Temperature Controls Sequence of Operation on the Drawings for additional information regarding operation of the fire alarm system.

2.05 FLASHING

A. Equipment that passes through roofs of buildings or structures shall be provided with flashing as indicated.

2.06 PIPE AND FITTINGS

A. Heating piping shall be Schedule 40 black steel pipe with screwed fittings.

B. Refrigerant piping shall be Type L hard temper copper with cast brass fittings.

C. Provide a drain at each low point in the piping system.

D. Joints in refrigeration piping shall be made with silver solder.

2.07 PIPING AND DUCTWORK INSULATION

A. HVAC Ductwork insulation shall be in conformance with the requirements of Section 23 07 13 – Duct Insulation.

2.08 WELDING

A. The welding of black steel or alloy pipe shall be carried out in strict accordance with AWS procedures, CSA-W 117.2, and the codes and ordinance of the City of Sandpoint , bylaws and the State of Idaho pertaining to welded steel pipelines.

B. Welding shall be accomplished by means of the shielded electric arc process and performed by workers who are certified for this Work.

2.09 HANGERS AND SUPPORTS

A. Anchorage and bracing for all suspended ductwork and other distribution systems needs to be provided per 2016 IBC Section 1613/ASCE 7-10 Chapter 13

B. Provide all necessary hangers, supports, concrete inserts, anchors and guides for material and equipment to be installed.

C. No perforated strap hangers and no wire supports will be accepted.

D. Insulation Allowance

1. Hangers supporting insulated pipe shall be sized to fit the pipe plus the insulation.

2. The insulation at support points shall be provided with a metal shield in order to prevent damage to the insulation.

E. Anchors and guides shall be constructed of steel, in accordance with approved Shop Drawings, and as indicated.

F. Pipe hangers used to support uninsulated copper piping shall be copper plated.

G. Anchors

1. Anchorages shall be obtained by welding lugs onto the pipe and providing abutting surfaces against the lugs to restrict longitudinal movement.

2. Anchors shall be designed such that the pipe may be removed by removing bolts; no welding of pipe to the anchor will be accepted.

3. bolting materials shall be cadmium plated.

H. Guides shall be located not more than 20 ft from each expansion loop or joint.

I. Horizontal runs of pipe shall be provided with supports spaced such that the sag of the unsupported length will not create any pockets in the piping (weight of fluid included).

J. Pipe support lengths shall be in conformance with the requirements of Section 40 05 07– Hangers and Supports for Process Piping.

K. Vertical Piping

1. Vertical piping shall be:

a. Supported at the base with fittings made for this purpose; or

b. Supported from the nearest horizontal member or floor with a riser extension pipe clamp.

2. Provide a riser extension clamp on each floor.

L. Hangers for ductwork and equipment shall be as indicated and in accordance with the guidelines of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

M. Inserts shall be galvanized.

2.10 FRP BACKDRAFT DAMPER

A. General

1. Provide backdraft dampers on the exhaust fans and ventilators where indicated.

2. Damper sizes and capacities shall be as indicated on the Drawings.

B. Fabrication

1. Fiberglass Material

a. Flame retardant, Series 625 vinyl ester-based resin.

b. Pultruded construction.

c. Comply with ASTM D 4385, ASTM E 84, and ANSI/ASME RTP-1.

d. Materials in Airstream: Meet or exceed required contamination concentrations.

e. Exposed Glass: Coat with resin compatible with that used in pultrusion process and covered with surfacing veil.

2. Frame: 8 inches x 2-3/16 inches x minimum 1/4-inch (203 x 56 x minimum 6 mm) fiberglass channel, vinyl ester resin.

3. Blades

a. Style: Triple-groove.

b. Action: Opposed

c. Material: Fiberglass vinyl ester resin.

d. Width: 6-5/8 inches (168 mm).

e. Thickness: Minimum 1/8 inch (3 mm).

f. Axles: Minimum 3/4-inch (19 mm) diameter fiberglass rod, pultruded construction of vinyl ester based resin, combined with continuous strand roving and complete with surfacing veil.

4. Bearing: Molded PTFE.

5. Linkage: Fiberglass face linkage, exposed, with monel rivets

a. Assembly: Factory assemble damper components with chemical resistant epoxy glue and monel fasteners.

6. Maximum Temperature: 200 degrees F (94 degrees C).

7. Performance Data for Damper Width of 12 inches (305 mm):

a. Maximum System Pressure: 20.0 inches w.g. (5.0 kPa).

b. Maximum System Velocity: 2,000 feet per minute (610 m/min).

c. Leakage without Seals: Based on pressure differential of 1-inch w.g. (0.25 kPa).

d. Percent of Maximum Flow: 3.00.

e. Leakage: 60 cubic feet per minute/square foot (18.3 m3/min/m2).

8. Actuator

a. Actuator shall be 120V, 60Hz electric, two-position and spring return

C. Damper Manufacturers, or Equal

1. Ruskin FRP Damper, Model 1108

2.11 VOLUME, CONTROL DAMPERS (MANUAL AND MOTORIZED)

A. General

1. Provide volume control dampers in accessible locations in branch supply ducts and at each exhaust air opening, in order to properly regulate the volume of air delivered or withdrawn from each inlet and outlet, and as indicated.

2. Damper sizes and capacities shall be as indicated on the Drawings.

B. Construction

1. The volume dampers shall be of the opposed blade type.

2. The dampers shall be constructed of aluminum, of B & S 14-gauge thickness.

3. The dampers shall be suitably reinforced with sturdy control shafts.

4. Ductwork shall be reinforced to double thickness at damper shaft openings.

C. Air Extractor Type

1. The volume control dampers indicated to be of the air extractor type shall be constructed of stainless steel, of 20-gauge for frames and of 24-gauge thickness for blades.

D. No splitter dampers will be accepted.

E. Manual control dampers shall be provided with mechanisms for adjustment and locking into position after being set.

F. Motors

1. Damper motors shall be electric, with either modulating or 2-position control and necessary linkages.

G. The motors shall be powered open and spring-closed, unless otherwise indicated.

2.12 BLANK OFF PANELS

A. Application

1. Blank-off panels are highly customized to prevent air through the louver and resist the transference of heat evaporating certain designated locations. Insulated panels are completely enclosed to eliminate outside exposure for longevity.

B. Standard Construction

1. Frame: 0.040: thick aluminum sheet. Offered with and without insulation.

2. Finish: Mill.

3. Maximum Factory Assembly Size: Sized to fit louver order panel size: (shown in table below)

4. Insulation Material (Optional): EPS Expanded Polystyrene Foam

5. Blank off Type:

Air Terminal Type	Max Size Blank-Off Dimension	
Blank Off Type	**48" Wide Assembly**	**60" Wide Assembly**
Non insulated	48"	60"
1" insulated	46"	58"
2" insulated	44"	56"

2.13 REGISTERS, GRILLES AND DIFFUSERS

A. Refer to specification 23 37 13 Diffusers, Registers and Grilles

1. Provide supply and return registers and grilles, and all supply diffusers as indicated.

2. The sizes, capacities, and deflection of each unit shall be as indicated on the Drawings.

B. The following schedule shall be followed:

Air Terminal Type	**Border Type**	**Manufacturer, Model and Material**	**Optional damper**	**Neck Type**	**Note to Designer (See Performance cutsheets for selection)**
Supply Grilles (SG)	Surface Mount	Titus Model 300 FL Aluminum; Tuttle and Bailey; or equal: with 1/2" x 1/2" x 1/2" aluminum grid	yes	Rectangular	To be used ceiling surface (not grided) mounted
Return Grilles (RG)	Surface Mount	Titus Model 350-FL; Tuttle and Bailey; or equal: with ½-in 12.7 mm x ½-in 12.7 mm x ½-in 12.7 mm aluminum grid	yes	Rectangular	To be used mainly for return on ceilings (both grided and hard surface) and wall surfaces

C. Registers, grilles and diffusers shall be constructed of aluminum.

D. The finish shall be a white baked-on enamel.

E. Accessory equipment shall be constructed of aluminum, or steel if aluminum is not available, and provided with a white baked-on enamel.

F. The proper border style shall be selected by the Contractor to suit the installation conditions.

2.14 VIBRATION ISOLATORS

A. General

1. Provide vibration control isolation all rotating equipment except electric motors.

2. Where rotating units are part of factory-assembled package units, such as a package air handling unit, provide the isolator under the unit casing.

B. Support suspended equipment by a combination of spring and fiberglass isolation hangers, incorporating minimum 2-in thick neoprene jacketed fiberglass inserts in series with springs, encased in steel brackets.

C. Mount floor-mounted or platform-mounted built-up or package air handling units on structural steel or concrete bases with isolator springs and brackets.

D. Springs used in the vibration isolators shall have approximately 1-in of deflection under load and shall have a minimum additional travel of 50 percent between the design height and the solid height.

E. All isolation equipment shall be provided in strict compliance with the manufacturer's recommendations.

F. Pads

1. For vibration isolation between HVAC equipment and supports and where indicated, provide ¾-in thick rubber pads for full contact between equipment and support

G. The pads shall be Mason Industries, Super W Pads, or equal.

2.15 ROOF CURBS AND ROOF EQUIPMENT SUPPORTS

A. Curbs

1. Roof curbs for all roof openings for roof mounted exhaust fans and air intakes and exhausts, unless otherwise indicated, shall be of the raised can’t type with a minimum 12-in height above the roof line.

2. The curbs shall be pitched at the base for roof pitches in excess of 3/8-in per foot.

3. Provide a minimum 4-in raised can’t unless otherwise indicated.

4. The curbs shall be of a box design, constructed from 20-gauge galvanized steel with continuous welded seams, full mitered angle seam corners, and factory-installed wood Nailers.

5. Insulate the curbs with a minimum of 1 ½-in thick, 3 lbs. per cu.ft. density rigid board fiberglass.

6. Roof curbs shall be provided with an 18-gauge stainless steel liner set in mastic and extended the full height of curb if the duct does not extend to the top of the curb.

7. The roof curbs shall be supplied by the manufacturer of the equipment being provided.

8. Roof Curb Manufacturers, or Equal

   a. Pate Model PC-5

   b. Thy curb

B. Equipment Supports

1. Provide roof equipment supports for roof-mounted equipment.

2. Construct the supports from 180 gauge galvanized steel, with continuous welded seams, an integral base plate, a wood nailer with a 1-in overhang to accommodate insulation, and counter flashing with lag screws.

3. Provide the supports with a raised cant of not less than 4-in and a minimum of 15-in high.

4. The length and width of the units shall conform to the support requirements of the equipment being supported.

5. Roof Equipment Supports Manufacturers, or Equal

   a. Pate Model PC-5

   b. Thycurb

2.16 TEMPERATURE AND EQUIPMENT CONTROL

A. Refer to specification section 23 09 01 Instrumentation and Controls for HVAC

2.17 NATURAL GAS SERVICE AND INSTALLATION

A. General

1. The Contractor shall provide the natural gas system and valving as indicated.

2. The Contractor shall pay any fees or charges levied by the Gas Company for installation or inspection.

B. Gas Piping

1. Gas piping shall be installed in strict conformance with applicable local or state regulations and the indicated requirements.

2. Black Steel Piping

   a. Gas piping shall consist of black steel, Schedule 40, ASTM A53. Fittings 2 ½-in and smaller shall be Malleable iron, ASME B16.3, Banded, Black, 150 PSI. Fittings 3-in and larger shall be steel ASME B16.9, butt welded.

   b. Joints for exposed piping shall be of the screwed type, with an adequate number of unions to facilitate removing of equipment and dismantling of piping for cleaning and inspection.

   c. Joint compounds on steel pipe shall be rated for natural gas service, shall be resistant to the action of gas, shall be non-hardening, and shall be used sparingly on the male threads only.

C. Valves

1. Valves shall be used in accordance with the rating and service recommendations of the manufacturer.

2. Valves shall conform to the requirements of ANSI B31.8.

3. Full-opening non-lubricated plug valves shall be used in sizes larger than 2-in or for pressures greater than 0.5 psig.

4. No unions or valves shall be installed on pipelines that will be concealed in partitions, ceilings, or the like.

5. Every union or valve shall be readily accessible for inspection and repair.

6. A plug valve shall be provided at each piece of equipment the gas system serves.

2.18 GAS PRESSURE REGULATOR

A. Provide a gas pressure regulator in accordance with the International Mechanical Code, Uniform Plumbing Code, International Fuel Code, International Fire code, ASHRAE and the local codes.

B. Gas pressure regulator shall be provided with high and low trip points

C. Design Features:

1. Maximum inlet pressure: 100 bar (1450 psi)

2. Outlet pressure range: 0.02 bar (0.3 psi) to 90 bar (1305 psi)

3. Maximum pressure drop: 1 bar

4. Class of lock-up pressure zone: SZ 2.5

5. Temperature range: -20 Deg C to +60 Deg C

D. Pipe Connections:

1. Pipe connections shall be in accordance with ISO 8434-1 for pipe diameters between 3/4" to 1 1/2"

2. Pipe flanges shall be Class 600 according to ANSI 16.5

E. Materials:

1. Main valve body shall be aluminum alloy or steel

2. Actuator shall be aluminum alloy

3. Internal parts shall be aluminum alloy, brass, steel, polyamide

4. Diaphragms, O-rings shall be perbunan

5. All mechanical components shall be without potential ignition sources and/or hot faces.

F. Manufacturers, or Equal

1. Honeywell, Model HON 200

2.19 PAINTING

A. Touch-Ups

1. Touch up factory-painted surfaces that are rusted or scratched.

B. Clean finishes to be touched up to bright metal, prime with a corrosion inhibitor, and finish with a coating to match the original finish.

PART 3 -- EXECUTION

3.01 GENERAL

A. Openings - New Construction

1. Provide necessary openings in walls, floors, and roofs for the passage of heating and ventilating equipment in the buildings.

2. Openings shall be as indicated or as required to provide passage for heating and ventilating Work.

3. Provide hanger and support inserts into masonry or structural steel as required for proper completion of the Work.

B. Openings - Existing Construction

1. Provide openings required in the existing construction for piping and equipment that are not specifically indicated.

2. Openings shall be cut in a neat and orderly manner with as little damage to existing structures as possible.

3. The patching of openings that have been cut shall match the existing construction.

4. Provide hangers and supporting members installed in the existing masonry or structural steel as required for proper completion of the Work.

3.02 BALANCING TESTING

A. Balancing Subcontractor

1. After the installation Work has been completed, the Contractor shall provide the services of an independent balancing subcontractor who shall perform necessary adjustments of volume dampers, volume controllers, exhaust blowers, exhaust fans, supply blowers, supply and return registers, and heating units, chilled water, and hot water.

B. Balancing Procedures

1. Balancing and testing shall be in conformance with the requirements of Section 23 05 93 – Testing Adjusting and Balancing for HVAC.

3.03 COMMISSIONING OF HVAC

1. Commissioning of HVAC shall be in conformance with the requirements of Section 23 08 00 – Commissioning of HVAC.

3.04 VIBRATION ISOLATORS

A. Install isolation equipment in strict compliance with the manufacturer's recommendations.

3.05 TEMPERATURE AND EQUIPMENT CONTROL

A. After completion of the installation, use trained personnel to adjust thermostats, and sensors in the motors and other provided equipment, and place them in complete operating condition subject to the approval of the Engineer.

B. Instruct the operating personnel in the operation of the control system.

END OF SECTION

SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 -- GENERAL

1.01 SUMMARY

A. The WORK included in this Section shall consist of the furnishing of all labor, and materials, for the installation of hangers and support for the heating, ventilating, and air conditioning (HVAC) systems as indicated in the Contract Documents and herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
01 33 17	Structural Design Support and Anchorage
09 96 00	High-Performance Coatings

B. Reference Standards

American Society of Civil Engineers (ASCE)	
ASCE/SEI 7-05	Minimum Design Loads and Associated Criteria for Buildings and Other Structures
ASCE 7-10	Minimum Design Loads for Buildings and Other Structures
American Society of Mechanical Engineers (ASME)	
ASME BPVC	Boiler and Pressure Vessel Code
ASME B31.9	Building Services Piping
American Welding Society (AWS)	
AWS D1.1/D1.1M	Structural Welding Code—Steel
ASTM International (ASTM)	
ASTM C552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)	
Society of Protective Coatings (SSPC)	
SSPC-PA 1	Shop, Field, and Maintenance Coating of Metals

C. Reference Standards

1. Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Comply with spec section 01 33 17 – Structural Design Support and Anchorage

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00– Submittal Procedures

B. Product Data: For each type of product indicated.

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:

1. Metal framing systems.

2. Fiberglass strut systems.

3. Equipment supports.

D. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.

2. Design Calculations: Calculate requirements for designing trapeze hangers.

3. Welding Certificates

1.04 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 -- PRODUCTS

2.01 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.

c. Flex-Strut Inc.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut Corporation; Tyco International, Ltd.

g. Wesanco, Inc.

2. Standard: MFMA-4.

3. Channels: Continuous slotted steel channel with in-turned lips.

4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

6. Metallic Coating: Hot-dipped galvanized.

7. Paint Coating: Vinyl or Acrylic.

8. Plastic Coating: PVC.

2.02 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.

2. Clement Support Services.

3. ERICO International Corporation.

4. PHS Industries, Inc.

5. Piping Technology & Products, Inc.

6. Rilco Manufacturing Co., Inc.

7. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C533, Type I calcium silicate with 100 psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength.

2.03 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.04 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon steel shapes.

2.05 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.

2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 -- EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Anchorage and bracing for all suspended ductwork and other distribution systems needs to be provided per 2016 IBC Section 1613/ASCE 7-10 Chapter 13

B. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4-in thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Comply with spec section 01 33 17 – Structural Design Support and Anchorage

1. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

B. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Trim excess length of continuous-thread hanger and support rods to 1.5-in.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 0.002-in.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 96 00 – High-Performance Coatings and Section 09 96 00– High-Performance Coatings.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Use thermal-hanger shield inserts for insulated piping and tubing.

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6-in for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 deg F to 450 deg F piping installations.

3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

F. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 -- GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, and Section 01 33 17– Structural Design Support and Anchorage, apply to this Section.

1.02 THE SUMMARY

A. Section Includes:

1. Isolation pads
2. Isolation mounts
3. Restrained elastomeric isolation mounts
4. Freestanding and restrained spring isolators
5. Housed spring mounts
6. Elastomeric hangers
7. Spring hangers
8. Spring hangers with vertical-limit stops
9. Seismic snubbers per Section 01 33 17– Structural Design Support and Anchorage
10. Restraining braces and cables
11. Steel and inertia, vibration isolation equipment bases.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Definitions

1. IBC: International Building Code
2. ICC-ES: ICC-Evaluation Service
3. OSHPD: Office of Statewide Health Planning and Development for the State of California

B. Reference Specifications

01 33 17	Structural Design Support and Anchorage
01 79 00	Owner Staff Training

C. Reference Standards

American Association of State Highway and Transportation Officials (AASHTO)

American Society of Civil Engineers (ASCE)	
ASCE/SEI 7-05	Minimum Design Loads for Buildings and Other Structures
ASCE 7-05	Wind Loads: Guide to the Wind Loads Provisions of ASCE 7-05
American Welding Society, Inc. (AWS)	
AWS D1.1/D1.1M	Structural Welding Code
ASTM International (ASTM)	
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A603	Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A492	Standard Specification for Stainless Steel Rope Wire
ASTM E488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)	

1.04 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Comply with ASCE/SEI 7-05 and IBC 200

2. Comply with Section 01 33 17 – Structural Design Support and Anchorage

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Comply with Section 01 33 17– Structural Design Support and Anchorage

5. Seismic- and Wind-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

e. Comply with Section 01 33 17– Structural Design Support and Anchorage

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer

B. Welding certificates

C. Field quality-control test reports

1.07 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Comply with Section 01 33 17– Structural Design Support and Anchorage.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 -- PRODUCTS

2.01 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.

2. Amber/Booth Company, Inc.

3. California Dynamics Corporation

4. Isolation Technology, Inc.

5. Kinetics Noise Control

6. Mason Industries

7. Vibration Eliminator Co., Inc.

8. Vibration Isolation

9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant rubber or hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge bearing neoprene as defined by AASHTO.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 0.24 in thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psi.

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 0.24 thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 0.24 in travel up or down before contacting a resilient collar.

H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.02 VIBRATION ISOLATION EQUIPMENT BASES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation

3. Isolation Technology, Inc.

4. Kinetics Noise Control

5. Mason Industries

6. Vibration Eliminator Co., Inc.

7. Vibration Isolation

8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1 in clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1 in clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation

3. Cooper B-Line, Inc.; a division of Cooper Industries

4. Hilti, Inc.

5. Kinetics Noise Control

6. Loos & Co.; Cableware Division

7. Mason Industries

8. TOLCO Incorporated; a brand of NIBCO INC.

9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A603 galvanized or ASTM A492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.04 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected

D. Comply with Section 01 33 17– Structural Design Support and Anchorage.

3.02 APPLICATION

A. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

B. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Refer to drawings for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.13 in.

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Comply with Section 01 33 17 –Structural Design Support and Anchorage.

C. Perform tests and inspections.

D. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

B. Adjust active height of spring isolators.

C. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.06 DEMONSTRATIONS

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Section 01 79 00 – Owner Staff Training

END OF SECTION

SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 -- GENERAL

A. The Work included in this Section shall consist of the furnishing of all labor, instruments, tools, and services as required for the total system balancing of the heating, ventilating, and air conditioning (HVAC) systems as indicated in the Contract Documents.

B. The Work under this Section shall include the following items:

1. Preparation for balancing of air systems

2. Preparation for balancing of hydronic and steam systems

3. Preparation of control systems

4. Notification requirements by the General Contractor of systems readiness

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Standards

Associated Air Balance Council (AABC)	
American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)	
ASTM International (ASTM)	
American National Standards Institute (ANSI)	
ANSI S1.13	(2020) American National Standard Measurement of Sound Pressure Levels in Air

PART 2 -- PRODUCTS

PART 3 -- EXECUTION

3.01 GENERAL

A. Testing, adjusting, and balancing (TAB) of the air conditioning systems and related ancillary equipment shall be performed by a certified, independent third-party, AABC Agency, selected and employed by the Contractor and approved by the Owner.

B. The preparation for and corrections necessary for the testing, adjusting, and balancing of these systems, as described herein, are the responsibility of the Contractor.

C. Make changes or replacements to fan sheaves and belts, dampers, valves, and the like, as may be required for correct balance as advised by the TAB firm, as part of the Work.

D. Provide and coordinate the services of qualified, responsible subcontractors, suppliers, and personnel, as required to correct, repair, or replace deficient items or conditions found during the course of the Project, including the testing, adjusting, and balancing period.

E. Operate the systems for the length of time necessary to properly verify their completion and readiness for TAB.

F. Scheduling

1. Project completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy.

2. Allow adequate time for coordinating Owner-required services associated with the testing and balancing activities during the construction period and prior to Substantial Completion.

G. Accessibility

1. Install valves, dampers, and miscellaneous adjustment devices in a manner that will leave them accessible and readily adjustable.

2. Should any such device not be readily accessible, provide access as requested by the TAB firm.

3. Malfunctions encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately such that the balancing work can proceed with minimal delays.

H. The TAB firm shall check, adjust, and balance the components of the HVAC system in order to obtain the optimal performance of the equipment.

I. The Work is intended to be accomplished after the system components are installed and operating as indicated and required.

J. It shall be the responsibility of the Contractor to place the equipment into service.

K. The following components of the HVAC systems shall be tested, adjusted, and balanced:

1. Air moving equipment

2. Air distribution systems

3. Heating systems

4. Control systems (testing and verification)

3.02 FIELD TESTING

A. During the progress of the work, tests shall be performed as indicated and as required by authorities having jurisdiction, including the local building department, the Owner, the Owner’s insuring agency, and the Engineer.

B. Perform such tests as part of the Work, including qualified personnel, equipment apparatus, additional thermometer wells, gauge connections, instrument connections, and services as required to perform the tests.

C. Submit 6 copies of each complete test report to the Engineer for review and send 2 copies of the accepted report to the Owner.

3.03 DEFECTIVE WORK

A. Leaks, damage, and defects discovered or resulting from tests shall be repaired or replaced to a like-new condition.

B. Leaky pipe joints, ductwork, and the like, shall be removed and replaced with acceptable materials.

C. Reporting

1. During the balancing process, as abnormalities and malfunctions of equipment or components are discovered by the TAB personnel, the TAB firm shall advise the Engineer and Owner in writing such that the conditions may be corrected by the Contractor.

2. The written document need not be formal but must be understandable and legible.

3. The TAB firm shall not instructor direct subcontractors in any of the Work.

3.04 CONTRACTOR'S RESPONSIBILITIES

A. Have the building and air conditioning systems in complete operational readiness for the TAB Work to begin.

B. Allow sufficient time for the TAB firm to perform their Work within the construction schedule.

C. Complete the W by systems or floors, whichever is the more efficient method for testing systems.

D. Scheduling

1. Within 2 weeks after the construction schedule has been developed, schedule a TAB coordination meeting to include the TAB firm, the Contractor and primary subcontractors, the Engineer, and the Owner, for the purpose of developing a testing schedule for the Project.

2. Submit copies of the proposed schedule to the TAB firm at least one week prior to the coordination meeting.

E. Promptly correct deficiencies of materials and workmanship identified as delaying completion of the TAB firm's Work.

F. Assume responsibility for added costs to the Owner resulting from failure to have the building and air conditioning systems ready for TAB when scheduled, and from failure to correct deficiencies promptly.

G. Coordinate with the TAB firm to compile and submit:

1. one set of HVAC specifications

2. one copy of relevant revisions, clarifications, and modifications

3. one complete set of Drawings, less the Civil and Structural sheets

4. one set of the HVAC floor plans of the conditioned spaces

5. one copy of approved submittal data for installed equipment

6. one copy of related changes as required to accomplish the indicated test procedures

3.05 TAB FIRM RESPONSIBILITIES

A. The following observations and tests shall be performed by the TAB firm:

1. During the construction submittal stage and before the submittal documents are finalized, review the mechanical and HVAC submittals, drawings and specifications for balance-ability and furnish commentary.

2. During construction, review approved HVAC submittals such as control diagrams, air handling devices, and the like, that pertain to TAB work and balancing.

3. Perform construction observations and submit a written report including the following topics.

a. The ductwork prior to insulation and ceiling cover-up

b. The piping prior to insulation and ceiling cover-up

4. Perform a pre-balance site review and submit a written report.

3.06 OPERATIONAL READINESS

A. “Operational readiness,” as referred to in this Section, shall be defined as the time when the construction status of the building permits the closing of doors, windows, ceilings, and the like, to obtain simulated or projected operating conditions.

B. Operational readiness of the HVAC system shall require that the following items have been accomplished:

1. Air Distribution Systems

a. The installation conforms to the indicated design requirements.

b. Volume, smoke, and smoke/fire dampers have been properly located and are functional.

c. Dampers have tight closure and open fully with smooth and free operation.

d. Supply, return, exhaust, and transfer grilles, registers, diffusers, and terminal devices have been installed and secured in a fully open position.

e. Air handling systems, units, and associated apparatus, such as heating and cooling coils, filter sections, access doors, and the like, have been sealed to eliminate uncontrolled bypass or leakage of air.

f. Final clean filters are in place, coils are clean with fins straightened, bearings are properly greased, belts are aligned and tightened, and the system is completely operational.

g. It has been verified that all systems are operating within the design pressure limits of the piping and ductwork.

h. Fans (supply, return, and exhaust) are operating and verified for freedom from vibration, proper fan rotation and belt tension.

i. Heater elements in motor starters are of proper size and rating, in accordance with the starter manufacturer's requirements.

j. Motor amperage and voltage have been recorded on each phase at start-up and verified that they do not exceed nameplate ratings.

2. Automatic Controls

a. A meeting has been held with the Engineer, the TAB firm, and the Owner, for a pre-submittal review of the proposed controls strategy.

b. Control components have been installed in accordance with project requirements and are functional, including electrical interlocks, damper sequences, air and water resets, fire and freeze stats, high- and low-temperature thermostats, safeties, and the like.

c. Controlling instruments have been calibrated and set for design operating conditions, with the exception of components that require input from the TAB firm, but a default has been set.

1) Cooperate with the TAB firm and provide all software and interfaces to communicate with the system.

d. Controls, sensors, operators, sequences, and the like, have been checked before notifying the TAB firm that the Energy Management System is operational.

1) Furnish technical support (technicians and necessary computers) for a complete check of these systems.

e. Fire alarm detection devices, sequences, inter-locks, and the like, have been checked before notifying the TAB firm that the system is operational.

1) Checked devices shall include the Fireman's Override Panel.

2) Provide all detection devices (fire and smoke), complete with all smoke zones identified along with all alarm and event chart devices identified.

3) Certify that the systems are totally operational prior to the TAB beginning.

f. A start-up report has been submitted.

1) The start-up report shall include the submitted and actual RPM, and the actual and nameplate voltage and amperage of all motors.

2) This requirement applies to each piece of electrically driven air conditioning equipment in the system, including supply and exhaust fans, other fans of fractional horsepower, pumps, and the like.

3) Furnish the addresses and initial set points of all controlled devices.

3.07 NOTIFICATION OF SYSTEM READINESS

A. After the above operational readiness items have been accomplished, notify the Engineer in writing, certifying that the Work has been accomplished and that the building and the air conditioning systems are in operational readiness for testing, adjusting, and balancing.

B. With the notification, include a copy of tabulated data as required.

C. The Engineer will notify the TAB firm of the readiness for balancing, and forward copies of the Contractor's certification and tabulated motor voltages, currents, and RPM.

D. If the TAB firm has been notified as described above and the inspection reveals that the TAB services notification is premature, costs of the inspection and wasted work accomplished by the TAB firm shall be reimbursed to the appropriate parties by the Contractor.

3.08 TESTING AND BALANCING

A. In coordination with the TAB firm, submit an overview of system TAB procedures including:

1. An agenda

2. Field observation reports

3. System testing, including:

a. Traverses to be made

b. Instrumentation to be used

c. How correction factors for grilles and diffusers will be obtained

d. How measurements will be verified at maximum and minimum

e. How control components will be verified

4. Report forms with each systems components identified and numbered.

3.09 INSTRUMENTATION

A. Ensure that instruments being used are currently calibrated and listed in the TAB report, showing instrument description, serial number, and date of calibration.

B. The accuracy of instruments used shall be as indicated in the current AABC National Standards.

3.10 FINAL AIR BALANCE

A. When systems are complete and ready for operation, the TAB firm shall perform a final air balance for all air systems and record the results.

B. The volume of air for the supply, return, exhaust, and outside air equipment and terminals shall be tested and balanced within the tolerances of the AABC Standard.

C. Air handling unit and fan volumes shall be adjusted by changing fan speed.

D. Air distribution device volume shall be adjusted using the spin-in damper for flexible duct-connected devices, and the damper for duct-connected devices.

E. Air distribution devices shall be balanced with air patterns as indicated.

F. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are indicated.

G. The general scope of balancing by the TAB firm shall include the following items:

1. Filters: Check air filters and filter media and balance only systems with essentially clean filters and filter media.

2. Fan Speed: Measure and record RPM at each fan speed.

3. Voltage and Amperage Readings: Measure and record the final operating amperages and voltage for each motor.

4. Static Pressure Profile

    a. Static pressure profiles shall be measured and recorded across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter, and exhaust fan, and at the furthest air device or terminal unit from the air handler supplying that device.

    b. Furnish static pressure profiles for systems which do not perform as designed.

5. Equipment Air Flow: Adjust and record exhaust, return, outside, and supply air CFM and temperatures, as applicable, at each fan and coil.

6. Coil Temperatures

    a. Set controls for full cooling and for full heating loads.

    b. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil, and HVAC terminal unit.

    c. At the time of reading, record water flow and entering and leaving water temperatures.

    d. In variable flow systems, adjust the air and water flow to design for all the above readings.

7. Zone Air Flow: Adjust each zone of multizone units, each HVAC terminal unit, and air handling unit for design CFM.

8. Outlet Air Flow

    a. Adjust each exhaust inlet and supply diffuser, register and grille to within the tolerances shown in the AABC Standard.

b. Include all terminal points of air supply and all points of exhaust.

9. Pitot Tube Traverses

a. For use in future troubleshooting by maintenance personnel, measure air velocity in all exhaust ducts, main supply ducts, outside air, and return ducts, and record by the Pitot tube traverse method shown in the AABC Standard.

b. Locations of these traverse test stations shall be described both verbally and by graphic representation on the sheet containing the data.

10. Maximum and minimum airflow on terminal boxes shall be adjusted, measured, and recorded.

3.11 SOUND

A. Read and record sound levels at up to 15 locations in the building designated by the Engineer, and show that all areas are within acceptable sound levels in accordance with ASTM and ASHRAE Standard Test method for measurement of sound in commercial Spaces, or the American National Standard Institute's Methods for the Measurement of Sound Pressure Levels, ANSI S1.13.

B. Perform measurements using an octave band analyzer.

C. Conduct the tests when the building is quiet and in the presence of the Engineer.

3.12 TESTING OF TEMPERATURE CONTROL SYSTEMS

A. Coordinate with the Contractor in order to ensure that the most effective total system operation is within the design limitations, and to obtain a mutual understanding of the intended control performance.

B. Verify that all control devices are properly connected and operated by the intended controller.

C. Observe the calibration of all controllers.

3.13 TAB FINAL ACCEPTANCE AND BALANCING

A. At the time of TAB final acceptance inspection, the TAB firm shall recheck, in the presence of the Engineer, specific and random selections of data that were recorded in the certified test and balance report.

B. Points and areas for recheck shall be selected by the Engineer.

C. Measurements and test procedures shall be the same as the submitted and approved test and balance agenda.

D. Selections for verification, specific plus random, shall not exceed 10 percent of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.

E. If 10 percent of the random verification tests demonstrate a measured flow deviation of 10 percent or more from that recorded in the certified test and balance report, the report shall be automatically rejected.

F. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test and balance report submitted, and a new inspection test made, as part of the Work.

G. Final Acceptance will not occur until after the successful completion of the TAB verification process.

END OF SECTION

SECTION 23 07 13 – DUCT INSULATION

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide Ductwork insulation, complete and in place, as indicated in accordance with the Contract Documents

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

23 05 29	Hangers and Supports for HVAC Piping and Equipment

B. Commercial Standards:

ASTM International (ASTM)	
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A240/A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C612	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C656	Standard Specification for Structural Insulating Board, Calcium Silicate
ASTM C795	Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C871	Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1290	Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM D1644	Standard Test Methods for Nonvolatile Content of Varnishes
ASTM D1784	Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM E84	Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

ASTM F1249	Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
Military and Government Specs & Standards (Naval Publications and Form Center) (NPFC)	
MIL-DTL-3316	Adhesives, Fire-Resistant, Thermal Insulation
National Fire Protection Association (NFPA)	
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	Standard for the Installation of Warm Air Heating and Air Conditioning Systems
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	
ASHRAE 90.1	Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

1.03 CONTRACTOR SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.

3. Detail application of field-applied jackets.

4. Detail application at linkages of control devices.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed

D. Submit information showing installed insulation meet the requirements of ASHRAE 90.1.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 -- PRODUCTS

2.01 INSULATION MATERIALS

A. All ductworks shall be insulated to meet or exceed the minimum requirements of ASHRAE 90.1.

B. Comply with requirements in Part 3 articles for where insulating materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.

b. Johns Manville; Microlite.

c. Knauf Insulation; Friendly Feel Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap.

e. wens Corning; SOFTR All-Service Duct Wrap.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Commercial Board.

b. Fibrex Insulations Inc.; FBX.

c. Johns Manville; 800 Series Spin-Glas.

d. Knauf Insulation; Insulation Board.

e. Manson Insulation Inc.; AK Board.

f. Owens Corning; Fiberglas 700 Series.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.

b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 8.0 oz./gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.

b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

c. P.I.C. Plastics, Inc.; Welding Adhesive.

d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 8.0 oz./gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

    b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.014 US perm at 0.043-in dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.

    b. Eagle Bridges - Marathon Industries; 501.

    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.

    d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F1249, 0.046 US perm at 0.035-in dry film thickness.

3. Service Temperature Range: 0 deg F to plus 180 deg F.

4. Solids Content: ASTM D1644, 44 percent by volume and 62 percent by weight.

5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.

    b. Eagle Bridges - Marathon Industries; 570.

    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F1249, 0.05 US perm at 0.031-in dry film thickness.

3. Service Temperature Range: Minus 50 deg F to plus 220 deg F.

4. Solids Content: ASTM D1644, 33 percent by volume and 46 percent by weight.

5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.

b. Eagle Bridges - Marathon Industries; 550.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

d. Mon-Eco Industries, Inc.; 55-50.

e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F1249, 1.8 US perms at 0.063-in dry film thickness.

3. Service Temperature Range: Minus 20 deg F to plus 180 deg F.

4. Solids Content: 60 percent by volume and 66 percent by weight.

5. Color: White.

2.04 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 8.0 oz./gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.

b. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire resistant lagging cloths over duct insulation.

4. Service Temperature Range: 0 deg F to 180 deg F.

5. Color: White.

2.05 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.

b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 deg F to plus 250 deg F.

5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 67.4 oz./gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 deg F to plus 250 deg F.

5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 67.4 oz./gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.30 US perm when tested according to ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yard with a thread count of 50 strands by 50 strands/sq. in for covering ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd with a thread count of 100 strands by 100 strands/sq. in , in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.

b. Vimasco Corporation; Elastafab 894.

2.08 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz/sq. yd.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.09 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.

b. P.I.C. Plastics, Inc.; FG Series.

c. Proto Corporation; Lo Smoke.

d. Speedline Corporation; Smoke Safe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.

b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.

c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B209M, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.

b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 0.003-in thick, heat-bonded polyethylene and kraft paper.

d. Moisture Barrier for Outdoor Applications: 0.003-i thick, heat-bonded polyethylene and kraft paper.

3. Stainless-Steel Jacket: ASTM A167 or ASTM A240/A240M.

a. Factory cut and rolled to size.

b. Material, finish, and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 0.003-in thick, heat-bonded polyethylene and kraft paper.

d. Moisture Barrier for Outdoor Applications: 0.003-in thick, heat-bonded polyethylene and kraft paper.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

c. Compac Corporation; 104 and 105.

d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3-in.

3. Thickness: 0.011-in.

4. Adhesion: 5.7 lbf./in in width.

5. Elongation: 2 percent.

6. Tensile Strength: 41 lbf./in in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.

c. Compac Corporation; 110 and 111.

d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3-in.

3. Thickness: 0.0063-in.

4. Adhesion: 5.7 lbf./in in width.

5. Elongation: 2 percent.

6. Tensile Strength: 41 lbf./in in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.

b. Compac Corporation; 130.

c. Venture Tape; 1506 CW NS.

2. Width: 2-in.

3. Thickness: 0.006-in.

4. Adhesion: 4.0 lbf./in in width.

5. Elongation: 500 percent.

6. Tensile Strength: 19 lbf./in in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

c. Compac Corporation; 120.

d. Venture Tape; 3520 CW.

2. Width: 2-in.

3. Thickness: 0.004-in.

4. Adhesion: 6.3 lbf./in in width.

5. Elongation: 5 percent.

6. Tensile Strength: 35 lbf./in in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.

b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; 0.015-in thick, wide with wing seal or closed seal.

3. Aluminum: ASTM B209M, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 2-in thick, 0.5-in wide with wing seal or closed seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.10-in diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.

2) GEMCO; CD.

3) Midwest Fasteners, Inc.; CD.

4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.10-in diameter shank, length to suit depth of insulation indicated with integral 1.5-in galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CHP-1.

2) GEMCO; Cupped Head Weld Pin.

3) Midwest Fasteners, Inc.; Cupped Head.

4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.

2) GEMCO; Perforated Base.

3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.03-in thick by 2-in square.

c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.10-in diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO; Nylon Hangers.

2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.03-i thick by 1.5-in in diameter.

c. Spindle: Nylon, 0.10-in diameter shank, length to suit depth of insulation indicated, up to 2.5-in.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.

2) GEMCO; Peel & Press.

3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.03-in thick by 2-in square.

c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.10-in diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-in thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1.5-in diameter.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; RC-150.

        2) GEMCO; R-150.

        3) Midwest Fasteners, Inc.; WA-150.

        4) Nelson Stud Welding; Speed Clips.

    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-in thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1.5-in diameter.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) GEMCO.

        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 0.75-in wide, stainless steel or Monel.

D. Wire: 0.08-in nickel-copper alloy, 0.063-in soft-annealed, stainless steel, or 0.063-in soft annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. C & F Wire

2.12 CORNER ANGLES

A. PVC Corner Angles: 0.031-in thick, minimum 1-in by 1-in , PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.039-in thick, minimum 1-in by 1-in , aluminum according to ASTM B209M, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024-in thick, minimum 1-in by 1-in, stainless steel according to ASTM A167 or ASTM A240/A240M, Type 304 or Type 316.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-in wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4-in o.c.

3. Overlap jacket longitudinal seams at least 1.5-in Clean and dry surface to receive self sealing lap. Staple laps with outward clinching staples along edge at 2-in o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4-in beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2-in.

4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):

1. Install insulation continuously through walls and partitions.

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18-in and smaller, place pins along longitudinal centerline of duct. Space 3-in maximum from insulation end joints, and 16-in o.c.

b. On duct sides with dimensions larger than 18-in, place pins 16-in o.c. each way, and 3-in maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over-compress insulation during installation.

e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2-in from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 0.5-in outward-clinching staples, 1-in o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F. at 18 ft intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness, but not less than 3-in.

5. Overlap unfaced blankets a minimum of 2-in on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18-in o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-in wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6-in o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18-in and smaller, place pins along longitudinal centerline of duct. Space 3-in maximum from insulation end joints, and 16-in o.c.

b. On duct sides with dimensions larger than 18-in space pins 16-in o.c. each way, and 3-in maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over-compress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2-in from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 0.5-in outward-clinching staples, 1-in o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F. at 18 ft intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3-in.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-in wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6-in o.c.

3.06 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-in overlap at seams and joints.

2. Embed glass cloth between two 0.063-in thick coats of lagging adhesive.

3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1.5-in laps at longitudinal seams and 3-in wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-in overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-in overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12-in o.c. and at end joints.

3.07 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.08 FIELD SITE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return and outdoor air duct and plenum.

2. Indoor, exposed supply, return and outdoor air duct and plenum.

3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.

4. Indoor, exposed, Type I, commercial, kitchen hood exhaust.

5. Indoor, concealed oven and warewash exhaust.

6. Indoor, exposed oven and warewash exhaust.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE 90.1.

2. Factory-insulated flexible ducts.

3. Factory-insulated plenums and casings.

4. Flexible connectors.

5. Vibration-control devices.

6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round, supply-air, return-air, and outside air duct and plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1.5-in thick and 1.5-lb/cu. ft nominal density.

B. Concealed, rectangular, supply-air, return-air and outside air duct and plenum insulation shall be one of the following:

1. Mineral-Fiber Blanker: 1.5-in thick and 1.5-lb/cu. ft nominal density.

2. Mineral-Fiber Board: 1.5-in thick and 2.0-lb/cu. ft nominal density.

C. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

D. Exposed, round, supply-air, return-air and outside air duct and plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1.5-in thick and 1.5-lb/cu. ft nominal density.

E. Exposed, rectangular, supply-air, return-air and outside air duct and plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 1.5-in thick and 2.0-lb/cu. ft nominal density.

F. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None

D. Ducts and Plenums, Exposed:

1. PVC : 0.02-in thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. If more than one material is listed, selection from materials listed is Contractor's option.

B. Ducts and Plenums:

1. Stainless Steel Jacket

END OF SECTION

SECTION 23 08 00 – COMMISSIONING OF HVAC

PART 1 -- GENERAL

1.01 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Subcontract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to Work under this Section.

B. Section Includes:

1. General requirements that apply to implementation of commissioning of HVAC systems, assemblies and components.

C. Reference Specifications

Division 23	HVAC Sections

D. Reference Standards

Associated Air Balance Council (AABC)
National Environmental Balancing Bureau (NEBB)

1.02 REFERENCES

A. General

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

1.03 DESCRIPTION

A. The purpose of commission is to ensure the Owner and Engineer that Work has been completed as specified and that systems are functioning in the manner as described in the design documents and specified system operating criteria. It will assist operating staff training and familiarization with new systems. It will serve as a tool to reduce post-occupancy critical systems operational difficulty or failure. It will, also, be used to develop test protocol and record the associated test data in an effort to advance the building systems from a state of substantial completion to a full dynamic operation.

B. Commission will commence after preliminary punch list items are completed by Subcontractors.

C. The steps associated with commissioning are outlined below:

1. Step One - Installation Verification

2. Step Two - System Start-Up.

3. Step Three - Functional Performance Testing.

D. Operational staff training is essential to the commission process and will run concurrently with steps one through three.

E. The Commissioning Team will include representatives of the Owner, Construction and Installing Subcontractors, Test and Balance Subcontractor, Temperature Controls Subcontractor and Construction Subcontractor's Commissioning Agent. Equipment manufacturer's representatives will be present for start-up as specified in the equipment Specification Sections and for equipment training.

1.04 SYSTEMS TO BE COMMISSIONED

A. Commissioning will be performed on the following systems:

1. Controls System

2. Central Supply and Exhaust Air Systems.

3. Air Terminals.

4. Smoke Detection (HSSD) System

1.05 SUBMITTALS

A. Commissioning Plan as prepared by the prime Subcontractor or his Commissioning Agent.

B. Prime subcontractors or his Commissioning Agent shall provide Functional Performance Tests (FPT) procedures for the above-listed systems. Prime subcontractors or his Commissioning Agent shall provide narrative system descriptions as part of the FPT procedures.

PART 2 -- PRODUCTS

2.01 COMMISSIONING PLAN

A. The commissioning plan shall outline the organization, scheduling, team members, and documentation pertaining to the overall commissioning process.

2.02 NARRATIVE DESCRIPTIONS

A. A narrative description of the design intents of the systems and their intended modes of sequences of operation.

2.03 FUNCTIONAL PERFORMANCE TESTS (FPT) PROCEDURES

A. The FPT procedures at the minimum shall consist of the following Sections:

1. Narrative Description:

a. This Section provides a narrative description of the design intents of the systems and their intended modes of sequences of operation.

2. Testing Prerequisites:

    a. This Section contains verification that primary mechanical, electrical, and controls systems that support or interact with the system that the FPT is prepared against are completed, tested and operational.

3. Installation Verification:

    a. This Section contains verification that the system installation is completed and is ready for commissioning.

4. Commencement of Functional Performance Testing:

    a. This Section records the date and time of the start of system commissioning.

5. System Condition Prior to Staring Performance Testing:

    a. This Section records the current set points and parameters of the system at the start of commissioning.

6. Functional Performance Test:

    a. This Section shall provide the following:

        1) Sequential steps required to set parameters and conditions required to test component and functions throughout intended ranges of operation.

        2) Full range of checks and tests carried out to determine if electric and pneumatic connections, components, subsystems, systems and interfaces between systems function in accordance with the contract documents and design intents.

        3) All modes and sequences of control operations, interlocks and conditional control responses and specified responses to abnormal emergency conditions.

7. End of Functional Performance Test:

    a. This Section records the date and time of the end of system commissioning.

8. Field Notes:

    a. This Section records notes or remarks during system commissioning.

9. List systems modifications, not required by the Contract Documents, but provided by the Subcontractor. List other questions regarding such system modifications.

10. List problems discovered during Commissioning that were corrected.

11. List problems discovered during Commissioning that were not corrected.

12. List recommended party that should take action on these problems.

PART 3 -- EXECUTION

3.01 GENERAL

A. The Subcontractors shall be responsible for performing procedures presented in specification and contract drawings as detailed in the Functional Performance Tests (FPT). Members of the designated Commissioning Team shall witness various portions of the commissioning process. Responsibilities for these activities are listed in the following paragraphs. Commissioning Team members shall sign-off on appropriate Sections after verifying installation, operation, or documentation. Final sign-off shall be by the Owner and Commissioning Agent.

B. Any test ports, gauges, test equipment, etc., needed to accomplish the functional performance tests shall be provided by Subcontractors.

C. Subcontractors shall provide to the Commissioning Team documentation of calibration of controls. Documentation shall include dates, setpoints, calibration coefficients, control loop verification, and other data required to verify system check-out. Documentation shall be dated and initialed by field engineer or technician performing the Work.

3.02 OPERATION STAFF TRAINING

A. System narrative descriptions will be prepared by the Commission Agent and supported by flow diagrams, one-line diagrams, and appropriate Specification Sections for major systems to be commissioned. The Commission Agent will coordinate “system description” meetings with members of facility management and maintenance department groups to review system description documentation. The meetings will provide an overview of major system features, components, and arrangements.

B. The Subcontractor and associated manufacturer’s representatives shall provide required training to operational staff after the system description meetings have occurred. The Subcontractor training sessions shall provide a more detailed analogy of systems operation and maintenance.

3.03 INSTRUMENTATION

A. Instrumentation will be provided by the Subcontractor. Instruments used for measurements shall be accurate. Calibration histories for each instrument shall be available for examination. Calibration and maintenance of instruments shall be in accordance with the requirements of NEBB or AABC Standards.

B. Application of instruments and accuracy of measurements shall be in accordance with NEBB or AABC Standards.

3.04 DOCUMENTATION

A. The installing Subcontractor shall be responsible for collection of pertinent data during system start-up and functional performance testing. The Subcontractor shall submit to the Commissioning Agent documentation of tests performed prior to and after system start-up. Documentation shall also include start-up procedures as approved by Commissioning Team.

B. Documentation is to be typewritten on 8.5 by 11 in paper and inserted in a 2-in to 3-in thick three ring binder. Indicate the project name, number, volume number, and volume title on the end panel of each binder.

C. Provide a title sheet for each volume and list the following:

1. Volume Title and Section Name and Number requiring this submittal.

2. Project name, project number, and address.

3. Subcontractor name, address, and phone number.

4. Name, title, signature, and date of person making the submittal.

5. Name of Owner, a blank line for signature, and the date of person accepting the submittal.

6. Name, address, and phone number of Commission Agent; a blank line for signature; and date of person accepting the submittal.

D. Provide a Table of Contents for multiple submittals. List each submittal and page number. Number each page, centered on the bottom in sequential numerical order. Provide tabs for multiple submittals in a single binder.

3.05 STEP ONE – INSTALLATION VERIFICATION

A. General Commissioning responsibilities:

1. Before system start-up begins, the Commission Team shall conduct a final installation verification audit. The Subcontractor shall be responsible for completion of Work including change orders and punch list items to the Owner's satisfaction. The audit shall include, but not be limited to, checking of:

a. Piping specialties including balance, control, and isolation valves.

b. Ductwork specialty items including turning devices, balance, fire, smoke, control dampers, and access doors.

c. Control sensor types and location.

d. Identification of piping, valves, equipment, controls, etc.

e. Major equipment, pumps, valves, starters, gauges, thermometers, etc.

f. Documentation of prestart-up tests performed, including manufacturer's factory tests.

B. If Work is found to be incomplete, incorrect, or non-functional, the Subcontractor shall correct the deficiency before system start-up Work proceeds.

3.06 STEP TWO – SYSTEM START-UP

A. General Commissioning Responsibilities:

1. A start-up plan shall be developed and submitted by the installing Subcontractor. Start-up plan to include the following:

    a. Flushing and cleaning of pipe.

    b. Filters, strainers, and screens.

    c. Valve/damper positions.

    d. Electrical tests.

    e. Pressure tests.

    f. Safeties.

    g. Chemical treatment.

    h. Manufacturer's tests.

B. The start-up plan will be reviewed and a prestart-up inspection performed by designated members of the Commissioning Team. The installing Subcontractor shall commence with system start-up after approval has been given to start-up plan and the prestart-up inspection is completed. Designated members of the Commissioning Team shall witness system start-up and list system and equipment deficiencies noted during start-up. The Subcontractor shall take corrective action on system deficiencies noted and demonstrate to the Commissioning Team members suitable system operation.

3.07 STEP THREE – FUNCTIONAL PERFORMANCE TESTING

A. General Commissioning Responsibilities:

1. Functional Performance Testing begins after operational testing, adjusting, and balancing of the systems have been completed by the Subcontractors; and the System Description and Hands-on Training sessions have been completed.

2. The objective of the Functional Performance Testing is to advance the building systems from a state of substantial completion to full dynamic operation in accordance with the specified design requirements and design intent.

3. Attaining this object will be accomplished by developing individual systems testing protocols which, when implemented by the Subcontractor, will allow the Commissioning Team to observe, evaluate, identify deficiencies, recommend modifications, tune, and document the systems and systems equipment performance over a range of load and functional levels.

4. Functional Performance tests for the systems to be commissioned are defined in the Commissioning Plan. These tests are intended to be conclusive but may require minor modifications as system operation dictates.

END OF SECTION

SECTION 23 09 01 – INSTRUMENTATION AND CONTROL FOR HVAC (STAND ALONE SYSTEM)

PART 1 -- GENERAL

1.01 PRODUCTS FURNISHED AND INSTALLED UNDER THIS SECTION

A. The HVAC Subcontractor shall:

1. Furnish and install all duct smoke detectors whether shown on the drawings or required by code. If the project includes an existing fire alarm panel all signals from the duct smoke detectors shall be transmitted to the existing fire alarm panel. If the project does not include an existing fire alarm panel, and a new fire alarm panel is not required for any other reason, signals from the duct smoke detectors shall be transmitted to the HVAC automatic temperature control panel.

2. Furnish and install all automatic dampers and provide necessary blank off plates or transitions required to install dampers that are smaller than duct size.

3. Assemble multiple section dampers with required interconnecting and jackshaft linkage and extend required number of shafts through duct for external mounting of damper motors.

4. Furnish and install all necessary sheet metal baffle plates to eliminate stratification and provide the air volumes specified. Locate baffles by experimentation. Fix and seal permanently in place only after stratification problems have been eliminated.

5. Furnish and install airflow stations specified under this Section.

6. Furnish and install access doors or other approved means of access through ducts for service to control equipment.

B. The Electrical Subcontractor shall:

1. Furnish and install and connect all power wiring. Power wiring shall be defined as:

a. Wiring of all power feeds through all disconnect starters and variable speed controllers to electric motors.

b. Provide local power disconnects where required.

c. Provide circuit breakers, starters in motor control centers, and 120-, 208-, 240- and 480-volt power feeders from the starters and circuit breakers to the HVAC equipment, as indicated.

d. Wiring of 120 VAC normal/emergency power feeds to all temperature control panels.

e. Power wiring to 120/277-volt single-phase motors shown on electrical plans and all VAV boxes shown (with or without fan motors).

C. The HVAC Subcontractor shall:

1. Design and install a complete HVAC controls system as described herein and contract drawings.

2. Provide controls, sensors and control panels relating to the HVAC systems, including starters, thermostats, duct smoke detectors, motorized dampers, louver operators and other equipment as indicated.

3. Provide control wiring of 120-volt and less as indicated in this Section and in conformance to the requirements of Division 26 and Division 40 – Instrumentation and Control

D. Enclosures shall be of the same NEMA class as the electrical equipment in the same area.

E. Starters shall be of the same manufacturer as the starters indicated under Section 26 24 19 – Motor Control Centers.

F. Low-voltage control wiring shall be in accordance with the National Electric Code.

G. Control wiring for line voltage 120-volt and higher shall be in conformance with the requirements of Division 26.

H. Conduit shall be in conformance with the requirements of Section 26 05 33 – Electrical Raceway Systems.

1.02 DUCT SMOKE DETECTORS

A. General

1. Furnish and install all duct smoke detectors whether shown on the drawings or required by code. If the project includes an existing fire alarm panel all signals from the duct smoke detectors shall be transmitted to the existing fire alarm panel. If the project does not include an existing fire alarm panel, and a new fire alarm panel is not required for any other reason, signals from the duct smoke detectors shall be transmitted to the HVAC automatic temperature control panel.

2. Fans

a. Provide duct smoke detectors on both the intake and the discharge of fans as required by code.

3. Smoke detectors shall operate on the photoelectric principle and shall respond to a predetermined smoke density regardless of the rate of combustion, the distance between the detector and fire source, the combustible material, the temperature or velocity of the smoke, and whether the fire is in a confined or open area.

4. The detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory-set alarm point.

5. The smoke detectors shall be capable of operating at a humidity range of 10 to 90 percent RH.

6. The smoke detectors shall operate from a 24-VDC power source, and shall be Simplex, 4098 Series, ADT; Pyrotronics; or equal.

1.03 SYSTEM DESCRIPTION

A. Performance Standards

1. The system shall conform to the minimum standards indicated in Tables 1 and 2, below.

2. Information transmission and display times shall be based upon network, rather than modem, connections.

3. Programmable controllers shall be capable of executing DDC PID control loops at a selectable frequency adjustable down to once per second.

4. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

5. The system shall report all values with end-to-end accuracy as listed or better than those listed in Table 1.

6. Control loops shall maintain measured variable at set point within the tolerances listed in Table 2.

TABLE 1 - REPORTING ACCURACY

MEASURED VARIABLE	REPORTED ACCURACY
Space Temperature	plus or minus 1 deg F
Ducted Air	plus or minus 1 deg F
Outside Air	plus or minus 2 deg F
Dew Point	plus or minus 3 deg F
Water Temperature	plus or minus 1 deg F
Delta-T	plus or minus 0.25 deg F
Relative Humidity	plus or minus 5 percent RH
Water Flow	plus or minus 5 percent of full scale
Airflow (terminal)	plus or minus 10 percent of full scale (see Note 1)
Airflow (measuring stations)	plus or minus 5 percent of full scale
Airflow (pressurized spaces)	plus or minus 3 percent of full scale
Air Pressure (ducts)	plus or minus 0.1-in w.g.
Air Pressure (space)	plus or minus 0.01-in w.g.
Water Pressure	plus or minus 2 percent of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	5 percent of reading (see Note 3)
Carbon Monoxide (CO)	plus or minus 5 percent of reading
Carbon Dioxide (CO2)	plus or minus 50 ppm

Note 1: 10 percent to 100 percent of full scale
Note 2: for both absolute and differential pressure
Note 3: not including utility-supplied meters

TABLE 2 - CONTROL STABILITY AND ACCURACY

CONTROLLED VARIABLE	CONTROL ACCURACY	RANGE OF MEDIUM
Airflow	plus or minus 10 percent of full scale	-----

CONTROLLED VARIABLE	CONTROL ACCURACY	RANGE OF MEDIUM
Space Temperature	plus or minus 2 deg F	-----
Duct Temperature	plus or minus 3 deg F	-----
Humidity	plus or minus 5 percent RH	-----

1.04 SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. No Work may begin on any segment of the Project until submittals have been successfully reviewed for conformity with the design intent.

C. Submittals shall include:

1. Direct Digital Control System Hardware

a. A complete bill of materials of equipment to be used, indicating quantity, manufacturer, model number, and other relevant technical data.

b. Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation and maintenance instructions for the following items and other relevant items not listed:

1) Direct Digital Controller (controller panels)

2) Transducers/Transmitters

3) Sensors (including accuracy data)

4) Actuators

5) Valves

6) Relays/Switches

7) Control Panels

8) Power Supply

9) Batteries

10) Wiring

2. Wiring diagrams and layouts for each control panel, showing all termination numbers.

3. Schematic diagrams for all field sensors and controllers, and floor plans of all sensor locations and control hardware.

4. Diagrams

a. Submit schematic diagrams for all control, communication, and power wiring.

b. Submit a schematic drawing of the central system installation. Show all interface wiring to the control system.

c. Submit riser diagrams of wiring between central control unit and all control panels.

D. Controlled Systems

1. Schematic Diagrams

a. Submit a schematic diagram of each controlled system.

b. Indicate all control points labeled, with point names shown or listed.

c. Graphically show the location of all control elements in the system.

2. Schematic Wiring Diagrams

a. Submit a schematic wiring diagram for each controlled system.

b. Label all elements.

c. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name.

d. Label all terminals.

3. Instrument List

a. Submit an instrumentation list for each controlled system.

b. Each element of the controlled system shall be listed in table format.

c. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.

4. Description

a. A complete description of the operation of the control system, including sequences of operation.

b. Include and reference a schematic diagram of the controlled system.

5. I/O

a. Submit a points list for each system controller, including both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, and the location of the I/O device.

6. Quantities of items submitted will be reviewed but this shall be the responsibility of the Contractor.

1.05 QUALITY ASSURANCE

A. All products used in this project installation shall be new and currently under manufacture and shall be the version currently being sold by the manufacturer for use in new installations.

B. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner in writing. Spare parts shall be available for at least five years after completion of this contract.

1.06 WARRANTY

A. Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and Owner receives beneficial use of the system.

B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.

C. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

D. All Work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up.

E. If the Work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Temperature Controls

1. The temperature control system shall be as indicated on contract documents and shall consist of DDC controllers.

2. HVAC Subcontractor shall be responsible for the installation, calibration, and operator training as necessary for a complete and full operating temperature control system.

3. The temperature control system shall be a complete stand-alone building automation system, modular in construction and not requiring a central computer for operation or programming.

4. All programming shall be possible from a keypad/display on any field panel or from a remote computer.

5. Systems which do not have a keypad/display capability shall be provided with a portable interface with required cables and software.

B. BAS Components

1. The basic elements of the Building Automation System (BAS) structure shall be built from only standard components kept in inventory by the BAS supplier.

2. The components shall not require customizing other than setting jumpers and switches, and adding firmware modules, software modules or software programming to perform required functions.

3. The BAS shall possess a fully modular architecture, permitting expansion through the addition of more DDCP units, sensors, actuators, and operator terminals.

4. Expansion beyond this must be able to be accomplished in additional panels or expansion modules without abandoning any initial equipment.

C. Direct Digital Control Panel

1. The Direct Digital Control Panel's (DDCP's) software shall include a complete operating system, control algorithm application packages, and a complete custom control, calculation application package to accomplish the indicated sequence of operation.

2. In addition to pre-programmed package software, DDCP controllers shall be provided with field-flexible programming capabilities without the use of external equipment such as EPROM programmers in order to meet the indicated requirements.

3. Each DDCP shall be capable of performing all specified control functions in a completely independent manner.

4. Each DDCP unit shall be capable of sharing point information with other such units, such that control sequences or control loops executed at one control unit may receive input signals from sensors connected to other units within the network.

D. Programming

1. Control software shall utilize “block” programming techniques connecting tested control blocks to form control sequencing.

2. Line-by-line programming requiring complete definition will not be accepted as a programming technique.

3. The programmer shall fill in the control parameters for each block to perform the required control sequence.

2.02 CONTROLLER SOFTWARE

A. Each intelligent field panel shall be completely user programmable and shall include the indicated programs installed in the base operating system.

B. Alarms

1. The alarm program shall provide for alarm reporting as follows:

a. Pilot light indication at local ATC Panel

C. Analog Input Scaling

1. Analog inputs shall be scaled and labeled to read out in engineering units of the variable being measured (e.g., deg, CFM, etc.).

D. Analog Outputs

1. Each analog output shall be user programmable to be direct or reverse acting and vary the output between 2 and 10 VDC.

2. The panel shall allow the user to program minimum and maximum output levels as well as a manual fixed output level.

3. The analog output shall be assignable to operate based on any physical input or calculated value on the network.

E. System Calendar

1. Each panel other than Application Specific Controllers (such as Terminal Controllers) shall be provided with a 365/366 day battery-backed clock, with an automatic daylight savings time switch-over on the day entered.

F. PID Control

1. In order to provide precise control, each analog output shall be programmable with a proportional plus integral plus derivative (PID) program.

2. Individual constants shall be programmable for the P, I, and D functions.

3. The integral time interval shall be user programmable.

4. The current proportional term, the integral term, and the PID sum shall be dynamically displayed on the screen to provide assistance to start-up and service personnel in tuning the system.

G. The diagnostics program in each panel shall monitor and report system status.

2.03 BUILDING CONTROLLERS

A. General

1. Provide an adequate number of Building Controllers to achieve the indicated performance.

2. Each controller shall meet the following requirements.

a. The Building Controller shall be provided with sufficient memory to support its operating system, database, and programming requirements.

b. Controllers that perform scheduling shall be provided with a real-time clock.

B. Communication

1. The Building Controller shall be provided with a service communication port for connection to a portable operator terminal.

C. Environment

1. Building Controller hardware shall be suitable for the anticipated ambient conditions.

2. Controllers used outdoors or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at minus 40 deg F to plus 150 deg F.

3. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32 deg F to 120 deg F .

D. Keypad

1. Provide a local keypad and display or a connection for a portable operator terminal for each Building Controller.

2. The keypad shall be provided for interrogating and editing data.

3. An optional system security password shall be available to prevent unauthorized use of the keypad and display.

4. If the manufacturer does not provide this keypad and display, provide a portable operator terminal.

E. Serviceability

1. Provide diagnostic LEDs for power, communication, and processor.

2. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

F. Memory

1. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

2. Applications shall be maintained in flash memory.

G. Immunity to Power and Noise

1. The controller shall operate at 90 percent to 110 percent of its nominal voltage rating and shall perform an orderly shutdown below 80 percent nominal voltage.

2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.

2.04 INPUT/OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through building controllers, advanced application controllers, or application-specific controllers.

B. Input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller.

C. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to the controller.

D. Binary Inputs

1. Provide binary inputs to allow the monitoring of ON-OFF signals from remote devices.

2. The binary inputs shall provide a wetting current of at least 12 mA in order to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise.

3. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

2.05 AUXILIARY CONTROL DEVICES

A. General

1. All materials and equipment used shall be standard components, of regular manufacture for this application.

2. All systems and components shall have been thoroughly tested and proven in actual use.

3. Exceptions to the indicated requirements will not be accepted.

B. Airflow Measurement Devices (AMD) with Temperature and Airflow Alarming Capability

1. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.

a. Thermal dispersion devices that indirectly heat a thermistor are not acceptable.

b. The manufacturer's authorized representative shall review, approve placement and the operating airflow rates for each measurement location indicated on the plans.

c. Provide one AMD for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.

2. Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.

a. Devices that have electronic signal processing components on or in the sensor probe are not acceptable.

3. Airflow measurement shall be field configurable to determine the average actual or standard mass airflow rate.

a. Actual airflow rate calculations shall have the capability of being adjusted automatically by the transmitter for altitudes other than sea level.

4. Temperature measurement shall be field configurable to determine the velocity weighted temperate or simple arithmetic average temperature.

5. Sensor Probes

   a. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube.

   b. Sensor probe mounting brackets shall be constructed of 304 stainless steel.

   c. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper. PVC jacketed internal wiring is not acceptable.

   d. Probe internal wiring connections shall consist of solder joints and spot welds. Connectors of any type within the probe are not acceptable. Printed circuit boards within the probe are not acceptable.

   e. Probe internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.

   f. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from minus 67 deg F to 392 deg F minus 55 deg C to 200 deg C and continuous and direct UV exposure. Plenum rated PVC jacket cables are not acceptable.

   g. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.

   h. Each sensor probe shall contain one or more independently wired sensing nodes.

   i. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter.

   j. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy. Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.

   k. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.

   l. Each sensor node shall be individually calibrated to NIST-traceable airflow standards at a minimum of 16 calibration points.

   m. The number of independent sensor nodes provided shall be as follows:

Area ft^2 m^2	**# Sensor Nodes**
≤ 0.5 ≤ 0.047	1
> 0.5 & ≤ 1 ≤ 0.093	2
> 1 & ≤ 2 > 0.093 & ≤ 0.186	4
> 2 & ≤ 4 > 0.186 & ≤ 0.372	6
> 4 & ≤ 8 > 0.372 & ≤ 0.743	8

> 8 & ≤ 12 > 0.743 & ≤ 1.115	12
> 12 & ≤ 14 > 1.115 & ≤ 1.30	14
> 14 > 1.30	16

n. A total of 4 probes shall be required for openings with an aspect ratio ≤ 1.5 and with an area ≥ 25 ft^2 ≥ 2.32 m^2.

6. Transmitter

a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.

b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.

c. All printed circuit board interconnects, edge fingers, and test points shall be gold plated.

d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.

e. All receptacle plug pins shall be gold plated.

f. The transmitter shall be capable of determining the average airflow rate and temperature of the sensor nodes.

g. Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).

h. The transmitter shall be capable of providing a high and/or low airflow alarm.

i. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.

j. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.

k. The airflow rate, temperature, airflow alarm and system status alarm shall be visible on the display.

l. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals and one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection;

m. Analog output signals shall provide the total airflow rate and be field configurable to output one of the following: temperature, airflow alarm; or system status alarm

n. Network communications shall provide the average airflow rate, temperature, airflow alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.

o. The transmitter shall be powered by 24 VAC and use a switching power supply that is over-current and over-voltage protected.

p. The transmitter shall use a “watchdog” timer circuit to ensure continuous operation in the event of brown-out and/or power failure.

7. Performance

a. Each sensing node shall have an airflow accuracy of ±2% of reading over an operating range of 0 to 5,000 FPM 25.4 m/s.

b. Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.

c. Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.

d. Each sensing node shall have a temperature accuracy of plus minus 0.18 deg F 0.1 deg C over an operating range of minus 20 deg F to 160 deg F. minus 28.9 deg C to 71 deg C.

8. Listings and Certifications

a. The AMD shall be UL873 Listed as an assembly.

b. Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.

c. The AMD shall be BTL Listed.

d. The AMD shall carry the CE Mark for European Union Shipments.

9. Installation

a. Install in accordance with manufacturer’s placement guidelines. A written report shall be submitted to the consulting mechanical engineer if any discrepancies are found.

10. Adjusting

a. The AMD shall not be adjusted to match field measurements without approval from the consulting mechanical engineer when installations meet or exceed manufacturer’s suggested placement

11. Acceptable Manufacturers or equal:

a. EBTRON, inc. model GTX116-P is the basis of design

b. Sierra

c. Johnson Controls

C. Damper Actuators

1. Electronic damper actuators shall be of the direct-couple rotary type, suitable for mounting directly on the damper end shaft.

2. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range.

3. On dampers with multiple sections, provide one actuator per section.

4. Damper actuators used on economizers and outside air dampers shall be of the spring return type.

D. Control Panels

1. All direct digital controllers mounted on HVAC equipment located indoors shall be installed in NEMA 4X enclosures.

2. All direct digital controllers mounted on HVAC equipment located outdoors shall be installed in NEMA 4X enclosures.

3. Enclosures shall be of suitable size to accommodate power supplies, relays, and accessories as required for the application.

4. Each enclosure shall include a subpanel for direct mounting of the enclosed devices, including matched key locks for all enclosures.

5. Construction

   a. Control panels shall contain all relays, control switches, transformers, pilot lights, timers, time clocks, step controllers, gages, thermostats, and other accessories as necessary for the particular system.

   b. The panels shall be constructed of aluminum with a baked enamel finish, and shall include a hinged front door with locking handle.

   c. All manual switches and direct-reading gauges shall be flush-mounted on the front face, and identified by engraved and riveted Bakelite or laminated plastic nameplates with white letters on black background.

   d. Manual switches shall be of heavy-duty, oil-tight construction.

6. Wiring

   a. Control devices shall be pre-wired internally.

   b. Terminate all wires leaving the panel at separate numbered terminal strips.

   c. Provide individual connectors for every item of mechanical equipment, all integral and remote pilot lights, and other devices indicated for each panel.

   d. Power and control circuit requirements shall be as indicated on the Electrical Drawings.

   e. Identify all wires by color coding or numerical tags at both ends.

   f. Wire each control device without splices to the terminal strip.

g. Provide integral circuit protection for all panel-mounted control devices.

h. Wire each panel with a single 20-amp, 120-volt, and AC feeder.

7. Panel electrical wiring diagrams shall be secured to the inside of the panel door.

E. Smoke Detectors

1. Division 26 – shall provide area smoke detectors and wire into the fire alarm system in accordance with the requirements of Section 23 05 00 – Common Work Results for HVAC.

2. Division 23 – shall provide HVAC duct detectors interlock wiring between duct smoke detectors and starter safety circuits.

F. Current Sensing Relays

1. Provide current switches for indication of equipment status.

2. Amperage ratings shall be adjustable, with the desired set point being within the top 50 percent of the current relay's operating range.

3. Current sensing relays shall incorporate trip indication LEDs and shall be sized for proper operation with the equipment served.

G. Thermostats - Line Voltage

1. Materials: cold-rolled steel; beige thermoplastic; liquid sensing element

2. Contact Rating

a. 6 amps running; 36 amps locked rotor; 120 VAC

b. 3.5 amps running; 21 amps locked rotor; 208 VAC

c. 3.0 amps running; 8 amps locked rotor; 240 VAC

3. Switch Action: single-pole, double-throw; open on rising temperature

4. Sensing Element: coiled bulb and capillary

5. Range: 0 to 130 deg F 54 deg C

6. Manufacturer, or Equal

a. Dry Locations (no hose valves or open water processes in room): **Johnson Controls Model A19BAC-1** in NEMA 1 enclosure

b. Wet (hose valves or open water processes in room) or Outdoor Locations: **Johnson Controls Model A19PRC-1** in NEMA 4X enclosure.

H. Selector Switches

1. Selector switches shall be of the 2- or 3-position, knob or key type as required by the sequence of operation.

2. Selector switches shall be of oil-tight construction and fitted with snap-fit contact blocks rated for 10A, 600 Vac/dc operation.

3. Provide labels indicating switch position.

I. Pushbutton Switches

1. Pushbutton switches shall be of either the maintained or momentary type as required by the sequence of operation.

2. Pushbutton switches shall be of oil-tight construction and fitted with snap-fit contact blocks rated for 10A, 600 Vac/dc operation.

3. Provide labels indicating switch function.

J. Pilot Lights

1. Provide pilot lights as required by the sequence of operation.

2. Pilot lights shall utilize multi-colored dome lenses and replaceable LED lamps.

3. Provide labels indicating light function.

2.06 WIRING AND RACEWAYS

A. Provide copper wiring, plenum cable, and raceways as indicated in the applicable Sections of Division 26 – Electrical.

B. All insulated wire shall be copper conductor, and UL-labeled for 194 deg F minimum service.

2.07 CONTROL SYSTEM MANUFACTURERS, OR EQUAL

A. Schneider Electric

B. Johnson Controls

C. Siemens

D. Honeywell

E. Trane

F. The above list of manufacturers applies to controller software, custom application programming language, building controllers, custom application controllers; and application specific controllers; all other indicated products (e.g., sensors, valves, dampers and actuators) need not necessarily be manufactured by the above manufacturers.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. The Drawings shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

B. Inspect the Project Site to verify that the equipment may be installed as indicated, and report any discrepancies, conflicts, or omissions to the Engineer for resolution before rough-in work is started.

C. Examine the Contract Documents for other parts of the Work, and if head room or space conditions appear inadequate, report these discrepancies to the Engineer and obtain written instructions for any changes that may be necessary to accommodate the Work with the work of others.

D. Changes in the Work made necessary by the failure or neglect of the Contractor to report such discrepancies shall be considered to be part of the Contract.

3.02 COORDINATION

A. Site

1. Where the Work will be installed in close proximity to, or will interfere with, the work of other trades, the Contractor shall assist in accommodating space conditions to make a satisfactory adjustment.

2. If the Contractor installs the Work before coordinating with other trades, so as to cause any interference with the work of other trades, the Contractor shall make the necessary changes in the Work in order to correct the condition as part of the Contract.

3. Coordinate and schedule the Work with all other work in the same area, or with work that is dependent upon other work, in order to facilitate mutual progress.

B. Coordination with Other Controls

1. Other controls and control devices that are to be part of or integrated into the control system specified in this Section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

2. All communication media and equipment shall be provided as specified in Part 2, “Communication” of this Specification.

3. Each supplier of a control product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this Section.

4. The HVAC Subcontractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other Sections or divisions of this Specification.

5. The HVAC Subcontractor is responsible for the integration of control products provided by multiple suppliers regardless of where this integration is described within the contract documents.

3.03 GENERAL WORKMANSHIP

A. Install equipment, piping, wiring, and raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration isolation of piping and equipment.

C. Install all equipment in readily accessible locations as defined by the National Electrical Code (NEC).

D. Verify the integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and shall be executed in strict adherence to local codes and standard practices.

3.04 SENSOR INSTALLATION

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air-sealed in their raceways or in the wall in order to stop air transmitted from other areas from affecting sensor readings.

E. Averaging Sensors

1. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type.

2. Averaging sensors shall be installed in a serpentine manner vertically across the duct.

3. Support each bend with a capillary clip.

F. Temperature Sensors

1. All pipe-mounted temperature sensors shall be installed in wells.

2. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

3.05 ACTUATORS

A. Mount and link control damper actuators according to manufacturer's instructions.

B. To compress seals when spring-return actuators are used on normally closed dampers, the actuator shall be powered to an approximately 5 degree open position, the damper closed manually, and then the linkage tightened.

C. Check the operation of damper/actuator combination in order to confirm that the actuator modulates damper smoothly throughout the stroke to both OPEN and CLOSED positions.

D. Provide all mounting hardware and linkages for the actuator installation.

E. Electric and Electronic Actuators

1. Dampers

a. Actuators shall be direct mounted on the damper shaft or jackshaft unless indicated as a linkage installation.

b. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5 degrees available for tightening the damper seals.

c. Actuators shall be mounted in accordance with the manufacturer's recommendations.

3.06 CONTROLLERS

A. General

1. Provide a separate controller for each AHU or other HVAC system.

2. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller.

3. Control of an AHU or other mechanical equipment item shall not be split between multiple controllers; points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

B. Building Controllers and Custom Application Controllers

1. Building controllers and custom application controllers shall be selected to provide a minimum of 15 percent of the spare I/O point capacity for each point type found at each location.

2. If input points are not universal, 15 percent of each type shall be required, and if outputs are not universal, 15 percent of each type is required.

3. A minimum of one spare is required for each type of point used.

4. The future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software.

5. No additional controller boards or point modules shall be required to implement use of such spare points.

3.07 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging.

B. Provide a minimum of 25 percent of available memory free for future use.

C. BACnet Points

1. Provide a detailed BACnet points list.

2. In addition to standard I/O information, the BACnet points list shall contain the proposed I/O names and BACnet object description.

3. The proposed I/O names and object descriptions are subject to change as directed by the Engineer.

4. Deliver an as-built list of the BACnet points with actual names and BACnet object addresses to the Owner at Project completion.

D. Software Programming

1. Provide programming for the system and adhere to the indicated sequences of operation.

2. Provide all other system programming necessary for the operation of the system but not indicated in this Section.

3. Embed into the control program sufficient comment statements to clearly describe each section of the program reflecting the language used in the sequences of operation.

3.08 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up Testing

1. All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system.

2. This testing shall be completed before the Engineer is notified of the system demonstration.

B. Furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this Section.

C. Verify that all control wiring is properly connected, free of shorts and ground faults, and that terminations are tight.

D. Enable the control systems and verify calibration of all input devices individually.

E. Perform calibration procedures according to manufacturers' recommendations.

F. Verify that all binary output devices (e.g., relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

G. Verify that all analog output devices (e.g., I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct.

H. Verify that the system operation adheres to the sequences of operation.

I. Simulate and observe all modes of operation by overriding and varying inputs and schedules.

J. Tune all PID loops and optimize START/STOP routines.

K. Alarms and Interlocks

1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.09 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this Section.

2. These tests shall occur after the Contractor has completed the installation, started up the system, and performed tests.

3.10 TRAINING

A. Provide a minimum of 3 on-site or classroom training sessions of one day each, throughout the Contract period for personnel designated by the Owner.

B. Additional Training

1. Provide one additional training session at 6 and 12 months following the facility's turnover.

2. Each session to be 8 hours in length and shall be coordinated with the Owner.

C. Train the designated Owner's staff to perform the following items:

1. Day-to-day Operations:

a. Operate the system proficiently

b. Understand the control system architecture and configuration

c. Understand the DDC system components

d. Understand system operation, including DDC system control and optimizing routines (algorithms)

e. Operate the workstation and peripherals

f. Log on and off the system

g. Access graphics, point reports, and logs

h. Adjust and change system set points, time schedules, and holiday schedules

i. Recognize malfunctions of the system by observation of the system graphics, trend logs, and other system tools

j. Understand system drawings and the operation and maintenance manual

k. Understand the job layout and location of control components

l. Access data from the DDC controllers and ASCs

m. Operate portable operator terminals

2. Advanced Operations:

a. Create, delete, and modify alarms, including annunciation and routing of these items

b. Create, delete, and modify trend and graph or print these both on ad-hoc basis and at user-definable time intervals

c. Create, delete, and modify reports

d. Add, remove, and modify the system's physical points

e. Create, modify, and delete programming

f. Add panels when required

g. Add operator interface stations

h. Create, delete, and modify system displays, both graphical and others

i. Perform DDC system field checkout procedures

j. Perform DDC controller unit operation and maintenance procedures

k. Configure hardware including controllers and I/O points

l. Maintain, calibrate, and replace system components

3. System Management and Administration:

a. Maintain software and prepare backups

b. Interface with job-specific, third-party operator software

c. Add new users and understand password security procedures

D. Groupings

1. Split the above objectives into 3 logical groupings, as follows and based on the above descriptions.

2. Participants may attend one or more of these, depending on their level of knowledge required.

a. Day-to-day operators

b. Advanced operators

c. System managers and administrators

E. Provide a course outline and materials in accordance with the “Submittals” article in Part 1 of this Section.

F. The instructor shall provide one copy of training material per student

G. The instructor shall be factory-trained and experienced in presenting this material.

H. Classroom training shall be performed using a network of working controllers representative of the installed hardware.

3.11 SEQUENCE OF OPERATION

A. Refer to the drawings for Control Sequence of Operations.

END OF SECTION

SECTION 23 31 16.16 THERMOSET FIBERGLASS-REINFORCED PLASTIC DUCTS

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide fiberglass-reinforced plastic (FRP) ductwork systems including duct and appurtenances, complete and operable, as indicated and in accordance with the Contract Documents.

B. The Work includes design calculations to determine duct wall thickness and reinforcements.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and spec 01 33 17 – Structural Design, Support and Anchorage.

B. Shop Drawings

1. Submit detailed layout drawings, including details keyed to the layout.

2. Show main and branch runs, fittings, offsets, takeoffs, accessories, supports, and anchorage, and point loads.

3. Show dimensions of sub-assemblies to be shipped.

C. Submit specifications, descriptive drawings, catalog cuts, and descriptive literature with physical and mechanical properties, including hanging weight for each size duct.

D. Submit engineering calculations, material selection, wall thickness, pressure, vacuum, and temperature ratings.

E. Submit a letter from the resin supplier stating that the material used for this project will comply with the indicated requirements and shall meet or exceed the indicated corrosive conditions.

F. Submit the following information regarding the laminate component:

1. construction type

2. laminate thickness

3. ply sequence

4. glass content range

5. resin identification

6. types and amounts of fillers

7. corrosion liner

8. thickness, ply sequence, and width of interior and exterior secondary overlays

G. Submit the manufacturer's Certification of Compliance with smoke-developed and flame spread criteria.

H. Submit the following information regarding dampers:

1. name of manufacturer

2. type, model, and materials of construction

3. pressure rating

4. dimensions and weight including operator

5. AMCA leakage test results for isolation dampers

I. Submit the following information regarding expansion joints:

1. name of manufacturer

2. type, model, materials of construction, and force required for expansion and contraction

J. Submit the following information regarding supports:

1. type, details, and materials of construction

2. stamped and signed design calculations by a registered engineer licensed in the State of Idaho for custom-designed supports

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Standards

Air Movement and Control Association (AMCA) International	
AMCA 500	Test Methods for Louvers, Dampers, and Shutters
ASTM International (ASTM)	
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2310	Standard Classification for Machine-Made “Fiberglass” (Reinforced Thermosetting Resin) Pipe
ASTM D 2563	Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
ASTM D 2992	Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D 2996	Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe

ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)	
SMACNA	Thermoset FRP Duct Construction Manual

1.04 FACTORY TESTING

A. Inspection by Engineer

1. The Engineer shall be given the right to inspect the ductwork at the factory at any stage of fabrication, without prior notice.

2. The Engineer shall be provided 72 hours prior notice of the start of fabrication.

B. The Engineer may select from the following test methods:

1. magnification

2. ultrasonic, magnetic, or other non-destructive technique

3. photographic

4. Barcol hardness testing

5. acetone sensitivity testing

6. acoustic emission testing

1.05 QUALITY ASSURANCE

A. Qualifications

1. Ductwork shall be fabricated and installed by experienced workers who have experience with lay-up, fabrication, and installation of ductwork.

B. Resin

1. The resin manufacturer shall approve the resin for the intended application.

2. The resin shall be applied in accordance with the manufacturer's recommendations.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Service Conditions

1. The FRP ductwork shall be designed and fabricated for odor control service to carry warm, moisture-laden air containing hydrogen sulfide, mercaptans, and other organic and inorganic compound typically associated with wastewater treatment facilities.

2. Internally, duct systems will be exposed to air saturated with water vapor containing foul odors, primarily hydrogen sulfide.

3. Externally, duct systems will be exposed to odorous air from inside the building and sunlight.

B. Seismic Restraints

1. Duct supports and restraints shall be provided and designed for static, dynamic, and seismic loads in Zone 1 in accordance with the Uniform Building Code, and spec 01 33 17– Structural Design, Support and Anchorage.

2. Seismic restraints shall not introduce stresses in the ductwork from thermal expansion and contraction.

C. Service Life

1. Materials and details shall be selected for a failure-free service life of 15 years, minimum.

2.02 DESIGN REQUIREMENTS

A. Standards

1. The ductwork system shall be in accordance with the latest editions of the ASHRAE Handbook, the SMACNA Manual, and the International Mechanical Code.

2. Where conflicts between these standards arise, the most stringent criteria shall be used.

B. Duct, Adapters, Transitions, and Expansion Joints

Internal positive pressure, inches w.c	20
Internal vacuum inches w.c	20
Temperature, deg F	0 to 180

C. Dampers

Differential pressure, inches w.c	10
Temperature, deg F	0 to 180

D. Dimensions

1. Indicated dimensions are net inside, i.e., the clear space inside the duct.

E. Laminates shall have the following minimum properties:

Property	**Standard**	**3/16-inch thick**	**1/4-inch thick**
Ultimate Tensile Strength, psi	ASTM D 638	9,000	12,000
Flexural Strength, psi	ASTM D 790	16,000	19,000
Flexural Modulus of Elasticity, psi (tangent)	ASTM D 790	700,000	800,000

F. Reinforcement

1. Bends, fittings, and special sections shall be reinforced or shall have their thickness increased at those locations where the combined stresses due to internal pressure and bending will exceed the maximum stress recommended by the manufacturer.

2. The duct manufacturer shall determine and provide reinforcements or additional thicknesses as required to keep the combined stresses within the recommended maxima.

G. Structural Criteria

1. Round duct shall have a safety factor of 10 to 1 for pressure and 4 to 1 for vacuum service.

2. The minimum wall thickness shall be 0.139-in.

3. After installation, the maximum sag of horizontal round duct shall not exceed 2 percent of the duct diameter.

H. Chemical Resistance

1. The duct shall provide chemical resistance to acids, caustic, water, hydrogen sulfide and other sulfide and disulfide compounds, mercaptans, and other materials commonly encountered in odorous air streams from wastewater treatment plants.

I. Flame Spread

1. Ducting and fabrications shall not exceed a flame spread index of 25 and smoke development rating of 50, when tested in accordance with ASTM E 84.

J. FRP Defects

1. Ductwork shall be in accordance with ASTM D 2563 and the following requirements:

Defect	**Inside Surface**	**Outside Surface**
Blister	None	Maximum dimension: ¼-in diameter x 1/8-in high Maximum density: one blister per square foot Minimum separation: 2-in
Chips	None	Maximum dimension of break: ¼-in Thickness: less than 10 percent wall thickness Maximum density: one chip per square foot
Crazing	None	Maximum length: 2-in Maximum density: 5 crazings per square foot Minimum separation: 2-in
Cracks	None	None
Exposed Glass	None	None
Scratches	None	Level III
Burned Areas	None	None

Defect	Inside Surface	Outside Surface
Surface Porosity	None	None
Foreign Matter of any kind	None	None
Sharp Discontinuity	None	None
Pits	Level II Maximum: 10 pits per square foot	Level III Maximum: 10 pits per square foot
Dry Spot	None	1 sq in per sq ft
Entrapped Air	None at the surface; maximum 1/16-in diameter and maximum 10 defects per sq in within laminate	4 defects per sq in (1/8-in diameter) or 10 defects per sq in (1/16-in diameter)

K. Manufacturer's Label

1. Ductwork and fittings shall have the manufacturer's name printed on the exterior surface.

2.03 DUCTWORK SYSTEMS

A. General

1. FRP ductwork shall be of filament-wound construction for sizes greater than 10-in and shall be hand lay-up or filament-wound construction for sizes 10-in and smaller, unless indicated otherwise.

2. Cast pipe with no reinforced internal corrosion barrier or press molded fittings will not be accepted.

B. Resins

1. Fabricate the ductwork using a single corrosion-resistant resin throughout the laminates.

2. The type and amount of catalyst, promoter, and resin shall be in accordance with the resin manufacturer's recommendations.

3. Fillers, additions, and pigments will not be accepted.

4. A thixotropic agent for resin viscosity control shall be used, but not on the corrosion liner or on surfaces in contact with a corrosive environment.

5. Resin putty shall be the same resin as above, but shall include not less than 15 percent milled glass fiber; no silica flour, grinding dust, or other filler will be accepted.

6. Fire Retardant

a. Antimony trioxide shall be added in the range of 3 to 5 percent for fire retardant.

b. No other fire retardant will be accepted.

c. Do not use antimony trioxide in the corrosion-resistant layer.

7. Fire Retardant Manufacturers, or Equal

a. Reichold Chemical Company, Reichold 9300

b. Ashland Chemical Company, Hetron FR 992

C. Duct

1. General

a. The maximum allowable deflection for any size ductwork shall be ½-in between supports.

b. The duct nominal diameter tolerance or out-of-round shall be no greater than one percent of its diameter.

c. The length of flanged duct sections shall not vary more than plus or minus ½-in at 70 deg F.

d. Non-flanged ducts shall have square ends in relation to their center axis, within plus or minus 1/8-in for ducts 24-in diameter and smaller, and within plus or minus 3/16-in for ducts greater than 24-in diameter.

e. The ductwork shall have a corrosion resistant layer, an interior structural layer, an exterior corrosion layer, and a UV-resistant coating where installed outdoors.

2. Interior Corrosion-Resistant Layer

a. The internal corrosion barrier shall consist of one layer of "C" veil and one layer of synthetic veil, such as Burlington Industries Type 1012 Nexus, or equal.

b. The overall thickness of this barrier shall be a minimum of 0.020-in, and shall contain a minimum of 90 percent resin.

c. The balance of the corrosion resistant layer shall consist of 2 layers of 1 ½ oz per square foot Type E glass, with a ratio of approximately 75 percent resin to 25 percent glass.

d. The overall thickness, including the corrosion barrier, shall be a minimum of 0.090-in.

3. Intermediate Structural Layer

a. Type E glass shall be provided, meeting the minimum indicated wall thicknesses.

b. The total wall thickness shall include the inner surface.

c. The contact-molded structural layer shall include alternate layers of chopped strand mat and woven roving.

d. A layer of chopped strand mat or spray chop shall precede the filament-wound structural layer.

e. The structural layer shall consist of a minimum of two complete cross-hatched layers of continuous filaments, applied in a helix angle of 55 to 65 degrees for aboveground ductwork and 75 degrees for buried ductwork.

f. The chopped strand mat shall consist of Type E glass, minimum 1 ½ oz per sq ft mats, and shall have a 24 oz per sq yard with a 5-by-4 weave.

g. The lamination sequence shall conform to Tables 5-1 and 5-2 in SMACNA.

h. Ducts with wall thicknesses less than 0.182-in shall be constructed of Type I laminates, and ducts with wall thicknesses greater than 0.182-in shall be constructed of Type II laminates.

i. Materials

1) For the hand-layup process, the intermediate structural layer shall be constructed of approximately 65 percent resin and 35 percent glass.

2) For the filament-wound manufacturing process, the intermediate structural layer shall be constructed of approximately 55 to 65 percent glass.

4. External Layer of Indoor Ductwork

a. Apply minimum 15 mils of intumescent paint for fire protection.

5. External Layer of Outdoor Ductwork

a. Apply a single "A" or "C" Veil to duct exteriors.

b. The exterior UV-resistant coating shall be factory applied, and shall consist of a white resin-based gel paint with UV inhibitors.

6. Duct Manufacturer, or Equal

a. Fiber-Tech Engineering

b. Belco Fiberglass

D. Fittings

1. Provide the manufacturer’s standard shop-fabricated fittings.

2. Fittings shall be of hand lay-up construction, and shall be fabricated from the same resin and have the same strength as the FRP ductwork.

3. Elbow fittings 24-in diameter and smaller shall be of smooth radius design.

4. Elbows 30-in and larger shall be of mitered bend design.

5. Provide a minimum of two mitered joints (3-piece) for elbows with greater than a 45 degree bend.

6. Fittings shall be compatible with the duct, shall be as chemical resistant as the duct, and shall comply with SMACNA.

7. The internal diameter of fittings shall be the same as the adjacent duct.

E. Flanges

1. Provide the manufacturer’s standard shop-fabricated flanges.

2. Flanges shall be of hand lay-up construction, and shall be fabricated from the same resin and have the same strength as the FRP ductwork.

3. Flanges shall be compatible with the duct, shall be as chemical resistant as the duct, and shall comply with SMACNA.

4. Flanges shall have thicknesses in accordance with SMACNA, and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

5. Flange gaskets shall be full- face, constructed of neoprene, have a 3/16-in minimum thickness, and have a hardness of Durometer 50 to 70 when tested according to ASTM D 2240.

F. Joints

1. Provide butt and strap joints in accordance with NBS PS 15-69.

2. Weld Kits

a. The duct manufacturer shall supply field weld kits.

b. Fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint.

c. "Build glass" rolls will not be accepted.

3. The resin, catalyst and putty shall be supplied in bulk in order to complete the field joints and allow 10 percent extra for waste.

G. Dampers

1. General

a. Round FRP dampers shall be the butterfly type.

b. Unless otherwise indicated, dampers are assumed to be for isolation.

c. The maximum leakage shall be 1.0 percent of maximum flow at a pressure differential of 1-i wc.

d. Damper Blades

1) The damper blade shall be constructed of fiberglass, and shall be center-pivoted with a composite or balsa core.

2) The blade seal shall be a full-circumference, double-tadpole wiper seal with an angle pin stop.

3) The axle shall be constructed of vinyl ester resin, and shall be manufactured by the pultrusion process.

4) The bearings shall be constructed of molded PTFE containing 10 percent graphite.

5) The shaft seal shall be a lip-type compression type, housed in a vinyl ester retainer with a stainless steel top plate.

e. Isolation Damper Manufacturers, or Equal

1) Swartout, Model 914

2. Volume Control Type

a. Volume control type dampers shall be manufactured from same material as the ductwork, including a 0.090-in corrosion resistant layer.

b. Volume control type dampers shall be supplied with a Type 316 stainless steel screen.

c. The maximum leakage shall be 0.094 percent of maximum flow at a pressure differential of 1-in w.c.

d. Flanges

1) Volume control type dampers shall have flanged connections.

2) The flanges shall have thicknesses in accordance with SMACNA, and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

e. Damper Blade

1) The damper blade shall be constructed of fiberglass, and shall be center-pivoted.

2) The shaft shall be a pultruded fiber glass vinyl ester rod, and shall be fully encapsulated at the non-actuated end for zero leakage.

f. Bearings

1) Bearings shall be of FRP at both ends of the shaft.

2) Provide a neoprene gasket between the bearing and the actuator.

g. Provide a manual actuator.

h. Volume Control Damper Manufacturers, or Equal:

1) Round Ductwork: Swartout, Model 914 or Fiber-Tech Engineering, Model STD

2) Rectangular Ductwork: Swartout, Model 1108

3. Gravity Back draft Type Dampers

    a. Gravity backdraft dampers shall be manufactured from same the material as the ductwork, including a 0.090-in corrosion-resistant layer.

    b. Flanges

        1) Gravity backdraft dampers shall have a flanged connection.

        2) Flanges shall have thicknesses in accordance with SMACNA, and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

    c. Gravity backdraft dampers shall be horizontal, circular type.

    d. Gravity Backdraft Damper Manufacturers, or Equal

        1) Swartout, Model 426

        2) Fiber-Tech Engineering, FTE-10002

        3) Belco Fiberglass

4. Manual Actuators

    a. Provide manual actuators for ducts less than 24-in diameter:

    b. Provide a rigid FRP locking-quadrant type hand level, allowing 90 degree movement in either direction.

5. Manual Actuators with Gear Drive

    a. Manual actuators for dampers 24-in diameter and larger shall be worm gear-driven, totally enclosed, weather-proof, and permanently lubricated in a die-cast aluminum housing.

    b. The housing shall be epoxy coated at the factory with a minimum dry film thickness of 8 mils .

    c. Worm gears shall be constructed of heat treated carbon steel, and the worm wheels shall be ductile iron.

    d. Shafting shall be of stainless steel, and shaft and worm wheel seals shall be of EPDM.

    e. The actuator shall be bolted to the duct with stainless steel bolts.

    f. Hand wheel size shall be computed assuming a maximum rim effort of 40 lb.

    g. The allowable number of turns of the hand wheel in order to rotate the blade 90 degrees shall be minimum of 4 and maximum of 12.

    h. Actuators shall be provided with indicating arrows to clearly identify directions of rotation for opening and closing of the dampers, and the arrows shall be clearly legible and of substantial durability.

6. Elevated Actuators

a. Dampers with shaft centerlines more than 5 ft 6-in above the floor shall be provided with chain wheels and operating chains.

b. Each chain-wheel shall be equipped with a chain guide that will permit rapid handling of the operating chain without “gagging” of the wheel and will also permit reasonable side pull on the chain.

c. Suitable actuator extensions shall be provided, if necessary, in order to prevent interference of chain and adjacent piping or equipment below.

d. The operating chains shall be hot-dip galvanized carbon steel, and shall be looped to extend within 4 ft of the floor below damper.

e. Galvanized tie-back hooks shall be provided on adjacent pipe supports to hold operating chains out of walkways or maintenance access areas when the damper is not being operated.

H. Drains

1. Provide drains in the bottom of main and branch ducts larger than 12-in diameter and at locations as indicated.

2. Locate drains at every rise in duct, every 50 ft along a continuous run, and at the heel of every drop.

I. Bolts, studs, washers, and nuts shall be in accordance with the requirements of Section 05 50 00– Metal Fabrications, except for flanges.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Field Measurements

1. Duct lengths shall be determined from measurements taken at the Site.

2. Indicated dimensions are approximate and are not for fabrication.

3. Exact or complete details of the ductwork are not indicated.

B. Delivery, Storage, and Handling

1. Duct, fittings, and dampers shall be protected from damage and shall be supported by 4-in wide, minimum, strapping in order to avoid damage due to flex strains and point loading during shipping and installation.

2. Debris and other extraneous material shall not be allowed to enter the duct.

3. Duct, fittings, and dampers shall not be thrown or dropped.

C. Installation

1. Ducts shall be installed as indicated.

2. Take necessary precautions during the fabrication and installation of ductwork in order to provide for expansion and contractions.

3. The ductwork shall be free from vibration when in operation, and necessary vibration isolation devices shall be provided.

4. Apply anti-seize compound to bolt threads.

5. Smooth bends or internal turning vanes shall be installed at elbows, tees, and other points where the air flow changes direction.

6. The ductwork shall be supported in accordance with the manufacturer's recommendations and as indicated.

7. The inside of duct, specials, and fittings shall be smooth, clean, and free from blisters, sand, and dirt when installed.

8. Ductwork shall be airtight.

D. Joints

1. Joints shall be carefully and neatly made in accordance with the indicated requirements and as recommended by the manufacturer.

E. Flanges

1. Tighten flange bolts sufficiently to slightly compress the gasket and make a good seal, but not so tightly as to distort the flanges.

2. Install a flat washer under each nut and bolt head.

F. Butt and Wrap Joints

1. Prior to joining, ends shall be ground smooth and dust and debris shall be completely removed.

2. Ends shall be resin-coated to prevent corrosion, and in duct 24-in diameter and above an interior corrosion wrap shall be provided.

3. The joint shall be of equal strength as the duct.

4. A butt and wrap sequence and thickness chart shall be shown on the fabrication drawings.

5. The laminate sequence for each size duct shall be supported by a separate section in the submitted design calculations.

G. Dampers

1. Dampers shall be positioned to fit into the connecting ductwork at the locations indicated.

2. Unless necessary for the proper operation of the damper, axles shall be installed in the horizontal position.

H. Supports and Hangers

1. Supports for the FRP duct shall be in accordance with the SMACNA Standards and appropriate code requirements regarding duct installation.

2. Supports and hangers shall transmit loads into the building structural frame through a system of intermediate beams and struts.

3. Supports or hangers employing clip angles or similar devices for attachment to the duct will not be accepted.

4. Supports shall be designed to resist UBC Zone 1 seismic forces.

5. Supports shall be in accordance with the requirements of Section 40 05 07– Hangers and Supports for Process Piping, and spec 01 33 17 – Structural Design, Support and Anchorage.

I. Alignment and Elevation

1. Ductwork shall be provided to the lines and elevations indicated, and shall be sloped to facilitate water drainage where indicated.

2. Laser beam equipment or surveying instruments shall be used to maintain alignment and elevation.

3. Accuracy Verification

a. If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracies.

b. If such measurements indicate thermal deflection of the laser beam due to differences between the ground temperature and the air temperature within the duct, take precautions to prevent or minimize further thermal deflections and previous alignments and elevations measured with the laser beam equipment shall be re-measured with properly calibrated equipment.

3.02 DUCT CLEANING

A. Duct shall be blown clean of dust and debris using compressed air.

B. The system fans shall not be used to provide air for duct cleaning.

3.03 FIELD TESTING

A. Ductwork shall be leak tested after installation in accordance with the National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, a publication offered by the Associated Air Balance Council (AABC).

B. The maximum allowable leakage criteria shall be in accordance with ASHRAE standards.

C. Leaks shall be repaired to the satisfaction of the Engineer.

D. The system shall be retested until no leaks are found.

END OF SECTION

SECTION 23 34 00 – HVAC FANS

PART 1 -- GENERAL

1.01 SUMMARY

A. Provide fans, blowers, ventilators, and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. Where 2 or more fans, blowers, ventilators or appurtenances of the same type or size are required, they shall be furnished by the same manufacturer.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings

1. Submit certified fan curves for each fan.

C. O&M Data

1. Submittals shall include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.03 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts:

1. Drive Belts: Provide one for each fan.

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Standards

Air Moving and Conditioning Association (AMCA)	
AMCA 300-14	Reverberant Room Method for Sound Testing of Fans
Standard 99	Standards Handbook, Reverberant Room Method for Sound Testing of Fans.
Standard 210	Laboratory Methods of Testing Fans for Rating
American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)	
	Spec 01 33 17 – Structural Design Support and Anchorage
Institute of Electrical and Electronics Engineers, Inc. (IEEE)	
112	Standard Test Procedure for Polyphase Induction Motors and Generators
National Electrical Manufacturers Association (NEMA)	
MG 112.53a	Motors and Generators
National Fire Protection Association (NFPA)	
70	National Electric Code (NEC)
90A	Standard for the Installation of Air Conditioning and Ventilating Systems

Occupational Safety and Health Act (OSHA)	
Underwriters Laboratories Inc. (UL)	
	Product Directories

1.05 MOTORS

A. All motors shall conform to the latest IEEE and NEMA requirements for mechanical and electrical characteristics, including service factors.

B. Motors shall be in accordance with the requirements of Section 26 05 10 – Low-Voltage Electric Motors.

C. Each motor shall bear the manufacturer's nameplate with complete motor data.

D. Each motor shall be of ample size and construction to carry continuously all loads which might be imposed by the piece of equipment it drives throughout the full range of operation of the equipment, and the maximum motor loading shall in all cases be less than or equal to the nameplate horsepower rating, exclusive of the service factor.

E. All 2-speed motors shall be 2-winding motors.

PART 2 -- PRODUCTS

2.01 CENTRIFUGAL SIDE WALL MOUNTED FRP FAN **(EF-01)**

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb/ft3).

2. Fan selected shall be capable of accommodating static pressure and airflow of scheduled values.

3. Fan shall be wall mounted as mentioned on the drawings.

4. For wall mounted fan, provide wall mounting assembly.

B. Fan Housing:

1. Fan housing to be aerodynamically designed with high-efficiency inlet venturi, engineered to precisely fit in the wheel inlet ring for maximum efficiency. Molded dome to have a smooth exterior and resin rich interior.

2. Fan shall be manufactured in specifically formulated resins, for maximum corrosion resistance, UV inhibited and reinforced with fiberglass for structural strength. Fastening bolts shall be 304 stainless steel, and hardware in the exhaust airstream are to be encapsulated in FRP. No uncoated metal fan parts in the exhaust airstream will be allowed.

3. The resin shall have antimony trioxide added to provide fire retardancy with a flame spread rating of 25 or less when tested per ASTM-E84.

4. Fans shall be supplied with an internal graphite liner and grounding strap to remove static electricity, if scheduled.

5. Hub seal to be neoprene or Teflon (when specified on the fan schedule).

6. Standard finish color to be light gray.

C. Fan Impeller:

1. Impellers should be solid molded FRP with backward inclined, flat blades. The hub to extend outside the casing. Impellers manufactured in steel and coated with a plastic material are not acceptable. The impeller shall be electronically balanced both statically and dynamically in accordance with ANSI/AMCA 204-96 “Balance Quality and Vibration Levels for Fans” to Fan Application Category BV-3, Balance Quality Grade G6.3.

D. Fan Motors and Drives:

1. Motors to be TEFC with a 1.15 service factor.

2. Motor to be attached to a coated steel support frame and plate, must be protected from the environment in a fiberglass weather cover. Air conduits to provide ventilation, warm air to exit at the openings on top of the enclosure.

3. Belts and pulleys are to be accessible for service and maintenance.

4. Shafts to be AISI -1045 carbon steel. The shaft shall not be in the corrosive air stream.

5. Bearings shall be spherical pillow block and have a minimum L-10 life of 40,000 hours life.

6. Drives shall be sized for a minimum of 150% of the motor size power and shall be accessible by easily removing the motor cover.

7. Fans up to 5 HP motor to have variable pitch.

E. Manufacturers, or Equal:

1. M.K. Plastics Corporation, RBK model

2. Approved equal

2.02 CENTRIFUGAL ROOF UPBLAST FRP FAN **(EF-02)**

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb/ft3).

2. Fans selected shall be capable of accommodating static pressure and airflow of scheduled values.

3. Fan shall be roof mounted as mentioned on the drawings.

B. Fan Housing:

1. Fan housing to be aerodynamically designed with high-efficiency inlet venturi, engineered to precisely fit in the wheel inlet ring for maximum efficiency. Molded dome to have a smooth exterior and resin rich interior.

2. Fan shall be manufactured in specifically formulated resins, for maximum corrosion resistance, UV inhibited and reinforced with fiberglass for structural strength. Fastening bolts shall be 304 stainless steel, and hardware in the exhaust airstream are to be encapsulated in FRP. No uncoated metal fan parts in the exhaust airstream will be allowed.

3. The resin shall have antimony trioxide added to provide fire retardancy with a flame spread rating of 25 or less when tested per ASTM-E84.

4. Fans shall be supplied with an internal graphite liner and grounding strap to remove static electricity, if scheduled.

5. Hub seal to be neoprene or Teflon (when specified on the fan schedule).

6. Standard finish color to be light gray.

C. Fan Impeller:

1. Impellers should be solid molded FRP with backward inclined, flat blades. The hub to extend outside the casing. Impellers manufactured in steel and coated with a plastic material are not acceptable. The impeller shall be electronically balanced both statically and dynamically in accordance with ANSI/AMCA 204-96 “Balance Quality and Vibration Levels for Fans” to Fan Application Category BV-3, Balance Quality Grade G6.3.

D. Fan Motors and Drives:

1. Motors to be TEFC with a 1.15 service factor.

2. Motor to be attached to a coated steel support frame and plate, must be protected from the environment in a fiberglass weather cover. Air conduits to provide ventilation, warm air to exit at the openings on top of the enclosure.

3. Belts and pulleys are to be accessible for service and maintenance.

4. Shafts to be AISI -1045 carbon steel. The shaft shall not be in the corrosive air stream.

5. Bearings shall be spherical pillow block and have a minimum L-10 life of 40,000 hours life.

6. Drives shall be sized for a minimum of 150% of the motor size power and shall be accessible by easily removing the motor cover.

7. Fans up to 5 HP motor to have variable pitch.

E. Manufacturers, or Equal:

1. M.K. Plastics Corporation, RBK model

2. Approved equal

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Fans, blowers, ventilators, and hoods shall be installed in strict accordance with the manufacturer's recommendations.

B. Pipe the housing drains to the nearest utility drain

END OF SECTION

SECTION 23 37 13– DIFFUSERS, REGISTERS, AND GRILLES

PART 1 -- GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.

1.02 SUMMARY

A. Section includes:

1. Fixed face grilles

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Abbreviations and Acronyms

B. Reference Standards

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

1.04 ACTION SUBMITTALS

A. Product Data

1. Data sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, noise ratings.

2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number size and accessories furnished.

B. Samples for initial Selection: For Diffusers, registers, and grilles with factory applied color finishes.

C. Samples for verification: For diffusers, registers, and grilles in manufacturers standard sizes to verify color selected.

1.05 INFORMATIONAL SUBMITTALS

A. Coordinated Drawings: Reflected Ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using the input from installers of the items of involved:

1. Ceiling suspension assembly members.

2. Method of attaching hangers to building structures.

3. Size and location of initial access modules for acoustical tile.

4. Ceiling mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers access panels, and special moldings.

5. Duct access panels.

B. Source quality control reports.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Provide supply and return registers and grilles, and all supply diffusers as indicated.

B. The sizes, capacities, and deflection of each unit shall be as indicated on the Drawings.

C. Submittal

1. Data sheet: Indicate materials of construction, finish, and mounting details, performance data including throw and drop, static pressure drop and noise ratings.

D. The following schedule shall be followed:

Air Terminal Type	Border Type	Manufacturer, Model and Material	Optional damper	Neck Type
Supply Grilles (SG)	Surface Mount	**Titus Model 300-FL Aluminum**; **Tuttle and Bailey**; or equal: with ½-in x ½-in x ½-in aluminum grid	yes	Rectangular
Return Grilles (RG)	Surface Mount	**Titus Model 350-FL**; **Tuttle and Bailey**; or equal: with ½-in x ½-in x ½-in aluminum grid	yes	Rectangular

E. Registers, grilles and diffusers shall be constructed of aluminum.

F. The finish shall be a white baked-on enamel.

G. Accessory equipment shall be constructed of aluminum, or steel if aluminum is not available, and provided with a white baked-on enamel.

H. The proper border style shall be selected by the Contractor to suit the installation conditions.

I. Registers, grilles, and diffusers located in corrosive atmospheres, as indicated, shall be painted with a special protective coating in accordance with the requirements of Section 09 96 00– High-Performance Coatings.

2.02 ACTION SUBMITTALS

A. Product Data

1. Data sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, noise ratings.

2.03 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate Diffusers, registers, and grilles according to ASHRAE 70, " Method of Testing for Rating the Performance of Air outlets and Inlets."

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling Mounted Outlets and Inlets : Drawings indicate general arrangement of ducts, fittings and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, air flow pattern, throw and pressure drop. Make final locations where indicated , as much as practical. For units installed in lay in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers and grilles to air patterns indicated, as directed, before starting air balancing.

END OF SECTION

SECTION 23 70 00– CENTRAL HVAC EQUIPMENT

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide the air handling units and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. Single Manufacturer: Where 2 or more air handling units or appurtenances of the same type or size are to be provided, they shall be furnished by the same manufacturer.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
23 05 00	Common Work Results for HVAC

B. Reference Standards

Air-Conditioning, Heating and Refrigeration Institute (AHRI)	
AHRI 410	Forced-Circulation Air Cooling and Air Heating Coils
AHRI 430	Standard for Application of Central-Station Air Handling Units
AHRI 260	Sound Rating of Ducted Air Moving and Conditioning Equipment
Air Movement and Control Association International, Inc. (AMCA)	
AMCA 99	Standard Handbook
AMCA 210	Laboratory Methods of Testing Fans for Rating Purposes
AMCA 300	Test Code for Sound Rating Air Moving Devices
AMCA 301	Method of Publishing Sound Ratings for Air Moving Devices
AMCA 500	Test Methods for Louvers, Dampers, and Shutters
AMCA 611-95	Methods of Testing Airflow Measurement Stations for Rating
American Bearing Manufacturers Association (ABMA)	
ABMA STD 9	Load Ratings and Fatigue Life for Ball Bearings
American National Standards Institute (ANSI)	
ANSI Z223.1	Natural Fuel Gas Code Handbook
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	
ASHRAE 52.1/52.2	Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62	Ventilation for Acceptable Indoor Air Quality
ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings
Canadian Electric Code (CEC)	
Canadian Gas Association (CGA)	
CGA B149.1	Natural Gas Installation Code

American Society of Mechanical Engineers (ASME)	
ASTM International (ASTM)	
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ETL Testing Laboratories (ETL)	
International Organization for Standardization (ISO)	
ISO-9002	Quality Standard
National Electrical Manufacturers Association (NEMA)	
National Fire Protection Association (NFPA)	
NFPA 54	National Fuel Gas Code
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)	
SMACNA	Low Pressure Duct Construction Standards
Underwriters Laboratories (UL)	
UL 181	UL Standard for Safety Factory-Made Air Ducts and Air Connectors
ANSI/UL 900	Test Performance of Air Filter Units

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00– Submittal Procedures.

B. The submittals shall include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

C. Furnish a certified fan curve for each fan.

1.04 CODE REQUIREMENTS

A. Perform the Work in strict accordance with the State Mechanical Code, the State of Idaho, City of Sandpoint, Bylaws and other authorities having jurisdiction.

B. Obtain the required certifications and become thoroughly familiar with the local codes.

C. Obtain and pay for all necessary permits.

PART 2 -- PRODUCTS

2.01 MAKE-UP AIR HANDLING UNIT–NATURAL GAS HEATING INDIRECT-FIRED **(MAU-01)**

A. Casing

1. Unit casing shall be of minimum 16-gauge satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be electrostatically applied enamel to all exposed surfaces. All unprotected metal and welds shall be factory coated.

2. Unit shall be double walled construction with 22-gauge galvanized steel inner face panels. Liner shall be epoxy coated for corrosion resistance.

3. All walls, roofs and floors shall be formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.

4. Casings shall be supported on 4" minimum structural steel channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.

5. Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include the prevention of infiltration of rain and snow into the unit, and louvres on air intakes and hoods on exhaust openings with 1" galvanized inlet screens; rain gutters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" with three break interlocking design; outer wall panels extend a minimum of ¼" below the floor panel; drain trap(s) for field installation. Provide draining louvres at fresh air intake designed to prevent penetration of moisture.

B. Access Doors

1. Access Doors shall be minimum 24"X60". Removal of screwed wall panels will not be acceptable. Provide hinged access doors, with zinc plated piano hinges and brass pins in welded steel frames. Doors shall be fully lined with closed cell, automotive bulb gasket and lever lock roller type or Ventlock handles, operable from both sides.

C. Insulation

1. All units shall be internally insulated with 2"(51mm) thick 1 1/2 lb./cu.ft. density insulation, neoprene coated fibre glass thermal insulation, secured to metal panels with a fire-retardant adhesive and welded steel pins at 16" o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

D. Filters

1. Filter sections shall be provided with adequately sized access doors to allow easy removal of filters.

2. 2" Pleated Panel Disposable Filters: Non-woven cotton fabric media with a metal support grid and heavy-duty beverage board enclosing frame. Permanent re-usable metal enclosing frame. The filter media shall have an average efficiency of 30% on ASHRAE Standard 52-76.

E. Damper Section

1. Damper frames shall be U-shaped satin coat galvanized metal sections securely screwed or welded to the unit casing. Pivot rods of 1/2" (13mm) diameter steel shall turn in nylon or bronze bushings. Rods shall be secured to the blade by nuts and bolts.

2. Damper operator mounted outside of air stream.

3. Dampers shall be certified low leak tested to AMCA Standard 500-89 by an accredited testing laboratory. These dampers include rigidly formed satin coat galvanized steel frame with corner reinforcing brackets, heavy duty satin coat galvanized damper blades secured with bolts to continuous ½" (13 mm) diameter steel drive rods, all weather PVC double seal blade gasket, tempered aluminum alloy blade end seal, complete with epoxy enamel coating.

4. Dampers shall be extruded aluminum, low leak, insulated blade

F. Fan Sections

1. Drives shall be adjustable on fans with motors 5 HP (3.73 kw) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

2. Unit shall be equipped with a non-overloading airfoil or backward incline blower, complete with greaseable self-aligning ball or roller type pillow block bearings.

3. All fans shall be epoxy coated for corrosion resistance.

4. Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension. Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor which is welded to the structural frame of the unit. The isolators shall be vertical spring type isolators with levelling bolts, bridge bearing waffled pads with minimum 1" static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a heavy glass fabric, neoprene impregnated, with a double locking fabric to metal connection.

5. Fan motors shall be rated for severe duty, and IEEE841 rated.

G. Indirect Gas Fired Auxiliary Heat

1. Heating units shall have an indirect natural gas heating section that is C-ETL, approved for both sea level and high-altitude areas. The entire assembly shall be approved and labelled by a nationally recognized certification agency.

2. Operating natural gas pressure at unit(s) manifold shall be 7" (1750 Pa) w.c.

3. Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal tubulators and shall be of a floating stress relieved design. Heat exchangers shall be provided with condensate drain connection. The heat exchanger casing shall have 1" of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not acceptable.

4. Unit shall be equipped with high efficiency heat exchangers and certified to ANSI standards to provide a minimum of 80% efficiency throughout the entire operating range as required by ASHRAE 90.1. The manufacturer shall be routinely engaged in the manufacture of this type of high efficiency equipment.

5. The burner assembly shall be a blow through positive pressure type with an intermittent pilot ignition system to provide a high seasonal efficiency. Flame surveillance shall be with a solid state programmed flame relay c/w flame rod. The burner and gas train shall be in a cabinet enclosure. Insulation in the burner section shall be covered by a heat reflective galvanized steel liner. Atmospheric burners, or burners requiring power assisted venting are not acceptable.

6. Unit discharge air control shall include 15:1 turndown. The high turndown burner minimum input shall be capable of controlling at 6.7% of its rated input without on-off cycling. Manufacturer shall provide a factory test proving indirect gas fired burner capable of 15:1 turndown ratio while maintaining minimum 80% efficiency throughout the range.

H. Purge Section

1. Unit to be complete with purge section with 2 separate supply air opening for serving hazardous location areas. On start-up, gas heat is locked out. Purge dampers open and supply air dampers remain shut for 60 seconds. After 1 minute, supply air dampers open, purge dampers close, gas heat enabled.

2. Heavy gauge shipped loose exhaust hood.

3. Damper operators must be mounted outside and the airstream, NEMA-4X rated, and individually controlled. Both dampers complete with damper end switch to prove dampers open.

4. Unit not certified to be mounted in a hazardous location.

I. Control Panel

1. Air handling units shall be factory wired and tested, and shall be certified by ETL, with C.S.A. approved components.

2. Control cabinet shall be NEMA-4X rated.

3. All electrical circuits shall undergo a dielectric strength test (CSA C22.2-0) and shall be factory tested and checked as to proper function.

4. Pre-wired air handling units shall bear an approved bilingual label with all the necessary identification marks, electrical data, and any cautions as required by the Canadian Electrical Code, Part 2.

5. All wiring in the airstream to be enclosed in liquid tight conduit.

6. Provide a system of motor control, including all necessary terminal blocks, motor contacts, motor overload protection, grounding lugs, control transformers, auxiliary contacts and terminals for the connection of external control devices or relays.

7. Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet the C.S.A. standard of the specific installation.

8. Unit complete with heresite coated supply and ambient temperature sensors, automatic summer/winter changeover, heating control output, and damper control.

9. Damper motors to be NEMA-4X rated or enclosed in NEMA-4X enclosure.

10. Provide NEMA-4X non-fused disconnect.

J. Manufacturer, or approved equal

1. Engineered Air, model DJE

2. Greenheck

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All air handling equipment shall be installed by a qualified Contractor in strict accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 26 00 10 – ELECTRICAL GENERAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SUMMARY

A. Section Includes

1. The work under this Contract consists of a complete and operational electrical system as detailed in the Contract Drawings and as specified herein.

2. The intent of the Contract Documents is to include all labor, products, components and services necessary to complete the work, tested, commissioned, and placed into full operation.

3. The work of this Section is required for installation, testing and operation of electrically driven equipment provided under Specifications in other Divisions.

4. The Contractor shall coordinate the work of Division 26 with the work of other Divisions of these Specifications to provide a coordinated installation.

5. The provisions of this Section shall apply to all Sections in Division 26, except as otherwise indicated.

6. This section of the specification forms part of the contract documents and is to be read, interpreted, and coordinated with all other parts.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Definitions

1. The word “supply” as used in these specifications shall be taken to mean that the so noted equipment is to be purchased, assembled and shipped to the site, including all costs associated with insurance and handling until the Contractor receives written acceptance at the site by the Engineer. The Contractor is responsible to ensure the Supplier of the equipment confirms the functionality of equipment at site prior to the commissioning of the system. Where an item is noted as supplied by the Owner, by others, or by another Division, the electrical work of mounting, connecting and commissioning the item shall be included in the Contract unless specifically noted otherwise. See also Section 01 16 00 – Owner-Furnished Equipment.

2. The word “provide” as used in these specifications shall be taken to mean that the so noted equipment is to be supplied, mounted, connected, adjusted, tested and placed into service by this Contract.

3. The word “reviewed” as used in these specifications shall be taken to mean that the so noted equipment is to be reviewed for conformance to the Contract Documents by the Engineer, prior to fabrication.

4. The word “install” means all work and material necessary to place the specified item into full operation, securely fastened and to give a presentable finished appearance. “Install” also includes all necessary connections, wiring, testing and commissioning. Where indicated, this Contract shall require the Contractor to install equipment that is supplied by Others.

5. The word “coordinate” means to make all arrangements directly with the Owner, Engineer, agencies, equipment suppliers, trades, sub-trades and individuals; confirm schedules; be in attendance at the time work is carried out; and take full responsibility for having the work carried out correctly and in a timely manner to meet the construction schedule.

B. Reference Standards

1. The following standards are referenced in this section and throughout Division 26. The edition/revision in effect at the time of bidding shall apply, unless otherwise specified.

   a. InterNational Electrical Testing Association (NETA)

   b. National Electrical Manufacturers Association (NEMA)

   c. Occupational Health and Safety Act (OHSA).

   d. Institute of Electrical and Electronics Engineers (IEEE)

   e. American National Standards Institute (ANSI)

   f. National Fire Protection Association (NFPA)

2. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or a Nationally Recognized Testing Laboratory (NRTL) acceptable to the local code enforcement agency having jurisdiction.

3. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes, amendments and regulations.

4. Where the requirements of the specifications conflict with UL/NRTL, NEMA, NFPA, or other applicable codes or standards, the more stringent requirements shall govern.

C. Reference Codes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	National Electrical Code, 2023 Edition
IDAHO ADMINISTRATIVE RULES	
Title 54, Chapter 10	Section 54-1001
2020 Idaho Energy Conservation Code (2018 International Energy Conservation Code)	

1.03 CODES, PERMITS, AND INSPECTIONS

A. The installation shall comply with the requirements of the edition of the National Electrical Code and the electrical by-laws and amendments as adopted by the local Authority Having Jurisdiction (AHJ). Where a local or regional AHJ has not adopted a specific electrical code, the latest version of the National Electrical Code shall apply.

B. Obtain all permits required and pay inspection fees according to the General Conditions. Take out all permits prior to beginning the work.

C. Coordinate all inspections with the AHJ and correct all identified installation issues to the satisfaction of the AHJ. Re-work associated with corrective actions identified by AHJ inspections, the Owner and Engineer; failure to meet applicable codes; and failure to meet requirements of the contract documents shall be corrected at no additional cost to the Owner.

D. After completion of the work, furnish to the Engineer the certificate(s) of final inspection and approval from the local AHJ.

E. Submit a set of electrical drawings to the local AHJ within 2 weeks from date Contract Notice to Proceed. Immediately notify the Engineer of any issues raised by the AHJ as part of the permitting process for resolution.

1.04 SITE CONDITIONS

A. Protection

1. Provide physical protection and energize space heaters (as applicable) for all equipment to protect from damage due to ambient conditions during storage and prior to energization. Protection and storage shall be provided in strict accordance with the manufacturers' and suppliers' requirements.

2. Protect finishes and nameplates on equipment to prevent defacing.

3. Repair, restore or replace damaged, corroded, and rejected items. Where damaged equipment cannot be repaired to a "like new" condition in the opinion of the Owner or Engineer, the equipment shall be replaced at no additional cost to the Owner.

B. Job Conditions

1. Schedule work which will cause interference or interruption in advance with Owner, Engineer, authorities having jurisdiction, and all affected trades. Shutdowns shall be performed in strict accordance with the requirements of the General Conditions and the Division 1 specifications.

2. Examine the Contract Documents to determine how other work will affect the execution of electrical work.

3. Where any material, equipment or system components are installed differently from that shown, show such differences clearly and neatly, using ink or indelible pencil.

4. Prior to substantial completion, submit record documents in accordance with the requirements of the individual Sections of Division 26, Section 01 33 00 – Submittal Procedures and Section 01 77 00 – Project Closeout.

C. Area Classifications

1. Electrical equipment shall be approved and listed for use in the area classification in which it is used. Area classifications shall be defined by the NEMA enclosure definitions described in NEMA 250 – Enclosures for Electrical Equipment (1,000 Volts Maximum).

2. Area classifications for electrical work specifically indicated in other Sections shall comply with the requirements of this Section.

3. Area classifications for electrical work shall be as follows, except where specifically indicated otherwise on the drawings:

AREA	NEMA ENCLOSURE CLASSIFICATION					
	1	**3R**	**4**	**4X**	**12**	**Notes**
Indoor					**X**	RVSS may be NEMA 1
Outdoors		**X**				

1.05 ACTION SUBMITTALS

A. Submit Shop Drawings, Product Data, and samples in accordance with Section 01 33 00 – Submittal Procedures and this Section.

B. Shop Drawings

1. Shop Drawings submitted for review shall be reviewed by Contractor for conformance with design intent, relevant Specifications and coordinated with other divisions' submittals. Shop drawings not signed and reviewed by Contractor will be returned "not reviewed".

2. Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

3. Highlight or otherwise indicate options or specific items to be provided. Cross out items not intended to be provided. Drawings or data indicating "optional" or "as required" will not be accepted.

4. Include wiring, line and schematic diagrams applicable to this project. Generic wiring diagrams that do not apply to the project shall not be included and are not acceptable. Include wiring drawings or diagrams showing interconnection with other equipment and with work of other divisions.

5. Content:

a. Shop Drawing submittal title sheet.

b. Data shall be specific and technical.

c. Identify each piece of equipment with appropriate project-specific equipment tag.

d. Information shall include all scheduled data.

e. Advertising and commercial presentation literature will be rejected.

f. The project and equipment designations shall be identified on each document.

g. Information shall be provided in Imperial units.

h. The Shop Drawings / Product Data shall include as a minimum:

1) Catalog cuts for all equipment and materials identifying the equipment manufacturer(s), catalog and model numbers, options, etc.

2) Bill of materials.

3) Dimensioned construction drawings with plans, elevations and sections showing size, arrangement, and necessary clearances, with all equipment weights and mounting point loads, and all approvals, certifications, listing/labelling, and manufacturing standards which apply.

4) Mounting arrangements showing access clearances and ventilation requirements. Include dimensioned areas for cable/conduit entries and access plates.

5) Detailed drawings of bases, supports and anchor bolts. Provide seismic installation data and instructions for installation.

6) Control explanation and complete ladder schematics and interconnection wiring diagrams. Provide details on interconnections, terminal and wire numbering and conductor sizing.

7) Types of materials and finish

8) Nameplate information including mounting locations, materials, font type/size, background and text colors, and text for each nameplate.

9) Temperature ratings and limitations, as applicable.

10) Electrical ratings including, but not limited to: Operating voltage, current, number of phases, frequency, and short circuit current ratings.

11) Grounding requirements.

12) Factory Test information.

13) Spare parts information.

i. Operation and maintenance training information and training syllabus. Provide in accordance with Section 01 79 00 – Owner Staff Training.

j. Equipment supports shall be designed and submitted for approval, meeting the requirements of Section 01 33 17 - Structural Design, Support and Anchorage.

6. Submission format:

a. Provide in accordance with Section 01 33 00 – Submittal Procedures, with the following additional requirements:

1) Text size shall be 10 point minimum. Smaller font sizes or unreadable text shall be grounds for rejection.

2) Text shall be in English.

3) Electronic submittals shall be in bookmarked, using pdf (portable document format) file structure. PDFs of drawings and other shop drawing information shall be generated from the original electronic documents. Scanned pdf documents shall be limited to equipment catalog cuts, provided they are clearly legible.

4) Markings and clarifications in the submittals by the Contractor or Supplier shall be in colors other than red, as this is reserved for Engineer/Owner review markings.

7. Coordination:

a. Where electrical equipment requires support or backing or interconnection with other trades (mechanical connections, etc.), the Shop Drawings shall also be circulated for review to the other relevant Subcontractor(s) prior to submission to the Engineer.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

1. Provide operation and maintenance data for incorporation into operation and maintenance (O&M) manuals. Manuals shall be prepared and submitted in accordance with Section 01 77 00 – Project Closeout and Section 01 33 00 – Submittal Procedures. The O&M manuals shall describe the equipment in full and shall include the following major items:

a. Operating instructions and start-up procedures, including receiving and installation requirements. Where installed in seismic areas, include specific requirements for seismic installations.

b. Maintenance instructions listing preventive and corrective maintenance procedures and frequency of maintenance. Corrective maintenance procedures shall identify the most probable failures and the appropriate repairs. Test measurement levels shall be referenced to specific test points on the installed equipment.

c. Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

d. Spare parts data shall be furnished for each item of material and equipment specified. The data shall include a complete list of parts and supplies with current source of supply. A list and itemized breakdown (with current pricing) of spare parts recommended for stocking shall be furnished. The parts selected shall be those which, in the manufacturer's judgment, will be involved in the majority of maintenance procedures expected.

e. Equipment fabrication drawings, one-line diagrams, schematic diagrams and connection diagrams. Wiring and schematic diagrams must be specific to each individual piece of equipment and be detailed with as-built wire/cable tags and termination information. Generic documentation is not acceptable.

f. Catalog cuts and technical manuals for all components of the system, with specific model numbers clearly identified, and including technical data, product data; supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising and sales literature are not acceptable.

g. Copy of all guarantees and warranties issued for the various items of equipment, showing all dates of expiration.

h. Copies of all testing and commissioning results.

i. Copies of all “as-left” adjustable and programmable settings. In addition, provide electronic files of programmable settings for devices that can be programmed using such settings files.

j. Final copies of all shop drawings, incorporating manufacturing and field “as-built’ changes.

k. Record (as-built) Contract Drawings updated to show revisions to the electrical work when different from the original Contract Drawings. Prepare by obtaining new, clean sets of Contract Drawings from the Owner, and pay all costs for the same.

l. Names and addresses of local suppliers for items included in maintenance manuals.

2. The O&M manuals shall be formatted in accordance with Division 1 requirements. Where specific formatting is not included in Division 1, the O&M manuals shall have tabs for the following major sections:

a. Title page (in plastic cover).

b. Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.

c. Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.

d. Local source of supply for each item of equipment.

e. Wiring and control diagrams.

f. Spare parts list.

g. Copies of guarantees and certificates.

h. Manufacturer's maintenance manuals and final as-built shop drawings.

3. Submit a single draft copy of each O&M Manual to the Engineer for review 30 days prior to start-up of the systems and equipment covered by the manual. Once approved, provide the remaining copies of the manuals to the Owner for distribution.

4. Electronic O&M Manuals shall be in a bookmarked portable document format (PDF). Manuals without bookmarks will be rejected.

B. Record Documentation

1. Provide project as-built documents as specified in Section 01 77 00 – Project Closeout and as further called for in this division.

2. During the construction period, keep on site a clean set of contract drawings marked up to reflect the "As-Built" state of all contract drawings, for examination by the Owner and/or Engineer on a regular basis. Include elevations and detailed locations of buried services, conduit and cable tray systems, junction boxes and pull boxes.

3. Upon completion of commissioning of the electrical equipment, the Contractor shall provide the marked-up “as-built” Shop Drawings to the respective Supplier for updating the Shop Drawings for inclusion into the O&M Manuals.

4. Submit the "as-built" full size hard copy redline markup to the Engineer prior to substantial completion of the Contract. Where the Engineer or Owner identifies items where the Contractor “as-built” drawings do not match the installation, the Contractor shall correct and resubmit all such drawings at no additional cost to the Owner prior to project final completion.

1.07 QUALITY ASSURANCE

A. Quality Assurance: Provide all project quality assurance/quality control in accordance with Section 01 45 00 - Quality Control.

B. Qualifications: All electrical work shall be carried out and supervised by qualified, licensed electricians and journeypersons holding valid licenses for the type of work performed in the location(s) where the work is performed, in accordance with local requirements.

C. Work shall be performed neatly and professionally in strict accordance with the written requirements of the equipment manufacturers and established trade procedures and practices.

1.08 PROJECT COORDINATION

A. Check Drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Owner’s written acceptance.

B. The Drawings indicate the general location of equipment to be installed and connected. Routing of raceways and cable trays, where indicated, as general in nature. Where details are not shown on the Drawings or only shown diagrammatically, the electrical equipment shall be routed based on field conditions and customary installation practices. Raceways and cable trays shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Raceways and cable trays shall be installed parallel and perpendicular to building lines. All raceways and cable trays installed above reflected ceilings shall be kept as tight as possible to beams or other limiting members at high level. All electrical installation shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

C. Work out jointly all interference problems on the site and coordinate all work before fabricating or installing any material or equipment. Where necessary, produce interference / coordination drawings showing exact locations of electrical systems, duct banks, or equipment within service areas, shafts and the restricted spaces. Distribute copies of the final interference / coordination drawings to the Engineer and all affected parties.

D. Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Engineer of space problems before installing any material or equipment. Demonstrate to the Owner on completion of the work that all equipment installed can be properly and safely serviced and replaced, if and when required.

E. No extra cost will be considered for any misunderstanding of the scope of work to be performed resulting from failure to coordinate between trades.

F. HVAC EQUIPMENT

1. The Electrical Drawings provide for single and three phase power feeds to HVAC equipment under the Division 26 scope of work.

2. Where starters and/or disconnect switches are provided with HVAC equipment, they shall meet the requirements of Division 26.

1.09 WARRANTY

A. Manufacturer Warranty

1. Refer to the General Conditions and Division 1 for warranty requirements.

2. Provide additional warranty as per individual equipment Specifications.

3. Warranty of any equipment that is energized and used by the Contractor shall not commence until accepted by the Owner for beneficial use.

4. Temporary or trial use, of any electrical devices or equipment, shall not be construed as evidence of acceptance of the same.

1.10 UTILITY COORDINATION

A. Contact the serving utilities and verify compliance with requirements before construction.

B. Coordinate schedules and payments for work by utilities.

C. The utility contact is:

D. Where conduits and conductors are required by the utility to be larger, heavier schedule, or have greater protective coating than specified requirements, provide the larger size, heavier schedule, or greater protection.

E. Provide electrical service(s) and service equipment as indicated and in strict accordance with the serving utility requirements.

F. Verify and provide service conduits, fittings, transformer pad/vault, grounding devices, and service wires not provided by the serving utility.

G. Verify with the utility the exact location of each service point and type of service.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. As indicated for individual equipment and material specifications.

B. Where identified with “or equal” or “or equivalent”, alternate materials of equal or superior quality may be submitted for approval in accordance with the requirements of the General Conditions and Division 1.

2.02 MATERIALS

A. Use only new materials, apparatus, and equipment, suitable for the location(s) where installed.

B. Provide similar items in the Work as products of the same manufacturer.

C. Provide equipment and materials of industrial grade standard of construction.

D. On devices indicated to display dates, display the year as 4 digits.

E. Temperature Ratings of Equipment Terminations

1. Provide terminations and lugs rated for use with 75 deg C conductors.

2. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75 deg C ratings.

2.03 PROTECTIVE MATTING

A. Provide full-width, high-voltage switchboard matting in front of indoor switchgear, service equipment, panelboards, and motor control centers.

B. Provide matting that is 1/4-in thick and not less than 36-in deep for the entire length of the equipment.

C. Matting Manufacturer, or Equal

1. **W.H.Salisbury and Company**

2. **Mats, Inc.**

3. **Rhino**

PART 3 -- EXECUTION

3.01 GENERAL

A. Field Control of Location and Arrangement

1. The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items.

2. Exact locations shall be determined by the Contractor in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Follow the locations on the Drawings, however, as closely as possible.

3. Circuits

    a. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the Contractor's responsibility to provide lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated.

    b. Provide No. 12 AWG minimum wiring, and 3/4-in minimum conduits (exposed) and 1-in minimum conduits (encased).

    c. Where circuits are combined in the same raceway, derate conductor ampacities in accordance with NEC requirements.

4. Workmanship

    a. Install materials and equipment in strict accordance with the printed recommendations of the manufacturer and using workers skilled in the Work.

    b. Coordinate installation in the field with other trades to avoid interferences.

5. Protection of Equipment and Materials

    a. Fully protect materials and equipment against damage from any cause.

    b. Cover materials and equipment, both in storage and during construction, in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint.

    c. Keep moving parts clean and dry.

    d. Replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the work.

3.02 CORE DRILLING

A. Perform core drilling as required for the installation of raceways through concrete walls and floors.

B. Base the locations of floor penetrations, as may be required, on field conditions.

C. Verify exact core drilling locations based on equipment furnished as well as exact field placement.

D. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the Owner prior to any core drilling activities.

E. Repair damage to encased conduits, wiring, and piping as part of the work.

3.03 CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for indoor floor-standing electrical equipment.

B. Extend housekeeping pads for equipment, including future units, 3 1/2-in above the surrounding finished floor or grade, and 1-in larger in both dimensions than the equipment, unless otherwise indicated.

C. Provide concrete housekeeping curbs for conduit stub-ups in indoor locations that are not concealed by equipment enclosures.

D. Extend housekeeping curbs to 3-in above the finished floor or grade.

3.04 EQUIPMENT ANCHORING

A. Floor-supported, wall, or ceiling-hung equipment and raceways shall be anchored in place by methods that will meet seismic requirements in the area where the Project is located. Refer to Section 01 33 17 – Structural Design, Support and Anchorage for support and anchorage requirements.

B. Provide wall-mounted panels that weigh more than 200 lbs or that are within 24-in of the floor with fabricated steel support pedestals.

C. If the supported equipment is a panel or cabinet enclosed within removable side plates, match supported equipment in physical appearance and dimensions.

D. Manufacturer's Recommendations

1. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the work of this Contract.

2. Submit such recommendations as Shop Drawings as indicated.

3.05 SETTING OUT OF WORK

A. Where equipment is built-in with work of other trades, supply equipment to be built-in or measurements to allow necessary openings to be made so as not to hold up work.

B. Coordinate between electrical, mechanical, structural, process and architectural drawings when setting out Work. Consult with respective Divisions in setting out locations for conduit runs, luminaires, panel assemblies, etc., so that conflicts are avoided, equipment is operable and serviceable, and symmetrical, even spacing is maintained.

C. Layouts shown for mechanical and electrical rooms are for general layout purposes only. Coordinate exact installation of conduit, cable trays, outlets and equipment with final room equipment layout using equipment manufacturers’ as-built dimensioned drawings.

D. Where switches and receptacles, are in the same general location, outlets shall be lined up vertically unless otherwise indicated.

E. Electrical equipment provided as part of prepackaged or prefabricated systems shall be installed in coordination with the vendor requirements and design.

3.06 FINISHES

A. Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint. Obtain touch-up coatings from the original equipment manufacturer to ensure a proper match.

3.07 ARC FLASH LABELLING

A. Provide arc-flash labels for all distribution equipment, stand-alone disconnects, and stand-alone starters. Fill in all values as required by NFPA 70E. Verify that all settings as have been implemented in the field.

3.08 CUTTING AND PATCHING

A. Do not cut or weld to structural members without prior written approval of the Engineer.

B. Patch all floor, wall or ceilings that are affected by the Work. Patches shall be neatly installed and shall match the surrounding areas.

3.09 CONDUIT AND CABLE INSTALLATION

A. Install embedded conduit and conduit sleeves prior to placement of concrete. Sleeves through concrete: plastic, sized for free passage of conduit.

B. Cables, other than bare copper grounding cable, shall not be directly buried or embedded in concrete.

C. Ensure all penetrations are properly sealed to prevent ingress of moisture. Above-grade conduit entries subject to flooding (up to the 100 year flood elevation) and below grade conduit entries shall utilize link seals. Conduit entries above the 100 year flood elevation shall be sealed using silicone caulk.

D. Raceways, fittings and appurtenances that are encased in concrete or direct buried shall be listed for the application.

3.10 LOCATION OF OUTLETS

A. Locate outlets in accordance with the drawings.

B. Do not install outlets back-to-back in wall; allow minimum 6-in horizontal clearance between boxes.

3.11 DEMOLITION AND RELATED WORK

A. General

1. Perform electrical demolition as indicated.

2. The Contractor is cautioned that demolition work related to electrical facilities may also be indicated on non-electrical drawings.

3. Coordinate with all trades and the Owner regarding electrical de-energization, disconnection, and removal, and the overall sequence of construction.

B. Electrical Requirements for Removed Equipment

1. Remove dedicated wiring and exposed conduits back to the source.

2. Abandon in place wiring that shares conduits with other equipment wiring that is to remain, except power wiring.

3. Remove power wiring that shares conduits with other equipment to remain from the power source to the first pullbox, junction box or manhole remote from the panel, and abandon in place the remaining wiring.

4. Encased Conduits

    a. Abandon in place wiring routed through encased conduits.

    b. Cut encased conduits flush to the floor and grout flush with the floor. Remove exposed conduit to the first fitting/coupling before encasement. Remove the fitting/coupling and replace with a 5-thread conduit cap.

5. Remove remote-mounted starters, disconnect switches, circuit breakers, sensors, and transmitters in their entirety.

C. Where new lighting and receptacles are installed, remove old lighting, receptacles, switches, wiring, boxes, fittings and conduits, unless specifically indicated to be re-used.

D. Junction Boxes

1. Wiring and conduits indicated to be extended shall be terminated in a new junction box with terminal strips.

2. Provide a junction box with a NEMA rating in accordance with the area in which it is located and sized as required.

3. Properly identify wires and terminals before disconnection.

E. Removed materials and equipment not indicated to be returned to the Owner shall, upon removal, become the Contractor’s property and shall be disposed of off-site.

3.12 CONSTRUCTION SEQUENCING

A. General

1. Continuous operations of existing facilities during construction is critical. The Contractor shall carefully examine the Work to be provided in, on, or adjacent to existing equipment.

2. Schedule the Work, subject to Owner's approval, to minimize any required shutdown time. The Owner reserves the right to limit or deny shutdowns that restrict the facility’s ability to operate within its permit, particularly during unfavorable weather conditions.

3. Submit a written sequencing request, including the sequence and duration of activities to be performed during a partial or complete facility shutdown.

4. Switching, safety tagging, and the like, as required for plant shutdown or to isolate existing equipment, shall be performed by the Contractor.

5. In no case shall the Contractor begin any work in, on, or adjacent to existing equipment without written authorization from the Owner.

B. Modifications

1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.

2. Perform modifications to existing equipment, panels, and cabinets in a professional manner. Modifications shall be made in a manner to preserve UL/NRTL listings.

3. Repair coatings to match existing.

4. The costs for modifications to existing electrical facilities that are required for a complete and operating system shall be included as part of the Work.

C. Existing Utilities

1. Exercise extreme caution when digging trenches to not damage existing underground utilities. Perform potholing or other non-destructive method to identify existing utilities prior to performing the required excavations.

2. The cost of repairs of damages caused during construction shall be included as a part of the Work.

D. Installation of Temporary Equipment

1. To facilitate the continuous operation of existing equipment, provide the temporary equipment as required and/or indicated.

2. Submit installation and connection details for review and acceptance by the Engineer.

3. Costs associated with the installation, operation and removal of these temporary installations shall be included as part of the work.

4. Temporary wiring and equipment shall remain the property of the Contractor unless indicated otherwise.

3.13 FIELD QUALITY CONTROL

A. The Contractor shall provide equipment testing and quality control. Equipment testing shall be in accordance with Section 26 01 26 –Electrical Tests and as elsewhere specified in Division 26.

1. Conduct test in presence of Engineer or Owner and, if required, inspectors of the AHJ.

2. Arrange date(s) of test(s) in advance with Engineer and Owner, testing company and AHJ. Give all inspectors a minimum of 7 days' notice.

3. Contractor shall furnish or arrange for the use of electrical energy or fuel required for all required test(s).

B. Repair or replace equipment and systems found inoperative or defective, and re-test.

1. If test results are not within prescribed limits, document all failed tests and provide recommendations for corrective action to the Owner/Engineer for approval. Provide corrective action and re-test until satisfactory results are obtained.

2. Continue remedial measures and re-tests until satisfactory results are obtained.

3.14 COORDINATION OF PROTECTIVE DEVICES

A. Ensure that adjustable circuit protective devices such as overcurrent trips, solid state starters, motor circuit protector circuit breakers and motor overloads are adjusted to required values and settings.

3.15 ADJUST AND CLEAN

A. Maintain cleanliness during construction by keeping doors closed or openings covered. Provide periodic cleaning of equipment that becomes dusty or dirty during construction.

B. Before final acceptance, thoroughly clean the electrical work of cement, plaster, splatters, dirt and other materials.

C. Install/clean rubber mats in front of electrical equipment.

D. Clean washable filters and replace disposable filters on equipment at time of acceptance.

E. Remove temporary tags, markings, stickers, and the like.

F. Remove oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.

G. Apply matching touch-up paint to scratches on panels and cabinets.

H. Place equipment drawings in control panel pockets and secure all panel door fasteners.

I. Vacuum clean electrical cabinets and enclosures. Do not use compressed air to clean cabinets or rooms.

J. Adjust emergency lighting to properly illuminate egress paths. Clean luminaires inside and out. Replace failed lamps or fixtures.

K. Properly dispose of cleaning debris and refuse off-site.

3.16 OTHER DIVISIONS

A. Coordinate the Work with other Divisions. Include labor and materials required to provide a complete, coordinated installation. Typical incidental items shall be provided and include but are not limited to: terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-supplied equipment to connect with other equipment.

3.17 OTHER CONTRACTORS

A. Coordinate the work with other Contractors on site to provide a complete installation while minimizing interference with, and disruption to, other projects.

END OF SECTION

SECTION 26 01 26 – ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated herein and functional testing of power and controls not tested under Division 40 - Instrumentation, shall be completed before commencement of the 7 Day test of Section 01 75 00 - Equipment Testing and Plant Startup. This scope may require the Contractor to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.

C. The requirements of Section 26 00 10 - Electrical General Requirements, apply to the WORK of this Section.

D. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.

1.2 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American National Standards Institute (ANSI)

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

D. IEEE 400-2001, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

E. IEEE 576-2000, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

F. InterNational Electrical Testing Association (NETA)

G. NFPA 70, National Electrical Code (NEC)

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures, Contractor Submittals.

B. Submit complete system test procedures for review. Test procedures shall include but not be limited to:

1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Incorporation of the Test Record Sheets included at the end of this Section.

3. Detailed comprehensive testing schedule including:

a. Each major piece of electrical distribution equipment.

b. Each major electrical subsystem.

c. Duration of each test.

d. Milestone test completion date.

e. Ambient Conditions at time of test

f. Date of test results submittals following completion of the tests.

g. Names and qualifications of the individual(s) responsible for performing the testing.

C. Following completion of the test submit the completed test results to the Engineer for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.

D. Test result shall be submitted in one submittal

E. Test reports shall be based on NETA’s latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA’s Acceptance Testing Specifications latest edition.

1.4 COMMISSIONING

A. Commissioning during the 7 Day test in Section 01 75 00 – Equipment Testing and Plant Startup shall not be attempted until all subsystems have been found to operate satisfactorily. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters shall be considered only upon receipt of a written request by the Contractor.

B. Motor Current Tabulation

1. The motor current tabulation required by Section 26 05 10 Low-Voltage Electric Motors shall reflect the values occurring during commissioning.

2. Motors which have current/power measurement capabilities shall have this data recorded every 5 minutes while operating during commissioning.

3. Power monitored amperes, voltage, and kilowatts for each phase shall be recorded every 5 minutes during commissioning.

PART 2 -- TESTING & REPORTS

2.1 PRE-ENERGIZATION AND OPERATING TESTS

A. The complete electrical system shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the protective device study and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.

1. Instrument Transformers. All instrument transformers shall be tested to verify correct polarity and burden.

2. Protective Relays. Each protective relay shall be demonstrated to operate by injecting current or voltage, or both, at the associated instrument transformer output terminal and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.

3. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.

4. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.

5. Metering Circuits. All metering circuits shall be verified to operate correctly from voltage and current sources, similarly to protective relay circuits.

6. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.

7. Relays and Metering Utilizing Phase Differences. All relays and metering that use phase differences for operation shall be verified by measuring phase angles at the relay under actual load conditions after operation commences.

B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the authority having jurisdiction prior to energization. Acceptance Testing shall be in accordance with NETA ATS-2017, *For Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association.

2.2 TEST REQUIREMENTS

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching, include remote control, if present in system. Circuitry is in accordance with panel schedules. All interior and exterior lighting shall be checked for proper operation.

2. Power Instrumentation: Demonstrate that voltmeter and ammeter switches are functional. Demonstrate that kilowatt meters are within catalog accuracy as installed.

    a. Visual and Mechanical Inspection

        1) Compare equipment nameplate data with drawings and specifications.

        2) Inspect physical and mechanical condition.

        3) Verify tightness of electrical connections.

        4) Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case-shorting contacts, as applicable.

        5) Verify freedom of movement, end play, and alignment of rotating disk(s).

    b. Electrical Tests

        1) Verify accuracy of meters at all cardinal points.

        2) Calibrate watthour meters according to manufacturer's published data.

        3) Verify all instrument multipliers.

        4) Verify that current transformer and voltage transformer secondary circuits are intact.

3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.

4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.

5. Low Voltage Cables-600 volts Maximum

    a. Visual and Mechanical Inspection

        1) Compare cable data with drawings and specifications.

        2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

        3) Inspect bolted electrical connections for high resistance using one of the following methods:

            a) Use of low-resistance ohmmeter

b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS- 2017, Table 100.12.

c) Perform thermographic survey in accordance with below Section Thermographic Survey.

4) Inspect compression-applied connectors for correct cable match and indentation.

5) Inspect for correct identification and arrangements.

6) Inspect cable jacket insulation and condition.

b. Electrical Tests

1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.

a) Motor feeders tested with motors disconnected and controller open.

b) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.

c) Panelboard feeders tested with feeder breaker open and panel-board connected. If a lighting transformer is associated with the panelboard, it shall be connected and the test made for both primary and secondary sides.

d) Conductors of main lighting feeders, including lighting panel with branch circuits open.

e) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid state device.

f) Equipment which may be damaged during this test shall be disconnected.

g) The Engineer shall be consulted if minimum insulation values cannot be obtained.

2) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3) Perform continuity test to insure correct cable connection.

c. Test Values – Visual and Mechanical

1) Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels should be in accordance with NETA ATS-2017, Table 100.12 unless otherwise specified by the manufacturer.

3) Results of the thermographic survey shall be in accordance with the below Section Thermographic Survey.

d. Test Values – Electrical

1) Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS-2017 Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.

3) Cable shall exhibit continuity.

4) Deviations in resistance between parallel conductors shall be investigated.

6. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

7. A functional test and check of electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

a. Visual and physical check of cables, circuit breakers, transformers, and connections associated with each item of new and modified equipment.

b. Verification that electrical equipment has been labeled with Arc Flash protection boundary and PPE levels, as required by the NEC.

c. Circuit Breakers

1) Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted at the lowest levels that allow reliable operation.

2) Setting shall be tabulated and proven for each circuit breaker in its installed position.

3) Test results shall be certified by the person performing the tests and shall be submitted to the Engineer.

8. Complete ground testing of grounding electrodes per requirements below prior to operating the equipment.

B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the Engineer and after process control

devices have been adjusted as accurately as possible. Alarm conditions shall be simulated for each alarm point, and alarm indicators shall be checked for proper operation. It is intended that the Contractor will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

C. Metering and indication lights for motors and other devices shall be tested for proper operation.

D. All control circuits such as motor, interlock and remote shall be tested for proper operation.

E. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

F. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.

G. All lighting panels, circuits and fixtures; and power panels, circuits and receptacles shall be tested for proper operation.

H. Provide ground resistance tests on the main grounding electrode or system in the presence of the Engineer and submit results.

1. Visual and Mechanical Inspection

    a. Verify ground system is in compliance with drawings and specifications.

2. Electrical Tests

    a. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.

    b. The earth resistance of each ground electrode shall be measured and recorded before electrodes are connected to the grounding loop.

    c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

3. Test Values

    a. The resistance between the main grounding electrode and ground shall be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner.

    b. Investigate point-to-point resistance values which exceed 0.5 ohm.

I. Subsystems shall be defined as individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.

2.3 TEST REPORTS

A. The test report shall include the following:

1. Summary of project.

2. Description of equipment tested.

3. Description of test.

4. Test data.

5. Analysis and recommendations.

B. Test data records shall include the following minimum requirements:

1. Identification of the testing organization.

2. Equipment identification.

3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.

4. Date of inspections, tests, maintenance, and/or calibrations.

5. Identification of the testing technician.

6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

7. Indication of expected results when calibrations are to be performed.

8. Indication of “as-found” and “as-left” results.

9. Sufficient spaces to allow all results and comments to be indicated.

C. The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

PART 3 -- TEST RECORD SHEETS

The test record sheets listed below shall be used to record testing of electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

Sheet No.	Title
1	Insulation Resistance (Power, Control Wire, and Cable) Test Record
2	Insulation Resistance (Instrument Wire and Cable) Test Record
6	Bonding Resistance Readings (Nonelectrical Equipment/Structures) Test Record
7	Bonding Resistance Readings (Electrical Equipment) Test Record
9	Insulation Resistance (Equipment) Test Record
10	Insulation Resistance (Rotating Equipment) Test Record
12	Record Feeder Breaker (240 V MCC) Test Record
13	Breaker/Contactor (240 V MCC) Test Record
14	240 V Motor Circuit (240 V MCC) Test Record
16	Electric Motor Run-In Test Record

INSULATION RESISTANCE
(POWER, CONTROL WIRE, AND CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: ___ºC . ºF DATE: _____

NOTES: 1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.

2. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.

3. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet “measured” or “temperature corrected.”

Panel No. Circuit No. Feeder No.	Wire Tagging	Cable Rated Voltage	Wire or Cable Quantity	Insulation Size	From	To	Resistance (megohms)*	Initials

*Minimum acceptable values:

Cable Rated Voltage	Test Duration	Resistance for Cable Only	Cable/Wire Size or Amperage (megohms)	Resistance When Cable Connected to Equipment (ohms)

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE
(INSTRUMENT WIRE AND CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: _____ºC _ ºF DATE: _____

NOTES: 1. Record only the lowest value.

2. MP - Multi-pair cable. SP - Single pair cable.
3. Megger with instruments disconnected.
4. Use 250 volt (or lower voltage, when specified) range on DC test set.
5. Readings will vary with temperature and cable length.*

Cable Number or Instrument Number	Indicate MP or SP Type (2)	Conductor to Conduit (Single Pair Non-Shielded Cables) (megohms)	Conductor to Conductor (megohms) (1)	Shield to Conductor to Shield (megohms) (1)	Overall Shield to Shield (Multipair Cables Only) (megohms) (1)	Lead and Armor (Multipair Cables Only (megohms)	Shield to Conduit (Single Pair Cables Only) (megohms)	Initials

DISTRIBUTION:

CONTRACTOR/Date _____

BONDING RESISTANCE READINGS
(NONELECTRICAL EQUIPMENT/STRUCTURES)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Vessels, tanks, and structural steel bonded to the main grounding system, dedicated ground rod or foundation, as indicated on drawings listed below.

2. Measure resistance from ground wire tap (or anchor bolt) to tagged equipment frame or structural steel.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

BONDING RESISTANCE READINGS
(ELECTRICAL EQUIPMENT)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Electrical equipment bonded to the main grounding system or dedicated ground rod, as indicated on drawings listed below.

2. Measure resistance from ground wire tap to tagged equipment bus bars, tagged equipment enclosures, and any other points indicated on the drawings.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE (EQUIPMENT)
TEST RECORD

TEST EQUIPMENT: _____ SUBSTATION: _____

AMBIENT TEMPERATURE: _____ºC _ ºF DATE: _____

REFERENCE DRAWING: _____ REF. SEC.: _____

NOTES: 1. Use 1,000-V test set for equipment rated 600 volts and below, 2,500/5,000-V test set for equipment rated over 600 volts.

2. For equipment with solid state control circuits, consult manufacturer's literature for maximum test voltages.

Switchgear MCC (other)	INSULATION RESISTANCE (megohms) *						Test Voltage (kV)	Rated Voltage (kV)	Initials/ Date
	∅A to G	∅B to G	∅C to G	∅A to ∅B	∅B to ∅C	∅C to ∅A			

*Minimum acceptable values:

EQUIPMENT VOLTAGE CLASS (megohms)	RESISTANCE

TESTER'S INITIALS/DATE _____

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE (ROTATING EQUIPMENT)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: _____ºC _ ºF DATE: _____

EQUIP. TEMP., IF KNOWN: _____ºC _ ºF HOW KNOWN: _____

NOTES: 1. Use 1,000-V test set for equipment 600-volt and below, 2,500/5,000-V test set for equipment rated over 600 volts.

2. Test duration shall be 1 minute, note if otherwise: _____.

3. Isolate all motor leads from one another and from frame, test phase separately, wherever practical.

4. Document testing of low voltage and medium voltage equipment on separate sheets.

5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Equipment Tag No.	INSULATION RESISTANCE (megohms) *						Rated Voltage	Equipment Initial/Date
	∅A to G	∅B to G	∅C to G	∅A to ∅B	∅B to ∅C	∅C to ∅A		

*Minimum acceptable values:

VOLTAGE CLASS	RESISTANCE (megohms)

DISTRIBUTION:

CONTRACTOR/Date _____

EQUIPMENT ABSORPTION RATIO AND POLARIZATION INDEX TEST RECORD

TEST EQUIPMENT: __ TEST VOLTAGE: _____
AMBIENT TEMPERATURE: ___ ºC ___ ºF DATE: ___
EQUIP. TEMP., IF KNOWN: ___ ºC ___ ºF REL. HUMIDITY: _____

NOTES: 1. Perform test as indicated on Test Records for each individual equipment type. Reference the following sheets:

Transformers	8
Equipment	9
Motors and Generators	10

Absorption Ratio = 1-Minute Resistance Value / 30-Second Resistance Value

Polarization Index = 10-Minute Resistance Value / 1-Minute Resistance Value

OHMS TO GROUND 30-SECOND READING ∅A TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅A TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅A TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅B TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅B TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅B TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅C TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅C TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅C TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX

TESTER'S INITIALS/DATE_____

DISTRIBUTION:
CONTRACTOR/Date _____

FEEDER BREAKER (240 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION		
LOAD (kW/kVA)	VOLTAGE	F.L.A.
CIRCUIT BREAKER MFG.	RATING	SETTING
CONDUCTOR SIZE POWER	GROUND	

1. Check nameplate data of breaker against approved vendor drawings. _____
2. Check breaker components for cleanliness. _____
3. Check mechanical function of breaker. _____
4. Check wiring for proper identification. _____
5. Check conduits/cables for tagging. _____
6. Check components for identification. _____
7. Check equipment for conformance of area classification. _____
8. Check installation for seals, breathers, and drains. _____
9. Verify power conductor continuity. _____
10. Check that power cable insulation resistance test (megger) is completed. _____

DISTRIBUTION:

CONTRACTOR/Date _____

BREAKER/CONTACTOR (240 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION			
LOAD (kW/kVA)		VOLTAGE	F.L.A.
CIRCUIT BREAKER MFG.		RATING	SETTING
CONTACTOR MFG.		SIZE	
CONDUCTOR SIZE	POWER	CONTROL	GROUND

1. Check nameplate data of breaker, contactor fuses and relays against approved vendor drawings. _____
2. Check main and auxiliary contacts. _____
3. Check contactor/breaker components for cleanliness. _____
4. Check control fuses, CPT rating, and coil voltage. _____
5. Check mechanical function of contactor and breaker. _____
6. Check wiring for proper identification. _____
7. Check conduits/cables for tagging. _____
8. Check components for identification. _____
9. Check equipment for conformance to area classification. _____
10. Check installation for seals, breathers, and drains. _____
11. Verify continuity of all power and control leads. _____
12. Check that power and control cable Insulation Resistance Test (megger) is completed. _____
13. Complete functional operation check of the control circuit using contract drawings and approved vendor drawings. Close and open the contactor using all control devices. _____

DISTRIBUTION:

CONTRACTOR/Date _____

240 V MOTOR CIRCUIT
TEST RECORD

EQUIPMENT DESIGNATION			
MOTOR TAG NO.		VOLTAGE	F.L.A.
KW/HP		RPM	S.F.
CIRCUIT BREAKER MFG.		RATING	SETTING
STARTER MFG.		SIZE	O/L HTR. SIZE
C.T. RATIO		O/L RELAY SETTING	
CONDUCTOR SIZE	POWER	GROUND	

1. Check motor starter for cleanliness. _____

2. Check nameplate data and tagging of motor starter components for conformance to approved vendor drawings. _____

3. Check conduits and/or cables for correct tagging. _____

4. Check equipment and installation for conformance to area classification. _____

5. Check main and auxiliary contacts of breaker and contactors. _____

6. Manually check mechanical operation of breaker, contactor, O/L relay, and O/L reset device. _____

7. Check continuity of power and control cables. _____

8. Complete functional operation check of the motor control circuit using the contract drawings and approved vendor drawings. Close and open the starter using all control devices. _____

9. Verify proper operation of motor winding space heater unit. _____

DISTRIBUTION:

CONTRACTOR/Date _____

ELECTRIC MOTOR RUN-IN
TEST RECORD

TEST EQUIPMENT: _____ REFERENCE DRAWING: _____

NOTES: 1. Duration of tests to comply with specifications.

TEST	REMARKS	INITIALS/DATE
RESISTANCE: Bonding resistance measured from motor frame to main ground/earth system tap. _____ ohms		
VOLTAGE (EACH PHASE): Actual voltage measured. _____, _____, _____ volts		
ROTATION CHECK: Bump motor to verify rotation. Motor to be uncoupled.		
NO LOAD CURRENT (EACH PHASE): At beginning of test _____ amps At end of test _____ amps		
TEMPERATURE OF BEARING: Check bearing for high temperature: Before start: 15 minutes after start 30 minutes after start 1 hour after start 2 hours after start 3 hours after start		
VIBRATION: Make visual inspection during run-test. Record any unusual vibration in remarks column.		
NOISE: Record any unusual noise in remarks column.		

DISTRIBUTION:

CONTRACTOR/Date_____

END OF SECTION

SECTION 26 05 10 – LOW-VOLTAGE ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 SUMMARY

A. Section Includes

1. Alternating current (AC) single-phase and three-phase induction motors, accessories, and appurtenances complete and operable, in conformance to the Contract Documents.

2. Motors shall be rated in accordance with NEMA standard MG-1, and shall be suitable for starting, accelerating, and running driven equipment using across-the-line starter, reduced voltage starter, soft starter or variable frequency drive as indicated in the Contract Documents.

3. Unless specified otherwise, electric motors are to be provided by the Supplier of the driven equipment, as an integral component of the driven equipment. Supplier of the driven equipment shall obtain the motor manufacturer's approval that the motors are appropriate for the intended use.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Standards

Institute of Electrical and Electronics Engineers (IEEE)	
IEEE 112	Polyphase Induction Motors and Generators - Testing
IEEE 114	Single Phase Induction Motors - Testing
National Electrical Manufacturers Association (NEMA)	
NEMA Std. MG1	Motors and Generators
American National Standards Institute / InterNational Electrical Testing Association (ANSI/NETA)	
ANSI/NETA ATS	Acceptance Testing Specifications for Electrical Power Equipment and Systems.
American National Standards Institute / American Bearing Manufacturers Association (ANSI / ABMA)	
ANSI/ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ANSI/ABMA 11	Load Ratings and Fatigue Life for Roller Bearings

B. Reference Codes

National Fire Protection Association (NFPA)	
NFPA 70	National Electrical Code

1.03 SUBMITTALS

A. General

1. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures and Section 26 00 10 – Electrical General Requirements.

B. Product Data

1. Submit sufficient information to determine compliance with the Contract Documents.

2. Annotate submittal data with the specific equipment tags and service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of the equipment that will be provided.

3. Provide Manufacturer's data sheets or catalog pages clearly identifying the make, model, part number, equipment and component ratings, selected options, and selected accessories.

    a. Include Manufacturer's data for environmental suitability, with all relevant listings (i.e., UL, NRTL).

    b. Include descriptive bulletins for equipment, including accessories.

C. Shop Drawings

1. Complete motor data shall be submitted with the Shop Drawings for the related driven equipment.

2. Motor data shall include:

    a. Tag, description, and specification number of driven equipment

    b. Motor manufacturer

    c. Motor type, model and dimension drawing. Include motor weight.

    d. Complete motor nameplate data

    e. Nominal power in horsepower or kilowatts

    f. NEMA MG 1 design

    g. Enclosure type, rating, and details

    h. NEMA frame size

    i. Winding insulation class and temperature rise class

    j. Voltage, phase, and frequency ratings

    k. Service factor

    l. Full load current at rated horsepower kilowatt for application voltage

    m. Locked rotor current

    n. Full load speed

    o. Guaranteed minimum full load efficiency. Also nominal efficiencies at ½ and ¾ load.

p. Type of thermal protection or overtemperature protection, where included.

q. Wiring diagram for accessory devices such as motor leak detection, temperature, or zero speed switches, as applicable.

r. Terminal box location, dimensions, and size of terminals. Include sealing arrangements.

s. Methods of connection to driven equipment and installation data.

t. Bearing data including part numbers. Include required lubricants for relubricatable type bearings. Provide insulated bearing details and information.

u. If used with a variable frequency controller, identify that the motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.

v. Shaft grounding details and information.

w. Power factor at ½, ¾, and full load.

x. Speed/torque characteristic. Include rated starting torque and breakdown torque information.

y. ABMA rated life for the motor bearings.

D. Test and Evaluation Reports

1. Contractor shall submit, with shop drawings, sample test forms as specified in Section 26 01 26 Electrical Tests.

E. Field Site Quality Control Submittals

1. Contractor shall submit documentation of successful testing, including completed test forms, as specified in Section 26 01 26 Electrical Tests.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

1. Contractor shall include the following operating and maintenance data for materials and products as per the requirements outlined in Division 01 and Section 26 00 10 – Electrical General Requirements:

1) Shop Drawings

2) Completed test forms

3) Manufacturer’s published operation and maintenance procedures, including recommended maintenance schedule.

4) List of spare parts

B. Warranty Documentation

1. Contractor shall provide manufacturer’s warranty documentation. Include this information in the submittal of operation and maintenance data.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts

1. Contractor shall provide a recommended spare parts list with the following information provided as a minimum:

a. Contact information for the closest parts stocking location to the Owner.

b. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.

c. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.

2. Contractor shall provide spare parts for each type and size of unit furnished. At a minimum, the following shall be provided:

a. Provide the minimum spare parts recommended by the manufacturer.

3. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall handle and store the products in accordance with the manufacturer’s written requirements.

B. Prior to delivery, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation, energize motor space heaters if recommended by the manufacturer. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

C. Protect motors from moisture, condensation and duct during shipping, storage, and installation.

D. Inspect and report any concealed damage or violation of delivery, storage, and handling requirements.

1.07 WARRANTY

A. Manufacturer Warranty

1. Contractor shall purchase and provide an extended manufacturer’s warranty.

a. The manufacturer shall warrant products against defects in material and workmanship for 24 months from the date of commissioning or 36 months from the date of shipment, whichever comes first.

b. During the warranty period the manufacturer shall repair or replace defective products.

c. This warranty shall be in addition to any provided by the Contractor.

d. The warranty shall exclude normal wear and tear under normal usage and any damage caused by abuse, modification, or improper maintenance by entities other than the manufacturer or its approved representative.

2. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 -- PRODUCTS

2.01 MOTORS

A. Acceptable Manufacturers

Note that the manufacturers below are listed in alphabetical order, not in order of preference.

1. **Allen-Bradley**
2. **Baldor**
3. **Flygt / Xylem** (integral to submersible pumps from same manufacturer)
4.
5. **Teco-Westinghouse**
6. **U.S. Motors**
7. **WEG**

B. Performance / Design Criteria

1. Exempt Motors

a. Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment (i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus) may be exempted from these requirements to the extent that such variations reflect a necessary condition of motor service or a requirement of the driven equipment. Exemption requires Engineer's approval.

2. Motor Capacity

a. Size motors for the larger of the following criteria:

1) Size motors to continuously carry the maximum load that develops across the full range of driven equipment without overloading under all operating conditions.

2) Size motors for minimum size, where indicated on Contract Documents.

3) Design motor so it can be restarted, using full voltage starting, after an immediate trip, and subsequently at an interval as defined below. Manufacturer of the driven equipment shall advise where motor capable of shorter restart intervals is required or recommended for the application. Minimal intervals for subsequent restart are as follows:

a) Up to 100 hp: 15 minutes

b. Coordination and adjustments to sizing of related electrical distribution equipment and materials (i.e., circuit breakers, starters, conductors, and raceways):

1) Where motor sizing required differs from sizing shown on the Contract Documents (i.e., to suit load characteristics of driven equipment and/or due to derating requirements), the Contractor shall coordinate and confirm sizing of associated electrical equipment and materials.

2) Where required, adjustments to the sizing of related equipment and materials shall be provided as part of the Work.

3. Site Conditions

a. Motor size shall be derated from nameplate values based on site conditions listed herein:

1) Ambient Temperature

a) For ambient temperatures up to but not exceeding 104 deg F 40 deg C, no derating is required.

b) For ambient temperatures exceeding 104 deg F 40 deg C, but less than 122 deg F 50 deg C, derate nameplate ratings to 85 percent.

2) Site Altitude: No derating is required for altitudes less than 3300 ft 1000 m above sea level.

C. Materials

1. Unless specified otherwise, provide all motors with:

a. Frame: Cast iron, steel, or cast aluminum

b. Endplates: Cast iron or cast aluminum

c. Terminal boxes: Cast iron, steel, or cast aluminum

d. Corrosion resistant cast metal fan blades and shrouds for fan-cooled motors

e. Hardware: Stainless steel

f. Windings: Copper with non-hygroscopic insulation

D. Ratings

1. Electric motors shall comply with NEMA MG-1. Motors greater than 10HP shall comply with NEMA MG-1, Part 31, and shall be clearly identified as “Inverter Duty”.

2. Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than specified in NEMA MG 1. Motors shall be suitable for the indicated starting method.

3. Low voltage motors shall have voltage ratings in accordance with the following, unless stated otherwise:

    a. Motors below ½ hp shall be rated 115 volts, single phase, 60 Hz. Dual voltage motors below ½ hp shall be rated 115/230 volts with all leads brought out to the terminal box.

    b. Motors ½ hp and larger shall be as shown on the Contract Drawings. Dual voltage motors are acceptable, provided every lead is brought out to the conduit box.

4. Three phase motors shall be provided with minimum Class F insulation, rated to operate at a maximum ambient temperature of 104 deg F 40 deg C and at altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG-1.

    a. Single phase motors shall have Class F insulation with temperature rise not to exceed insulation class.

5. Motors to be operated from variable frequency drives shall be provided with insulation systems to withstand voltage spikes as defined in NEMA MG 1-31.4.4.2.

    a. The Contractor shall coordinate with the variable frequency drive manufacturer and the motor manufacturer to determine when additional dV/dT protection is required for the application. Where required, it shall be furnished and installed as per the manufacturer’s written instructions.

6. Motors less than 100 hp located shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15 unless otherwise indicated.

7. NEMA Premium Efficiency Motors

    a. Motors with a nameplate rating of 1 hp and larger shall be NEMA premium efficient units.

    b. Motors shall be stamped with the efficiency on the nameplate with the caption “NEMA Nominal Efficiency” or “Nema Nom. Eff.” Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.

    c. Efficiency: Nominal efficiency and minimum efficiency shall be defined in accordance with NEMA MG1, Table 12-12. Both efficiencies shall be included in the Shop Drawing submittal.

E. Components and Accessories

1. Horizontal motors 3 HP and larger, and every vertical motor, shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Where conduit sizes indicated do not match the motor terminal box, the Contractor shall provide means to accommodate the motor requirements. Motor boxes shall be gasketed. Provide diagonally split, gasketed, terminal boxes complete with threaded hub for conduit entry. Conductors in terminal boxes will be connected to compression connectors.

2. Bearings

    a. Bearings shall conform to the standards of the American Bearing Manufacturers Association, Inc. (ABMA), except as indicated herein.

    b. Motors greater than 2 hp shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

    c. Motors with fractional horsepower through 2 hp shall be provided with lubricated-for-life ball bearings.

    d. Horizontal motors over 2 hp shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

    e. Vertical motors larger than 2 hp shall be provided with relubricatable ball, spherical roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

    f. Insulated bearing(s) shall be provided for motors greater than 10 HP to prevent circulating bearing currents.

3. Lifting devices: Motors weighing 265 lb 120 kg or more shall have suitable lifting eyes for motor installation and removal.

4. Grounding lugs: Provide motor grounding lugs suitable to terminate ground wire, sized as indicated.

5. Special requirements: The Contractor shall refer to individual equipment specifications for special requirements such as motor winding thermal protection or multi-speed windings.

6. Current imbalance

    a. Do not exceed the current imbalance values allowed by the motor manufacturer when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system.

    b. Base imbalance criteria upon the highest value measured.

7. Winding Overtemperature Protection

    a. Provide stator winding overtemperature protection on all motors rated 10 hp and larger. Motors rated less than 10 hp to have stator winding overtemperature protection when required by the specific equipment specification section, or if recommended by the driven equipment manufacturer.

b. Thermostats: Overtemperature protection for motors rated 10 hp and larger and other motors, where specified and/or indicated on control schematics, shall be normally-closed, snap action, bimetallic, temperature actuated switches installed in the connection end-turns of the motor windings. The contacts shall be connected to shut down the motor upon excessive winding temperatures. Thermostats shall automatically reset. Leads shall be brought out to the main conduit box.

8. Vibration Monitoring

9. Cooling Fans

   a. Fabricate cooling fans from non-sparking, corrosion-resistant material.

10. Anti-Condensation Heaters

    a. Provide anti-condensation heaters on all motors rated 10 hp and larger suitable for connection to a 120-volt, single-phase, 60 Hz source.

11. Nameplate

    a. Provide motor nameplates on engraved or stamped stainless steel. Include information enumerated in NEMA Standard MG1, paragraph 10.37, 10.38 or 20.60, as applicable.

    b. Additionally, indicate:

       1) The AFBMA L-10 rated life for the motor bearings for motors 50 hp and larger.

       2) The nominal efficiency for all motors.

    c. Permanently fasten nameplate to the motor frame in a position to be easily visible for inspection.

F. Assembly

1. Factory Assembly

   a. Motors as part of an assembly are to be aligned and balanced with the related equipment at the factory to minimize vibration and undue stresses.

G. Source Quality Control

1. Tests and Inspections

   a. Test motors in accordance with NEMA MG-1, including winding resistance, no load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

   b. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the Engineer.

2. Non-Conforming Work

    a. A failure on any portion of the test will result in the rejection of the motor. The manufacturer shall repair or remediate noted deficiencies and retest at their expense until all tests are successfully carried out within the limits set out in the project schedule and other sections of this specification.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.

B. The motor frame and shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer's recommendations and as required by code.

C. Related electrical Work involving connection, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 26.

D. Ensure the motor is properly aligned.

E. Provide lamacoid label with equipment tag to clearly identify the motor.

F. Make connections with liquid-tight PVC jacketed flexible conduit between rigid conduit and motor. Ensure flexible conduit is long enough to allow removal of the motor without disconnecting wiring.

G. Check for correct direction of rotation.

H. Install anchor devices in accordance with requirements of the manufacturer.

I. Shaft Grounding Rings

    1. Shaft grounding rings (SGR) shall be factory installed inside the motors by the manufacturer wherever possible. SGRs may be field installed by the Contractor subject to Engineer's approval.

    2. Provide **AEGIS SGR Colloidal Silver Shaft Coating**, or approved equal, on shafts prior to rings installation, per SGR manufacturer's recommendations, after first cleaning shafts.

    3. Install and test SGRs in accordance with manufacturer's recommendations. Install the SGR so that the aluminum frame maintains an even clearance around the shaft. Conductive microfibers shall be in full circumferential contact with conductive metal surface of the shaft. Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground. If thread lock is required, use a small amount of **EP2400 AEGIS Conductive Epoxy**, or approved equal, to secure the screws in place.

    4. Shafts shall be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending upon the condition of the shaft, it may require using emery cloth or **Scotch-Brite**. If the shaft is visibly clean, a non-petroleum-based solvent may be used to remove any residue. Check the conductivity of the shaft using an ohm meter. Ohms test: Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general one should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.

3.02 SITE QUALITY CONTROL

A. The Contractor shall perform the following field tests (see also Section 26 01 26 Electrical Tests:

1. Perform mechanical tests to ensure equipment is coupled and aligned properly.
2. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation. Test the motor under operating conditions and measure and record each phase voltage and current and provide a written report to the engineer. Immediately identify and correct the cause any deviation of voltage or current. Do not continue to operate the motor until this work is done.
3. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.
4. Test insulation (Megger test) of new and re-used motors in accordance with ANSI/NETA ATS-current addition. Exercise caution in selecting the correct megger equipment and the correct test voltage and procedure for the specific motor. Determine whether the results meet or exceed the expected test result established by the standard. Provide a written report to the engineer including measured values and indicating pass or fail.
5. After motors with SGR are fully installed in the field, for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Place one probe on metal frame of SGR and one probe on motor frame. Motor must be grounded to common earth ground with variable frequency drive according to applicable standards. Verify that SGR installations and test readings comply with SGR manufacturer’s requirements.
6. Check winding and bearing temperature detectors for functional operation.
7. Visually check that motor overload heaters are properly sized and that motor circuit protector (MCP) breaker settings are correct for the motor.
8. Before operating, confirm that rotation-checking can be done without damage to the connected equipment. If necessary to protect equipment, uncouple the motor from the equipment. Check for correct rotation.
9. Complete motor data form per paragraph 1.03.

3.03 ATTACHMENTS

END OF SECTION

Forms

Motor Data Form

Motor Data Form

Equipment Name _____ Equipment Number(s) _____

Site Location _____

Nameplate Markings

Mfr _____ Model _____ Frame _____ HP _____ _____

Volts _____ Phase _____ RPM _____ Service factor _____

FLA _____ LRA _____ Freq _____ Amb temp rating __ °C

Time rating _____ (NEMA MG1-10.35) Design letter _____ (NEMA MG-1.16)

KVA code letter _____ Insulation class _____

The following information is required for explosionproof motors only:

A. Approved by UL for installation in Class _____, Div _____

B. UL frame temperature code _____; Group Atmosphere (NEC Tables 500-2 and 500-2(b))

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load or NEMA efficiency index _____ (NEMA MG1-12.53b)

B. Nameplate or nominal efficiency _____

Data Not Necessarily Marked on Nameplate

Type of enclosure _____ Enclosure material _____

Temp rise _____ °C (NEMA MG1-12.41,42)

Space heater included? _____Yes _____No; if Yes, _____watts _____volts

If applicable, maximum power factor capacitor _____ kVA

Type of motor winding overtemperature protection, if specified:

_____

Use the space below to provide additional information on other motor modifications, if specified:

_____

SECTION 26 05 19 - WIRE AND CABLING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The Contractor shall provide wire and cable, complete and operable, in accordance with the Contract Documents.

B. In the event that motors provided are larger horsepower than the motors indicated, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the increased motor horsepower in accordance with Section 26 05 10 – Low-Voltage Electric Motors. Revisions are part of the WORK of this Section.

1.2 ACTION SUBMITTALS

A. The Contractor shall submit Shop Drawings in accordance with Sections 01 33 00 – Submittal Procedures and 26 00 10 – Electrical General Requirements. Submit cable test results in accordance with this Section as well as Section 26 01 26 – Electrical Tests.

1.3 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall protect all cables from damage at all times.

B. Cable ends shall be protected from water entry in accordance with the manufacturer’s recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become submerged prior to splicing or termination, the cables shall be replaced in their entirety.

C. Cables shall be pulled into raceways in accordance with the manufacturer’s requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer’s written instructions.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

A. Conductors, include grounding conductors, shall be stranded copper. Aluminum conductor and/or solid conductor wire and cable will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

B. Low Voltage Power and Lighting Wire

1. Wire rated for 600 volts in duct or conduit for power and lighting circuits shall be single conductor, Class B Type XHHW or XHHW-2 cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any power or control wiring in this project.

2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

3. 3. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Wiring for 600-volt class power and lighting shall be as manufactured by **Okonite**, **General Cable**, **Southwire**, or equal.

C. Low Voltage Control Wire

1. Low voltage control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2. Control wiring shall be No.14 AWG.

3. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by **American, General Cable,** or equal.

D. Instrumentation Cable

1. Instrumentation cable shall be rated at 300 volts, minimum.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-clear for 2 conductor cable and black-red-clear for 3 conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 or larger AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.047-inches.

4. Single pair, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8719,** similar by **General Cable,** or equal.

5. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8618,** similar by **General Cable,** or equal.

E. Cable Splices and Terminations

1. Where cable lugs are required for power cable terminations, utilize compression lugs – **3M Scotchlok 30000 and 31100 Series**, **Penn Union HBBLU** and **BLU**, **Burndy Hylug**, or equal. Utilize compression tools as recommended by the manufacturer. Pressure type, twist-on connectors (wire nuts) will not be acceptable.

2. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy**, or equal.

3. General purpose insulating tape shall be **Scotch No. 33**, **Plymouth Slip-knot**, or equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M,** or equal.

4. Labels for coding 600-volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by **W.H. Brady, 3M**, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The Contractor shall provide, terminate and test all power, control, and instrumentation conductors.

B. The Contractor shall, as a minimum, provide the number of control wires listed in the conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.

C. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.

D. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

E. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be neatly fanned out to terminals.

3.2 FIELD ASSEMBLY

A. General

1. Wire taps and splices shall be properly taped and insulated according to their respective classes.

2. In general, there shall be no cable splices. If splices are necessary, the cables shall be spliced using submersible cable splices, suitable for continuous submergence. Splices in below grade may be made only with the approval of the Engineer.

3. Stranded conductors shall be terminated directly on equipment box lugs making sure that conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4. Excess control and instrumentation wires shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin, and be neatly coiled.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In control panels, control wire and spare wire shall be terminated to terminal strips.

3. The Contractor shall provide as a minimum the number of control wires listed in the conduit schedule or as indicated in the Contract Documents. Excess wires shall be treated as spares.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.

2. Two and 3 conductor shielded cables installed in conduit runs which exceed available standard cable lengths may be spliced in pullboxes with the prior approval of the Engineer. Such cable runs shall have only one splice per conductor.

D. Power Wire and Cable

1. 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor. Cables rated above 2,000 volts shall be spliced or terminated only at equipment terminals indicated.

2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape.

E. Cable Identification

1. General: Wire and cable shall be identified for proper control of circuits and equipment and to reduce maintenance effort. Identification shall be installed at every termination point.

2. Identification Numbers: The Contractor shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3-inches of conductor terminals. "Control and Instrumentation Conductors" shall be defined as any conductor used for control, interlock, alarm, annunciator, or signal purposes.

   a. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.

   b. 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white. The 120/240-volt system conductors shall be color coded as follows: Line 1 - Black, Line 2 - Red, Neutral – White, and 208-volt high leg where present - Orange. The 480/277-volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs. Color coding tape shall be used where colored insulation is

not available. Colored identification tape may be used on conductors between the local disconnect and the load, where permitted by the NEC. Any phase changes necessary for proper rotation shall be made at the driven equipment where colored insulation is used. Phase changes may be made on the load side of the local disconnect, where phase colors are identified using tape.

c. General purpose AC control cable shall be red. General purpose DC control cable shall be blue.

d. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

e. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

3.3 FIELD QUALITY CONTROL

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-95-658/NEMA WC70 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01 33 00 – Contractor Submittals, prior to shipment of cable. The following field tests (in addition to the tests specified in Section 26 01 26 – Electrical Tests) shall be the minimum requirements:

1. Insulation resistance testing, using a DC megohmeter, shall be performed on cables operating at more than 2,000 volts to ground. Time-resistance readings shall be taken and recorded at intervals of 30 seconds and one minute. Time-resistance voltage levels shall be per the cable manufacturer's recommendations.
2. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.
3. Field testing shall be done after cable is installed in the raceways.
4. Field megger testing may be performed by the Contractor or a NETA-certified test organization. When tested by the Contractor, submit test equipment calibration sheets prior to performing any field testing. Test results shall be submitted to the Engineer for review and acceptance.
5. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cable shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cable in service.

END OF SECTION

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SECTION 26 05 33 - ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide electrical raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures, and Section 26 00 10 - Electrical General Requirements.

B. Shop Drawings

1. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

2. As-Built Drawings

a. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

b. Furnish the drawings to the Engineer in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.

2.2 CONDUIT

A. Rigid Galvanized Steel (RGS) Conduit

1. Provide rigid steel conduit manufactured from mild steel, hot-dip galvanized inside and out.

2. Provide rigid steel conduit manufactured in accordance with NEMA C80.1 – Electrical Rigid Steel Conduit, and UL-6 – Electrical Rigid Metal Conduit - Steel.

3. Manufacturer, or Equal

a. **Allied Tube & Conduit**

b. **Triangle**

c. **Wheatland Tube**

B. PVC Rigid Non-Metallic Conduit

1. Provide rigid non-metallic conduit manufactured from Schedule 40 or Schedule 80 PVC, as indicated, and sunlight-resistant.
2. Provide rigid non-metallic conduit manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.
3. Manufacturer, or Equal
    a. **Carlon**
    b. **Cantex**

C. Rigid PVC-Coated Galvanized Steel (RPGS) Conduit
1. The conduit shall meet the requirements for RGS conduit as indicated above.
2. Bond a PVC coating to the outer surface of the galvanized conduit.
3. Ensure that the bond between the coating and the conduit surface is greater than the tensile strength of the coating.
4. Provide the inside surfaces and threads of the conduit with a 2-mil urethane coating.
5. Provide a PVC coating thickness not less than 40 mils.
6. The PVC-coated RGS shall be manufactured in accordance with the following standards:
    a. UL-6
    b. ANSI C80.1
    c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
7. Manufacturer, or Equal
    a. **Robroy Industries**
    b. **O'Kote**
    c. **Thomas & Betts**

D. Liquid-Tight Flexible Conduit
1. Provide liquid-tight flexible conduit constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.
2. Provide liquid-tight flexible conduit manufactured in accordance with the requirements of UL-360 - Steel Conduits, Liquid-Tight Flexible.
3. Manufacturer, or Equal
    a. **Anaconda, Sealtite**
    b. **Electriflex, Liquatite**

E. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General

1. For use with metallic conduit, provide cast and malleable iron fittings of the threaded type with 5 full threads.
2. Fittings and Boxes
    a. Provide fittings and boxes with neoprene gaskets and non-magnetic stainless steel screws.
    b. Attach covers by means of holes tapped into the body of the fitting.
    c. Covers for fittings attached by means of clips or clamps will not be accepted.
3. Provide boxes larger than standard cast or malleable types manufactured of Type 304 or Type 316 stainless steel, NEMA 4X.
4. Terminations
    a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or equal.
    b. In other than outdoor areas, provide sealed locknuts and bushings.

B. Malleable Iron Fittings and Boxes

1. For use with galvanized steel conduit, provide fittings and boxes constructed of malleable iron or gray-iron alloy with zinc plating.
2. Manufacturer, or Equal
    a. **O.Z. Gedney**
    b. **Crouse-Hinds**
    c. **Appleton**

C. PVC Fittings and Boxes

1. For use with rigid non-metallic conduit, provide fittings manufactured of solvent-welded PVC.
2. Provide boxes manufactured of PVC or fiberglass reinforced polyester (FRP).
3. Manufacturer, or Equal
    a. **Carlon**
    b. **Crouse-Hinds**
    c. **Hoffman**
4. Provide welding solvent as required for the installation of non-metallic conduit and fittings.

D. PVC-Coated RGS Fittings

1. For use with PVC-coated RGS, provide PVC-coated coated that are the products of the same manufacturer as the conduit.
2. Provide male and female threads and internal surfaces with a 2-mil urethane coating.

E. Stainless Steel Boxes

1. Provide stainless steel boxes with PVC-coated RGS conduit and where indicated.
2. Provide NEMA 4X stainless steel boxes, constructed of Type 304 stainless steel.
3. Provide stainless steel of a minimum of 14-gauge thickness, with a brushed finish.
4. Door Hinges
    a. Provide doors with full-length stainless steel piano hinges.
    b. Non-hinged boxes will not be accepted.
5. Manufacturer, or Equal
    a. **Hoffman**
    b. **Rohn**
    c. **Hammond**

F. Sheet Steel Boxes

1. Sheet steel boxes shall be galvanized steel outlet and switch boxes.
2. Manufacturer, or Equal
    a. **Raco**
    b. **Steel City**
    c. **Appleton Electric**

2.4 WIREWAY

A. General

1. Provide wireway of the lay-in type and NEMA-rated for the area in which it is to be installed in accordance with the requirements of Section 26 00 10 - Electrical General Requirements.
2. Separate power, control, signal and communications cables by grounded metallic dividers in wireways or run in separate wireways.

B. Fittings and Covers

1. Provide fittings and sections with non-magnetic stainless steel screws.
2. Attach covers by hinges and clamps to the bodies.
3. Covers attached by means of clips or screws will not be accepted.
4. Provide covers and bodies constructed of aluminum or minimum 14-gauge steel.

C. Grounding

1. Ground the steel and aluminum wireway bodies.
2. Provide steel dividers with steel wireways or aluminum dividers with aluminum wireways, and ground by means of an individual grounding conductor.
3. Non-metallic dividers will not be accepted.

D. Terminations

1. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, or equal.
2. In other than outdoor areas, provide sealed locknuts and bushings.

PART 3 -- EXECUTION

3.1 GENERAL

A. Run wiring in raceway unless indicated otherwise.

B. Install raceways between equipment as indicated.

C. Provide raceway systems that are electrically and mechanically complete before conductors are installed.

D. Bends and Offsets

1. Provide bends and offsets that are smooth and symmetrical, and accomplished with tools designed for this purpose.
2. Provide factory elbows wherever possible.

E. Combined Raceways

1. Raceways other than those containing power conductors may be combined in strict accordance with the NEC and with prior written permission from the Engineer.
2. In general, combine only raceways containing the same type (control, signal, and the like) and voltage of conductors/cables, or dedicated conduits from one source to one device/equipment, in accordance with the NEC.
3. Permission from the Engineer shall not relieve the Contractor of responsibility to meet national, state and local requirements.

F. Routing

1. Where raceway routings are indicated, follow those routings to the extent possible.
2. Where raceways are indicated but routing is not indicated, such as home runs or on conduit developments and schedules, raceway routing shall be the Contractor's choice and provided in strict accordance with the NEC as well as customary installation practice.
3. Provide the raceway encased, exposed, concealed, or under-floor as indicated, except conceal conduit in finished areas unless specifically indicated otherwise.
4. Adjust routings in order to avoid obstructions.

G. Coordination

1. Coordinate between trades prior to installing the raceways.
2. The lack of such coordination shall not be justification for extra compensation, and any costs for removal and re-installation to resolve conflicts shall be part of the Contract Price.

H. Install exposed raceways parallel or perpendicular to structural beams.

I. Expansion Fittings

1. Install expansion fittings with external bonding jumpers wherever exposed raceways cross building expansion joints.

2. Install expansion/deflection fittings where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur.

3. Encased Expansion Fittings

   a. Install encased expansion fittings wherever encased conduits cross building expansion joints.

   b. Deflection type fittings shall not be required for encased conduits crossing an expansion joint within a single structure.

4. Provide expansion and expansion/deflection fittings constructed of the same material as the raceway to which they are installed.

J. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

K. Install exposed raceways at least 1/2 inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, install exposed raceways at least 1/4 inch from the face of walls or ceilings by the use of clamp backs or struts.

L. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, provide a means of suitable insulation in order to prevent such corrosion.

3.2 CONDUIT

A. Provide exposed conduit manufactured of rigid galvanized steel, except as follows and unless indicated otherwise:

1. In chemical areas, provide Schedule 80 PVC conduit.

2. For conduit containing only grounding system bonding conductors, provide Schedule 80 PVC conduit.

B. Power conduit encased in concrete shall be constructed of Schedule 40 PVC.

C. Analog control or instrumentation conduit shall be RGS.

D. Concrete Encasement

1. Where PVC or RGS conduit is stubbed up from a concrete encasement, provide a PVC-coated RGS elbow.

2. The conduit shall emerge from the concrete in a direction perpendicular to the surface whenever possible.

3. Do not encase conduit in the bottom floor slab below grade.

E. Size

1. Provide exposed conduit of 3/4-inch minimum trade size.

2. Provide encased conduit of one-inch minimum trade size.

F. Install supports at distances required by the NEC.

G. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4 inch for concrete not exposed to weather or in contact with the ground.

H. Penetrations

1. Provide conduit passing through walls or floors with plastic sleeves.
2. Perform core drilling in accordance with the requirements of 26 00 10 - Electrical General Requirements.
3. Conduits passing through a slab, wall, or beam shall not significantly impair the strength of the construction.

I. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall meet the following requirements:
1. Conduits with their fittings embedded within a column shall not displace greater than 4 percent of the gross area of cross section;
2. Conduits shall not be larger in outside dimension than 1/3 the overall thickness of the slab, wall, or beam in which it is embedded; and,
3. Conduits shall not be spaced closer than 3 outside diameters on centers.

J. Place the conduit such that cutting, bending, or displacing reinforcement from its proper location will not be required.

K. Coat threads with a conductive lubricant before assembly.

L. Joints
1. Provide joints that are tight, thoroughly grounded, secure, and free of obstructions in the pipe.
2. Adequately ream the conduit in order to prevent damage to the wires and cables inside.
3. Use strap-wrenches and vises to install the conduit, in order to prevent wrench marks on the conduit.
4. Replace conduit with wrench marks.
5. Where installed in chemical or fuel containment areas, the conduit shall not have joints or fittings located below the top of the containment area to prevent entry of chemicals or fuel into the conduit system.

M. Slope
1. Wherever possible, slope the conduit runs to drain at one or both ends of the run.
2. Wherever conduit enters a substructure below grade, slope the conduit in order to drain water away from the structure.
3. Take extreme care in order to avoid pockets or depressions in the conduit.

N. Where conduits from duct banks enter building walls below grade, transition to PVC-coated RGS at least 12” outside the wall. Installation of PVC-coated rigid steel conduit though a core-drilled hole in an exterior wall below-grade shall utilize a sealing device as manufactured by **Link Seal**, or equal.

O. Connections
1. Make connections to lay-in-type grid lighting fixtures by using flexible metal conduit not exceeding 4 feet in length.
2. Make connections to motors and other equipment subject to vibration by using liquid-tight flexible conduit not exceeding 3 feet in length.

3. Provide equipment subject to vibration that is normally provided with wiring leads with a cast junction box for the make-up of connections.

P. Duct sealant shall be foam duct sealant such as **Polywater FST or approved equal.** Provide duct sealant at the following locations:

1. Where required by NEC Article 300.7.

Q. Empty Conduits

1. Tag empty conduits at both ends to indicate the final destination.
2. Where it is not possible to tag the conduit, identify the destination by means of a durable marking on an adjacent surface.
3. Install a pull-cord in each empty conduit in floors, panels, manholes, equipment, and the like.
4. Install a removable plug on empty conduits that terminate below grade, in vaults, manholes, handholes, and junction or pullboxes.

R. Identification of Conduits

1. Identify conduits at ends and at pulling points.
2. Identification shall be the unique conduit number assigned in the Contract Documents.
3. Other than 120 VAC panelboard circuits, if a conduit has not been assigned a unique number in the Contract Documents, assign a unique number following the numbering scheme used in the Contract Documents.
4. Provide conduit identification by a stamped or engraved non-corroding metal tag attached to the conduit bushing.
5. Provide an engraved phenolic nameplate in accordance with the requirements of Section 26 00 10 - Electrical General Requirements, or a computer printed self-adhesive label attached to the equipment or enclosure inside which the conduit terminates.
6. Markings with a pen or paint will not be accepted.

S. Identification of Pullboxes and Junction Boxes

1. Identify pullboxes and junction boxes.
2. Identification shall be the unique conduit number assigned in the Contract Documents, or if not assigned a unique number the Contractor shall assign one following the numbering scheme used in the Contract Documents.
3. Provide box identification by a stamped or engraved non-corroding metal tag or an engraved phenolic nameplate, in accordance with the requirements of Section 26 00 10 - Electrical General Requirements, and attached to the box or enclosure.
4. Markings with a pen or paint will not be accepted.

T. Provide conduit for data cables in accordance with the equipment manufacturer's recommendations, especially regarding separation from low- and medium-voltage power raceways.

END OF SECTION

SECTION 26 05 36 - WIRING DEVICES

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The Contractor shall provide wiring devices, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 26 00 10 – Electrical General Requirements apply to this Section.

C. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings

1. Submit complete catalog cuts of switches, receptacles, enclosures, covers and appurtenances, marked to clearly identify the proposed materials.

2. Submit documentation showing that the proposed materials comply with the requirements of NEC and U.L.

3. Submit documentation of the manufacturer's qualifications.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Devices shall carry the U.L. label, and shall be designed for use with stranded copper conductors.

B. Color

1. General purpose duplex receptacles and toggle switch handles shall be Brown everywhere except unless otherwise indicated.

2. Special purpose receptacles shall have a body color as indicated.

C. Receptacles and switches shall be of specification grade and shall conform to NEMA WD-1, Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

A. Toggle switches shall be AC only type switch.

1. 20A, 120/277V, Single, Double, 3-Way and 4-Way, Respectively

a. **Leviton**: 1221-2, 1222-2, 1223-2, 1224-2
b. **Hubbell:** HBL1221, HBL1222, HBL1223, HBL1224
c. **Pass and Seymour:** PS20AC1, PS20AC2, PS20AC3, PS20AC4
d. **Or Equal**

2.3 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles shall be of the polarized 3-wire type for use with a 3-wire cord with grounded lead, and one designated stud shall be permanently grounded to the conduit system in accordance with NEC article 406.4.

B. Damp/Wet Areas

1. Receptacles for damp/wet locations shall be weather-resistant with extra duty, in-use listed covers in accordance with NEC Article 406.8.

C. GFCIs

1. Ground-fault circuit-interrupting receptacles (GFCIs) shall be installed at the indicated locations and as required by the NEC.

2. GFCIs shall be duplex receptacles, of specification grade, and tripping at 5 mA.

3. GFCI ratings shall be 125V, 20 amperes, NEMA WD-1, Configuration 5-20R, and capable of interrupting 5,000 amperes without damage.

4. GFCIs shall be weather resistant-listed in accordance with NEC Article 406.8.

5. Feed-through-type GFCIs serving standard receptacles will not be permitted.

a. Leviton: G5362-WT
b. **Hubbel:** GFR5362SG
c. **Or Equal**

2.4 ENCLOSURES AND COVERS

A. Surface-mounted switches and receptacles shall be housed in FS or FD-type weatherproof conduit fittings.

B. Wet Locations

1. Receptacles in wet locations shall be provided with a hinged non-metallic Clear cover/enclosure marked "Suitable for Wet Locations when in use" and "UL Listed."

2. Provide a gasket between the enclosure and the mounting surface, and between the hinged cover and mounting plate/base.

a. **Appleton**: WCIU
b. **Crouse-Hinds**: TP74
c. **Hubbell TayMac:** Extra Duty
d. Or Equal

2.5 NAMEPLATES

A. Provide nameplates or equivalent markings on the switch enclosures to indicate the ON and OFF positions of each switch.

B. ON and OFF for 3-way or 4-way switches will not be accepted.

C. Provide receptacles for special purposes with nameplates indicating their use.

D. Nameplates shall meet the requirements of Section 26 00 10 – Electrical General Requirements.

PART 3 -- EXECUTION

3.1 GENERAL

A. Perform WORK in accordance with the requirements of the NEC.

3.2 CONNECTION

A. Rigidly attach wiring devices in accordance with the NEC and as indicated, avoiding interference with other equipment.

B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

C. Nameplates shall meet the requirements of Section 26 00 10 – Electrical General Requirements, and shall consist of a red plate with white letters a minimum of 1/4 inch tall.

3.3 GROUNDING

A. Devices, including switches and receptacles, shall be grounded in accordance with NEC, Article 250.

B. Switches and associated metal plates shall be grounded through the switch mounting yoke, outlet box, and raceway system.

3.4 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 00 10 – Electrical General Requirements.

B. Test each receptacle for polarity and ground integrity, using a standard receptacle tester.

END OF SECTION

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SECTION 26 29 23 – VARIABLE FREQUENCY DRIVE UNITS

PART 1 -- GENERAL

1.01 SUMMARY

A. Section Includes

1. The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, as indicated in accordance with the Contract Documents.
2. It is the intent of this Section to require complete, reliable, and fully tested variable frequency drive systems suitable for attended or unattended operation.
3. The work of this Section is required for installation, testing and operation of electrically driven equipment provided under Specifications in other Divisions.

B. The requirements of Section 26 00 10 - Electrical General Requirements, apply to the WORK of this Section.

C. Coordination

1. Equipment provided under this Section shall operate the electric motor driver and the driven equipment as indicated under other equipment specification Sections.
2. The CONTRACTOR'S attention is specifically directed to the need for proper coordination of the WORK under this Section and the WORK under the equipment Section.

1.02 ACTION SUBMITTALS

A. Submit Shop Drawings, Product Data, and samples in accordance with Section 01 33 00 – Submittal Procedures and this Section.

B. Shop Drawings - Include the following information:

1. Equipment Information.
   a. Name of drive manufacturer.
   b. Type and model.
   c. Assembly drawing and nomenclature.
   d. Maximum heat dissipation capacity in kW.
2. Ladder Diagram
   a. Submit the system schematic ladder diagram and interconnection diagrams.
   b. The schematic ladder diagram shall include remote devices.
   c. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic as indicated.
   d. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the CONTRACTOR stamped "REJECTED".
3. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements of this Section.

C. The Technical Manual shall include the following documentation:

1. Manufacturer's 2-year warranty.

2. Field test report.
3. Programming procedure and program settings.

D. Spare Parts List.

1. Submit information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS, OR EQUAL

A. **Eaton / Cutler-Hammer**

B. **Rockwell Automation / Allen-Bradley**

C. **Schneider Electric / Square D**

2.02 EQUIPMENT

A. General.

1. The power supply shall be an adjustable frequency inverter designed to convert incoming power to a DC voltage and then to adjustable frequency AC by use of an inverter.
2. Current-source inverters will not be accepted.
3. Inverters shall be sized to match the kVA and inrush characteristics of the motors actually provided.
4. The CONTRACTOR shall be responsible for matching the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled.

B. Inverter.

1. The inverter shall be of a voltage-source design, producing a pulse-width-modulated type output.
2. Current-source inverters will not be accepted.
3. Inverters shall be capable of delivering the nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers.
4. The VFD shall vary both the AC voltage and frequency simultaneously in order to operate the motor at required speeds.

C. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent efficiency at 50 percent speed and load.

D. Power Outage

1. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases.
2. Upon restoration of power and a START signal, the motor shall restart and run at the speed corresponding to the current process input signal.

E. The VFD shall be provided with the following features:

1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent).
2. Overload capability at 110 percent for 60 seconds for variable torque loads and 150 percent for constant torque loads.
3. Adjustable acceleration and deceleration.
4. Input signal of 4 - 20 mA from process.
5. Output speed signal of 4 - 20 mA; Signals other than 4 - 20 mA will not be accepted.
6. Upon loss of input signal, the VFD shall operate at a preset speed.
7. A minimum of 2 selectable frequency jump points in order to avoid critical resonance frequency of the driven system.
8. Additional devices and functions as indicated.
9. Ethernet TCP/IP I/O communications to transmit VFD data to/from a plant PLC-based control system.

F. The VFD shall be provided with, as a minimum, the following protection features:
1. Input line surge protection.
2. Protection against single phasing.
3. Instantaneous overcurrent protection.
4. Electronic overcurrent protection.
5. Ground fault protection.
6. Overtemperature protection for electronics.
7. Protection against internal faults.
8. Ability to start into rotating motor (forward or reverse rotation).
9. Additional protection and control as indicated and as required by the motor and driven equipment.

G. The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.
1. Elevation
a. Elevation to 3300 feet.
b. For elevation greater than 3300 feet, the VFD shall be derated in accordance with the manufacturer's recommendation.
2. Ambient Temperature: 0 to 40 degrees C.
3. Humidity: 0 to 95 percent, non-condensing.
4. AC Line-Voltage Variation: plus 10 percent to minus 10 percent.
5. AC Line-Frequency Variation: plus and minus 2 Hertz.

H. Electrical equipment provided in addition to the adjustable frequency inverter for each drive shall include:
1. 2-1/2-percent (minimum) line reactor integral to the drive enclosure.

2. Provide a dV/dT filter device at the motor or VFD output per the VFD and motor manufacturer's recommendation. Submit documentation demonstrating where such devices are required, along with mounting and cabling requirements.
3. fused 480-to-120-volt control transformer to provide system control power for the logic and pilot lamps.
4. Bypass Starters are not required.
5. Inverter Signal Circuits
6. The inverter signal circuits shall be isolated from the power circuits and shall be designed to accept an isolated 4-20 mA signal in the automatic mode of operation.
7. The inverter shall follow the setting of a remote or local potentiometer control while in the manual mode.
8. Refer to the Contract Drawings for speed control and START/STOP methods.
9. Access to set-up and protective adjustments shall be protected by user password.
10. The following operator monitoring and control devices for the inverter shall be provided on the face of the VFD enclosure, either as discrete devices or as part of a multi-function microprocessor-based keypad access device:
    a. AUTO/HAND selection from a remote logic relay or switch.
    b. While in AUTO, the inverter shall operate from the remote 4-20 mA input, where applicable, and while in HAND control shall operate from a local or remote manually operated speed potentiometer; speed pot ratings shall be coordinated with the supplier of the Local Control Station.
    c. Speed indicator calibrated in percent speed.
    d. Inverter fault trip pilot light and output alarm contacts.
    e. Trip reset pushbutton.
    f. RUN and OFF indicating lights.
    g. Provide other controls and readouts normally furnished as standard equipment, or as otherwise indicated on the Contract Drawings.
    h. Properly identified screw type terminal boards shall be provided for interconnection to remote controls and instrumentation.
    i. Pilot devices, control relays, time delay relays, elapsed time meters, and indicators provided as a part of the VFD equipment package shall meet the applicable requirements of Section 26 05 15 - Industrial Control Panels.

2.03 SPARE PARTS

A. The CONTRACTOR shall furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.

B. Modified Parts

1. At any time prior to Substantial Completion, the CONTRACTOR shall notify the ENGINEER in writing about any manufacturer's modification of spare part numbers, interchangeabilities, or model changes.

2. If the ENGINEER determines that the modified parts no longer apply to the equipment provided, the CONTRACTOR shall furnish other applicable parts as part of the WORK.

C. The following spare parts shall be furnished:

1. Provide one set of spare power fuses of each form, voltage, and current rating.

2. Provide 3 sets of spare power fuses of each type and rating.

3. Provide 5 sets of spare control fuses each type (form, voltage, and current rating).

4. Provide one set of any special tools required for maintenance of the VFD units

PART 3 -- EXECUTION

3.01 MANUFACTURER'S SERVICES

A. General

1. An authorized service representative of the manufacturer shall be present at the Site for 3 Days to furnish the services listed below.

2. For the purpose of this Paragraph, a Day is defined as an 8-hour period excluding travel time.

B. The authorized service representative shall supervise the following and shall certify that the equipment and controls have been properly installed, aligned, and readied for operation:

1. Installation of the equipment.

2. Inspection, checking, and adjusting the equipment.

3. Startup and field testing for proper operation.

4. Performing field adjustments such that the equipment installation and operation comply with requirements.

C. Instruction of OWNER's Personnel

1. The authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with test equipment.

2. The instruction shall be specific to the VFD models provided.

3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

4. Training shall include individual sessions for 1 shift of plant personnel.

5. Proposed training materials shall be submitted for review, and comments shall be incorporated.

6. Training materials shall remain with the trainees.

7. The OWNER may videotape the training for later use with the OWNER's personnel.

3.02 INSTALLATION

A. Programming

1. The CONTRACTOR shall perform programming of drive parameters required for proper operation of the VFDs included in this project.

2. Submit records of programming data in the equipment Technical Manual, including setup and protective settings.

3.03 FIELD TESTING

A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer.

B. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

C. Verify proper operation of control logic in every mode of control.

END OF SECTION

SECTION 33 92 20 - DUCTILE IRON PIPING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The Contractor shall provide ductile iron pipe and appurtenant Work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in for Water
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water
AWWA C153	Ductile-Iron Compact Fittings. for Water Service
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Joints
ASTM C 150	Portland Cement

1.3 CONTRACTOR SUBMITTALS

A. Furnish Submittals in accordance with Section 01 33 00 – Submittal Procedures and the following supplemental requirements:

B. Shop Drawings

1. Certified dimensional drawings of valves, fittings, and appurtenances.

2. fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at changes in grade or horizontal alignment; elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

C. Certifications: Certified affidavit of compliance for pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

D. The Contractor shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.4 QUALITY ASSURANCE

A. Tests: Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

B. The Contractor shall perform said material tests as part of the Work. The Engineer shall have the right to witness testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

C. In addition to those tests specifically required, the Engineer may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished as a part of the Work.

D. Inspection: Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The Contractor shall notify the Engineer in writing of the manufacturing starting date not less than 14 Days prior to the start of any phase of the pipe manufacture.

E. During the manufacture of the pipe, the Engineer shall be given access to areas where manufacturing is in process and shall be permitted to make inspections necessary to confirm compliance with the Specifications.

PART 2 -- PRODUCTS

2.1 PIPE GENERAL

A. Mortar-lined and polyethylene-wrapped ductile iron pipe shall conform to AWWA C151, C104, and C105 subject to the supplemental requirements in this Section. The pipe shall be of the diameter and class indicated, shall be provided complete with rubber gaskets, specials, and fittings as required under the Contract Documents.

B. Markings: The Contractor shall legibly mark specials 24-inches diameter and larger in accordance with the laying schedule and marking diagram. Each fitting shall be marked at each end with top field centerline.

C. Handling and Storage: The pipe shall be handled as a minimum at the 1/3 points by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be supported on padded skids, sand or earth berms free of rock exceeding 3-inches diameter,

sand bags, or suitable means so that the coating will not be damaged. The pipe shall not be rolled and shall be secured to prevent accidental rolling.

D. Laying Lengths: Nominal pipe laying lengths shall be 20-feet.

E. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

F. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing on the Drawings. The locations of correction pieces and closure assemblies are indicated. Any change in location or number of said items shall only be as accepted by the Engineer.

2.2 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of AWWA C153 or AWWA C110 and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inches shall conform to AWWA C153.

2.3 DESIGN OF PIPE

A. The pipe shall be designed, manufactured, tested, inspected, and marked according to AWWA C150 and C 151 except where modified by this Section.

B. Pipe Dimensions: The pipe shall be of the diameter and class indicated.

C. Fitting Dimensions: The fittings shall be of the diameter and class indicated.

D. Joint Design: Ductile iron pipe and fittings for buried pressure service shall be furnished with restrained joints, unless otherwise indicated. Ductile iron pipe and fittings for buried gravity service shall be furnished with mechanical joints or push-on joints as required, unless otherwise indicated. Above ground ductile iron pipe and fittings joints shall be as indicated. Flanged joints or grooved and shouldered joints shall be furnished where required.

1. Mechanical and push-on joints shall conform to AWWA C111.

2. Flanged joints shall conform to AWWA C115. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe.

3. Restrained joints shall be **Field-Lok** restrained joint by **U.S. Pipe**, **Flex-Ring** by **American D.I. Pipe**, or equal.

4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options for joint restraint available. Under such circumstances, the Contractor may propose such devices provided the following conditions are met and the request is made as a substitution:

a. A formal request for substitution is submitted stating the locations where the devices are intended to be used and a statement from the device manufacturer and the pipe manufacturer that the proposed device is appropriate for the intended installation and is rated at least for the class of the pipe being supplied.

b. A statement from the pipe manufacturer is provided accepting the use of the retaining devices and indicating that the use of such devices will in no way affect the warranty of the pipe and/or the performance of the pipe.

c. The manufacturer of the device and the pipe manufacturer jointly provide instruction on the proper installation of the device to the personnel installing the units and provide certification to the Owner that the installers are adequately trained in the installation of the units and that warranties are in full affect for the project.

d. The devices shall be **MegaLug Model 1100** as manufactured by **EBAA Iron** or equal. The restraint shall be stainless steel.

5. Grooved and Shouldered Joints shall meet the requirements of mechanical-type couplings in accordance with Section 40 05 01 – Piping General and conform to AWWA C606.

E. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

2.4 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

1. Cement: Cement for mortar lining shall conform to the requirements of AWWA C104; provided, that cement for mortar lining shall be Type II or V. Cement shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

B. The minimum lining thickness shall be as follows:

Nominal Pipe Diameter, inches	**Minimum Lining Thickness, inches**

3 - 12	1/16
14 - 24	3/32
30 - 64	1/8

2.5 EXTERIOR PROTECTION OF PIPE

A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 96 00 – High Performance Coating.

B. Polyethylene Sleeve: Sleeves shall conform to the requirements of AWWA C105, Contractor's choice between tubular 8-mil thick linear low-density film or 4-mil thick high-density cross-laminated film. Color shall be white**.**

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

A. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

B. Pipe Laying: The pipe shall be installed in accordance with AWWA C600.

C. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

D. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.

E. Pipe and Specials Protection: The openings of pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

F. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of debris. The Contractor shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying and shall perform any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.2 RUBBER GASKETED JOINTS

A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket shall be placed in the bell groove. The spigot end of the pipe and the inside surface of the gasket shall be carefully cleaned and lubricated. The lubricant shall be suitable for lubricating the parts of the joint for assembly and be a compound listed as in compliance with NSF Standard 61. The lubricant shall be nontoxic, shall not support the growth of bacteria, and shall have no deleterious effects on the gasket material. The lubricant shall not impart taste or odor to water in the pipe. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.3 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is dielectric-coated, buried appurtenances shall be coated in kind. Where pipe is encased in polyethylene sleeves, buried appurtenances shall be encased in polyethylene.

B. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust stem packing and operate each valve prior to installation to insure proper operation.

C. Valves shall be installed so that the valve stems are plumb and in the location indicated.

END OF SECTION

SECTION 33 05 05.50 – PRESSURE PIPE TESTING

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall test pipelines and appurtenant piping, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Definitions

1. Makeup water: The quantity of water that must be supplied into a pipeline section to maintain the specified test pressure during a hydrostatic pressure test.

2. Pigging: Passage of a sufficient number of pigs through a pipeline to achieve the clean conditions required.

3. Testing allowance: The maximum quantity of makeup water that may be added into a pipeline section undergoing hydrostatic pressure testing to maintain the specified test pressure.

4. Visible Leakage: The visible escape (e.g., drip, spray, stream, flow) of test liquid from the test section through components, joints, connections, appurtenances, and the like in the test section.

B. Reference Specifications

01 33 00	Submittal Procedures

C. Reference Standards

American National Standards Institute (ANSI) / American Water Works Association (AWWA)	
ANSI/AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in. Through 60-in
AWWA Manual M9	Concrete Pressure Pipe
AWWA Manual M41	Ductile-Iron Pipe and Fittings
AWWA Manual M55	PE Pipe - Design and Installation
ASTM International (ASTM)	
ASTM F2164	Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Furnish:

a. A testing plan and schedule for flushing and pigging, and hydrostatic testing. This shall include all equipment to be used including but not limited to pump, metering device, pressure gauge, etc., to be used for maintaining test pressure and measuring the amount of water required to maintain test pressure; method of connection of pump to pipeline; sections of pipeline to be tested with length and size of pipe, the exact area being tested, and the valves, plugs, caps, etc., being tested against indicated; and allowable loss calculations.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Liquid Chlorine (Gas) Technician: Shall be familiar with the biological, chemical, and physical properties of liquid chlorine (gas) and be trained and equipped to handle emergencies that may arise.

PART 2 -- PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the Contractor. No materials shall be used that would be injurious to the WORK

B. Pressure Monitoring: A pressure gage or sensor accurate to within 2 percent of full scale, with full scale not to be more than twice the test pressure and scale graduations no greater than 2 percent of the full scale.

PART 3 -- EXECUTION

3.01 GENERAL

A. Hydrostatic pressure testing shall be performed for all pressure pipelines. Potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the Engineer.

B. Disposal of flushing water shall be by methods acceptable to the Engineer.

C. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the Work is accepted by the Owner. Results of the bacteriological testing shall be satisfactory with the state Department of Health or other regulatory agency having jurisdiction.

3.02 FLUSHING AND PIGGING

A. Flushing is recommended prior to a pressure test to reduce the probability of foreign material causing valve-seat or hydrant-seat leakage during pressure tests. Flushing should be accomplished by partially opening and closing valves and hydrants several times under expected line pressure, with flow velocities adequate to flush foreign material out. The pipeline flow velocity shall be no less than 3.0 ft/s.The duration of the initial flushing procedure shall be continued until the discharge appears clean; however, the minimum duration shall be based sufficient that a minimum of three changes of pipeline volume occurs.

B. For larger mains or where conditions do not permit the required flow to be discharge to waste, pigging shall be required. The Contractor shall clean the system thoroughly by pigging to remove sand, grit, gravel, stones, fluids, construction waste, and all material which would not be found in a properly cleaned pipeline. Pigging shall obtain a smooth interior pipe surface free from any material or fluid not used in cleaning.

1. Provision for pig access and egress points and disposal of water and materials shall be the Contractor's responsibility.

2. Pigs shall be individually marked and their location shall be controlled and monitored so that no pigs remain in the system after cleaning.

3. Pigging may be done in conjunction with initial filling for the hydrostatic test.

3.03 HYDROSTATIC TESTING OF CONCRETE, DUCTILE IRON, PVC, AND WELDED STEEL WATER PIPELINES

A. General Requirements:

1. The Contractor shall test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline or, where such valves are not present, the Contractor shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero leakage allowance may be tested as a unit.

2. The Contractor shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment.

3. The Contractor shall remove or protect pipeline-mounted devices that may be damaged by the test pressure.

4. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 days.

5. Hydrostatic testing shall be conducted in accordance with this Section and requirements of the following:

a. Concrete pressure pipe: AWWA Manual M9.

b. Ductile iron pipe: AWWA Manual M41 and ANSI/AWWA C600.

c. PVC pipe: ANSI/AWWA C900.

d. Welded steel water pipe: ANSI/AWWA C601.

B. Pre-test Procedures:

1. The test section shall be slowly filled with potable water at a rate that allows air to leave the line at the same rate as water entering the line to minimize air entrapment and potential surge pressures. The test section shall be filled from a low point.

2. Air shall be expelled completed from the test section. If permanent air vents are not located at all high points, corporation cocks shall be installed at all high points to expel any air as the line is filled with water. Following the removal of any air, the corporation cocks shall be closed and the test pressure applied.

    a. At the conclusion of the pressure test, the corporation cocks shall either be removed and the pipe plugged or be left in place as directed by the Engineer.

3. The main valve of hydrants in the test section shall be closed.

4. Pipe with cement-mortar linings shall be filled for a minimum of 24 hours prior to testing to allow for water absorption into the lining. Concrete pressure pipe shall be filled for a minimum of 48 hours prior to testing to allow concrete lining to be saturated.

5. The specified test pressure shall be applied using a suitable pump connected to the pipeline.

6. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic pressure. This may require several cycles of pressurizing and bleeding trapped air prior to beginning the test.

C. Hydrostatic Pressure Testing for Acceptance:

1. The hydrostatic test shall be of at least a 2-hr duration.

2. The test pressure in the test section shall be as indicated in the Piping Schedule. The test pressure shall be measured at the lowest point of the test section.

3. The test pressure shall not vary by more than 5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline to return the pressure in the test section to the starting pressure.

4. At the end of the test period, makeup water shall be added through the pressure test pump into the pipeline to return the pressure in the test section to the starting pressure.

5. The section of pipe passes if the total amount of makeup water added during the test period and at the end of the test period does not exceed the applicable testing allowance.

D. Testing Allowance:

1. If pipe with a zero leakage allowance is included in a test section, then length of pipe with a zero leakage allowance shall not be considered when calculating the testing allowance.

2. For distribution and transmission pipelines with rubber-gasketed joints, the testing allowance shall be:

    a. PVC and Ductile Iron Pipe: 10.5 gallons per nominal inch diameter per mile per 24 hours.

    b. Welded Steel Water Pipeline and Concrete Pressure Pipe: 10 gallons per nominal inch diameter per mile per 24 hours.

3. Pipelines with welded or heat-fusion joints shall have no leakage.

4. Exposed piping shall have no visible leakage and no pressure loss during the test.

3.04 HYDROSTATIC TESTING OF HDPE PIPELINES

A. General Requirements:

1. The Contractor shall test pipelines in sections. The maximum length of pipe to be tested at one time shall be 3,000 feet. Sections to be tested shall be defined by isolation valves in the pipeline or, where such valves are not present, the Contractor shall install temporary bulkheads or plugs for the purpose of testing.

2. The Contractor shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment.

3. The Contractor shall remove or protect pipeline-mounted devices that may be damaged by the test pressure.

B. Pre-test Procedures:

1. The test section shall be slowly filled with potable water at a rate that allows air to leave the line at the same rate as water entering the line to minimize air entrapment and potential surge pressures. After filling, allow between 3 and 24 hours for the system to reach thermal equilibrium.

2. Air shall be expelled completed from the test section. If permanent air vents are not located at all high points, corporation cocks shall be installed at all high points to expel any air as the line is filled with water. Following the removal of any air, the corporation cocks shall be closed and the test pressure applied.

a. At the conclusion of the pressure test, the corporation cocks shall either be removed and the pipe plugged or be left in place as directed by the Engineer.

3. The main valve of hydrants in the test section shall be closed.

C. Hydrostatic Pressure Testing for Acceptance

1. Pressurize the test section by gradually adding water using a suitable pump connected to the pipeline. Initially advance the pressure to 50 psi. Then the pressure shall be advanced in gradual additional until the test pressure is achieved. The test pressure shall be maintained for 4 hours to allow for pipe expansion, adding water as necessary.

2. Immediately after the 4-hour expansion period, the test pressure shall be reduced by 10 psi and the addition of water stopped. Monitor for 1 hour. If the pressure drops by less than 5 percent, then the test section of HPDE pipeline passes.

3.05 REPAIR AND RETESTING AFTER FAILING TESTS

A. In the case of pipelines that fail to pass the leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

END OF SECTION

SECTION 40 05 01 – PIPING GENERAL

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings and as indicated in the Piping Schedule.

C. The Drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. The Contractor shall prepare pipe spooling and fabrication drawings and shall submit them to the Engineer for review.

D. Where pipe layout details are not indicated on the Drawings, it is the Contractor's responsibility to develop the details necessary to design and construct piping systems to accommodate the specific equipment provided, and to provide spacers, adapters, and connectors for a complete and functional system.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Definitions

1. Pipe, piping, pipe work, pipe system, piping system, or similar words, singular or plural shall mean and include, any type of pipes, tubes, fittings, valves, piping specialties, appurtenances, supports, restraints, anchors, coatings and linings and items related to piping.

2. Submerged piping, underwater piping, or similar words, shall include any piping located 2 feet above water surface in basins or tanks

3. Potable water or similar words shall mean and include any type of potable water or process water that be deemed potable after treatment processes.

4. Corrosive service shall mean and include in locations listed below:

a. Buried locations

b. Submerged locations or submerged piping.

c. Inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump.

d. Chemical handling areas

e. Inside trenches, containment walls, and curbed areas

f. Locations indicated or designated in the contract documents.

B. Reference Specifications

Division 33	Utilities
Division 40	Process Interconnections
01 33 00	Submittals Procedures
01 33 17	Structural Design, Support and Anchorage
09 96 00	High-Performance Coatings
33 05 05.50	Pressure Pipe Testing and Disinfection
40 05 07	Hangers and Supports for Process Piping s

C. Reference Standards

American Society of Mechanical Engineers (ASME)	
ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	Pipe Threads, General Purpose
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B31	Boiler and Pressure Vessel Code, Section 9
ASME B31.1	Power Piping
ASTM International (ASTM)	
ASTM A193	Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM D792	Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC)
ASTM F436	Hardened Steel Washers
ASTM F467	Standard Specification for Nonferrous Nuts for General Use
ASTM F468	Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
ASTM F493	Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
American Welding Society (AWS)	
AWS D1.1	Structural Welding Code
American Water Works Association (AWWA)	
AWWA C115	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)

AWWA C606	Grooved and Shouldered Joints

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00– Submittal Procedures.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Drawings: Layout drawings including necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, and material lists. Pipe spooling and fabrication drawings shall indicate spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.

2. Welding Qualifications and Procedures

3. Pipe Supports: Submit pipe support fabrication drawings including calculations in accordance with Section 40 05 07- Hangers and Supports for Process Piping.

4. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable style or series designation, and restraint system if applicable.

5. Thermoplastic Pipe Joints: Submit solvent cement manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

6. Gasket Material: Submit gasket manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

7. Seals and Seating Materials: Submit elastomer material and manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

8. Modular Seals for Pipe: Manufacturer's catalog sheet showing materials and installation procedures.

9. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings

10. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Samples

1. Performing and paying for sampling and testing as necessary for certifications are the Contractor's responsibility.

D. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor.

2. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricators or a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the manufacture of any pipe.

1.04 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Extent of Work

1. Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. Materials in contact with potable water or process water that be deemed potable after treatment processes shall be listed as compliant with NSF Standard 61.

B. Piping Supports

1. Pipes shall be adequately supported, restrained, and anchored in accordance with Section 40 05 07 – Hangers and Supports for Process Piping, and as indicated.

2. Piping support seismic and wind loads shall be sized in accordance with the design criteria as specified in Section 01 33 17 – Structural Design, Support and Anchorage.

C. Lining

1. Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 33, unless otherwise indicated.

D. Coating

1. Application, thickness, and curing of coating on buried pipe shall be in accordance with the applicable Sections of Division 33 and Section 09 96 00 - Protective Coating, unless otherwise indicated.

2. Pipes above ground or in structures shall be coated in accordance with Section 09 96 00 – High-Performance Coatings.

E. Pressure Rating

1. Piping systems shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

F. Inspection

1. Pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture, the Engineer shall be given access to areas where manufacturing is in progress and shall be permitted to make inspections necessary to confirm compliance with requirements.

G. Tests

1. Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards.

2. Welds shall be tested as indicated.

3. The Contractor shall be responsible for performing material tests.

H. Welding Requirements

1. Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of AWS D1.1 - Structural Welding Code or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

I. Welder Qualifications

1. Welding shall be performed by skilled welders and welding operators who have adequate experience in the methods and materials to be used.

2. Welders shall be qualified under the provisions of AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

3. Machines and electrodes similar to those used in the Work shall be used in qualification tests.

4. Qualification testing of welders and materials used during testing is part of the Work.

2.02 PIPE FLANGES

A. General

1. Flanges shall be provided with flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated.

2. Flange faces shall be perpendicular to the axis of the adjoining pipe.

3. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for those pipes.

B. Pressure Ratings

1. 150 psig or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4-in through 144-in., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150.

2. 150 psig to 275 psig: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5, Class 150.

3. 275 psig to 700 psig: Flanges shall conform to ASME B16.5, Class 300.

4. Selection Based on Test Pressure

    a. Do not expose AWWA flanges to test pressures greater than 125 percent of rated capacity.

    b. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

C. Blind Flanges

1. Provide blind flanges in accordance with AWWA C207, or as indicated for miscellaneous small pipes.

2. Blind flanges for pipe diameters 12-in and greater shall be provided with lifting eyes in the form of welded or threaded eye bolts.

D. Flange Coating

1. Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

E. Flange Fasteners

1. Unless otherwise shown on the drawings, or indicated in the applicable Sections of Divisions 33 and 40, Bolts and nuts shall conform to the following requirements;

    a. Threads shall be in accordance with ANSI/ASME B1.1, Class 2, UNC for bolt diameters 1-in and smaller and UN8 for bolt diameters greater than 1-in.

    b. Bolts shall have heavy hexagon heads and heavy hexagon nuts. Length of studs shall provide a projection of not less than 0.25 inch and no more than 0.5-in through the nut when it is drawn tight.

    c. Thread studs on flange connections are not permitted except where space restrictions preclude the use of standard bolts and where approved by the Engineer.

    d. Through bolt holes shall be drilled in accordance with the applicable flange standard.

    e. All bolts fastening metallic flanges shall be provided with plain washers installed under the nut. Washer materials shall be of the same material as the bolt. If the through bolt holes are drilled larger than the applicable standard by 1/8-in in diameter or more, bolts shall be also installed with a plain washer under the bolt head as well.

    f. All bolts fastening non-metallic flanges shall be provided with plain washers installed under both the bolt head and nut.

    g. Washer materials shall be of the same material as the bolt.

h. Anti-seize compound shall be used on carbon steel fasteners, and shall be Husk-ITT, Husky 2000; or equal.

i. Anti-galling compound used for stainless steel fasteners in LOX, nitrogen injection, oxygen, ozone process/off-gas/vent and ozone contactor maintenance air service shall be DuPont “Krytox”; or equal.

j. Anti-galling compound used for stainless steel fasteners for other services shall be certified for potable water use and shall be Husk-ITT, Lube O’seal; Hercules, Real-Tuff; La Co, Slic-Tite; or equal.

2. Fastener Material Group Numbering System

a. Flange fasteners shall conform to the following material standards and shall be categorized within the Fastener Material Schedule Groups as indicated:

1) Material Group C1 (Carbon steel): ASTM A307 Grade B bolts, ASTM A563 Grade B nuts with ASTM F436 washers

2) Material Group C2 (Carbon steel): ASTM A193 Grade B7 bolts, ASTM A194 Grade 2H nuts with ASTM F436 washers

3) Material Group S1 (316 SS): ASTM A193, Grade B8M bolts, ASTM A194 Grade 8M nuts with Type 316 SS plain washers.

4) Material Group S2 (304 SS): ASTM A193, Grade B8 bolts, ASTM A194 Grade 8F nuts with Type 304 SS plain washers.

5) Material Group S3 (Hastelloy C-276): ASTM F468 N10276 bolts ASTM F467 N10276 nuts with type Hastelloy plain washers.

3. Fastener Material Group Numbers used in Non-Corrosive Service Applications

a. AWWA C115 ductile iron flanges - Material Group C1

b. AWWA C207 steel flanges - Material Group C2

c. ASME B31 group piping flanges – Material Group C2

d. Non-metallic pipe flanges - Material Group S1

e. Stainless steel pipe flanges and all others not listed above - Material Group S1

f. Where mating flanges are of different flange material standards and the specified Fastener Material Groups are in conflict, then fasteners of the higher grade shall be utilized unless otherwise indicated. For the purpose of this requirement, the Material Groups in order of decreasing grade shall be S1, C2, C1. Provide insulating flange sets for dissimilar metal flanged piping to electrically isolate the dissimilar piping.

g. Where gaskets of Teflon or Viton-A are required, fasteners of Material Group C2 shall be utilized for all C1 flange standards.

4. Fastener Material Group Numbers used in Corrosive Service Applications

a. All Flange fasteners shall be of Material Group S1 unless S2 and S3 are otherwise indicated on the drawings.

F. Insulating Flanges

1. Insulated flanges shall be provided with bolt holes 1/4-in diameter greater than the bolt diameter.

G. Insulating Flange Sets

1. In order to prevent corrosion, insulating flange sets shall be furnished on all piping connections where two dissimilar metals are to be connected. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer.

2. For bolt diameters 1-1/2-in or smaller, insulating sleeves and washers shall be one piece and shall be made of minlon or approved equal.

3. For bolt diameters larger than 1-1/2-in, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic material.

4. Insulating flange sets materials used for fluids other than general water and wastewater shall be made of materials compatible with the fluid services.

5. Insulating gaskets shall be full-face.

H. Insulating Flange Manufacturer, or Equal

1. JM Red Devil, Type E

2. Fluid Sealing Products, Inc.

3. Enpro Industries, Inc. (GPT)

I. Flange Gaskets

1. Gaskets for flanged joints used in general water and wastewater service shall be full faced type in accordance with AWWA C207, suitable for the flange pressure rating and design temperatures and the pH of the fluid being contained.

2. Blind flanges shall be provided with gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange.

3. Ring gaskets will not be accepted unless otherwise indicated.

4. Unless otherwise indicated, flange gaskets up to 150 psi shall be EPDM sheet material, NSF 61 approved, Garlock, Style 98206-U (unbranded), or similar products from John Crane, or equal.

5. Unless otherwise indicated, flange gaskets up to 500 psi shall be aramid fiber with rubber binder material, NSF 61 approved, Garlock, Style 3760-U (unbranded), or similar products from John Crane, or equal.

6. Gaskets for flanged joints used in water with chloramines shall be Teflon material, NSF 61 approved, Garlock, Gylon Style 3505, or similar products from John Crane, or equal.

7. Gaskets for flanged joints used in water with ozone shall be Teflon material, NSF 61 approved, Garlock, Gylon, Style 3504, or similar products from John Crane, or equal.

8. Gaskets for flanged joints used in cryogenic oxygen (LOX and GOX) service shall be Teflon material, Garlock Gylon, Style 3502 and 3503 or similar products from John Crane, or equal.

9. Gaskets for flanged joints in PVC and CPVC piping used in general water and wastewater service shall be NSF 61 approved, full-faced, 1/8-in thick, and made of fluoroelastomer having a durometer hardness of 50 to 70. Gaskets for pipe sizes up to 24-in and 150 psi shall be Garlock Style XP or similar products from John Crane, or equal.

10. When the mating flange has a raised face, provide stainless steel flat ring gasket filler between the PVC flange and gasket and the adjacent flange.

11. Gaskets for flanged joints used in chemicals, hot air, ozone gas, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature. Consult gasket Manufacturer for recommended gasket material.

2.03 PIPE THREADS

A. Pipe threads shall be in conformance with ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

B. Unless otherwise indicated, use metal FNPT and plastic MNPT for threaded pipe connections between metal and plastic pipes.

2.04 THREADED INSULATING CONNECTIONS

A. General

1. Threaded insulating bushings, unions, or couplings, as appropriate, shall be furnished for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials

1. Threaded insulating connections shall be constructed of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.05 MODULAR MECHANICAL SEALS FOR PIPING PENETRATIONS

A. Where indicated and where required in order to prevent flow of water or air, the passages of piping through wall sleeves and cored openings shall be sealed with modular interlocking link mechanical closures.

B. Individual links shall be constructed of EPDM rubber, be suitable for temperatures between minus 40 and plus 250 degrees F and be shaped to fill the annular space between the outside of the pipe and the inside of the wall sleeve or cored opening.

C. Assemble the links using Type 316 stainless steel bolts and nuts to form a continuous rubber belt around the pipe.

D. Pressure plates under each bolt and nut shall be fabricated of a corrosion-resistant composite material.

E. After the seal assembly is positioned in the sleeve, tighten the bolts against the pressure plates to expand the rubber links and form the watertight seal.

F. Sizing and installation of sleeves and assemblies shall be in accordance with the manufacturer's recommendations.

G. Modular Mechanical Seals Manufacturer, or Equal

1. EnPro Industries Company (GPT), Link-Seal

2. Proco Products, Inc., Pen-Seal

2.06 AIR AND GAS TRAPS

A. Air and gas pipes shall slope to low points and shall be provided with drip legs, shut-off valves, strainers, and traps.

B. Pipe the traps to the nearest drain.

C. Air and gas traps shall be not less than Class150 iron body float-type, with a copper or stainless-steel float.

D. Bracket, lever, and pins shall be constructed of stainless steel.

E. Drain traps shall be provided with threaded connections.

F. Air and Gas Traps Manufacturer, or Equal

1. Armstrong International, Inc.

2. Spirax Sarco, Inc.

2.07 GLASS LINING

A. General

1. Ductile iron or steel pipe and fittings shall be glass-lined where indicated.

2. The glass lining shall be suitable for handling sewage, primary sludge, digested sludge, and scum.

3. The lining shall be smooth, continuous, and suitable for prevention of grease and foam build-up.

4. The glass lining shall be capable of withstanding thermal shock of 350 degrees F (from 430 degrees F to 80 degrees F) without crazing, blistering, or spalling.

B. The glass lining shall consist of a vitreous material to meet or exceed the following criteria:

1. Unaffected by scraping with a sharp knife, simulating the effects of rodding.

2. Unaffected by the continuous application of live steam from a steam generator, immediately followed by a cold-water quench.

3. Unaffected by an 8 percent sulfuric acid solution at 148 degrees F for a 10 minute period.

4. A minimum thickness of 10 mils by micro test.

5. Spark-tested to be free of pinholes.

6. A hardness of 5 to 6 Mohs; and,

7. A density of 2.5 to 3.0 g/cu cm, measured by ASTM D792 - Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

C. Application

1. Cast or ductile iron pipes and fittings shall be bored or machined smooth in order to remove voids or protrusions.

2. Steel pipe shall be seamless pipe, with internal fitting welds ground smooth, slag holes ground out, re-welded, and ground smooth.

3. Interior surfaces shall be grit-blasted to white metal, and lining shall be fused onto chemically clean metal at above 1400 degrees F.

4. Welded flanges shall be factory-installed before lining.

5. Threaded flanges or cast and ductile iron pipes shall be installed after lining.

6. Pieces shall be sealed and tested prior to shipment.

7. Finish shall be subject to the Engineer's approval.

D. Manufacturer, or Equal

1. Pfaudler, Inc.

2. A.O. Smith Corp.

3. U.S. Pipe

PART 3 -- EXECUTION

3.01 GENERAL

A. This section specifies the general installation requirements for piping, valves, and related items and shall be installed in accordance with the manufacturer's technical data and printed instructions. Specific piping materials, systems, appurtenances, and related installation and testing requirements are specified in related sections of Divisions 01, 33, and 40, and as noted on the Drawings, Pipe and Valve Schedules.

B. Piping shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.

C. Contractor shall obtain the assistance of the pipe manufacturer to instruct the pipe fitters in the correct installation and support of the piping system. Valves and flanges attached to the pipe shall be provided with adequate supports.

D. Lined Piping Systems

1. The lining manufacturer shall take full responsibility for the complete, final product and its application.

2. Pipe ends and joints of lined pipes at threaded flanges shall be epoxy-coated in order to assure continuous protection.

3.02 INSTALLATION

A. Installation shall be free from defects. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true straight. Ends of threaded pipes shall be reamed and filed smooth. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove. Fittings shall be equally cleaned before assembly.

B. Building gravity flow plumbing pipes shall be installed in a neat and workmanlike manner, in accordance with the prevailing plumbing and building codes. Pipes shall have the required slopes for proper drainage. Pipe locations inside buildings shall be coordinated with the rest of the Work to avoid interferences and to provide sufficient headroom. Installations shall be acceptable to the local plumbing inspector.

C. Supports and Anchors: Piping supports, thrust, and seismic restraints shall be provided where shown on the Drawing or were determined to be required in according to Section 40 05 07 - Hangers and Supports for Process Piping. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences. Pipe shall be firmly supported with fabricated or commercial hangers or supports.

D. Piping Joints: Pipe joints requirements shall conform to the applicable piping sections of Division 33 and Division 40.

1. Threaded Joints: Pipe threads shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.

2. Welded Joints: Welded joints shall conform to the specifications and recommendations of ASME B31.1 - Power Piping. Welding shall be done by skilled and qualified welders. Pipe surface residues, oxides, and heat stains are to be removed from a field weld and the affected areas adjacent by the use of stainless-steel wire brushes. For alloy and stainless-steel pipe, the post welding surfaces shall be cleaned with a pickle agent such as nitric/hydrofluoric acid solutions or pickle paste or equal, then complete removal of the agent by wash the surface thoroughly with clean water.

3. Flange Joints: Flanged joints shall be made with gaskets with bolts and nuts as specified. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

4. Fusion-Welded Joints: Fusion-welded joints shall be made with the manufacturer's recommended equipment on clean, dry pipe ends. The joints shall be made up at the recommended ambient temperatures, to the pipe manufacturer's written recommendations. The pipe supplier shall be consulted to obtain machinery and expertise for the joining by fusion welded of pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe. Socket fusion, extrusion welding and hot gas welding shall not be used for field connections.

5. Brazed and Soldered Joints: Brazed and soldered joints shall conform to the manufacturer’s recommendations and to the specifications and recommendations of ASME B31.1 - Power Piping. Brazing shall be done by skilled and qualified welders. Prior to the application of flux, the ends of tubes shall be thoroughly dried and cleaned

6. Grooved Joints: Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conform to AWWA C606 – Joints, Grooved and Shouldered Type. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

7. Push On Joints: Push on joints and gasket installation shall be in accordance with the manufacturer's recommendations and lubricants. Pipe ends shall be beveled to facilitate assembly. Lubricants shall be suitable for potable water service and shall be kept clean in closed containers.

8. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept always closed and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. PVC socket connections shall be joined with PVC cement conforming to ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC). CPVC socket connections shall be joined with CPVC solvent cement conforming to ASTM F493. For chemical service applications, solvent cement shall be formulated and labeled for use on that chemical.

9. Adhesive Joints: Adhesive joints shall be made with freshly-mixed 2-part epoxy on clean, dry pipe ends per pipe manufacturer recommendations. The joints shall be made up at the recommended ambient temperatures, to the pipe or adhesive manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

E. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

F. Branch Connections: Branch connections in horizontal runs of air and gas piping shall be made from the top of the pipe, to avoid drainage of condensate into the equipment. Unless otherwise indicated for threaded pipe connections between metal and plastic pipes, use metal FNPT and plastic MNPT.

1. Pipe ends and joints of lined pipes at threaded flanges shall be epoxy-coated in order to assure continuous protection.

G. Isolation Joints / Dielectric Protection: Provide electrically isolate connections between dissimilar metal piping connections. Electrical checks shall be made to assure no contact is made between dissimilar metal piping elements.

1. Use dielectric couplings specially designed for the prevention of galvanic reaction between dissimilar metals.

2. For flanged connections, use stainless steel bolts with isolation bushings, washers, and full-face flange gaskets.

H. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction in order to avoid damage to embedded raceways and reinforcing bars.

I. Coating: Exposed pipes shall be coated with a finish coat to the pipe manufacturer's standard protective coating, with the manufacturer's recommended prime coat and a finish coat in accordance with Section 09 96 00 – High-Performance Coatings.

J. Low points in piping systems and drip legs in steam, gas, and air systems shall have drainage valves.

K. Care shall be taken to ensure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected.

3. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

4. Flange Bolts

a. Flange bolts shall be initially hand-tightened with the piping connections properly aligned.

b. Bolts shall be tightened with a torque wrench in a staggered sequence to the recommended torque for the applicable piping material per AWWA or manufacturer's recommendation. Care shall be taken to avoid over-torquing the bolts especially on plastic flanged joints.

c. Harness, thrust restraint, and tie rod bolts used for sleeve couplings, flange coupling adapters, or flexible joints shall be tightened gradually and equally at diametrically opposite sides until snug, in order to prevent misalignment and to ensure that all studs carry equal loads.

d. In order to prevent induced stress or misalignment, do not over-torque connections to adjoining pump or equipment. Flanges shall not be deformed nor cracked.

3.03 INSPECTION

A. After completion of the Work, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be in a clean and functional condition.

B. Inspection: Finished installations shall be carefully inspected for proper joints and supports, interferences, and damage to pipe, fittings, and coating. Temporary plugs and covers shall be removed from openings and floor drains. Defective Work shall be repaired to the satisfaction of the field engineer or plumbing inspector.

3.04 FIELD TESTING FOR PRESSURE PIPING

A. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule for a period of not less than two hours without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The Contractor shall furnish test equipment, labor, materials, and devices as part of the Work. For additional testing requirements, refer to Section 33 05 05.50 - Pressure Pipe Testing and Disinfection.

B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

C. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

3.05 FIELD TESTING FOR GRAVITY PLUMBING PIPING

A. Prior to enclosure or burying, drains and vents shall be tested in the presence of the local plumbing inspector and the Engineer for a period of not less than one hour, or as requested by the plumbing inspector if the request is more stringent. The Contractor shall furnish test equipment, labor, material, and devices as part of the Work. Defective Work shall be repaired to the satisfaction of the plumbing inspector, and the piping shall be re-tested until no leaks are found.

B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

C. Testing and defective Work shall be repaired to the satisfaction of the plumbing inspector.

END OF SECTION

SECTION 40 05 02 – PIPING IDENTIFICATION

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide identification for the piping and valves, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
09 96 00	High-Performance Coatings

B. Commercial Standards

American Society of Mechanical Engineers (ASME)	
ASME A13.1	Scheme for the Identification of Piping Systems

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Provide a list of the suggested wording for each pipe label and valve tag, prior to fabrication.

C. Samples

1. Sample of each type of identification device.

2. Sample of each proposed color required by the pipe color schedule.

PART 2 -- PRODUCTS

2.01 EXPOSED PIPING OR ABOVE GROUND PIPING IDENTIFICATION

A. Pipe markers, type as indicated below, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements.

1. Marker Type

a. Adhesive: Vinyl or polyester sheet with UV- resistant ink, shaped similar to pipe curvature and coated with pressure sensitive adhesive.

2. Marker Area: Sized per pipe size according to ASME A13.1 and conforming to the color codes in the Identification Colors table below.

3. Lettering: Sized per pipe size according to ASME A13.1 and conforming to the color codes in the Identification Colors table below.

4. Arrows: At least one arrow at each marker area, showing direction of flow.

B. Pipe 1-inch diameter and smaller or pipe not suitable for the marker type(s) listed above shall be identified with aluminum or stainless-steel pipe identification tags with stamped-in ¼" high identification lettering.

C. Manufacturer or Equal

1. Seton Identification Products, Opti Code Pipe Markers (adhesive type)

2. Grainger, Inc. (adhesive, snap around)

3. Marking Services, Inc.(adhesive, snap around)

2.02 EXISTING IDENTIFICATION SYSTEMS

A. In installations where existing piping identification systems have been established, the Contractor shall follow the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the system indicated herein.

2.03 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

A. Valves and sections of pipe that are too short to be identified with markers and arrows shall be identified with metal or plastic tags.

B. Metal tags shall be stainless steel with embossed lettering. Plastic tags shall be solid black plastic laminate with white embossed letters. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to the valves or short pipes.

C. Wording on valve tags shall describe the exact function of each valve (e.g., "HWR-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.) and include the valve number as indicated in the Contract Drawings. Wording on small pipes shall describe the contents of the pipe.

2.04 PIPE COATING:

A. Unless otherwise indicated, pipe coating shall be in conformance with Section 09 96 00 – High-Performance Coatings.

PART 3 -- EXECUTION

3.01 GENERAL

A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

3.02 VALVE TAGS

A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.

3.03 MARKER LOCATIONS

A. Each pipe shall be marked at:

1. Intervals of 20-feet in straight runs.
2. At least once in every room.
3. Within 2 feet of turns, elbows, and valves.
4. On the upstream side of tees, branches, and other distribution points.
5. On both sides of walls and floors through which the piping passes.

Color Combinations	New Standard ASME A13.1-2007	Old Standard ASME A13.1-1996 (R2002)
White on Red	Fire quenching fluids	Fire quenching materials
Black on Orange	Toxic and corrosive fluids	
Black on Yellow	Flammable fluids	Hazardous Materials Flammable or explosive Chemically active or toxic Extreme temperatures or pressures Radioactive
White on Brown	Combustible fluids	
White on Green	Potable, cooling, boiler feed, and other water	Low hazard materials
White on Blue	Compressed air	Low hazard gases
White on Purple	User defined	
Black on White	User defined	
White on Gray	User defined	
White on Black	User defined	

3.04 IDENTIFICATION COLORS

A. Conform to the following color codes.

Pipe Contents		Marker Color	Letter Color	Pipe Color
Symbol	**Service**			
DSL	Digested Sludge	orange	black	
PA	Plant Air	blue	black	
PEC	Polymer-cationic	orange	black	
NPW	Non-Potable Water	green	white	
UW	Utility Water (Non-Potable Water)	green	white	
WW	Wash Water	orange	black	

END OF SECTION

SECTION 40 05 06 – COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide pipe couplings indicated, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 01 - Piping General apply to the Work of this Section

C. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings.

D. The couplings, adapters and joints shall be provided with restraining devices to restrict pipe axial movement. Where the restraining devices and/or details are not indicated on the Drawings, it is the Contractor's responsibility to provide the devices/details necessary to restraint the piping system.

E. The Items specified in this section include the following:

1. Groove Couplings
2. Sleeve Couplings
3. Flanged Coupling Adapters
4. Dismantling Joints
5. Expansion Joints
6. Flexible Connectors
7. Transition Couplings.
8. Quick Disconnect Couplings
9. Tapping Sleeves
10. Miscellaneous Adapters

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Product submittals and shall be specifically identified with the applicable style or series designation, pressure rating and restraint system if applicable.
2. Couplings schedule or layout indicating where the couplings will be installed.

3. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and guides, including information on materials, temperature, and pressure ratings

4. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor.

1.03 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping couplings, adapters and joints accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
09 96 00	High-Performance Coatings
40 05 01	Piping General

B. Reference Standards

American Iron and Steel Institute (AISI)	
AISI 1012	Carbon Steel
ASTM A512	Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing
ASTM A513	Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 576	Steel Bars, Carbon, Hot Wrought, Special Quality
American Water Works Association (AWWA)	
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)
AWWA C219	Bolted Sleeve-Type Couplings for Plain-End Pipe
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe: A Guide for Design and Installation

PART 2 -- PRODUCTS

2.01 GENERAL

A. Extent of Work

1. Piping couplings, adapters, joints and accessories shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. The Contractor shall not be allowed to substitute any other type of coupling in lieu of the couplings as specified herein unless approved by the Engineer.

3. The Contractor shall assign the responsibility to the coupling manufacturer to review the piping connection to the equipment and submit any modifications to the Engineer for review.

B. Pressure Rating

1. Couplings, adapters, and joints shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

C. Seals

1. Seal elastomer materials shall be selected to be compatible with the fluid service, pressure, and temperature. They shall be composed of elastomeric-compound material that will not deteriorate from age under normal storage or use conditions.

2. Where couplings are used in water containing dissolved ozone residual or chloramines, seal material shall be Viton-A.

D. Coating

1. Couplings shall be lined and coated at the factory, unless otherwise indicated.

2. Coating shall be in accordance with the Section 09 96 00 – High-Performance Coatings, unless otherwise indicated.

2.02 GROOVED TYPE COUPLINGS

A. General

1. Provide cast grooved type couplings where indicated, conforming to the requirements of AWWA C606 - Grooved and Shouldered Joints.

2. Grooved or banded piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.

a. If grooved connections are used, the remaining thickness of pipe material after grooving shall be adequate to carry the load imparted to the joint. Joints for thin wall pipes shall be banded or welded with a collared end to fit coupling.

b. Rolled pipe ends are not acceptable as a means of connection for metallic piping.

3. Equipment connections with mechanical-type couplings shall be provided with rigid grooved couplings or flexible type coupling with harness in sizes where rigid type couplings are not available, unless thrust restraint is provided by other means.

4. Couplings shall be electrically bonded.

5. For uniformity and compatibility of the piping components; grooving tools, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling.

B. Grooved Type Couplings Manufacturer, or Equal

1. Grooved couplings for ductile iron piping shall be provided with flush seal gaskets.

   a. Victaulic Company, Style 31 (flexible or rigid)

   b. Gustin-Bacon (banded or grooved)

2. Grooved couplings for steel piping

   a. Victaulic Company, Style 177 / 77 / W77 (grooved, flexible, or rigid)

   b. Victaulic Company, Style 107H / 07 / W07 or HP-70 (grooved, rigid)

   c. Gustin-Bacon (banded or grooved)

3. Grooved couplings for stainless steel piping

   a. Victaulic Company, Style 489 (rigid)

   b. Victaulic Company, Style 77S (flexible)

   c. Gustin-Bacon (banded or grooved)

2.03 SLEEVE COUPLINGS

A. General

1. Provide sleeve couplings specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.

2. Couplings shall be constructed without pipe stop.

3. The middle ring shall be at least the same wall thickness as the pipe to which the coupling is connected and not less than 1/4-inch thick.

4. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. For standard sleeve couplings, the coupling shall be either 5 or 7 inches long for pipe diameters up to and including 30-inch and 10 inches long for pipe diameters greater than 30-inch. For long sleeve couplings, the coupling shall be 16 inches long for all pipe diameters.

6. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling.

C. Insulating Sleeve Couplings

1. Where insulating couplings are required, both ends of the coupling shall be provided with a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of coupling metal parts from the pipe.

D. Sleeve-Type Couplings Manufacturer, or Equal

1. World Wide Metric, Inc. (Dresser), Style 38

2. Ford Meter Box Company, Inc., Style FC1 or FC3

3. Smith-Blair, Inc., Style 411

2.04 FLANGED COUPLING ADAPTERS

A. Provide flanged coupling adapters specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or ASTM A513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012 – Carbon Steel.

C. Flanged Couplings Adapter Manufacturer, or Equal

1. Smith-Blair, Inc., Model 913

2. Dresser®, Style 128-W

3. JCM Industries, Inc., Model 303

2.05 DISMANTLING JOINTS

A. Provide dismantling joints products specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012 – Carbon Stee.

C. Dismantling Joints Manufacturer, or Equal

1. Smith-Blair, Inc., Model 975

2. Dresser®, Style 131

3. JCM Industries, Inc., Model 309

2.06 EXPANSION JOINTS

A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures, accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints.

B. Expansion joints shall be provided with flanged ends and constructed of stainless steel, Monel, rubber, or other materials best suited for each individual service. Where expansion joints are used in water containing dissolved ozone residual or chloramines, provide Type 316 stainless-steel expansion joints.

C. Where bellows-type expansion joints are mounted near the suction nozzle of the pump, a stainless-steel internal liner shall be provided to minimize turbulence as the flow passes through the arches of the bellows.

D. Expansion joints for Plastic Tanks

1. Expansion joints for piping connections to polyethylene tanks nozzles shall be provided by the tank manufacturer, selected for the fluid service, and sized for up to 4% tank expansion or movement as required by the tank manufacturer. Fastener hardware shall be of Type 316 stainless steel construction.

2. Expansion joints for other plastic tanks shall be constructed of molded PTFE with at least two convolutions and flanged joints. Flanges shall be ductile iron with Type 316 stainless steel bolts and nuts. Flexible connectors shall be **Proco Series 442 molded expansion joint, or equal**.

2.07 FLEXIBLE CONNECTORS

A. Low-Temperature

1. Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated.

2. Flexible connectors for service temperatures up to 180 degrees F shall be flanged-reinforced neoprene or butyl spools, rated for a working pressure of 40 to 150 psig, or reinforced flanged duck and rubber, as best suited for the application.

3. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for a minimum 150-psig working pressure, unless otherwise recommended by the equipment manufacturer.

4. The connectors shall be a minimum of 9 inches long and provided with face-to-face flanges, unless otherwise indicated.

5. The final material selection shall be approved by the manufacturer.

B. High-Temperature (temperature exceeding 250 degree F (120 degree C)

1. Install flexible connectors in engine exhaust piping and where indicated.

2. Connectors shall be sufficient to compensate for thermal expansion and contraction and to isolate vibration between the engine and the exhaust piping system.

3. Connectors shall be stainless steel bellows-type, flanged, and rated for minimum 150 psig, 2000 degrees F.

2.08 TRANSITION COUPLINGS

A. Provide transition-coupling products specifically designed suitable for the fluid service and manufactured for the piping applications.

B. The transition couplings shall have function and design similar to the flexible couplings, joint and flanged coupling adapters for connecting piping having different outside diameters.

2.09 QUICK DISCONNECT COUPLINGS

A. Quick disconnect couplings shall be of the cam lock type (cam and groove type) consisting of a male adapter conforming to Specification MIL A-A-59326A. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leak proof up to full system pressures.

B. Each adapter shall be furnished with a dust cap complete with an 18-in long security chain of corrosion resistant material.

C. Unless otherwise indicated, the quick disconnect couplings shall be flanged connection to piping and materials shall be Type 316 stainless steel.

D. Quick connect couplings shall be as manufactured by **LMC-Couplings**; **Dover Corporation**; **Ever-Tite Coupling Products**; or equal.

2.10 TAPPING SLEEVES

A. Provide tapping sleeve products specifically designed suitable for the fluid service and manufactured for the piping applications

B. Unless otherwise indicated, the tapping sleeves shall be of full circumference band with flanged outlet connection sized to ANSI class 150. Material of construction for the body and fastener shall be stainless steel.

C. Gasket material: Nitrile (Buna-N) or EPDM.

D. Tapping sleeves shall be as manufactured by **Smith-Blair Inc.**; **Romac Industries Inc.**; **Dresser®**, or equal.

2.11 MISCELLANEOUS ADAPTERS

A. A special pipe adapter may be required to provide proper connection between different type of pipes and/or fittings. The adapter may be indicated on the Drawing with the pipe type or equipment. However, it is the Contractor's responsibility to ensure proper connection between various type of pipes and pipe appurtenances. Provide adapters as required whether specifically indicated or not.

B. Provide piping adapter products specifically designed suitable for the fluid service and manufactured for the piping applications.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection, and field testing of the pipes shall in accordance with the requirements of Section 40 05 01 - Piping General.

B. The Contractor shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation.

C. The Contractor shall assign the responsibility to the couplings manufacturer to review the piping connection to the couplings and submit any modifications to the Engineer for review.

3.02 INSTALLATION

A. Where couplings are shown to connect piping to mechanical equipment such as pumps, compressors, and blowers, the piping shall be aligned with the equipment point of connection and shall be perpendicular to the axis of the flange or fitting for which the piping is to be connected.

B. The couplings or the piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment.

C. Restrained Joints on couplings, adapters, and joints

1. Couplings, adapters, and joints on pressure lines shall be harnessed unless thrust restraint is provided by other means.

2. Harnesses shall be designed by the pipe manufacturer in accordance with AWWA M11, or as indicated.

3. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.

4. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation in order to prevent misalignment of the pump imparted by the thrust within the piping system.

5. Other means of restraining the coupling such as set screws on piping will not be accepted.

END OF SECTION

SECTION 40 05 07 – HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the Contractor shall design and provide the supports in accordance with this Section. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing the pipe supports.

C. The provisions of this Section shall apply to piping in Divisions 33 and 40.

1. The Contractor shall provide supporting devices for supporting and restraining piping as indicated on the Drawings. Where pipe support devices and/or restraining details are not indicated on the Drawings, it is the Contractor's responsibility to develop the details necessary to support and restraint the piping for a complete and functional pipe support system.

D. Seismic and Wind Forces

1. Pipe support details indicated in the Contract Drawings are sized for gravity loads only, and not designed to resist seismic and wind forces.

2. The Contractor shall arrange for the services of a registered professional engineer experienced in pipe support design to design such pipe supports to resist seismic and wind forces.

3. Piping support seismic and wind loads shall be sized in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit Shop Drawings which shall include the following information:

a. Drawings of pipe supports, hangers, anchors, and guides.

b. Pipe support schedule or layout indicating where the supports will be installed.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
01 33 17	Structural Design, Support and Anchorage
05 50 00	Metal Fabrications

09 96 00	High-Performance Coatings
40 05 01	Piping General

B. Reference Standards

American Society of Mechanical Engineers (ASME)	
ASME B31.1	Power Piping
ASTM International (ASTM)	
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)	
ANSI/MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Code Compliance

1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, and probable forces applied during construction as well as stresses on piping, equipment, and structures.

2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping – Chapter II, Part 5 -Expansion, Flexibility, and Pipe Supporting Element and design the pipe supporting elements in accordance with the rules of MSS SP-58 -Pipe Hangers and Supports – Materials, Design and Manufacture, except as supplemented or modified in this Section.

3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.

2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor.

3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction and shall be as acceptable to the Engineer.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment.

2. Hangers shall have a means of vertical adjustment after erection.

3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.

4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.

5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Lateral or Axial Movement.

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.

2. Where lateral or axial pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold-to-hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers

1. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping.

2. Spring-type hangers shall be sized per the manufacturer's printed recommendations and for the loading conditions encountered.

3. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate the compression of the spring.

4. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. Thermal Expansion

1. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely away from the anchored points.

2. Components shall be structurally suitable to withstand the imposed loads.

G. Heat Transmission

1. Supports, hangers, anchors, and guides shall be designed and insulated such that excessive heat will not be transmitted to the structure or to other equipment.

H. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to support frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

J. Materials of Construction

1. Pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged supports, as well as piping, conduits, and equipment in hydraulic structures located two feet above water level, shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel, unless otherwise indicated.

3. Piping in chemical and corrosive service areas shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

4. Corrosive service areas are indicated in section 40 05 01 – Piping General, 1.2 Definitions - Corrosive Service.

K. Point Loads

1. Meters, valves, heavy equipment, and other point loads on PVC, FRP, or other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, FRP, or other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields for general service and Type 316 stainless steel shields for chemical or corrosive areas.

L. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table: consult the Engineer for any anchor applications not appearing on the table.

2. Anchor embedment shall be in accordance with the requirements of Section 05 50 00 – Metal Fabrications.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.

Existing Concrete	Use non-shrink grouted anchors, expansion anchors, or epoxy anchors. Epoxy anchors are not permitted for vertical hanging applications or where sustained tension is exerted on the anchor. Exceptions: Expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100-degree F or higher than the limiting temperature recommended by the manufacturer.
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors.

M. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar suitable material at each pipe support, bracket, clip, or hanger.

2.02 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads.

B. Where pipe spacing are indicated on the Drawings and are referenced to a Standard Detail, that requirement shall take preference over the general requirements of this section.

C. Pipe support spacing shall not exceed the maximum indicated spans. Piping with grooved joint couplings, flexible joints, and bend fittings shall be balanced supported by a minimum of two pipe supports per pipe length, one at near each joint/fitting.

D. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.

E. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

F. Steel Pipe

1. Where support spacing is not indicated on the Drawings, the Contractor shall use the spacing below.

2. Support Spacing for standard wall or heavier welded steel, stainless steel or alloy steel pipe.

Nominal Pipe Diameter, Inches	**Maximum Span, ft (Water Service)**	**Maximum Span, ft (Gas or Vacuum Service)**
1/2	6	7
3/4 and 1	8	9

1-1/4 to 2	10	12
3	12	14
4	14	15
6	16	18
8 and 10	18	20
12 and 14	20	24
16 and 18	22	26
20 and greater	24	30

G. Ductile Iron Pipe

1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the Contractor shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, inches	Support Configuration
All diameters	two supports per pipe length, with one of the two supports located at a joint

H. Schedule 80 PVC and CPVC Pipe

Nominal Pipe Size, inches	100 °F and below	101 to 120 °F	121 to 140 °F
1	5	3.5	3
1-1/2	5.5	3.5	3.5
2	6	4	3.5
3	7	4.5	4
4	7.5	5	4.5
6	9	6	5
8	9.5	6.5	5.5
10 and larger	10	7	6

I. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.03 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.

2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. Basic PSA, Inc.

2. Bergen-Paterson Pipe Supports Group

3. Grinnell

4. Power Piping Company

5. TOLCO (Eaton B-Line)

2.04 COATING

A. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and shall receive protective coatings in accordance with the requirements of Section 09 96 00 – High Performance Coatings.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's printed instructions and per ANSI/MSS SP-58 Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

2. Embedded concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.

3. Hangers shall be adjusted to line up groups of pipes at the proper slope for drainage and venting, as close to ceilings or roofs as possible, and without interference with other Work.

3.02 FIELD FABRICATION

A. Quality Control

1. Field fabricated pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.

2. Hangers and supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

SECTION 40 05 24 – STEEL PROCESS PIPE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 01 - Piping General and 40 05 07 – Hangers and Supports for Process Piping apply to the Work of this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

40 05 01	Piping General
40 05 07	Hangers and Supports for Process Piping

B. Reference References

American Society of Mechanical Engineers (ASME)	
ASME B16.3	Malleable-Iron Threaded Fittings
ASME B16.4	Cast Iron Threaded Fittings
ASME B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ASME B16.9	Factory-Made Wrought Steel Butt Welding Fittings
ASME B16.11	Forged Fittings, Socket - Welding and Threaded
ASME16.12	Cast Iron Threaded Drainage Fittings
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASTM International (ASTM)	
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106	Seamless Carbon Steel Pipe for High Temperature Service
American Water Works Association (AWWA)	
AWWA C606	Joints, Grooved and Shouldered Type

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. Water, Air, Fuel Gas, Oil, Steam, and Waste Service: Unless otherwise indicated, galvanized and black steel pipe shall conform to ASTM A53 Type E or S- Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless or ASTM A106 - Seamless Carbon Steel Pipe for High Temperature Service, Grade B, and shall be Schedule 40 or 80, as indicated in the Piping Schedule. Galvanized steel pipe shall not be cement mortar lined unless so indicated.

2.02 PIPE JOINTS

A. Black steel pipe for general service shall have threaded ends with NPT threads, welded joints, or flanged joints. Threaded joints shall be made up with Teflon tape and welded joints may have butt-weld fittings, socket-weld fittings, or flanges. Where indicated, black steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

B. Black steel pipe for chlorine or sulfur dioxide pressure service shall be socket-welded except where required to match mating fittings of vacuum regulator-check units, gas filters, valves, diaphragm units, gauges, and switches.

C. Galvanized steel pipe shall have threaded ends with NPT threads made up with Teflon tape. Where indicated, galvanized steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

D. Where pressure conditions permit, black and galvanized steel pipe may have push-on joints for compression type fittings. For high pressure service these joints shall be harnessed.

2.03 FITTINGS

A. Common Use: The following fittings shall be provided for galvanized or black steel pipe, as indicated in the Piping Schedule:

1. Threaded malleable iron fittings conforming to ASME B16.3 - Malleable-Iron Threaded Fittings, Classes 150 and 300.

2. Threaded cast iron fittings conforming to ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

3. Forged steel socket welded fittings conforming to ASME B16.11 - Forged Fittings, Socket - Welding and Threaded.

4. Butt welding fittings conforming to ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings, Schedule 40 or 80, as indicated.

5. Threaded cast iron drainage fittings conforming to ASME16.12 - Cast Iron Threaded Drainage Fittings.

6. Flanged steel fittings conforming to ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

7. Grooved ductile iron fittings with grooving dimensions conforming to AWWA C606 - Joints, Grooved and Shouldered Type.

8. Compression-type steel fittings with armored Buna S gaskets for plain end pipe.

B. Special Applications

1. Fittings for chlorine and sulfur dioxide under pressure shall be Class 3000. forged steel socket welded fittings conforming to ASTM A105, Grade 2 - Forgings, Carbon Steel, for Piping Components, and Class 3000. forged steel fittings conforming to ASME B16.11, as indicated in the Piping Schedule.

2. Flanges for chlorine and sulfur dioxide pressure service shall conform to ASTM A105, ASME B16.5, Class 300, with 1/16-inch raised face, with 1/16-inch-high temperature, compressed, self-centering ring type gaskets to ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

3. Unions shall be 4 bolt tongue and groove, ammonia type, suitable for chlorine and sulfur dioxide service, with female threads and lead gaskets. Unions shall be rated for 500 lb. CWP service pressure, reducing-type, straight-type or blind-type, as required for the installation. Blind unions shall be provided as cleanouts where indicated, and straight unions shall be provided adjacent to each threaded valve or piece of equipment. Unions shall be as manufactured by **Henry Valve Machine Company (Vogt Valves Inc.),** or equal. High tensile alloy steel corrosion-resistant bolts and nuts shall be used with each set of flanged unions.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection, and field testing of the pipes shall in accordance with the requirements of Section 40 05 01 - Piping General.

END OF SECTION

SECTION 40 05 31.13 – POLYVINYL CHLORIDE PROCESS PIPE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide polyvinyl chloride (PVC) pressure pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 01 - Piping General and Section 40 05 07 – Hangers and Supports for Process Piping apply to the Work of this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

40 05 01	Piping General
40 05 02	Piping Identification
40 05 07	Hangers and Supports for Process Piping

B. Reference Standards

American Society of Mechanical Engineers (ASME)	
ASME B16.5	Pipe Flanges and Flanged Fittings
ASTM International (ASTM)	
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe
ASTM D2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings
ASTM D2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM F1498	Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings
American Water Works Association (AWWA)	
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. PVC pipe shall be made from new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, Schedule 80, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D1785 –Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2.02 PIPE JOINTS

A. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the fluid in the pipe.

B. Threaded joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape. Pipe threads shall conform to ASTM F1498 - Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings and shall be full and cleanly cut with sharp dies or molded.

C. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated.

2.03 FITTINGS

A. Solvent Welded and Threaded Fittings: Solvent-welded and threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

B. Flanged Fittings: Flanged fittings shall be Schedule 80 fabricated PVC fittings with Class 150 flanges in accordance with ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150.

2.04 SOLVENT CEMENT

A. Solvent cement shall be in accordance with ASTM D2564 and certified by the manufacturer for the service of the pipe.

B. Potable Water Applications: Solvent cement listed by NSF for potable water applications.

C. Manufacturer: IPS® Corporation, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection, and field testing of the pipes shall in accordance with the requirements of Section 40 05 01 - Piping General.

END OF SECTION

SECTION 40 05 51 – COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 -- GENERAL

1.01 SUMMARY

A. Provide valves, actuators, and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated.

C. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls, as indicated.

D. Support

1. Submit the support design, including drawings and calculations sealed by an engineer, with the Shop Drawings.

E. Unit Responsibility

1. The Contractor shall assign a single manufacturer to be responsible for the supply, coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve Section.

F. Single Manufacturer

1. Where 2 or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
05 50 00	Metal Fabrications
09 96 00	High-Performance Coatings
40 05 01	Piping General
40 05 02	Piping Identification

B. Reference Standards

American National Standards Institute (ANSI)	
American Water Works Association (AWWA)	
ASTM International (ASTM)	
ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A 216	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 351	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A 395	Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 515	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 536	Standard Specification for Ductile Iron Castings
ASTM B 62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 584	Standard Specification for Copper Alloy Sand Castings for General Applications
Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)	
MSS SP-25	Standard Marking Systems for Valves, Fittings, Flanges, and Unions
NSF International (NSF)	
NSF/ANSI 61	Drinking Water System Components – Health Effects

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Furnish the following information on Shop Drawings:

1. valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. complete information on the valve actuator, hydraulic power units (HPU), pneumatic air supply system including size, manufacturer, model number, limit switches, and mounting.

3. cavitation limits for control valves.

4. assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, hand wheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. complete wiring diagrams and control system schematics; and,

6. A valve-labeling schedule, listing the valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

C. Furnish a technical manual containing the required information for each valve, as indicated.

D. Furnish a spare parts list, containing the required information for each valve assembly, as indicated.

E. Factory Test Data

1. Where indicated, submit signed, dated, and certified factory test data for each valve requiring certification, before shipping the valve.

2. Furnish a certification of quality and test results for factory-applied coatings.

F. Field Test Data

1. Submit signed, dated, and certified field test data for each valve.

PART 2 -- PRODUCTS

2.01 PRODUCTS

A. General

1. Provide valves and gates of new and current manufacture.

B. Protective Coating

1. Coat the exterior surfaces of valves and the wet interior surfaces of ferrous valves of sizes 2-inch and larger in accordance with the requirements of Section 09 96 00 – High-Performance Coatings.

2. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with the indicated requirements.

3. Do not coat the machined flange faces of valves except where such flanges are not adjoining a mating flange as shown in the Contract Documents. Apply rust inhibitor coating on machined surfaces of the flange prior to shipment.

C. Valve Labeling

1. Except when such requirement is waived by the Engineer in writing, provide a label on shut-off valves and control valves except for hose bibbs and chlorine cylinder valves.

2. Furnish a label composed of 1/16-inch plastic or stainless steel, a minimum of 2 inches by 4 inches in size, as indicated in Section 40 05 02 – Piping Identification Systems, and permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

D. Valve Testing

1. As a minimum, unless otherwise indicated or recommended by the reference standards, test valves 3 inches in diameter and smaller in accordance with the manufacturer's standard procedure.

2. Factory-test valves 4 inches in diameter and larger as follows:

a. Hydrostatic Testing

1) Subject valve bodies to an internal hydrostatic pressure equivalent to twice the water-rated pressure of the valve.

2) Metallic valves rating pressures shall be based at 100 degrees F.

3) Plastic valves rating pressures shall be based at 73 degrees F, or at a higher temperature according to material type.

4) During the hydrostatic test, there shall be no visible leakage through the valve body, end joints, or shaft seals, nor shall parts of the valve be permanently deformed.

5) Allow test duration of at least 10 minutes, in order to allow visual examination for leakage.

b. Seat Testing

1) Test the valves for leaks in the closed position, with the pressure differential across the seat equal to the water rated pressure of the valve.

2) Provide test duration of at least 10 minutes, in order to allow visual examination for leakage.

3) The leakage rate shall be the more stringent of the following:

a) As recommended by the reference standard for that type of valve; or

b) Leakage past the closed valve not to exceed one fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

c. Performance Testing

1) Shop-operate the valves from the fully-closed to the fully-open position and reverse under no-flow conditions in order to demonstrate that the valve assembly operates properly.

E. Certification

1. Prior to shipment of valves with sizes larger than 12-inches in diameter, submit certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

F. Valve Markings

1. Permanently mark valve bodies in accordance with MSS SP-25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.02 MATERIALS

A. General

1. Provide materials suitable for the intended application.

2. Provide materials in contact with potable water listed as compliant with NSF/ANSI 61.

3. Ensure that materials not indicated are of high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

4. Unless otherwise indicated, provide valve and actuator bodies conforming to the following requirements:

    a. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings

    b. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

    c. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

    d. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications. Bronze materials in contact with potable water service shall be free of lead content meeting the Lead Reduction Act.

    e. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel

    f. PVC: Polyvinyl chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454

    g. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447

    h. NSF/ANSI 61: Materials shall be listed for use in contact with potable water.

    i. Elastomeric materials used for seat, seals and O-rings shall be compatible with temperature, pressures and fluid or gas service.

        1) Elastomeric materials for water with chloramines shall be Teflon or Viton-A.

        2) Elastomeric materials for water with dissolved ozone residual shall be Teflon suitable for ozone service.

        3) Elastomeric materials for oxygen (LOX or GOX) shall be Teflon specially manufactured and packaged suitable for oxygen service.

2.03 VALVE CONSTRUCTION

A. Bodies

1. Provide valve bodies that are cast, molded (in the case of plastic valves), forged, or welded, of the materials indicated, and with smooth interior passages.

2. Provide wall thicknesses uniform and in agreement with the applicable standards for each type of valve, without casting defects, pinholes, and other defects that could weaken the body.

3. Perform welds on welded bodies by certified welders and ground welds smooth.

4. Provide valve ends as indicated and rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections

1. Unless otherwise indicated, valves 2-1/2 inches in diameter and smaller may be provided with threaded end connections.

2. Provide valves 3 inches in diameter and larger with flanged end connections.

3. Flanges, bolts and gaskets shall be as specified in Section [[[40 05 01]]] [[[15001]]] - Piping General.

C. Bonnets

1. Connect valve bonnets to the body by clamping, screwing, or flanging.

2. Provide bonnets of the same material, temperature, and pressure rating as the body.

3. Make provisions for the stem seal with the necessary glands, packing nuts, and yokes.

D. Stems

1. Provide valve stems of the materials indicated, or, if not indicated, of the best commercially-available material for the specific service, with adjustable stem packing, O-rings, chevron V-type packing, or other suitable seal. Bronze materials in contact with potable water shall be NSF 61 approved and free of lead. Elastomeric materials shall be compatible with fluid service.

E. Stem Guides

1. Provide stem guides spaced with an L/R ratio not to exceed 200:1. Submit calculations for L/R ratios and guide spacing to the Engineer for review.

2. Stem guides shall have slotted holes and shall be adjustable in two directions.

3. Construct submerged stem guides from Type 316 stainless steel.

F. Internal Parts

1. Provide internal parts and valve trim as indicated for each individual valve.

2. Where not indicated, construct valve trim from Type 316 stainless steel or other material best-suited for the intended service.

G. Nuts and Bolts

1. Unless otherwise indicated, provide nuts and bolts on valve flanges and supports in accordance with the requirements of Section 05 50 00 – Metal Fabrications and Section 40 05 01 – Piping General.

2.04 TORQUE TUBES

A. Submerged or buried valves with a remote gearbox and actuator shall be supplied with a torque tube to transfer torque from the actuator to the valve. Torque tubes shall be directly connected to the valve and the floor stand and gear actuator. Each torque tube and floor stand shall be sized to operate under the maximum service conditions for the valve. Unless otherwise indicated, torque tubes shall be made of schedule 40, steel pipe with epoxy coating suitable for the fluid service. Each submerged valve, torque tube, floor stand and actuator shall be pre-assembled and “matched marked” in the manufacturer’s shop to ensure proper fit when assembled in field.

2.05 EXTENSION SHAFT STEM

A. Valves mounted in dry areas with gearbox attached to the valve and with remote actuator shall be supplied with an extension shaft stem with universal joint attached to the gear and actuator. All components shall be sized to operate under the maximum service conditions for the valve. Unless otherwise indicated, shaft stem and universal joints shall be made of carbon steel with epoxy coating suitable for the fluid service. Each valve, shaft stem, floor stand and actuator shall be pre-assembled and “matched marked” in the manufacturer’s shop to ensure proper fit when assembled in field.

2.06 VALVE ACCESSORIES

A. Provide valves complete with the accessories required to provide a functional system.

2.07 SPARE PARTS

A. Furnish the required spare parts, suitably packaged and labeled with the valve name, location, and identification number.

B. Furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve.

C. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

2.08 MANUFACTURERS

A. Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the indicated valves.

PART 3 -- EXECUTION

3.01 VALVE INSTALLATION AND TRIAL OPERATION

A. General

1. Install valves, actuating units, stem extensions, valve boxes, and accessories in accordance with the manufacturer's written instructions and as indicated.

2. Adequately brace gates in order to prevent warpage and bending under the intended use.

3. Firmly support valves in order to avoid undue stresses on the pipe.

B. Access

1. Install valves in a manner to provide easy access for actuation, removal, and maintenance, and to avoid interference between valve actuators and structural members, handrails, and other equipment.

C. Valve Accessories

1. Where combinations of valves, sensors, switches, and controls are indicated, properly assemble, and install such items such that systems are compatible and operating properly.

2. Clearly note the relationship between interrelated items on Shop Drawing submittals.

D. Trial Operation

1. After installation, schedule trial operation witnessed by the Engineer and the Owner representative.

2. All valves shall be cleaned thoroughly of all foreign materials and final adjustments made. The valves shall then be operated through one complete cycle from a fully closed position to a fully open position and back to a fully closed position to verify that the assembly is functional.

3. For control valves that operate in multiple operating scenarios, the Contractor shall simulate all operational scenarios including the hydraulic power units, pilot control system or pneumatic air supply system to demonstrate compliance to the specifications.

4. A field leakage test meeting the maximum allowable specified requirement shall be conducted.

5. Test certificate shall be signed by the valve manufacturer and the Contractor and shall be submitted to the Engineer.

END OF SECTION

SECTION 40 05 61 – GATE VALVES

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 – Common Requirements for Process Valves apply to this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

09 96 00	High-Performance Coatings
40 05 51	Common Requirements for Process Valves

B. Reference Standards

American Water Works Association (AWWA)	
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C509	Resilient-Seated Gate Valves for Water and Sewerage System
AWWA C515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
ASTM International (ASTM)	
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A395	Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A536	Ductile Iron Castings
ASTM B62	Composition Bronze or Ounce Metal Castings
ASTM B371	Copper-Zinc-Silicon Alloy Rod

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Common Requirements for Process Valves.

PART 2 -- PRODUCTS

2.01 GATE VALVES (SMALLER THAN 3-INCHES)

A. Construction: Gate valves smaller than 3-inches, for general purpose use, shall be non-rising stem, heavy-duty type for industrial service, with screwed or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B62 - Composition Bronze or Ounce Metal Castings. The stems shall be of bronze conforming to ASTM B62, or ASTM B371 - Copper-Zinc-Silicon Alloy Rod. The solid wedges shall be of bronze conforming to ASTM B62. The valves shall have malleable iron handwheels unless otherwise indicated, and stem seals shall be of

Teflon-impregnated or other acceptable non-asbestos packing. Valves shall have a pressure rating of minimum 125 psi steam and 200 psi coldwater, unless otherwise indicated.

B. Manufacturers, or Equal

1. Crane Company

2. Milwaukee Valve Company

3. Wm. Powell Company

4. Stockham Valves and Fittings

5. Walworth Company

PART 3 -- EXECUTION

3.01 GENERAL

A. Gate valves shall be installed in accordance with the provisions of Section 40 05 51 – Common Requirements for Process Valves. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION

SECTION 40 05 62 – PLUG VALVES

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51– Common Requirements for Process Valves apply to this Section.

C. Plug valves shall have undergone a proof-of-design test to demonstrate that the valve components operate at the service flow, pressure, temperature, and fluid conditions, free from binding, excessive noise, and premature failures. Proof-of-design test results shall be available to the Engineer on request. The proof-of-design test shall be conducted in accordance with the applicable provisions of AWWA C517- Resilient-Seated Cast-Iron Eccentric Plug Valves.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

09 96 00	High-Performance Coatings
40 05 51	Common Requirements for Process Valves

B. Reference Standards

American Water Works Association (AWWA)	
AWWA C517	Resilient-Seated Cast-Iron Eccentric Plug Valves
ASTM International (ASTM)	
ASTM A 126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 216	Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service
ASTM A 536	Ductile Iron Castings

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Common Requirements for Process Valves.

PART 2 -- PRODUCTS

2.01 LUBRICATED PLUG VALVES (1/2-INCH TO 36-INCHES)

A. Construction: Lubricated plug valves shall be the tapered plug top- or bottom- entry type, with flanged ends for sizes 3-inches and larger, and flanged or screwed ends for smaller valves, as indicated. The body and top plate shall be of cast steel conforming to ASTM A 216 - Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service, or other acceptable cast or forged steel. The plug shall be of steel or cast iron and the stem shall be of stainless steel or alloy steel, with weather seal and Teflon impregnated packing. Valves up to and including 20-inches size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not

less than 70 percent for larger valves. Valves 24-inches and larger shall have an unobstructed port area of 100% of pipe area. The valve body and plug shall have smoothly-finished water passages free from sharp corners when the plug is in the wide-open position. The valve shall be rated for ANSI class 150 300 or as indicated, between service temperatures of minus 20 to plus 100 deg F.

B. Sealant System: The valves shall be provided with fittings designed to feed a sealant through a check-valve protected passage in the stem, through the side, or through a stainless-steel tube for worm-gear actuated or buried valves. There shall be ducts or grooves in the face of the plug to insure the maintenance of a closed, pressurized sealant system between contact surfaces of moving parts. Surfaces of the plug shall be coated with a dry film lubricant, such as polyfluoride or equal, to suit the service, permanently bonded to the metal surfaces. Sealant for LP gas service shall be the manufacturer's recommended type. The plug shall be held toward the seat by factory-adjusted gland assemblies set for proper sealing and operating torque. The gland assemblies shall be adjustable from the valve exterior and shall utilize either spring washers or gland deflection to allow plug unseating when pressurized sealant is injected.

C. Lubricating Gun: The Contractor shall furnish a manual lubricating gun for lubricated plug valves in sizes up to 6-inches, inclusive. For larger valves, the Contractor shall furnish a pneumatically-operated lubricating gun and a manual lubricating gun. For installations of more than 6 lubricated plug valves, the number of guns shall be doubled. The guns shall be from the same manufacturer as the valves. Guns shall each be equipped with flexible connectors, pressure gauge, safety valve, and be furnished in labeled toolboxes with operating instructions.

D. Manufacturers, or Equal

1. Nordstrom Audco Valves, Inc. (Nordstrom & Rockwell are the same company)

2.02 ECCENTRIC PLUG VALVES (1/2-INCH TO 72-INCHES)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inches and larger, and screwed or flanged ends for smaller sizes. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09 96 00 – High-Performance Coatings. The seats shall be of nickel or stainless steel welded to the body. Top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals. Valves up to and including 20-inches in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. Valves 24-inches and larger shall have an unobstructed port area of 100% of pipe area. Eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

B. Manufacturers, or Equal

1. DeZurik Corporation

2. Clow Valve Company

3. Pratt Valve

4. Victaulic

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Common Requirements for Process Valves.

B. Eccentric Plug Valves: Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for the full range of sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION

SECTION 40 05 65.10 – CHECK VALVES

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide check valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 – Common Requirements for Process Valves apply to this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

40 05 51	Common Requirements for Process Valves

B. Reference Standards

American Society of Mechanical Engineers (ASME)	
ASME B1.20.1	Pipe Threads, General Purpose (inch)
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	Pipe Flanges and Flanged Fittings
American Water Works Association (AWWA)	
AWWA C508	Swing-Check Valves for Waterworks Service
ASTM International (ASTM)	
ASTM A48	Gray Iron Castings
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM B16	Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines
ASTM B148	Aluminum-Bronze Castings
ASTM B584	Copper Alloy Sand Castings for General Applications
ASTM B763	Copper Alloy Sand Castings for Valve Application

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Common Requirements for Process Valves.

PART 2 -- PRODUCTS

2.01 SWING CHECK VALVES (3-INCHES AND LARGER)

A. General: Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with AWWA C508 - Swing-Check Valves for Waterworks Service, 2-in. through 24-in. NPS, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. Units shall have a flanged cover piece to provide access to the disc. Where indicated, swing check valves shall be provided with position indicators.

B. Body: The valve body and cover shall be of cast iron conforming to ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or be mechanical joint ends, as indicated.

C. Disc: The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B584 - Copper Alloy Sand Castings for General Applications.

D. Seat and Rings: The valve seat and rings shall be of bronze conforming to ASTM B584 or ASTM B148 - Aluminum-Bronze Castings or of Buna-N.

E. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

F. Manufacturers, or Equal

1. DeZurik/APCO

2. Kennedy Valve

3. Mueller Company

4. Stockham Valves and Fittings

5. GA Industries

2.02 METALLIC BALL SEWAGE CHECK VALVES

A. General: Metallic ball check valves for sewage service, in sizes up to 24-in, shall be used for vertical up-flow conditions and horizontal positions only.

B. Construction: The valve shall be designed with non-clogging feature for raw sewage. The ball shall be guided to and from its seat by smooth ribs integrally cast into the housing wall. An internal clog-proof design shall insure a completely free and unobstructed flow with no projections or pockets to trap solid material. The valve body and cover shall be of cast or ductile iron and be epoxy-coated suitable for the service condition. Units shall have flanged ends conforming to ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150. Ball shall be made of hollow metal with vulcanized Buna-N rubber or hypalon cover suitable for the service. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

C. Manufacturers, or Equal

1. Flygt (HDL)

2. GA Industries

PART 3 -- EXECUTION

3.01 GENERAL

A. Valves shall be installed in accordance with provisions of Section 40 05 51 – Common Requirements for Process Valves.

END OF SECTION

SECTION 40 91 00 - PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide Process Control and Instrumentation Systems (PCIS) complete and operable, in accordance with the Contract Documents. For the purpose of this CONTRACT, PCIS is synonymous and interchangeable with supervisory control and data acquisition (SCADA) where applicable.

The requirements of this Section apply to every component of the PCIS unless indicated otherwise.

B. Responsibilities

1. The CONTRACTOR, through the use of qualified electrical and mechanical installers, shall be responsible to the OWNER for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.
2. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these specifications that the CONTRACTOR will be responsible for the integration of the PCIS with existing devices and devices provided under this and other Divisions with the objective of providing a completely integrated control system free of signal incompatibilities.
3. The CONTRACTOR shall request the OWNER to demonstrate that all existing equipment that is to be reused or interfaced with in this project works properly for the intended function. In the event the existing equipment does not work, the issue should be brought up in the preconstruction/ pre-submittal meeting(s).
4. As a minimum, the implementation of the PCIS by the CONTRACTOR shall include the following WORK:
    a. Integrate the PCIS with existing devices and systems provided under this and other Divisions
    b. Prepare the required PCIS submittals
    c. Design and develop project-wide loop diagrams including those associated with equipment provided under other Divisions and OWNER-furnished and existing equipment
    d. Design and develop control panel drawings
    e. Field verify existing conditions
    f. Prepare factory and field test submittals
    g. Prepare training plan
    h. Prepare spare parts submittal
    i. Procure hardware
    j. Configure and factory test the PCIS
    k. Verify calibration of instruments after installation
    l. Terminate signals inside control and network panels; terminate communication and network devices and nodes

m. Supervise and coordinate installation and termination of field signals, power, and utilities associated with the PCIS. Resolve signal, power, or functional incompatibilities between the PCIS and new and existing interfacing devices.

n. Loop test in accordance with the loop diagrams. Validate and certify loops

o. Oversee, document, and certify system commissioning

p. Conduct system performance test

q. Prepare technical manuals

r. Conduct training classes

s. Prepare PCIS as-built final construction drawings

C. RELATED WORK AND REQUIREMENTS SPECIFIED ELSEWHERE

1. All electrical work required under this section shall conform to the requirements of this Section and the applicable requirements of the Sections in Division 01, Division 26 and Division 27.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all WORK specified herein shall conform to or exceed the applicable requirements of the referenced documents to the extent that the requirements therein are not in conflict with the provisions of this Section; provided, that where such documents have been adopted as a code or ordinance by the public agency having jurisdiction, such code or ordinance shall take precedence.

B. The PCIS WORK shall conform to or exceed the applicable regulations, standards, specifications, and codes and current as of the date of the final inspection for this Contract, including, but not limited to, those which are established by the following sources:

1. The International Society of Automation (ISA)
2. National Electrical Code (NEC)
3. National Fire Protection Association (NFPA)
4. Institute of Electrical and Electronic Engineers (IEEE)
5. Occupational Safety and Health Administration (OSHA)
6. American National Standards Institute (ANSI)
7. National Electrical Manufacturers Association (NEA)
8. Insulated Cable Engineers Association (ICEA)
9. Local Power and Telephone Companies
10. Local Authorities having jurisdiction over the work
11. Federal Communication Commission (FCC)
12. Underwriter Laboratory (UL)

C. Where the requirements set forth in these Specifications or on the Drawings are greater or more rigid than the mandatory requirements referenced above, the applicable Specifications or Drawings shall govern.

D. In the case of conflict between any mandatory requirements and Specifications or Drawings, the mandatory requirement shall be followed in each case, but only after submitting such proposed changes to the ENGINEER for approval.

E. Nothing contained in these Specifications or shown on the Drawings will be so construed to conflict with any national, state, municipal, or local laws or regulations governing the installation of work specified herein, and all such acts, ordinances, and regulations, including the National Electrical Code, are hereby incorporated and made a part of these Specifications. All such requirements will be satisfied by the CONTRACTOR at no additional expense to the OWNER.

F. The Drawings and Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If a conflict between Drawings and Specifications is discovered, this shall be referred to the ENGINEER as soon as possible for resolution. Should a conflict exist between the Drawings, Specifications, and/or mandatory requirements (i.e., codes, ordinances, etc.), it will be assumed that the more expensive method has been estimated, unless such alternate has been agreed to prior to submission of bids.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. The CONTRACTOR shall provide submittals in accordance with Section 01 33 00-Contractor Submittals and the additional submittal requirements specified in this Section, in Division 40, and the following:

1. The CONTRACTOR shall coordinate the PCIS part of the WORK so that a complete instrumentation and control system will be provided and will be supported by accurate Shop Drawings and as-built drawings.
2. The submittals and their schedules shall be shall be in accordance with the requirements listed below: Any incomplete submittal will be rejected and returned without comments.
3. Interface between instruments, motor control centers, engines, starters, control valves, flowmeters and other equipment related to the PCIS shall be included in the shop drawing submittal. Interface between existing equipment, instruments and control panels shall also be included.
4. Exchange of Technical Information: During the period of preparation of these submittals, the CONTRACTOR shall authorize a direct, informal liaison with the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be authorized informally by the ENGINEER, but will not alter the scope of WORK or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the ENGINEER shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.
5. Symbols and Nomenclature: In these Contract Documents, systems, meters, instruments, and other elements are represented schematically, and are designated by symbols as derived from Instrument Society of America Standard ISA S5.1 - Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout

Shop Drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

B. Shop Drawings Submittal Organization

1. Shop Drawings shall include the letter head or title block of the CONTRACTOR. The title block shall include, as a minimum, the CONTRACTOR's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.
2. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual. Submittals not so organized will not be accepted.
3. Drawings that require more than one sheet due to space limitation or continuation in the subject of the drawings (e.g. loop diagrams, etc.) shall be given the same drawing number but with different sheet number (e.g. sheet 1 of x, sheet 2 of x, etc.).
4. Each submittal shall include a complete index appearing in the front of each bound submittal volume. Drawings and/or system groups shall be separated by labeled tags. The organization of the initial shop drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting as-built conditions.
5. Interfaces between new and existing instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders, panels, and other equipment related to the PCIS shall be included in the Shop Drawing submittal.

C. Field Instrument Submittal

1. Submittal Schedule: The CONTRACTOR shall submit for approval a complete field and process instrument submittal, **all at one time, within 60 calendar days** after the date of Notice to Proceed is given to the CONTRACTOR.
2. Submittal Contents: The submittal shall include a complete index which lists each device by tag number, type, and manufacturer in accordance with the specified data sheets provided in this CONTRACT. A separate manufacturer technical brochure or catalog sheet shall be included with each specified instrument data sheet. If, within a single system or loop, a single instrument is employed more than once, one manufacturer brochure or catalog sheet may cover multiple identical uses of that instrument in that system. Each manufacturer brochure or catalog sheet shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags. Special options and features which are furnished shall be identified.

D. System Hardware Submittal:

1. Submittal Schedule: The CONTRACTOR shall submit for approval a complete system hardware submittal, **all at one time, within 30 calendar days** after the date of Notice to Proceed is given to the CONTRACTOR. This submittal shall be submitted together with the submittal for theProject-Wide Wiring Diagrams and Panel Drawings submittal specified below.

2. Submittal Contents:

   a. The submittal shall include a complete index which lists each device by type, and manufacturer in accordance with the contract documents. A separate

manufacturer technical data sheet or brochure shall be included for each hardware component. If, within a single system a single component is employed more than once, one manufacturer technical data sheet or brochure may cover multiple identical uses of that component in that system. Special options and features which are furnished shall be identified.

b. Spare Parts and Tools List: A list of spare parts and tools shall be submitted, covering items which are specified and furnished under this Contract. The list shall include the name, address, and phone number of manufacturer and manufacturer's local service representative of these parts. The list shall also include recommended spare parts and tools, quantities and prices from which the OWNER will select the "Additional Recommended Spare Parts and Tools".

E. Project-Wide Wiring Diagrams Submittal:

1. Submittal Schedule: The CONTRACTOR shall submit for approval a complete set of project-wide wiring diagrams (PWWD) and panel drawings, **all at one time within 30 calendar days** after the date of Notice to Proceed is given to the CONTRACTOR.

2. Submittal Contents: The PWWD and panel drawings shall be submitted as a single and comprehensive set of drawings. Diagrams shall be tagged in a manner consistent with the Contract Documents and shall include the following:

a. Project-Wide Wiring Diagrams: The PWWD shall define and document the contents of each analog and discrete monitoring, alarming, hardware interlock, and control functions associated with equipment provided under Division 40 sections. The PWWD shall also cover equipment provided under sections in other Divisions, existing, and OWNER-furnished equipment. The PWWD shall also include both field and panel wiring diagrams.

1) Drawings showing definitive diagram for every analog and discrete instrumentation loop system. These diagrams shall show and identify each component in each loop or system using legend and symbols. The wiring diagrams shall be presented with no more than 10 loops per drawing.

2) In general, loops shall be grouped and organized by PLC (if used) and the I/O cards within the PLC. Each I/O card shall be presented on a separate sheet(s) and on the right side of the drawing. The type of card, part number and its slot location shall be identified. Each I/O shall be identified as well as its location on the card and its address. Existing, spare, and future I/Os shall also be shown. Power supply wiring to the card/loops, wire colors, and terminal numbers shall be shown on the wiring diagrams. The I/O cards, the loops and any device in the loop shall be shown together. Each loop shall be complete, including the source/destination within new or existing panels, device(s) in the loop, field connection panels or field junction boxes, field and PLC interface terminal blocks and wire numbers.

3) In addition wiring diagrams shall show the following details

a) Functional name of each loop

b) Reference name, drawing, and loop diagram numbers for any signal continuing off the wiring diagram sheet.

c) MCC panel, circuit, and breaker numbers for power feeds to the loops and instrumentation.

d) Wiring type, size and color

e) Designation, and if applicable, terminal assignments associated with every manhole, pull box, junction box, conduit in which wiring is to be located, and panel through which the loop circuits pass.

f) Vendor panel, instrument panel, conduit, junction boxes, equipment and SCADA terminations, termination identification wire numbers and colors, power circuits, and ground identifications.

4) Wiring diagrams shall be developed for loops in equipment vendor-supplied packages, equipment provided under Division 40, and OWNER-furnished equipment.

b. Panel Wiring Diagrams: Panel wiring and/or piping diagrams shall be prepared in concert with the PWWD and shall include the following information:

1) Name of panel

2) Power distribution schematic diagrams associated with each panel or system (120VAC, 24VDC and other DC systems, control circuits). The schematic diagram shall show source of power for the panel (circuit breaker panel and breaker) and fuses. All power backup system distribution shall also be shown.

3) Schematic diagrams for control circuits in accordance with ANSI standards. The diagrams shall show complete details on the circuit interrelationship of all devices within and outside each Control Panel. Including primary measurement and control devices.

4) Communication diagram(s) for the equipment inside the panel.

5) Interfaces with existing control and monitoring systems. The CONTRACTOR shall furnish all necessary diagrams that depict any and all modifications made to existing measurement and control circuits, equipment and wiring. It is the responsibility of the System Supplier to ascertain actual field conditions of the existing circuits, equipment and wiring. The CONTRACTOR may request copies of as built drawings and data that the OWNER can provide that show such existing conditions. Lack of such drawings shall not alleviate the contractual responsibility to ascertain and implement interfaces and modifications to existing measurement and control circuits, equipment and wiring.

6) Surge protection and signal and safety grounding circuits

7) Wiring type and piping size and material

8) Terminal block numbers and wire numbers

c. Panel Drawings: Panel drawings, including console, and cabinet layout drawings, shall be prepared and submitted for each panel and shall include the following information: These drawings shall include enough other details to define exactly the style, the contents, and overall appearance of the panel assembly.

1) Name of Panel.

2) Panel Dimensions; front, side, and plan views and layout to scale.

3) Arrangement of internally and externally mounted instruments and equipment to scale. Note: Control panel layouts shown on the Contract Drawings are diagrammatic.

4) Location of terminal blocks, electrical devices, and conduit entry location(s).

5) Tag number or item number and functional name of items mounted in and on panel, console, or cabinet.

6) Nameplate legend which includes text, letter size, and colors to be used.

7) Complete and detailed Bills of Materials shall include all items within a panel and shall be presented on the panel layout drawing. The bill of material list shall include quantity, description, manufacturer, and part number.

8) Panel mounting information, including conduit entrance location.

9) Communication hardware installation, such as radio, mast and antenna.

10) Assembly and construction drawings. These drawings shall include dimensions, identification of all components, construction material and gauge, surface preparation and finish data, panel door locks and hinge mechanism, nameplates, and the like.

F. Startup and Commissioning Submittals

1. Submittal Schedule: The CONTRACTOR shall submit for approval a proposed procedure to be followed during startup and commissioning of the PCIS and its components **complete within 270 calendar days** after the date of Notice to Proceed is given to the CONTRACTOR, but not later than **60 calendar days** prior to the Factory Acceptance Test date. The CONTRACTOR shall submit the proposed.

2. Preliminary Submittal: Outlines of the specific procedures and examples of proposed forms and checklists.

3. Detailed Submittal: After approval of the Preliminary Submittal, the CONTRACTOR shall submit the proposed detailed procedures, forms, and checklists. This submittal shall include a statement of objectives with the test procedures.

G. Training Plan and Training Manual Submittals:

1. Submittal Schedule: The CONTRACTOR shall submit for approval a training plan and a training manual submittal **complete and within 270 calendar days** after the date of Notice to Proceed is given to the CONTRACTOR, but no later than **60 calendar days** prior to start of the first training session.

2. Submittal Contents: The Training submittal shall consist of two parts:

a. Training Plan, which shall include:

1) Schedule of training courses including dates, durations, and locations of each class. Number of times each class will be offered, if applicable and the number of people expected in each class.

2) List of courses and lessons and who will conduct them

3) Resumes of the instructors who will actually conduct the training classes. The CONTRACTOR shall identify in the submittal the courses and lessons that will be performed by the equipment manufacturer.

4) List of material used for the training, which shall include the Technical Manuals for the PCIS.

b. Training Manual

1) Training subjects' syllabus and associated lesson plans. The training subjects are listed in Part 3 "Execution "of this Section. If, in the opinion of the System Supplier, additional subjects that are not listed and are pertinent to the training and will benefit the OWNER's staff, these subjects shall also be included in the training manuals and taught in the class.

1.4 CLOSEOUT SUBMITTALS

A. Technical Manuals Submittal

1. Submittal Schedule:

a. The CONTRACTOR shall submit for approval Technical Manuals for the PCIS: Initial set shall be submitted **complete and within 60 days** after the date of Notice to Proceed is given to the CONTRACTOR. But at least **15 days** prior to the starts of the OWNER's training.

b. Each set shall consist of one (1) or more volumes and provided in PDF on a thumb-drive.

2. Submittal Contents:

a. Information in the Technical Manual shall be based upon the approved Shop Drawing submittals as modified for conditions encountered in the field during the WORK. The Technical Manuals shall therefore contain the as-built drawings and information.

b. The Technical Manuals shall include installation, connection, operating, calibration, set points (e.g., pressure, pump control, time delays, etc.) adjustment, test, troubleshooting, maintenance, and overhaul instructions in complete detail.

c. The Manuals shall have the following material organized in volumes and divided by subject and tabs The Technical Manual shall have the following organization for each process (the number and the enumeration of the sections shall be project specific):

1) Section A - Process and Instrumentation Diagrams (as built copy)

2) Section B - System Architecture and Communication System Block Diagram(s)

3) Section C - Wiring Diagrams. A separate set of drawings shall be provided for each site. Each set shall be arranged in a separate tab (drawings shall also be provided in PDF).

4) Section D – Functional design report. It shall include a copy of the site graphic display(s) and description how the site is controlled and any special control strategies specific for each site. Special control functions

in the server shall also be included. Calibration, set points (e.g., pressure, pump control, time delays, etc.) shall also be included.

5) Section E - Instrument Data Sheets and corresponding manufacturer's data sheet/catalog cuts/brochure that was used in the hardware submittal and the operation and maintenance/user manual.

6) Section F - Calibration Documentation

7) Section G – Communication survey and test results

8) Section H - Loop, Commissioning and Performance Test Results

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. The CONTRACTOR shall provide the specified spare parts and tools. In addition, The ENGINEER and the OWNER will select from the priced list of "Additional Recommended Spare Parts" in the Hardware Equipment Submittal. The CONTRACTOR shall furnish these parts and will be paid for them from the corresponding allowance item in the Bid. The total price will not exceed the amount of the allowance item.

1.6 QUALITY ASSURANCE

A. Field Tests: The CONTRACTOR's attention is directed to the Article "EXECUTION" of this Section which delineates all the tests that are required to be performed in the field in order to demonstrate compliance with the Contract Documents.

B. The CONTRACTOR shall provide and assign to the OWNER all user software and hardware licenses. Computer and software system shall be purchased on behalf of the OWNER who shall also be designated as the licensee. Each software package shall be provided with a "Site License" or with as many licenses as a "Site License" includes (site is defined as the name of the OWNER). The CONTRACTOR shall include in the bid price all license fees.

C. The CONTRACTOR shall provide the proper number of software licenses for all the servers, workstations, and laptops to provide concurrent and simultaneous user operation.

D. Prior to final acceptance of the PCIS System and related equipment, the CONTRACTOR shall propose and present in writing to the OWNER a one-year maintenance contract and quotation which will become effective upon the expiration of the warranty. The maintenance contract is an option that the OWNER may purchase from the System Supplier. The contract shall offer different maintenance, site visit and help-desk with options each with its respective cost.

1.7 FIELD SITE CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following environmental conditions:

1. Wastewater treatment facility

B. Site Equipment:

1. Ambient temperature range: 5° to 104° F (-15° to +40° C)

2. Thermal shock: 1.8° F (1.0° C) per minute maximum

3. Relative humidity: 95 percent maximum non-condensing

1.8 WARRANTY

A. All parts, material labor, travel, subsistence, or other expenses incurred in providing services and service visits during the warranty period shall be borne by the CONTRACTOR under the guarantee specified in Division 1. Equipment, software, and materials that do not achieve their intended purpose shall be replaced by the CONTRACTOR to attain compliance, at no additional cost to the OWNER.

B. Extended Period for Correction of Defects: The CONTRACTOR shall correct defects in the PCIS upon notification from the OWNER within 2 years from the date of Substantial Completion. Corrections shall be completed within 5 Days after notification

C. The performance of the servers and workstations hardware shall be guaranteed (repair of parts and labor at the owner's site including travel expenses) for a period of three (3) years following the date of completion and formal acceptance of the work (next business day on-site service).

D. Software Upgrades: During the warrantee period, the CONTRACTOR shall furnish and install at no additional cost to the OWNER any application software upgrades published applicable to OWNER’s applications and compatible with OWNER’s hardware and operating system.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Standard and Current Technology: All PCIS hardware, software, materials, and equipment furnished under this contract shall be new, free from defects, and shall be standard products and technology produced by manufacturers regularly engaged in the manufacturer of these products. Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

The CONTRACTOR shall submit a Substitute Item Request Form in case of discontinued or upgraded product or other cases where changing technology requires changes in equipment or software.

B. Adverse Environmental Impact: No component of an instrumentation system shall contain liquid mercury.

C. Hardware Commonality and Modularity: Instruments which utilize a common measurement principle shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer. All equipment shall be of modular design to facilitate interchangeability of parts to assure ease of servicing and expandability.

D. Instrument and Loop Power: Power requirements and input/output connections for components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2 wire" transmitters is preferred, and use of "4 wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as specified and/or as required by the

manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

E. Loop Isolators and Converters: The CONTRACTOR is responsible to resolve any signal level incompatibilities where required.

F. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 milliamperes DC except as indicated. Signals within enclosures may be 1 to 5 volts DC. Electric signals shall be electrically or optically isolated from other signals. Pneumatic signals shall be 3 to 15 psig with 3 psig equal to 0 percent and 15 psig equal to 100 percent.

G. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER through the "or equal" process of The Bid Forms. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage, and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Shipping: After completion of shop assembly, factory test, and approval, the tested PCIS equipment, cabinets, panels, and computer hardware shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. Tagging: A permanent stainless steel or other non-corrosive material tag marked with the instrument or equipment tag number shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package.

D. Storage: It is the CONTRACTOR's responsibility to assure proper handling and on-site storage of instrumentation and control equipment in accordance with the System Supplier's recommendations. All equipment and materials delivered to the jobsite shall be stored in a location which will not interfere with the operations of other contractors or the OWNER. Equipment shall not be stored outdoors. Storage and handling will be performed in manners which will afford maximum protection to the equipment and materials.

E. Equipment shall be stored in dry shelters, including in-line equipment, and shall be adequately protected against mechanical damage. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through

tests as directed by the ENGINEER. If such tests reveal defects, the equipment shall be replaced.

3.2 INSTALLATION

A. General

1. All systems and instrumentation, including instrumentation furnished under other Divisions, shall be installed, connected calibrated, tested, started, and placed into operation in accordance with CONTRACT documents under Division 40 and the manufacturers' instructions. The installation shall be coordinated with the ENGINEER and the OWNER. This shall include final integration in concert with equipment specified and provided by others.
2. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all PCIS equipment.
3. Equipment Locations: The monitoring and control system configurations indicated in the contract documents are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.
4. The CONTRACTOR shall review the existing site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.
5. The Contract Documents identify conduits and instruments required to make a complete PCIS. The CONTRACTOR shall be responsible for providing any reasonable additional or different type connections as required by parts of the PCIS' specific installation requirements, or as practical.

B. Conduit, Cables, and Field Wiring

1. Conduits, process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments and to control panels, SCADA input and output wiring, and other field wiring and cables shall be provided under Division 26 and without delay to the WORK of Division 40.
2. SCADA equipment cables, shall be provided under Division 40, but the installation in the field shall be under Division 26.
3. Terminations and wire identification inside PCIS equipment and panels furnished under this or any other Division shall be provided under Division 40.
4. The CONTRACTOR shall supervise and coordinate installation and termination and identification of field signals, power, and utilities associated with the PCIS. Resolve signal, power, or functional incompatibilities between the PCIS and new and existing interfacing devices.

C. Installation and Connections:

1. Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site. Appropriate mounting stands and bracket materials and workmanship shall be provided and shall comply with requirements of the Contract Documents.
2. Existing Instruments that are to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this WORK prior to reinstallation of each instrument.
3. The Contract Documents show necessary conduit and instruments required to make a complete instrumentation. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the ENGINEER for approval prior to commencing that WORK. Such changes shall not be a basis of claims for extra WORK or delay.
4. Conduits and/or raceways in building interior locations shall be surface mounted on walls or ceilings wherever possible and run perpendicular and parallel to building lines. Conduits shall not be routed on floors in areas subject to foot traffic. In exterior locations conduit shall be routed below grade.
5. Wires and cables shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the ENGINEER. Wiring shall be protected from sharp edges and corners.
6. Field wiring shall terminate at terminal blocks in the control panel. Field wiring shall not be wired directly to equipment in the control panel except communication and specialty cables that must be wired directly to their respective equipment.
7. Power and signal wires shall be terminated with crimped type lugs.
8. Wires shall be marked clearly with an identification wire number labels that are of a permanent nature. Computer system equipment cables shall be identified and marked for their location at each end of the cable. Computers and peripheral equipment connections/ports shall also be identified as to what cable is connected to its port location.
9. Connectors shall be, as a minimum, water tight.
10. The CONTRACTOR shall verify the correctness of each installation, including polarity of electric power and signal connections. The CONTRACTOR shall certify in writing all discrepancies have been corrected for each loop or system checked out. In addition, the CONTRACTOR shall make sure process connections are free of leaks.

D. Removal of Abandoned Equipment: Unless otherwise specified, all existing equipment in each facility that is no longer required after the new system has been put in service shall be removed and delivered by the CONTRACTOR to the OWNER.

3.3 FIELD QUALITY CONTROL

A. General:

1. Devices provided under Division 40 shall be initially calibrated by the manufacturer at the manufacturer’s facility prior to shipment. Following installation, the devices shall be field calibrated according to the manufacturer's recommended procedures

to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

2. Each instrument shall be field tested, inspected, and adjusted to the indicated performance requirement in accordance its manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirement, or, in the absence of a contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER.

B. Calibration Points: During field calibration each instrument shall be calibrated at least at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and outputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. Field Calibration: Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

D. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1. Project name
2. Loop number and site or process name and number
3. Tag number
4. Manufacturer
5. Model number
6. Serial number
7. Calibration range
8. Calibration data: Input, output, and error at 0 percent, 50 percent, and 100 percent of span
9. Switch setting, contact action, and dead-band for discrete elements
10. Space for comments
11. Space for sign-off by System Supplier and when applicable by the manufacturer and date
12. Test equipment used and associated serial numbers

E. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall have the System Supplier sign the calibration sheet when calibration is complete. The ENGINEER will sign the calibration sheet when the calibration and testing has been accepted.

F. Loop Testing: The Contractor shall test newly installed and modified existing loops for continuity and functionality. The up-to-date wiring diagrams shall be used as reference. The ENGINEER and/or the OWNER shall witness the loop testing.

G. The CONTRACTOR shall notify the ENGINEER of scheduled tests minimum of [[[30]]] calendar days prior to the estimated completion date of installation and wiring of the PCIS. After the ENGINEER's review of the submitted loop diagrams for correctness and

compliance with the specifications, loop testing shall proceed. The loop testing shall be witnessed by the ENGINEER and/or the OWNER.

H. Interlocks: Hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers, and packaged equipment controls shall be checked to the maximum extent possible.

I. Loop Validation:

1. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the HMI displays associated with the SCADA. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.
2. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by contract requirements or by published manufacturer accuracy specifications, whenever contract accuracy requirements are not indicated. Each analog loop shall be tested by applying simulated analog or discrete inputs to the first element of an analog loop. For loops which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75, and 100 percent of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. Analog loop test data, including calculated RMS summation system accuracy tolerance, shall be documented by the CONTRACTOR on the loop validation sheets. The validation sheets shall be included in the O&M Manuals.

J. Loop Validation and Certification Sheets:

1. Loop Validation: The CONTRACTOR shall prepare loop validation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop validation sheets shall form the basis for operational tests and documentation. Each loop validation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the System Supplier:
    a. Project name
    b. Loop number
    c. Tag number, description, manufacturer, and model number for each element
    d. Installation bulletin number
    e. Specification sheet number
    f. Loop description number
    g. Adjustment check
    h. Space for comments
    i. Space for loop sign-off by the System Supplier and date
    j. Space for ENGINEER witness signature and date

2. Loop Certification**:** A certified copy of each loop test validation sheet signed by the System Supplier, the ENGINEER or the ENGINEER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that the loops have been tested and the instrumentation in the loop has been successfully calibrated, inspected, and tested.

3.4 PRE-COMMISSIONING

A. General:

1. Pre-commissioning, which is defined in Section 017500 – Equipment Testing and Plant Startup, is basically the demonstration of proper operation of every part in the PCIS with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible. All systems shall be exercised through field operational tests, as a complete PCIS in accordance with the approved test procedures and in the presence of the ENGINEER and/or the OWNER.
2. Pre-commissioning shall commence after completion and acceptance of continuity tests, calibration tests and loop tests, and inspections have demonstrated that the instrumentation and control system complies with contract requirements.
3. Pre-commissioning Procedures and Documentation: Pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the ENGINEER. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the ENGINEER, which include calculated tolerance limits for each step. Completion of system pre-commissioning and test activities shall be documented by a certified report, including test forms with test data entered, delivered to the ENGINEER with a clear and unequivocal statement that system pre-commissioning and test requirements have been satisfied. The result of the testing shall also include a punch list developed by the ENGINEER.
4. The burden of proof of conformance of the system to specified functions and performance is on the CONTRACTOR. Tests that fail to demonstrate the required operation shall be repeated in their entirety or continued after corrective action has been completed at the discretion of the ENGINEER.
5. The CONTRACTOR shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the OWNER, wherever the OWNER or ENGINEER has reasonable doubt or evidence of malfunction or poor performance appears.
6. The CONTRACTOR shall coordinate the scheduling of tests among all parties involved so that the tests may proceed without delays or disruption by uncompleted work. Field operational and functional testing must be successfully completed prior to the start of the 30-day final acceptance test.

B. Operational Validation:

1. Where feasible, system pre-commissioning activities shall include the use of the actual process to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, PLCs, control panels, and ancillary equipment shall be tested under startup and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational.

2. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of process controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any), and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

3. Pre-commissioning shall also include the testing of remote sites to verify compliance with all functional requirements and communication specified. The testing shall include manual and automatic control modes, fail-safe and backup control modes, and PLC interlocks and control strategies provided by the System Supplier.

C. Loop and Equipment Tuning: Controllers incorporating proportional, integral and/or derivative control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 0, 25, 50, 75, and 100 percent of span and the results checked against indicated accuracy tolerances.

D. Pre-commissioning Validation Sheets: Pre-commissioning shall be documented on test forms as follows:

1. The validation form, which shall include:

a. Project name

b. Loop number

c. Loop and function description

d. Tag number, description, manufacturer, and data sheet number for each component.

e. Pre-Commissioning Certification - A statement certifying that the contract requirements have been met. It shall also include a listing of instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system testing must be provided in writing by the ENGINEER before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

f. Space for sign-off and date by the CONTRACTOR, the System Supplier, and the ENGINEER.

3.5 COMMISSIONING

A. Commissioning is the verification that the complete WORK functions on an extended basis are in full conformance with the Contract requirements.

B. As part of the commissioning, the entire PCIS shall operate continuously without failure for 30 consecutive days without failure (see test details below), thus extending its operation test longer than the commissioning period specified in Section 017500.

3.6 STARTUP OPERATION

A. General: Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities must be completed before startup activities begin.

B. When all equipment and systems have been assessed by the CONTRACTOR to have been successfully carried through complete operational and functional tests with not less than a minimum of simulation, and the ENGINEER concurs in this assessment, system startup by the OWNER'S operating personnel can follow.

C. Each facility, process, or site startup shall be performed in accordance with the approved test procedures.

D. Scheduling of startup shall be coordinated by the CONTRACTOTR among all parties involved so that the tests may proceed without delays or disruption by uncompleted work. System startup and training and instruction of the OWNER's personnel must be completed a minimum of seven (7) days prior to the final acceptance test.

1. Troubleshooting and Corrections

a. The Contractor shall participate in all start-up activities. If problems occur, the CONTRACTOR and the System Supplier shall jointly participate in the diagnosis wiring, control interface, hardware and software problems and correct deficiencies. The Contractor shall be responsible and bear all expenses to diagnose and correct all the deficiencies for work and equipment furnished under this CONTRACT.

b. Existing Instruments, Wiring and Interface: As specified above, prior to start of the WORK the CONTRACTOR shall request the OWNER to demonstrate that all existing equipment and software that is to be reused or interfaced with in this project works properly for the intended function. Consequently, if during the calibration, testing or start up the Contractor and/or the System Supplier encounters problems with existing instruments, hardware, wiring, or software that have been demonstrated to work, the CONTRACTOR shall notify the Engineer and the OWNER. In this case, the CONTRACTOR, the System Supplier and the Owner's representative shall jointly participate in the diagnosis of the problem. The course of action how to correct the deficiency shall be determined jointly by the OWNER, the Engineer and the CONTRACTOR/System Supplier. The CONTRACTOR shall be compensated for correcting the deficiencies or replacing the equipment.

c. If a problem is found to be a result of the CONTRACTOR's workmanship or equipment and work furnished under this CONTRACT, the CONTRACTOR shall be responsible and bear the expenses for correcting the deficiencies.

3.7 FINAL ACCEPTANCE TEST (COMMISSIONING)

A. After the pre-commissioning, functional tests and startup have been completed, the CONTRACTOR shall submit a report/letter states that CONTRACT requirements have been met and the PCIS is ready for the Final Acceptance Test.

B. The entire PCIS shall go through a final 30-day acceptance test. For the purpose of this CONTRACT, the terms "Final Acceptance Test" and "Final Performance Test" are synonymous and are used interchangeably. The 30-day test must be successfully completed prior to the date of and as a condition to substantial completion of the entire

project WORK. During the testing period, all system functions shall be exercised, and any system interruption and accompanying component, subsystem, software, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure.

C. In addition to the requirements of Section 017500, the CONTRACTOR shall furnish support staff as required to operate the system and to satisfy the repair or replacement requirements. The CONTRACTOR shall also provide a competently programmer on call during all normal working days and hours from the start of the acceptance test until final acceptance of the system. The on-call programmers shall be ready to respond within two hours of the notification of the problem.

D. Testing: The entire PCIS shall be tested and shall include, but not limited to, the field instrumentation, control and PLC panels and PLC programs, application SCADA software, graphics and trends, reports, and the control and monitoring functions. Each system function, e.g., status report-backs, alarms, logs, and displays shall be exercised several times at a minimum, and in a manner which approximates "normal" system operation. At least two displays and reports shall be generated during the test.

E. Failure During Testing: Failure of the system during the testing shall be considered as indicating that part of the PCIS does meet the requirements of the specifications and corrective action shall be required before restarting the acceptance test.

Failures shall be classified as either major or minor as follows, and it is at the discretion of the ENGINEER how to classify the failure:

1. Minor Failure: A minor failure would be a small and non-critical component failure which can be corrected by the OWNER's operators. This occurrence shall be logged, but shall not be reason enough for stopping the test and shall not be grounds for non-acceptance or –restart, provided that the function(s) can be provided by backup equipment and repairs can be made and equipment returned to service within one (1) working day.

   However, should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance and termination of the test.

2. Major Failure: A major failure shall be considered to have occurred when a major component of the PCIS, subsystem, communication, or program fault causes a halt in operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system. A major failure shall cause termination of the acceptance test. When the causes of a major failure have been corrected, a new acceptance test shall be started.

F. Technician Report: Each time a technician is required to respond to a malfunction in the PCIS he/she must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report shall be required (logged as specified above). Each report shall be submitted within 24 hours to the ENGINEER or its representative, and the OWNER.

3.8 CLOSEOUT ACTIVITIES

A. Training:

1. The CONTRACTOR shall train the OWNER'S personnel on the PCIS operation, maintenance, calibration, and repair of equipment provided under this Contract.

The training shall be by qualified instructors. The training courses shall be given on-site to a minimum of four (4) people of the OWNER's personnel. All instruction, tools and training material shall be provided by the CONTRACTOR.

2. These courses shall be designed to provide the operations, maintenance and supervisory personnel with training in routine and preventive maintenance of all the PCIS including instrumentation, communication, PLCs software, and HMI. The training course shall include instruction on the use of all maintenance equipment and special tools provided under the contract.

3. Instructions: The training shall be performed by qualified instructors. The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

4. Training Manuals and Material: The CONTRACTOR shall use the approved Training syllabus and Training Manuals to develop training material. The training material shall be designed to provide the operations, maintenance and supervisory personnel with training in routine operation procedures, and preventive maintenance and troubleshooting of the PCIS, PLCs and the computer monitoring and control systems.

5. Schedule: Training shall be performed on-site during the calibration, loop and functional testing of the PCIS prior to the 30-day Final Acceptance Test. The training sessions shall be scheduled a minimum of 2 weeks in advance of when the courses are to be initiated. The ENGINEER will review the course outline for suitability and provide comments that shall be incorporated. Due to availability and scheduling of the OWNER's staff, the CONTRACTOR shall coordinate with the OWNER the schedule of the classes. The OWNER reserves the right to videotape the training sessions for later use. Due to possible limited availability of the OWNER's staff, the CONTRACTOR shall provide the number of identical courses/sessions of each of the following training courses as indicated, each up to four (4) people of the OWNER's staff.

6. Training Subjects, Duration, and Agenda: The training shall include operation and maintenance procedures, troubleshooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment. During the course, hands-on experience with the system equipment shall be provided. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the PCIS and the PLCs. Operator classes shall stress operational theory and use of the PCIS and the PLCs.

   a. Field Instruments

      1) Duration – an average of one (1) hour per each type of instrument

      2) Subjects - installation, setup, configuration, maintenance, calibration, and troubleshooting:

         a) Flow measuring device and transmitter

3.9 CRITERIA FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section and all Division 40, the following conditions shall be fulfilled before the WORK is considered substantially complete:

1. Submittals have been completed and approved.

2. The PCIS has been calibrated; loop tested, pre-commissioned, commissioned, and the startup completed.

3. The OWNER's training has been performed.

4. Spare parts and expendable supplies and test equipment have been delivered to the OWNER.

5. The Final Acceptance Test has been successfully completed.

6. Major punch-list items have been corrected.

7. As built drawings have been submitted.

8. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

9. Debris associated with installation of instrumentation has been removed.

10. Instruments and enclosures have been cleaned and are in like-new condition.

END OF SECTION

SECTION 40 91 02 – IN-LINE LIQUID FLOW MEASURING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Section in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

D. Section 09 96 00 – Protective Coating

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.1 MAGNETIC FLOW MEASURING SYSTEMS

A. Manufacturers: The Magnetic flow meter manufacturer and model flow meters shall be as follows and or equal:

1. **Rosemount model 8705 Sensor & 8732E/8712E Transmitter or 8707 Sensor (High Signal)/8712H Transmitter**

2. **Endress+Hauser Promag 400W**

B. Description: Magnetic flowmeter systems shall be the low frequency electromagnetic induction type that produces a DC pulsed signal directly proportional to and linear with the liquid flow rate. .

C. Performance / Design Criteria: Magnetic flowmeter system shall be suitable for the intended service and shall be based on the conductivity properties and solid content of the process fluid, in accordance with the manufacturer's recommendations.

1. Magnetic flowmeter system shall be capable of measuring fluid velocities in the range of 0.04 and 39 ft. /sec. in both forward and reverse flow in all sensor sizes.

2. Accuracy: The flow metering system shall be installed in accordance with the manufacturer's recommendations to provide at least 0.5 percent of flow rate from 10 to 100 percent full scale for velocities over 3 feet per second.

3. Repeatability: 0.1 percent of reading.

4. Power consumption shall be as indicated in the data sheet.

5. Power input requirements shall be as indicated in the data sheet.

D. Materials / Components: The magnetic flow metering system shall include a metering tube, transmitter, and signal cable and flowmeter grounding rings.

1. Metering Sensor/Tube:

a. The metering sensor shall employ a pulsed DC technique to drive flux-producing coils. Sensors using high pulsed DC signals shall be used in accordance with the manufacturer's recommendations for the required service application and as indicated in the data sheet.

b. The metering tube sizes shall be available from at least 1-inch to 48-inch line size. It shall be sized in accordance with the installation application and the intended service and as recommended by the manufacturer, and as indicated in the data sheet. If fractional size or larger size meters are required, the manufacturer shall be consulted for availability.

c. Metering Sensor/Tube

1) Flanged Connections: The flanges' size, style, type and construction material shall be in accordance with the required installation and the intended service application and as recommended by the manufacturer, and as indicated in the data sheet. Pressure ratings shall be as indicated in the Contract Documents and as recommended by the manufacturer for the intended service.

2) A minimum of two (2) electrodes shall be provided. The electrodes' material shall be suitable for the required service as recommended by the manufacturer, and as indicated in the data sheet. A reference electrode shall be provided as recommended by the manufacturer for the required installation application.

3) Lining material shall be in accordance with the manufacturer's recommendation for the intended service, and as indicated in the data sheet.

4) Meter housing shall be rated for NEMA 4X (IP67) (limited depth) and shall be offered with certified ratings for different hazardous locations as specified in the data sheet. It shall be able to operate between -20 to 140 Degrees F (-29 to 60 degrees C).

5) Meter tube shall have epoxy protective coating.

6) Grounding rings shall be provided and designed to protect and shield the liner's edge interface from abrasion at the meter end. Grounding rings shall conform to the manufacturer's bore and material recommendation for the intended service Grounding shall conform to the manufacturer’s recommendations.

2. Transmitter/Converter

a. The transmitter/converter shall be capable of being mounted integral to the metering tube or remotely as indicated in the data sheet. Mounting hardware shall be provided.

b. The transmitter/converter shall be rated for NEMA 4X (IP67). Certified ratings for different hazardous locations shall be offered as an option as specified in the data sheet. It shall be able to operate in ambient temperatures of -20 to 140 degrees F (-29 to 60 degrees C).

c. The transmitter shall convert the DC pulse signal from the metering tube to a linear 4 to 20 mA DC signal into a minimum of 700 ohms. The 4-20 mADC signal shall comply with HART protocol. Output signal shall be continuously adjustable over the full scale. Other digital outputs options shall be available.

d. The transmitter shall have an LCD displays for flow rate, percent of span, totalization, operator configuration interface, and diagnostic information.

e. The transmitter shall have an adjustable integral low flow cutoff and zero return.

f. The transmitter shall perform self-diagnostics and automatic data checking and activate a switch closure output when a transmitter fault is detected.

3. Cables

a. Remote transmitter configuration shall be provided with the required lengths and types of electrodes and coil drive cables as recommended by the manufacturer for the required installation application. Maximum distance of transmitter from the metering tube shall be as recommended by the manufacturer.

E. Calibration: Each flow metering system shall be hydraulically calibrated at a facility that is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of ANSI/NCSL Z 540-1 Calibration. A real-time computer generated printout of the actual calibration data shall be submitted to the ENGINEER at least 30 Days prior to shipment to the site.

PART 3 -- EXECUTION

3.1 FIELD QUALITY CONTROL

A. In-line liquid flow measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer's service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 91 06 - LEVEL MEASURING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide level measuring systems, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.1 NON-CONTACT ULTRASONIC TYPE LEVEL MEASUREMENT

A. Manufacturers: Ultrasonic level measuring systems shall be **Siemens Hydroranger series, Endress + Hauser,** or equal.

B. Description: Ultrasonic level measuring systems shall use continuous ultrasonic echo ranging technology to monitor liquid level of any consistency consist of an electronic controller-transmitter, a separate non-contact ultrasonic transducer, and interconnecting cables. The controller-transmitter shall generate the ultrasonic signal to drive the transducer, detect the return echo and convert the elapsed time to a level signal. The controller-transmitter shall display the measured level, the state of each relay output, and have the user input method to configure all the settings, reset alarms, etc.

C. The level transducer shall and controller-transmitter shall be rated for mounting in corrosive locations.

D. Performance / Design Criteria:

1. The transmitter unit shall provide an isolated 4-20 mADC output signal, linearly proportional to level. The output shall be compatible with HART protocol. The transmitter shall have a single or a dual point level monitoring. In addition, the transmitter shall provide a minimum of four (4) programmable SPDT relay outputs, rated at 5 amp.

2. The transmitter’s accuracy shall be at least 0.25-percent of span. It shall have non-interacting zero and span controls. The unit shall have a local LCD display for configuration and monitoring scalable in the desired process variable. Measuring range shall be as indicated in the data sheet.

E. Materials / Components: Transducer shall have temperature compensation and a contact output upon transmitter failure (loss of echo). Input power shall be as indicated in the data sheet. The ultrasonic transducer shall be housed in an enclosure suitable for the required installation location.

PART 3 -- EXECUTION

3.1 FIELD QUALITY CONTROL

A. Level measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer's service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

3.2 FIELD CONFIGURATION

A. Program one relay to stop Screw Press 1 when the receiving truck bed is full.

B. Program one relay to stop Screw Press 2 when the receiving truck bed is full.

END OF SECTION

SECTION 40 91 08 - PRESSURE MEASURING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

1.3 ACTION SUBMITTALS / INFORMATIVE SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturers: Shall be **Ashcroft 1279, Ametek Solfrunt Series 1900**, or Equal.

B. Performance / Design Criteria: Gauge Protection: Gauges shall be protected with the appropriate components as indicated in the data sheet.

C. Materials / Components:

1. Pressure gauges shall be 4-1/2 inches, with white laminated dials and black graduations, and have either a shatterproof glass or acrylic window as indicated in the data sheet. The gauges' bottom connection size shall be as indicated in the data sheet.

2. Sensing element shall be bourdon tube with welded, stress-relieved joints. Sensing element material shall be as recommended by the manufacturer and as indicated in the data sheet. Gauges shall have an accuracy of plus and minus 1/2-percent of full scale.

3. Body material shall be as recommended by the manufacture and as indicated in the data sheet.

4. Gauge shall be either dry or liquid-filled as indicated in the data sheet.

5. Gauges shall be provided with a 316 stainless steel pulsation dampener (snubber), unless otherwise noted in the data sheet. The pulsating dampener shall absorb system pressure pulses.

2.2 DIAPHRAGM SEALS FOR PRESSURE MEASURING SYSTEMS

A. Manufacturers:

1. For sewage, sludge, liquids containing solids, and pulsating flow applications: **Ashcroft Model 100 or 101, U.S. Gauge (Ametek) SG, Marshalltown Series 225-01,** or equal.

2. For chemical solutions, sewage, sludge, and the like, where breakage would not create a major shutdown: **Plast - O - Matic Valves, Inc. GGS/GGSE, Harrington Industrial. Plastics, Inc.,** or equal.

B. Description: Operating Principles The diaphragm seal shall attach to the inlet connection of a pressure instrument in order to isolate its measuring element from the process fluid due to incompatibility and/or high process fluid temperature. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

C. Materials / Components:

1. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.
2. The bottom housing shall be removable in order to permit servicing. Bottom housing material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the data sheet.
3. As a minimum, top housing and bolts shall be 316 stainless steel, or as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.
4. Diaphragm capsule material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the data sheet.
5. The diaphragm seal shall be factory-assemble to the corresponding pressure instrument and factory-filled. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.
6. Material of exposed surfaces, housings, and diaphragm shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.
7. The seal shall be provided with a ring, flushing port connection, and fill/bleed connection.
8. The diaphragm seal shall be shipped a tag reading "Do not disassemble for installation.

PART 3 -- EXECUTION

3.1 FIELD QUALITY CONTROL

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer’s service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 95 13 – CONTROL PANELS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The Contractor shall provide control panels for the PCIS, complete and operable, in accordance with the Contract Documents.

B. The Contractor shall be responsible for selecting, sizing, and providing the correct and necessary type and quantity of the panels for each process control application. The necessary hardware and responsibilities shall include but not limited to:

1. Locating and mounting interior and exterior instruments, pilot devices, hardware and equipment in the panel

2. Field interface terminal blocks

3. Terminating panel internal wiring and signals

4. Terminating communication and network cabling and wiring

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems

C. Division 26 – Electrical

D. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

E. All panels shall conform to the specifications; codes and standards requirements specified Section 40 91 00 - Process Control and Instrumentation System.

F. Each control panel, including panels for service entrance equipment, shall meet all UL listing and labeling requirements including UL Standard 508 and UL Standard 508A and shall be UL labeled accordingly. Contractor shall arrange components and wiring to meet UL requirements stated above.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. The Submittals shall be provided in accordance with the requirements specified in Section 01 33 00 – Contractor Submittals.

1.4 QUALITY ASSURANCE

A. Factory and field tests shall be performed in accordance with Section 40 91 00 – Process Control and Instrumentation System.

1.5 WARRANTY

A. Guarantee and Special corrections of defects and software upgrade requirements and warrantee shall be in accordance with Section 40 91 00 - Process Control and Instrumentation System.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All PCIS control panel assemblies, such as analyzer systems, communication systems, etc. shall be mounted inside a new outdoor or indoor NEMA-rated type enclosure, suitable and designed for the application for which it was intended, as specified or as shown on the drawings. Where shown or specified, PCIS panel assemblies shall be mounted in existing enclosures. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted.

B. The enclosure and back panel shall be sized to contain the equipment required to make the installation complete and suitable for its intended purpose. Field conditions and the guidelines provided in the specifications and/or the drawings shall be followed. Accessibility for ease of maintenance, future expansion and good installation and industry practices shall be considered when sizing an enclosure. Spare space shall be kept clear of wiring, etc., to give contiguous clear space for future additions.

C. In cases where existing panel is used, the Contractor shall review the available space in the field or in the existing panel to determine the proper size of back panel suitable to accommodate the required equipment for the facility. It should be noted that control panel layouts shown on the Drawings are diagrammatic. The control panel submittal shop drawing shall reflect the accurate layout of the equipment in the panel.

D. Environmental Suitability and NEMA Rating

1. Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain instrumentation devices 20-percent within the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide power wiring for these devices. Enclosures shall be suitable for the environment that they are installed. Panel instruments and equipment in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

2. Control panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.

3. NEMA Rating

a. All PCIS panel assemblies shall be mounted in a NEMA-rated type enclosure suitable for the environment that it is located. Different NEMA rated enclosures and suitable materials of construction (e.g. stainless steel, fiberglass, etc.) shall

be used for specific applications, project requirements and for corrosive and/or hazardous environments.

b. In areas that are classified as general purpose, the minimum rating of all outdoor mounted panels shall be NEMA 4 (IP66) steel construction. The minimum rating of all indoor mounted enclosures in general purpose classified areas shall be NEMA 4 or NEMA 12 (IP52) steel construction, unless otherwise indicated.

c. Instrumentation and enclosures in hazardous areas shall be suitable and/or protected for use in the particular hazardous or classified location in which it is to be installed.

2.2 CONSTRUCTION

A. Material and Fabrication

1. Wall mounted type enclosure shall be constructed of a minimum of 16-gauge, 14-gauge or 12-gauge 316 stainless steel, depending of the size of the enclosure, application, environment, and the project requirements. Floor mounted free standing enclosures shall be made of 12-gauge 316 stainless steel, depending of the size of the enclosure, application, and the project requirements.

2. Seams shall be continuously welded and ground smooth. Corners shall be welded and ground smooth.

3. Each enclosure shall have a heavy gauge, continuous piano hinge pin which shall support each door.

4. Door and body stiffeners shall be provided where required. The stiffeners shall be welded to the inside of enclosures to prevent deformation due to the weight of face-mounted instruments.

5. Doors shall be sealed with a closed cell neoprene gasket.

6. The interior rear and sides of each enclosure shall have steel mounting channels for supporting mounting panels.

7. Enclosures shall be provided with external mounting feet as shown, as well as door clamps, hasp and staple for padlocking, data pocket, and closed-cell oil-resistant gasket. Removable lifting lugs to facilitate handling shall be provided on large enclosures.

B. Back and Side Panels: Each enclosure shall be provided with a removable back panel. Depending on the size of the enclosure more than one back panel may be required. Removable side panels shall be provided as required for additional mounting space.

C. Finish: Non-stainless steel enclosures shall have an ANSI 61 gray polyester urethane powder coating electrostatically applied to inside and outside surfaces. Enclosure interior, and back and side panels shall be white.

D. Accessories: The Contractor through the System Supplier shall provide additional panel accessories to meet the specifications, such as floor stand and mounting kits, door handle and lock kits (common key shall be provided for all doors), 3-point latch, etc.

E. Instruments Mounting

1. Equipment mounted at the rear of enclosure shall be installed to allow for commissioning adjustments, operation and servicing requirements. The Contractor shall arrange components and wiring to meet UL requirements.

2. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

3. For front mounted hardware, cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth. Mounting the instruments shall not degrade the NEMA rating of the enclosure.

4. DIN rail mounted equipment shall be used as much as possible.

5. Each enclosure shall be provided with interior nameplates to identify equipment tags and functions.

F. Enclosures shall be **Hoffman, Hubbel-Wiegmann**, or equal.

2.3 ELECTRICAL REQUIREMENTS

A. The main power supply to the control panel controls shall be 120 VAC, 60 Hz. The Contractor shall provide the main power supply from an external source. The Contractor shall provide a step down transformer as required to power the panel.

B. The Contractor shall provide wireways, wire, and electrical fittings and components for 120V and 24VDC circuits to instruments and other electrical devices in the panel for a complete and operable installation. Wiring methods and materials for all panels shall be in accordance with the NEC requirements.

C. The circuits for 24VDC shall run in separate wireways from the 120 VAC circuits.

D. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external foreign voltage. A “CAUTION- Foreign Voltage” nameplate shall be attached to the outside of the enclosure door warning of foreign voltages inside the enclosure.

E. If required by the contract documents, the control panel shall be the source of power for any field instrument loads interconnected with the control panel.

F. Terminal Blocks

1. The control panel shall be provided with sufficient terminal blocks for the connection of external field conductors, signals, and power and for use inside the panel for power distribution and for future expansion.

2. Terminal blocks shall be positioned such that the internal and external wiring does not cross and there must be unobstructed access to the terminals and their conductors.

3. Spare Terminal Blocks for Signals: The Contractor shall provide sufficient spare terminal blocks to connect additional signals for future use (implemented and future spares). Implemented spare signals shall be wired to terminal blocks. For future signals (i.e. the source of inputs or final control elements are not yet known or available in the field), the Contractor shall provide 25-percent spare terminals in the panel for each type of signal. The number of terminals shall take in account the types of I/O for which spares are provided (five (5) terminal for each AI or AO shall be provided).

4. Spare Terminal Blocks for Power and Other Applications: In addition to the spare terminals for signals, The Contractor shall provide spare terminals for 3 additional power distribution and grounding applications circuits.

5. Terminal blocks for all wiring shall be modular terminals, DIN rail mounted type rated at 30 amperes at 600 VAC and have a minimum width of 8-mm suitable for No. 12 A.W.G. stranded wire. Terminals shall be the solderless box lug type with pressure plates in actual contact with the wire to minimize wire breakage. Each terminal shall have a light colored strip for marking the terminal number or circuit designation. Double-high stack-type terminal blocks shall be acceptable. Triple-high terminal blocks shall not be acceptable.

6. Wire duct shall be flame retardant plastic wiring duct, slotted with dust cover. Wire duct shall be as manufactured by **Panduit.**

7. External connections to and from enclosures shall terminate on terminal blocks, except approved communication and data cables. Circuit isolating switches and fuse terminals shall include non-conducting pullers which can be removed with finger alone, without tools. Additionally, the panel shall be provided with identified terminal strips for the connection of external/field conductors.

8. Terminals shall be as manufactured by **Square D Class 9080 Type M**, **Allen-Bradley Bulletin 1492 Type H or J**, **by Entrelec**, or Engineer approved equal.

G. Electrical Hardware Accessories: If the following optional accessories are used provide them as follows:

1. A duplex 15-amp, 120 VAC GCFI type receptacles for service and maintenance use. The receptacle shall be 2-pole, 3-wire grounding, and heavy duty industrial grade by **Hubbell, Leviton**, or Engineer approved equal.

2. A duplex 15-amp 120 VAC type receptacle dedicated for a powering an uninterruptible power supply (UPS). The receptacle shall be color coded, 2-pole, 3-wire grounding, heavy duty industrial grade by **Hubbell, Leviton,** or Engineer approved equal.

3. A 120 VAC LED light strip lamp with guards and a toggle switch (**Phoenix Contact Type PLD E 608 W 315/B – part number 2702227**, or Engineer approved equal), mounted on the top or the near the of the enclosure back panel shall be provided for panel lighting. A separate fuse/circuit breaker shall be provided for the lamp.

   a. Provide one luminaire for each section, on the interior of each panel, spaced evenly along the top-front of the enclosure door opening.

   b. Lighting shall be covered or guarded.

c. Provide On-Off door-activated switches where indicated on the Drawings.

d. Additional fixtures shall be provided for every 36 inches of width.

4. A ¼-inch by one (1)-inch copper grounding bus bar with multiple connecting terminals. The grounding bus shall be complete with solderless connector for one 4 AWG bare stranded copper cable and with tapped holes to accommodate ground connections from various devices in the enclosure. Provide ground connections for different AWG wires and shield connection clamps by **Phoenix Contact**, or equal. Provide separate ground buses for power and analog wire drain grounding. The copper cable shall be provided by the Contractor and be connected to a system ground loop.

5. Circuit Breakers, Fuses, and Disconnects

   a. Circuit breakers, fuses and disconnects shall be installed in the control panel to protect against fault current the 120 VAC and 24 VDC branch circuits and the instruments and the electrical components that these circuits power. Circuit breakers shall be installed as disconnects of external power feeds for control circuits from outside the enclosure and branch circuits within the enclosure.

   b. The circuit breakers, fuses and disconnects shall also allow disconnecting the power from these instruments in a safe manner. Individual plug and cord set power supply connections, such as for a UPS, may be used without switches. Each circuit breaker and fuse shall be identified by a service nametag.

   c. The fuses shall be mounted in a DIN mounted fuse holder terminal block and shall have a blown fuse indicator light. The fuse holders for 120 VAC applications shall have a neon light indicator and shall be **Entrelec part number 0115-661.21, or Engineer approved equal.** The holders for 24 VDC applications shall have an LED indicator light and shall be **Entrelec part number 0115-663.23**, or Engineer approved changed equal.

6. The number of power distribution circuits depends on the type of electrical devices they power. A single pole circuit breakers or a fuse, as noted, with the following minimum rating shall be provided in each branch circuit as listed below. The circuit load shall not exceed 10-amp. The interrupting rating shall be 10kA or the available fault current at the line terminal, whichever is higher. The circuit breakers shall be DIN rail mounted type with manual Open-Close toggle switch. The 120 VAC breakers shall by **Square D model QUO-120 and QUO-115**, depending on the amperage rating, or equal.

   a. 15-amp main circuit breaker for the 120 VAC control panel power supply and the distribution of the power. Line side barriers shall be covered by a barrier within the panel.

   b. A fuse, sized as required, shall be provided for the protection of each 24 VDC branch (including spares) and equipment that is powered by the 24 VDC power supply. Each analog and discrete input loop shall also be protected by a fuse. A fuse shall be provided to each instrument regardless if it is equipped with integral replaceable fuse.

H. Control Panel 24 VDC Power Supplies

1. Control panels shall be provided with redundant power supplies which shall be configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply.

2. The Contractor shall size the power supplies to meet the control panel requirement and the instruments and loops they support. Power supplies shall have an excess rated capacity of 40 percent. The failure of a power supply shall be alarmed at the SCADA System

3. Power Supplies – 24 VDC: The control and PLC panels shall be the source of power for any 24 VDC two-wire field device, devices in the panel requiring 24 VDC power, or where applicable, solenoid valves interconnected with the panel.

4. The failure of a power supply shall generate a dry relay contact output that can be used as an input to the PLC/ SCADA system.

5. Power supply shall be UL508C listed to allow full rated output without de-rating.

6. Power supplies shall be DIN rail mountable and of a touch safe design.

7. Power supplies shall be **Phoenix Contact 24 VDC Quint series,** or Engineer approved equal.

I. Control Panel Signal, Control and Power Wiring

1. General: The signal, control and power wiring specified herein shall apply only to the wiring inside the control panel. Field wiring shall be in accordance with requirements specified in Division 26.

2. Wire type and sizes: Conductor shall be flexible, stranded, copper UL approved type wires, and shall be rated 600 volts. The following wire sizes and insulation types and color shall be used inside the control panel for the listed applications:

   a. 120 VAC power wires: Main 120 VAC power wiring for distribution in the control panel (line, neutral and ground) shall be a minimum of 12 AWG, or heavier as required by the panel load, with **THHN/THWN** insulation.

   b. Power conductors in branch circuits such as for lighting, receptacle, heater and thermostat, etc. shall be a minimum of 14 AWG also with **THHN/THWN** insulation.

   c. Wiring for 600-volt class power and lighting shall be as manufactured by **Okonite**, **General Cable**, **Southwire**, or Engineer approved equal.

   d. The following insulation color code designation shall be used:

      1) Line Power – Black

      2) Neutral (grounded circuits) – White

      3) Power Ground – Green

      4) Ungrounded 120 VAC control circuit conductors (switched power) – Red

5) Wires energized by 120 VAC source external to the control panel (usually used for DO) shall have yellow insulation

e. 120 VAC Control Wires: For AC control wiring shall be No. 14 AWG machine tool grade type **MTW**, rated for 90 degrees C at dry locations and be as manufactured by **American, General Cable,** or Engineer approved equal.

f. 24 VDC power, status, alarm, and control wires shall be a minimum of 16 AWG or heavier as required, with **TFFN/MTW** insulation.

g. The following insulation color code designation shall be used:

1) Positive (+) – Blue

2) Common (-) – Blue/White

3) DC Ground – Green/Yellow

h. Signals and Instrumentation Wires and Cables

1) Analog and instrumentation signal wiring inside the panel shall be No. 18 AWG minimum twisted shielded pair of stranded tinned copper conductors rated at 600 volts. Insulation shall be color coded PVC/Nylon - black-white for 2 conductor cable and black-red-white for 3 conductor cable.

2) Multi-conductor cables where indicated shall consist of No. 18 AWG copper stranded tinned copper signal wires twisted in pairs, with 90-C, 600V fault insulation. Multi-conductor cables shall be sized to allow for 10 percent spare signal wire.

3) All analog and Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 22 or larger AWG stranded tinned copper drain wire, and a PVC outer jacket with a minimum thickness of 0.047-inches.

4) Insulation color code designation for 2- conductor cable shall be as follows:

a) Positive (+) – Black

b) Negative (-) - White

5) Insulation color code designation for Triad cable shall be Black-Red-White.

6) Single pair, No. 18 AWG, twisted, shielded cable shall be **Belden Part No. 3088AE,** similar by **General Cable,** or equal.

7) Single triad, No. 18 AWG, twisted, shielded cable shall be **Belden Part No. 3089A,** similar by **General Cable,** or equal.

i. Industrial Ethernet Cables

1) Industrial Ethernet cables shall be No. 23 AWG with four pairs of solid bare copper conductors rated at 300 volts. Individual pairs shall be twisted.

Cable shall be UL certified for as CAT 6 cable. Cable shall be **Belden Cat6** , or equal.

2) Conductor Insulation : Polyolefin for individual conductors. Overall cable shall have industrial grade PVC outer jacket. Outer jacket shall be oil and sunlight resistant.

3) Installation Temperature Range of 0°C to +50°C. Operating Temperature Range of -20°C to +75°C.

4) Minimum Bend Radius: 2.5 inches.

5) Electrical : Compliance: NFPA 262; UL 910 (Plenum)

6) Performance: Category 6.

J. Wire Markings: Each conductor in the control panel connected to a given electrical point shall be designated by a single unique wire number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal connection using numbered wire marking sleeves or heat shrink plastics by **Brady**, or Engineer approved equal. Markings shall be readily identifiable without twisting the conductor.

2.4 ELECTRICAL COMPONENTS

A. General Purpose Relays

1. General purpose relays in the control panel(s) shall be full-sized (not compact) plug-in type with blade contacts rated 10 amperes at 120 VAC; or 24 VDC. Quantity and form of contacts shall be as required by the application. However, the relay shall have a minimum of two (2)-form C contacts (double pole-double throw). Each relay shall be provided with a light or mechanical flag to indicate energized state.

2. The relay socket and mounting shall be a standard DIN rail mount with pullover wire spring (”horseshoe clip”).

3. For all types of 120VAC relays, provide surge protection across the coil of each relay.

4. For all types of 24VDC relays, provide a flyback/free-wheeling diode across the coil of each relay.

B. Interposing Relays: Additional interposing relays shall be provided when the number or type of contacts required exceed the contact capacity and/or rating of the specified relays and timers. Additional relays shall be provided when higher contact rating is required in order to interface with starter circuits or other equipment. The slave and interpose relays shall be as the general purpose relays specified above.

C. Time Delay Relays - Electronic Type: Time delay relays shall be plug-in electronic type with on-delay or off-delay actuation as required. Output contacts shall be DPDT rated 10-amperes at 120-volts ac minimum. Each unit shall include an adjustable time delay with a time range scale. Operating temperature range of the units shall be -20 to +120 degrees-F minimum and each device shall be rated for 10,000,000 mechanical operations and 500,000 electrical operations. Time delay relays shall be **Idec RTE series**, **Finder 86 series, Agastat Series SCC,** or Engineer approved equal.

D. Indicating Pilot Lights

1. Indicating lights shall be ultra-bright multiple LED cluster lamps, push-to- full voltage and shall be heavy-duty, oil-tight construction. Operators shall be nickel or chrome plated. Each light shall have a screwed-on prismatic lens approximately 1-inch in diameter. Miniature style devices are not acceptable.

2. Lens colors shall be green for "run," "open," or "on"; red for "stopped," "closed," or "off"; and amber for alarm.

3. Indicating lights shall be **Square D Company, Class 9001 Type K, General Electric Company Type CR104P, or equal**. Each light shall have a factory-engraved legend plate, as shown on the Contract Documents.

E. Selector and Pushbutton Switches: Selector and pushbutton switches shall be rated 10-amperes at 600 volts; shall be heavy-duty, oil-tight construction; and shall have the number of positions and poles required. Miniature style devices are not acceptable. Operators shall be nickel or chrome plated. Switches shall be **Square D Company, Class 9001 Type K, General Electric Company Type CR104P,** or Engineer approved equal. Each switch shall have a factory-engraved legend plate as shown on the Contract Documents.

F. Signal Isolators, Conditioners and Converters

1. Signal isolators conditioners and converters shall be provided as required to resolve any signal level incompatibilities, to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component.

2. Signal isolators, integrators and converters shall be 24 VDC or 120 VAC powered as applicable, and shall DIN rail mounted. Isolators shall be by **Phoenix Contact**, **Acromag,** or Engineer approved equal.

G. Nameplates: Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front or the inside of the control panel. A nameplate shall be provided for each instrument and device. The nameplates shall be descriptive to define the function and system of such device in accordance with the CONTRACT DOCUMENTS or the approved shop drawings. Adhesives shall be acceptable for attaching nameplates, but stainless steel nameplates shall be fastened with screws. Nameplates shall be fabricated from white-face, black-center, laminated engraving plastic.

H. Power Transfer Relay: Power Transfer Relays shall be provided where electrical power is switched from one source to another, or as noted in the Contract Drawings. Power Transfer Relays in the control panel(s) shall be compact plug in type with contacts rated 15 amperes at 120-volts AC or 24 VDC. Power Transfer Relays shall have a minimum of three normally opened contacts and two normally closed contacts. Termination shall accept 10 to 16 AWG conductors. Provide Allen Bradley 700-CFM series, or equal.

2.5 SPARE PARTS AND SPECIAL TOOLS

A. Control panel spare parts selected by the Engineer or the Owner and special tools shall be furnished in accordance with Section 40 91 00 - Process Control and Instrumentation System.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Preparation for Shipment and Shipping

1. Control panels shall be crated for shipment using a heavy framework and skids as required and cushioned to protect the finish and the instruments during shipment. Shipments shall be by air-ride vehicle. Suitable cushioning material shall be used to protect interior hardware that could be damaged due to mechanical shock.

2. Depending on panel size, each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

3. Control panels shall be installed in accordance with Section 40 91 00 - Process Control and Instrumentation System.

3.2 INSTALLATION

A. CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

1. Wiring Installation

a. Wiring methods and materials for panels shall be in accordance with the NEC requirements and industry practices.

b. Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, and (3) wiring from components on a swing out panel to components on a part of the fixed structure.

c. Neatly group wires using nylon tie straps, and shall be fanned out to terminals. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the hinge loop so that conductors are not strained at the terminals.

d. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

e. Splicing of shall be kept to a minimum and only if the wire cannot be replaced. Splicing shall be either soldered or pressure crimped type. Data and communication wires/cables shall not be spliced.

f. Wire nuts shall not be used.

2. Wiring Termination

a. All field wiring shall terminate at a terminal block in the enclosure. Field wiring shall be terminated first at the field interface terminal block and then wired to the devices/instrument or PLC inside the panel. Except for antenna cable, Cat 5e cables and other specialty cables, such as thermocouples and data cables, field wiring shall not be wired directly to the panel mounted device.

b. Terminals and fuses for each conductor and shield drain wire of a twisted shielded pair or triad cable shall be mounted consecutively next to each other.

c. Terminal blocks shall be grouped based on their function and voltage. Each group of terminal blocks shall be located in the panel to provide easy access, safety, practicality, and minimization of internal wiring.

d. Terminal blocks for 24 VDC signals shall be grouped separate from the power and other 120 VAC terminals.

e. Terminal blocks for 24 VDC signals shall be grouped separate from the 24VDC power as well. Likewise, terminal blocks for 120 VAC power and distribution shall be grouped separate from the 120 VAC terminals for control signals.

f. Each terminal and wire connection shall be tagged in accordance with the approved shop drawings or Owner's standard tagging/numbering, if available.

3.3 FIELD QUALITY CONTROL

A. General: Calibration, testing, and instruction shall be performed in accordance with Section 40 91 00 - Process Control and Instrumentation System.

3.4 ADJUSTING

A. As specified elsewhere in these specifications and as shown on the drawings, the Contractor is required to remove or disconnect some existing equipment as a result of their complete or partial replacement of their functionality, and in some cases to provide space for the new equipment. In all cases the Contractor shall disconnect the replaced equipment and functions and ensure that the remaining equipment and their remaining (not replaced) functionality shall continue to function/operate as originally intended. The Contractor shall also restore the condition of the modified operational control or monitoring circuits. A "demolition plan" shall be issued by the Contractor prior to any removal or disconnection of existing equipment can take place.

B. Analog Loops: Whenever an existing analog loop is modified, the Contractor shall ensure that the integrity and isolation of the loop is maintained and the shield is grounded correctly. In modifying the analog loop the Contractor shall also modify the 24 VDC to that loop so that the power supply source of that loop is part of the control panel.

C. Field Connection Panels and Interface Terminal Blocks: In cases where field I/O wiring has to be extended to the control panel from enclosures that are removed or modified, the Contractor shall provide separate enclosures/field connection panel (FCP), as required, to which field I/Os are wired, and from which the signals shall be wired to the control panel.

END OF SECTION

SECTION 43 30 52 – MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 – Common Requirements for Process Valves, apply to this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

40 05 51	Common Requirements for Process Valves

B. Reference Standards

American Water Works Association (AWWA)	
AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
National Electrical Manufacturers Association (NEMA)	
Underwriters Laboratories (UL)	

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Common Requirements for Process Valves.

PART 2 -- PRODUCTS

2.01 AIR-VACUUM AND AIR-RELEASE VALVES

A. Air and Vacuum Valves: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves.

D. Sewage Air Release Valves: Sewage air release valves shall vent accumulating gases during system operation. Valves shall have long float stems and bodies to minimize clogging. The same general requirements shall apply as indicated for air and vacuum valves. Each sewage air release valve shall be furnished with the following backwash accessories, fully assembled on the valve:

1. Inlet shut-off valve.

2. Blow-off valve.

3. Clear water inlet valve.

4. Rubber supply hose.

5. Quick disconnect couplings.

E. Manufacturers, or Equal

1. APCO (Valve and Primer Corporation)

2. Crispin - Multiplex Manufacturing Company

3. GA Industries

4. Val-Matic (Valve and Manufacturing Corporation)

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Backflow preventers shall be installed in potable water lines where required by applicable codes or regulations, wherever there is any danger of contamination, and where indicated.

B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with this Section.

C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly-supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

END OF SECTION

City of Sandpoint – Sandpoint WWTP

Volume 1 - Technical Specifications

September 26, 2025

Prepared for:
City of Sandpoint, ID

Prepared by:
Stantec Consulting Services Inc.

Pre -Purchase Specifications
ISSUED FOR PROCUREMENT
Project Number: 2002003233

TECHNICAL SPECIFICATIONS

Sandpoint Wastewater Treatment Plant Screw Press Upgrade

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SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Wherever submittals are required by the Contract Documents, submit them to the Engineer.

B. Within 7 Days after the date of commencement as stated in the Notice to Proceed, submit the following items for review:

1. Submittal Schedule

a. Submit a preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("or equal") submittals listed in the Bid.

b. Allow time for resubmittals.

1.02 SHOP DRAWINGS

A. Wherever called for in the Contract Documents or where required by the Engineer, furnish one copy plus one reproducible copy of each Shop Drawing submittal.

B. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items.

C. Whenever the Manufacturer is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the Project is located, unless otherwise indicated.

D. Transmittal Form

1. Shop Drawing submittals shall be accompanied by the Engineer's standard submittal transmittal form, a reproducible copy of which is available from the Engineer.

2. A submittal without the form, or where applicable items on the form have not been completed, will be returned for resubmittal.

E. Organization

1. Use a single submittal transmittal form for each technical specification Section or item or class of material or equipment for which a submittal is required.

2. A single submittal covering multiple Sections will not be accepted, unless the primary specification references other Sections for components: For example, if a pump Section references other Sections for the motor, shop-applied protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted, whereas a single submittal covering vertical turbine pumps and horizontal split-case pumps would not be accepted.

3. On the transmittal form, index the components of the submittal.

4. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.

5. Unless otherwise indicated, match terminology and equipment names and numbers used in the submittals with those used in the Contract Documents.

F. Format

1. Submittals shall be submitted as a PDF document.

2. Number every page in a submittal in sequence.

3. Where product data from a Manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports.

4. Present a sufficient level of detail for assessment of compliance with the Contract Documents.

5. Before accepting the number system option in the following Subparagraph, the Specifier should verify that the document tracking system to be used in the field office will function under an alphanumeric system. If not, select the second optional wording for compatibility.

6. Numbering

a. Assign to each submittal a unique number.

b. Number the submittals sequentially, with the submittal numbers clearly noted on the transmittal.

1) Assign original submittals a numeric submittal number followed by a decimal point and a numeric digit in order to distinguish between the original submittal and each resubmittal: For example, if submittal "25.1" requires a resubmittal, the first resubmittal will bear the designation "25.2" and the second resubmittal will bear the designation "25.3," and so on.

G. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.

H. Engineer's Review

1. Except as otherwise indicated, the Engineer will return prints of each submittal to the Manufacturer with comments noted thereon, within 30 Days following receipt by the Engineer.

2. It is considered reasonable that the Manufacturer shall make a complete and acceptable submittal to the Engineer by the first resubmittal on an item.

3. The Owner reserves the right to withhold monies due to the Manufacturer to cover additional costs of the Engineer's review beyond the first resubmittal.

4. The Engineer's maximum review period for each submittal or resubmittal will be 30 Days; thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 90 Days.

I. If a submittal is returned to the Manufacturer marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required.

J. If a submittal is returned marked "MAKE CORRECTIONS NOTED," the Manufacturer shall make the corrections on the submittal, but formal revision and resubmission will not be required.

K. Resubmittals

1. If a submittal is returned marked "AMEND-RESUBMIT," the Manufacturer shall revise the submittal and resubmit the required number of copies.

2. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.

L. Rejected Submittals

1. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request.

M. The fabrication of an item may commence only after the Engineer has reviewed the pertinent submittals and returned copies to the Manufacturer marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

N. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.

O. Review by Manufacturer

1. Submittals shall be carefully reviewed by an authorized representative of the Manufacturer prior to submission to the Engineer.

2. Each submittal shall be dated and signed by the Manufacturer as being correct and in strict conformance with the Contract Documents.

3. In the case of Shop Drawings, each sheet shall be dated and signed.

4. Any deviations from the Contract Documents shall be noted on the transmittal sheet.

5. The Engineer will only review submittals that have been verified by the Manufacturer.

6. Non-verified submittals will be returned to the Manufacturer without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Manufacturer.

P. Conformance

1. Corrections or comments made on the Manufacturer's Shop Drawings during review shall not relieve the Manufacturer from compliance with Contract Drawings and Specifications.

2. A lack of comments made on the Manufacturer's Shop Drawings during review shall not relieve the Manufacturer from compliance with Contract Drawings and Specifications.

3. Review is for conformance to the design concept and general compliance with the Contract Documents only.

4. The Manufacturer shall be responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating Work with the trades, and satisfactory and safe performance of the Work.

1.03 SAMPLES

A. Quantity

1. The Manufacturer shall submit the number of samples indicated by the Specifications.

2. If the number is not indicated, submit not less than 3 samples.

3. Where the quantity of each sample is not indicated, submit such quantity as necessary for proper examination and testing by the methods indicated.

B. Identification and Distribution

1. Individually and indelibly label or tag each sample, indicating the salient physical characteristics and the manufacturer's name.

2. Upon acceptance by the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Manufacturer, one set of samples will be retained by the Engineer, and one set shall remain at the Site in the Engineer's field office until completion of the Work.

C. Selection

1. Unless otherwise indicated, the Engineer will select colors and textures from the Manufacturer's standard colors and standard materials, products, or equipment lines.

2. If certain samples represent non-standard colors, materials, products, or equipment lines that will require an increase in Contract Times or Price, the Manufacturer shall clearly state so on the transmittal page of the submittal.

D. The Manufacturer shall schedule sample submittals such that:

1. Sample submittals for color and texture selection are complete so the Engineer has 45 Days to assemble color panels and select color- and texture-dependent products and materials without delay to the construction schedule; and,

2. After the Engineer selects colors and textures, the Manufacturer has sufficient time to provide the products or materials without delay to the construction schedule.

3. The Contract Times will not be extended for the Manufacturer's failure to allow enough review and approval or selection time, failure to submit complete samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.04 TECHNICAL MANUAL

A. The Manufacturer shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the Technical Manual.

B. The manual shall be written such that it can be used and understood by the Owner's operation and maintenance staff.

C. The Specifier must consider whether the organization of information in the manuals is appropriate for the scope of the Work. If possible during customization, discuss the manual organization with Owner staff and O&M manual specialists.

D. Categories

1. The Technical Manual shall be subdivided first by Specification Section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

a. Category 1 - Equipment Summary

1) Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.

2) Form: The Engineer will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the Work. The Manufacturer shall fill in the relevant information on the form and include it in Part 1.

b. Category 2 - Operational Procedures

1) Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:

a) Installation

b) Adjustment

c) Startup

d) Location of controls, special tools, equipment required, or related instrumentation needed for operation

e) Operation procedures

f) Load changes

g) Calibration

h) Shutdown

i) Troubleshooting

j) Disassembly

k) Reassembly

l) Realignment

m) Testing to determine performance efficiency

n) Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices

o) List of all electrical relay settings including alarm and contact settings

c. Category 3 - Preventive Maintenance Procedures

1) Procedures: Preventive maintenance procedures shall include Manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.

2) Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

d. Category 4 - Parts List

1) Parts List: A complete parts list shall be furnished, including a generic description and Manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

2) Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

e. Category 5 - Wiring Diagrams

1) Diagrams: Category 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

f. Category 6 - Shop Drawings

1) Drawings: This category includes approved shop or fabrication drawings with Engineer comments and corrections incorporated, complete with dimensions.

g. Category 7 - Safety

1) Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

h. Category 8 - Documentation:

1) Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

E. Format

1. Bind each Technical Manual in standard size 3-ring hardcover binders, labeled on the spine and cover with Project name, Owner's project number, Specification Section number, equipment name, and equipment identification number

2. Each Binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.

3. Documents in binders shall be 3-hole punched, with no text punched out, and pages larger than 8-1/2 by 11 shall be folded to 8-1/2 by 11 size.

4. Provide an electronic file with each final set of Technical Manuals, as follows:

a. Project-specific files created in the latest version of Microsoft Word;

b. Adobe Acrobat portable document format (PDF) or other software required by the Specifications; or,

c. Manufacturer literature in Adobe Acrobat portable document format (PDF).

F. Review Process

1. Furnish one electronic draft Technical Manuals for each Specification Section that requires a manual.

2. The Engineer will retain one copy, will forward one copy to the Owner, and will return one copy to the Manufacturer with review comments.

3. Incorporate comments into the draft and submit one hard copy and one electronic version of the final manual for acceptance.

G. Schedule

1. Submittal and Corrections

a. The Work under this Contract involves start-up and commissioning of equipment in multiple areas of the facility at independent times within the Project Schedule.

b. The manuals shall be completed for each piece of equipment prior to placing equipment into service.

c. Except as otherwise indicated, submit the manuals for review in final form a minimum of 30 Days prior to pre-commissioning and commissioning for each piece of equipment.

d. Discrepancies found by the Engineer shall be corrected within 30 Days from the Date of written notification by the Engineer.

1.05 SPARE PARTS LIST

A. General

1. Furnish to the Engineer one set of spare parts information for mechanical, electrical, and instrumentation equipment.

2. The spare parts list shall include those spare parts that each Manufacturer recommends to be maintained by the Owner in inventory.

B. Sources and Pricing

1. The spare parts list shall include a current list price of each spare part.

2. Each Manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts, to assist the Owner in ordering.

C. Format

1. Cross-reference the spare parts lists to the equipment numbers designated in the Contract Documents.

1.06 QUALITY CONTROL (QC) SUBMITTALS

A. Quality control submittals are defined as those required by the Specifications to present documentary evidence to the Engineer that the Manufacturer has satisfied certain requirements of the Contract Documents.

B. Unless otherwise indicated, QC submittals shall be submitted:

1. Before delivery and unloading, for the following types of submittals:

a. Manufacturers' installation instructions

b. Manufacturers' and Installers' experience qualifications

c. Ready mix concrete delivery tickets

d. Design calculations

e. Affidavits and manufacturers' certification of compliance with indicated product requirements

f. Laboratory analysis results

g. Factory test reports

2. Within 30 Days of the event documented for the following types of submittals:

a. Manufacturers' field representative certification of proper installation

b. Field measurement

c. Field test reports

d. Receipt of permit

e. Receipt of regulatory approval

C. The Engineer will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

D. Retain the following article only if our CM forms will be used.

1.07 INFORMATIONAL SUBMITTALS

A. Informational submittals formalize the flow of information between the Manufacturer and the Engineer.

B. Electronic forms shall be obtained from the Engineer for such purpose.

C. The following forms may be used, but the list is not necessarily inclusive:

1. CM - 302 Request for Clarification

2. CM - 306 Manufacturer's Submittal Transmittal Form

3. CM - 307 Memorandum of Delay

4. CM - 1003 Request for Payment for Material on Hand

5. CM - 1004 Request for Adjustment of Retainage

6. CM - 1005 Consent of Surety for Reduction of Partial Release of Retainage

7. CM - 1006 Consent of Surety for Final Payment

8. CM - 1007 Affidavit of Payment

9. CM - 1102 Initiator Change Order Request

10. CM - 1106 Deviation Request

11. CM - 1110 Substitution Request Form

12. CM - 1301 Partial Waiver of Lien

13. CM - 1302 Final Waiver of Lien

D. CM - 1303 Affidavit of Release of Lien

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 75 00 – EQUIPMENT TESTING AND PLANT STARTUP

PART 1 - GENERAL

1.1 THE SUMMARY

A. The new dewating system startup is prerequisite to satisfactory completion of the contract requirements and shall be completed within the Contract Times.

B. Conduct all test, check out, startup, and related requirements indicated in the Contract Documents and provide documentation of same to the Engineer prior to requesting Substantial Completion from the Engineer. Where manufacturer onsite inspections are required before startup, the manufacturer shall furnish a written statement that the installation and check out is complete and proper and that the item(s) are ready for startup.

C. Startup of a treatment plant is a highly complex operation requiring the combined expertise of the Contractor, Subcontractors, the Engineer, Manufacturer and the Owner. The Contractor shall be responsible for coordinating all parties for a successful startup: the Manufacturer, Engineer and Owner shall be available for technical and operational advice prior to and during startup.

D. General requirements for startup activities are included in this Section. More specific requirements may also be included in other portions of the Contract Documents.

E. Temporary facilities may be necessary. If so, Contractor shall design, provide, operate, and later decommission them.

1.2 DEFINITIONS

A. Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.

B. Pre-commissioning is the systematic demonstration through testing and extended operation that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function. Pre-commissioning involves balancing, adjustments, calibration, loop checks, and loop validation. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the Engineer. Pre-commissioning of all portions of the work shall be successfully completed prior to starting Commissioning.

C. Commissioning is the verification that the complete work functions on an extended basis in full conformance with the Contract requirements.

1.3 SUBMITTALS

A. Startup Plan: Not less than 60 Days prior to startup, the Manufacturer shall submit for review a detailed Startup Plan related to the Dewatering Screw Press. The Manufacturer shall revise the Plan as necessary based on review comments. The Maunfacture's Plan shall include:

1. Schedules for manufacturers' equipment certifications.

2. Schedules for submitting final Technical Manuals.

3. Schedule for training the Owner's personnel.

4. Description of temporary facilities, if necessary, and schedule for installation and decommissioning them.

5. Detailed schedule of operations to achieve successful pre-commissioning and commissioning.

6. Checklists and data forms for Dewatering Screw Press.

7. Address coordination with the Owner's staff.

8. Designate a representative of the Manufacturer who has the authority to act in matters relating to startup and has experience in testing Dewatering Screw Press. The Plan shall also designate the roles and responsibilities of the Contractor that may be involved in startup activities.

9. Safety, startup, and testing procedures and proposed inspection and certification forms and records.

10. The Contractor shall be responsible for:

    a. the Interconnection of new to existing facilities

    b. Date and time frame of proposed shutdown or interconnection, including sequence of events and activities to be conducted.

    c. A detailed description of sequences and activities for the planned shutdown and interconnection.

    d. Staff, equipment, and materials that will be at the Site before commencing the shutdown.

    e. Other provisions so that interconnection, testing, and startup will be completed within the planned time.

11. The Contractor shall be responsible for hydrostatic testing of water-holding structures and pipelines and other potable water equipment. Schedule and plan shall indicate source of water, testing and disinfection sequence, disinfection procedures, and the disposal of the water following disinfection.

B. System Outage Requests: Request for shutdown of existing systems as necessary to test or start up new facilities.

C. Records and Documentation

1. Where required by the specifications, submit equipment installation certifications under those Sections.

2. Records of startup as indicated below.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MALFUNCTIONS

A. During the extended operational demonstrations, all components, subsystems, systems, and equipment must properly run continuously 24 hours per day at rates indicated by the Engineer throughout the test period. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired by the Contractor and the test restarted at time zero with no credit given for the operating time before the failure or malfunction. Malfunctions satisfying all 3 of the following conditions will allow the demonstration period to resume at the elapsed time when the malfunction started:

1. Malfunction did not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment.

2. Malfunction was corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations.

3. Malfunction was corrected within one hour of the time the malfunction was detected (the one hour period includes the time required to locate the cause of the malfunction, beginning upon Contractor’s notification from the Engineer that a malfunction has occurred and ending when the item is corrected and the system is successfully placed back into operation).

B. The Contractor shall arrange for manufacturer's representatives to visit the Site as often as necessary to correct malfunctions.

3.2 PREREQUISITES

A. Pre-commissioning and commissioning activities shall be scheduled by the Contractor. The 7 Day demonstrations and the 8 Day demonstration shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the Owner's calendar.

B. The following shall be completed before pre-commissioning begins.

1. All Technical Manual information required by the Contract Documents has been submitted and approved.

2. Safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents are provided. Devices and equipment shall be fully functional, adjusted, and tested.

3. Manufacturer's certifications of proper installation have been accepted.

4. Leakage tests, electrical tests, and adjustments have been completed.

5. The Engineer has approved the Startup Plan.

6. Temporary facilities are functional, adjusted, and ready for use.

7. Individual instrumentation loops (analog, status, alarm, and control) have been verified functionally.

8. Pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and other control devices to the settings determined by the Engineer or the equipment manufacturer have been adjusted for accuracy.

9. Individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls have been verified.

3.3 GENERAL

A. Supplies

1. The Contractor shall furnish:

a. Fuel

b. Oil and grease

c. Other necessary materials not listed for the Owner to furnish

2. The Owner will furnish:

a. Polymer

b. Water

c. Power

B. Startup Records: The Contractor shall maintain the following during testing and startup and submit originals to Engineer:

1. Lubrication and service records for each mechanical and electrical equipment item

2. Hours of daily operation for each mechanical and electrical equipment item

3. Equipment alignment and vibration measurement records

4. Logs of electrical measurements and tests

5. Instrumentation calibration and testing logs

6. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms

7. Factory and field equipment settings

8. Log of problems encountered and remedial action taken

9. Other records, logs, and checklists as required by the Contract Documents

3.4 PRE-COMMISSIONING

A. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.

B. Subject to the malfunction criteria above, each system shall be demonstrated for a continuous, 7 Day, 24 hour/day period. If any system malfunctions, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

C. The Contractor shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.

D. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup Plan. Completion of systems shall be documented by a report.

E. The Contractor shall demonstrate utility, chemical feed, safety equipment, and other support systems before whole process systems.

F. Furnish the Engineer at least 10 Days written notice confirming the start of pre-commissioning. The Owner's staff will observe pre-commissioning.

3.5 COMMISSIONING

A. The Contractor shall start up the new dewatering system and operate it without malfunction for a continuous 8 Day, 24 hour/day period. The Engineer will determine the operational parameters.

B. Defects that appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons that interrupt the test may, at the judgement of the Engineer, be cause for extending the demonstration an equal amount of time.

C. Commissioning shall not begin until leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, and system tests have been completed to the satisfaction of the Engineer.

D. The Owner will furnish certified treatment plant operators during the startup period to comply with Idaho Department of Environmental Quality requirements. Certified operators will be under the direct supervision of and be responsible to the Contractor. The Contractor shall furnish continuous, 24 hour staffing at the facility.

E. During commissioning, the Contractor shall:

1. Lubricate and maintain equipment in accordance with the manufacturers' recommendations.

2. Clean or replace strainers, screens, and filter elements.

END OF SECTION

SECTION 01 78 36 – WARRANTIES

PART 1 -- GENERAL

1.01 REQUIREMENTS INCLUDED

A. Preparing and submitting of warranties and bonds.

1.02 FORM OF SUBMITTALS

A. Electronic PDFs.

B. Label cover of each binder with typed or printed title "WARRANTIES AND BONDS", with title of Project; name, address and telephone number of Manufacturer; and name of responsible principal.

C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Contract Documents, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

D. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.03 PREPARATION OF SUBMITTALS

A. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers within 10 days after completion of the applicable item of work. Except for items put into use with Owner’s permission leave date of beginning of time of warranty open until the date of substantial completion is determined. All warranty coverage shall be extended directly to the benefit of the Owner.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

1.04 TIME OF SUBMITTALS

A. For equipment or component parts of equipment put into service during construction with Owner’s permission, submit documents within 10 days after acceptance.

B. Make other submittals within 10 days after date of substantial completion, prior to final application for payment.

C. For items of Work when acceptance is delayed beyond date of substantial completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00 - OWNER STAFF TRAINING

PART 1 - GENERAL

1.1 THE SUMMARY

A. The Manufacturer shall furnish all labor, materials, equipment, and incidentals necessary to train Owner's personnel on the dewatering screw press equipment, products, and systems furnished under this Contract and outlined in Section 46 76 27 – Dewatering Screw Press. Owner training is a prerequisite to satisfactory completion of the Contract requirements and shall be completed within the Contract Time.

B. The minimum onsite training requirements for various plant components are described in various sections of the specifications.

C. Except where otherwise indicated, all costs for training shall be the responsibility of the Manufacturer.

1.2 SUBMITTALS

A. Training Schedule: Schedule for training the Owner's personnel shall be submitted with the detailed Testing and Startup Plan required by Section 01 75 00 – Equipment Testing and Plant Startup.

B. Resumes of instructors.

C. The training lesson plan and materials shall be submitted to the Engineer for review at less than 3 weeks prior to the provision of training.

D. Approved operation and maintenance manuals shall be available at least 30 days prior to the scheduled date for the individual training session.

E. Training classes shall be scheduled a minimum of 4 weeks in advance of the date of the first class to allow Owner staffing arrangements to take place. The Manufacturer shall schedule training classes within the period 8:00 a.m. to 5:00 p.m. Monday through Friday.

F. Training classes shall be organized in conjunction with the Startup Systems, as defined in Section 01 75 00 – Testing and Plant Startup. Each training class shall consist of a classroom portion and a field tour portion. Each training class shall include:

1. Safety to be conducted by the plant safety officer.

2. Overview of the startup system, conducted by the Engineer.

3. Training on each item of equipment within the startup system, conducted by the Equipment Manufacturer's representative.

4. Training on the mechanical piping system within the startup system, conducted by the Contractor's mechanical superintendent.

5. Training on the power distribution system within the startup system, conducted by the Contractor's electrical superintendent.

6. Training on the instrumentation and control systems within the startup system, conducted by the Manufacturer's representative

G. Class Agenda: A class agenda shall be prepared by the Contractor, with equipment specific agenda items provided by the Manufacturer and submitted to the Engineer with the training schedule. The agenda shall include a listing of subjects to be discussed, time estimated for each subject, a list of documentation to be used and provided to support training, the proposed route of the field tours, and the instructor(s) name and qualifications. Agendas shall include an allocation of time for all components of the training session, including time for Owner staff to ask questions and discuss the subject matter. The Owner may request that particular subjects are emphasized and the agenda shall be adjusted to accommodate these requests. Copies of the agenda shall be distributed to each student at the beginning of each training class.

H. Within 10 days after the completion of each training session, the Contractor shall submit the following:

1. A sign-in sheet of all personnel that attended the training session.

2. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

3. A flash drive or other digital transfer as acceptable to the Owner containing the above information and a video of the training.

1.3 INSTRUCTOR QUALIFICATIONS

A. Instructors shall be completely knowledgeable in the products and systems for which they are providing training, and shall be experienced in conducting classes. Sales representatives are not considered qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.

B. Instructor shall have at least two years of experience in providing training certified by the Manufacturer.

C. If, in the opinion of the Owner, the Instructor did not provide the adequate training, such training shall be rescheduled and repeated with a suitable instructor at the Contractor's expense.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where specified, the Contractor, with support of the Manufacturer, shall conduct training sessions for the Owner's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this Contract.

2.2 TRAINING AIDS

A. Each instructor is encouraged to use audio-visual devices, P&IDs, models, charts, or other means to effectively increase the transfer of knowledge. The instructor conducting the training shall furnish all such equipment (televisions, CD/DVD recorder/player, projectors, screens easels, etc.), models, and charts for each class. It shall be the responsibility of the instructor to confirm in advance that the class room will be appropriate for the types of audio-visual equipment to be employed.

2.3 LOCATION

A. Training sessions and field training shall take place at the Project Site, unless otherwise specified by the Owner.

2.4 FORMAT AND CONTENT

A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

1. Familiarization

   a. Review catalog, parts lists, drawings, etc., which have been previously provided for the Owner's files and operation and maintenance manuals.

   b. Inspection on how the equipment has been installed. Demonstrate the operation of the unit and describe how all parts of the equipment meet the requirement of the Specifications.

   c. Answer questions.

2. Safety

   a. Using material previously provided, review safety features of the equipment.

   b. Discuss proper precautions when working around equipment.

3. Operation

   a. Using material previously provided, review reference literature.

   b. Explain all modes of operation (including emergency).

   c. Check out Owner's personnel on proper use of the equipment.

4. Preventive Maintenance

   a. Using material previously provided, review preventive maintenance (PM) lists including:

      1) Reference material.

      2) Daily, weekly, monthly, quarterly, semiannual, and annual PM activities.

b. Demonstrate how to perform Preventive Maintenance procedures.

c. Demonstrate to the Owner's personnel what to look for as indicators of potential equipment problems.

5. Corrective Maintenance

a. Identify possible problems.

b. Demonstrate how to perform repairs. Point out special problems.

c. Open up equipment and demonstrate O&M procedures, where practical.

6. Parts

a. Demonstrate the use of previously provided parts list and order parts.

b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.

7. Local Representatives

a. Identify local vendors where to order parts: name, address, telephone.

b. Service problems:

1) Identify contacts local contacts.

2) Identify emergency contacts.

8. Operation and Maintenance Manuals

a. Review any other material submitted.

b. Update material, as required.

PART 3 - EXECUTION

3.1 GENERAL

A. The objective of the training included under this Section shall be to convey the knowledge needed by the Owner operations, maintenance, and engineering staff to safely operate, maintain, and repair the equipment and systems furnished under this Contract.

B. Owner personnel who will participate in this training have existing full-time work assignments and this training is an additional assigned work task. Owner's staff work schedules regularly shift, as the plant is operated on an around-the-clock basis.

C. Training shall be tailored to suit the skills and job classifications of the personnel attending the classes e.g., plant manager, plant operator, maintenance technical, electrician, etc.

D. Minimum onsite training requirements for plant components are described in various sections of the Specifications. For the purpose of the times given in individual Specification sections, a workday is defined as an eight hour day at the site, excluding travel time.

E. Training shall be scheduled as a separate trip from equipment inspection, startup, and field adjustment. Training shall not be done until the manufacturer certifies that the equipment is operable as specified.

F. Specific Training Objectives: The training shall include a review of the equipment and drives, including internal parts, as prepared at the factory. The training shall include safety, removal, inspection, cleaning, operation and maintenance of the equipment such as startup, normal operation and shutdown procedures, step-by-step troubleshooting procedures with all necessary test equipment, and emergency or abnormal operation procedures. Training shall include preventive maintenance and long-term maintenance procedures, special tools necessary, and a discussion of recommended spare parts.

3.2 TRAINING CLASSES

A. Number of Classes on Each Subject: A minimum of two classes on identical subject matter shall be conducted, unless otherwise indicated. The purpose of having two classes on each subject is to accommodate the attendance of as many Owner personnel working different shifts as possible.

B. A maximum of one class per day shall be held on consecutive days unless otherwise approved by the Owner. Multiple classes may be scheduled if the class duration is shorter than 4 hours. Times shall be scheduled at the discretion of the Owner.

C. Class Length: Each class shall be subdivided into 2 to 6 hour modules, or as appropriate for the subject matter being discussed.

D. Number of Students: It is estimated that 5 to 10 persons will attend each training class. The Owner will determine the actual number of students. Provide training materials for all attendees.

E. Cancellation of Classes: If a class must be canceled because the equipment is not ready for operation, etc. the Contractor shall notify the Manufacturer and Owner at least 1 week in advance. The Contractor shall coordinate with the Manufacturer and Owner to reschedule the training.

3.3 TRAINING AIDS

A. Training Aids: Each instructor is encouraged to use audio-visual devices, P&IDs, models, charts, etc. to increase the transfer of knowledge. The Contractor shall provide all such equipment (televisions, videocassette recorder/player, projectors, screens, easels, models, charts, etc.) for each class. It shall be the responsibility of the Contractor to confirm in advance that the training room set-up will be appropriate for the types of audiovisual equipment to be employed.

B. Classroom Documentation: If training is being completed on equipment, systems, or products for which a Technical Manual is required, the draft Technical Manual shall have been returned by the Engineer with a status of “No Exceptions Taken” or “Make Corrections Noted” before the training class is scheduled. The approved Technical

Manual shall be used during the classroom instruction. Supplemental documentation handouts shall be provided by the organization conducting the training as required to the support instruction.

3.4 DOCUMENTATION OF TRAINING

A. The Contractor shall record the entire detailed training course in proper operation and maintenance and provide the video to the Owner. The recording shall be organized by each segment of the training session and be presented in a table of contents style with selectable segments of the session. The video shall become the exclusive property of the Owner. The Owner reserves the right to video, photograph, audio record, and otherwise document any or all training classes provided under this Work.

B. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.

1. As a minimum, classroom equipment training for operations personnel will include:

a. Identify and discuss safety items and procedures.

b. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.

c. Purpose and plant function of the equipment.

d. A working knowledge of the operating theory of the equipment.

e. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

g. Operator detection, without test instruments, of specific equipment trouble symptoms.

h. Required equipment exercise procedures and intervals.

i. Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.

2. As a minimum, hands-on equipment training for operations personnel will include:

a. Identify and review safety items and perform safety procedures.

b. Identify location of equipment and review the purpose.

c. Identifying piping and flow options.

d. Identifying valves and their purpose.

e. Identifying instrumentation:

f. Location of primary element.

g. Location of instrument readout.

h. Discuss purpose, basic operation, calibration, maintenance, troubleshooting, repair, and information interpretation.

i. Discuss, demonstrate, and perform standard operating procedures and round checks.

j. Discuss and perform the preventative maintenance activities.

k. Discuss and perform start-up and shutdown procedures.

l. Perform the required equipment exercise procedures.

m. Perform routine disassembly and assembly of equipment if applicable.

END OF SECTION

SECTION 46 10 00 – EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 SUMMARY

A. The provisions of this Section shall apply to all equipment throughout the Contract except where otherwise indicated. The Manufacturer shall provide equipment and appurtenant Work, complete and operable, in accordance with the Contract Documents.

B. The equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available from manufacturers at the time of design and it is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the Drawings are diagrammatic, and some features of the illustrated equipment arrangement may require revision by the Contractor to meet the actual equipment requirements proposed by the Manufacturer. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered by the Contractor to accommodate the equipment provided. No additional payment will be made to the Contractor for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the fabrication of equipment.

C. Unit Responsibility:

1. The Manufacturer shall furnish, coordinate, assemble, and test the system as an operating unit. Unless otherwise specified:

2. The Contractor shall install the Manufacturer provided equipment.

3. The manufacturer shall assure selected components of the system are checked for compatibility, ease of construction, and efficient operation and maintenance. The manufacturer shall ensure coordination of design of all system components such that all equipment furnished under the specifications for the equipment system, including equipment specified elsewhere but referenced in the specification, is compatible and operates properly to achieve the performance requirements specified. Agents, representatives, or other entities who are not a direct component of the manufacturing corporation will not be acceptable as a substitute for the manufacturer's corporation in meeting this requirement.

4. This requirement for unit responsibility shall in no way relieve the Contractor of responsibility for meeting the overall performance of equipment as specified in the Contract Provisions.

5. The Contractor shall assure that all equipment systems provided for the project are products for which unit responsibility has been coordinated by the responsible party.

6. Where the specification requires a Certificate of Unit Responsibility, submit a statement signed by an officer of the manufacturer's corporation that the equipment has been designed, selected and coordinated are compatible with the overall integrated system as specified.

7. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory.

D. Single Manufacturer: Where two or more pieces of equipment of the same type or same size are required, the equipment shall be produced by the same Manufacturer.

E. Protection During Shipment and Storage

1. General: Unless otherwise specified in the specific Section for the equipment, this paragraph applies.

2. Shipping:

a. Equipment: Ship in sealed, weather-tight enclosed containers with silica gel desiccants to protect equipment from moisture and corrosion during shipment. Equipment shall be properly and protected against from being damaged or stresses during transport to the job site.

b. Bearing housings: Protect antifriction bearings from being damaged in transit due to moisture and contaminants. Shafts locked to equipment housing to prevent bearing damage during shipment.

3. Damage: Correct to conform to the Contract requirements before the assembly is incorporated into the work.

4. Factory applied coatings: Each item of equipment shall be shipped to the site of the work with the manufacturer's shop applied prime coating.

5. Special monitoring: For the equipment listed below, a recording accelerometer, designed to record the magnitude of sudden impacts in 3 directions (X, Y, Z) on continuous strip charts with both time and "g" force scales, shall be shipped with, and fixed to each separately packed assembly or its packing crate. The units shall be shipped with a backup accelerometer and with new batteries. Upon arrival of each shipment, immediately notify the Project Representative; the accelerometer: shall be removed in the presence of representatives of the Project Representative and the Contractor. If the magnitude of the maximum acceleration exceeds 3.0 g, the assembly and any subassembly shall be dismantled and inspected for damage.

6. The following list of equipment shall be monitored during shipment:

a. All electric motors and pumps 500 hp and larger or pump with a rated capacity of 10,000 gpm or larger.

b. All blowers, compressors with motors 500 hp and larger.

F. Products Supplied but Not Installed

1. The dewatering screw press shall be supplied by the Manufacturer and installed by others. The equipment supplied by the Dewatering Screw Press Manufacturer is outlined in Section 46 76 27 – Dewatering Screw Press

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Abbreviations and Acronyms

B. Reference Specifications

01 33 00	Submittal Procedures
01 75 00	Equipment Testing and Plant Startup
01 79 00	Owner Staff Training

C. Reference Standards

American Bearing Manufacturers Association (ABMA)	
American Gear Manufacturers Association (AGMA)	
American National Standards Institute (ANSI)	
ANSI B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)	
American Society of Mechanical Engineers (ASME)	
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ASME B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and other Special Alloys
ASME B46.1	Surface Texture
ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASME B31.1	Power Piping
ASME B31.3	Process Piping
American Water Works Association (AWWA)	
AWWA M11	Steel Pipe – A Guide for Design and Installation
AWWA C206	Field Welding of Steel Water Piping
AWWA C207	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA D100	Welded Steel Tanks for Water Storage
American Welding Society (AWS)	
American Society for Testing and Materials (ASTM)	
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality
Federal Specifications (FS)	
Hydraulic Institute (HI)	
Mechanical Power Transmission Association (MPTA)	

National Electrical Manufacturers Association (NEMA)	
National Fire Protection Association (NFPA)	
NFPA 820 Standard for Protection in Wastewater Treatment and Collection Facilities	
NSF International (NSF)	
NSF/ANSI 61	Drinking Water System Components – Health Effects
Occupational Safety and Health Administration (OSHA).	
Underwriters Laboratories (UL)	
Rubber Manufacturers Association (RMA)	

1.03 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Product Data

1. Submit product data consisting of manufacturer's printed data sheet or catalog cuts illustrating product information required to demonstrate that the equipment meet project section subject to review by the ENGINEER.

B. Shop Drawings Submittals

1. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

2. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the Manufacturer.

3. Spare Parts List: The Manufacturer shall submit as part of Shop Drawings a list of specified and recommended spare parts for each piece of equipment. The manufacturer shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

1.04 QUALITY ASSURANCE

A. Costs: Responsibility shall be by the Manufacturer's for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The Owner will pay for costs of power and water. If available, the Owner's operating personnel will provide assistance in the field testing.

B. Inspection: The Contractor shall inform the local authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, cranes, and related items to obtain required permits and certificates, and shall pay inspection fees.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

D. Machine Work shall be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members or machine parts without machined or milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30-feet or less in length, and not greater than 1/8-inch for members over 30-feet in length.

E. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The Engineer shall be notified of larger defects. No repair welding of such defects shall be carried out without the Engineer's written approval. If the removal of metal for repair reduces the stress resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress, then the casting may be rejected. Costs of casting new material shall be the Contractor's responsibility as part of the Work.

F. Materials shall meet the physical, chemical, metallurgical and mechanical properties in accordance with the reference standards. All materials or products shall be new and from a Manufacturer specializing in the manufacture of the product. All materials shall be high-grade, standard commercial quality, free from all defects and imperfection, and shall be recommended by the Manufacturer for the intended application.

G. Machine Finish: The type of finish shall be the most suitable for the application as recommended by the equipment manufacturer in micro-inches in accordance with ANSI B46.1 Surface Texture (Roughness, Waviness, Lay). In the absence of manufacturer's recommendations, the following surface finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for surfaces in sliding contact.

2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.

3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.

4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

H. Manufacturer's Experience: Equipment manufacturer shall have a record of proven experience of at least 5 years of successful, trouble-free operation in similar applications, type, model and size equal or larger than the equipment specified in this Contract. Where indicated in each individual equipment specifications, the Manufacturer shall submit this experience record to the Engineer for approval.

I. Certificates

1. Submit all equipment certificates to demonstrate that the equipment met provisions of specification in performance, materials, function, controls and operation as specified in each specific equipment specification sections.

J. Manufacturer's Instructions

1. Submit equipment manufacturer's instruction documenting packaging, shipping and delivery, storage, installation, startup, and operation and maintenance.

K. Source Quality Control Submittals

1. Submit source quality control procedures for foundry, machining, welding assembly and field installation in accordance with ISO 9001 Quality Procedures. Include non-destructive testing procedures as required to demonstrate and ensure quality of finished product. Equipment manufacturer shall be responsible of enforcing quality assurance procedures to producers for sub-manufactured parts.

L. Field Quality Control Submittals

1. Submit field quality control procedures for equipment from installation, startup and commissioning. Quality control procedure shall clearly describe specification performance requirement, function and controls, checkout steps, sign-off by Inspector. Submit test results and certificate signed by the equipment manufacturer representative, contractor and witnessed by the field engineer.

1.08 MAINTENANCE MATERIAL SUBMITTAL

A. Spare Parts

1. Submit list of spare parts as specified in each equipment specification Section.

2. Submit list of spare parts recommended by the equipment manufacturer in addition to what was already required as part of the contract.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Noise Level: When the equipment is in operation, no equipment shall exceed the following OSHA permissible noise exposure levels per day; 105 dBA for one hour, 100 dBA for two hours or 90 dBA for eight hours.

B. High Noise Level Location: The Contractor shall provide one personal hearing protection station at each location defined as follows:

1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise permissible level for a 2-hour exposure. Where such equipment is separated by a distance of more than 20-feet, measured between edges of footings, the area for each group of equipment shall be provided with a separate hearing protection station.

2. Indoor Location

a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise permissible level for a 2-hour exposure.

b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers that produces noise exceeding OSHA noise permissible level for an 8-hour exposure.

C. Personal Hearing Protection: The Contractor shall furnish 3 pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

D. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque (whichever is the greatest), speed, and horsepower. Applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, and temperature. Drive train components include couplings, shafts, gears, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	**Service Factor**	**Load Classification**
Reciprocating Air Compressors		
multi-cylinder	2.0	Heavy Shock
single cylinder	2.0	Heavy Shock
Dewatering Screws	1.25	Moderate Shock

E. Mechanical Service Factors

	Mechanical Service Factors	
	Electric Motor	**Internal Combustion Engine**
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

F. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to the manufacturer sizing information.

G. Where load classifications are not indicated, the equipment manufacturer’s recommendations for service factors shall be utilized.

H. Welding: Unless otherwise indicated, welding shall conform to the following:

1. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

2. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a smooth and acceptable appearance with uniform weld contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent corrosion of hard-to-coat metallic surfaces.

4. Welded steel tanks: Latest revision of AWWA D100.

5. Welded steel piping: Latest revision of AWWA C206.

I. Protective Coating: Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

J. Potable Water Contact: Materials immersed in or exposed to potable water shall be made of materials or coated compliant with NSF/ANSI 61. Bronze alloy materials in contact with potable water shall be constructed of zero-lead materials or materials whose lead content do not exceed the weighted average criteria as required by the Lead Reduction Act. Equipment manufacturer shall submit to the Engineer a certification of compliance with the requirement of NSF Standard 61 and the Lead Reduction Act.

K. Protection of Equipment: Machined and coated surfaces shall be protected by rust inhibitor material prior to shipment. Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry. Equipment with anti-friction bearings or sleeve bearings shall be protected from being damaged due to jarring motion during shipment. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized, and shafts shall be rotated per manufacturer's recommendation. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, recoated, or otherwise corrected to restore it to original condition.

L. Identification of Equipment Items

1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

2. After installation, each item of equipment shall be given permanent identification.

a. Pumps, compressors, and blowers of 150 horsepower or less shall receive acrylic plastic or stainless steel plate nametags.

b. Pumps, compressors, and blowers larger than 150 horsepower shall receive stainless steel plate nametags.

M. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

N. Equipment Maximum Allowable Vibration Level: Unless otherwise indicated, maximum allowable vibration level shall be in accordance with the acceptance criteria recommended by the reference Standard for that particular type of equipment

O. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

P. Controls: Equipment and system controls shall be in accordance with Division 40 - Instrumentation.

2.02 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Equipment Supports: Equipment components and supports, anchors, and seismic restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greatest of the following design criteria:

B. Submit design calculations for equipment supports, anchors, and seismic restrainers signed and sealed by an engineer registered in the State wherein the project is to be built. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, and normal operation plus wind loadings.

1. Wall-mounted equipment weighing more than 250 pounds, or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

2. Seismic requirements: Freestanding and wall-hung equipment shall be anchored in place. Calculations shall be performed and signed and stamped for equipment weighing more than 400 pounds. Calculations shall analyze lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

3. Wind requirements: Exterior freestanding equipment shall be anchored in place. Calculations shall be performed and signed and stamped, analyzing lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

4. Anchors: Manufacturer shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the Shop Drawings.

5. Equipment Grout: Mechanical equipment installed on top of concrete foundations or bases shall be provided with non-shrink concrete or epoxy grout. Grout shall be applied between the base plate and the concrete foundation or base in accordance with the grout manufacturer's recommendation. Grout shall be free of void space.

2.03 COUPLINGS

A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	**Coupling Type**
Horizontal and end suction pumps	Gear or flexible spring
Vertical turbine pumps	3-piece spacer for solid shaft or double nut for hollow shaft
Vertical nonclog pumps, close coupled	Flexible disc pack
Screw pumps	Flexible spring, gear coupling, fluid coupling
Vertical nonclog pumps with extended shaft	Flexible disc pack
Belt conveyors	Gear coupling for fractional to 7.5 horsepower, Silicone filled fluid coupling for 10 hp and larger
Sludge collector	Gear coupling or jaw clutch
Engine driven pumps	Flexible disc pack or elastomeric flexible type
Single stage centrifugal blowers	Flexible disc pack
Air compressors	Gear or flexible disc pack

B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, 2 sets of flexible disc pack couplings or as recommended by equipment manufacturer shall be provided.

D. Taper-Lock or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.04 SHAFTING

A. General: Equipment manufacturer shall be responsible for designing and manufacturing shafting to carry all loads applied to the shaft. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: Shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications.

C. Materials: Shafting materials shall be compatible with the type of service and load transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

2.05 GEARS AND GEAR DRIVES

A. Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used unless specifically approved by the Engineer.

B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather with humidity control filter to allow air to escape but keep moisture, dust and dirt out. The casing shall be of cast iron, ductile iron, or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.

C. Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall be selected by the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with required appurtenances shall be provided when necessary.

F. Where gear drive input or output shafts from one manufacturer connect to couplings or sprockets from a different manufacturer, the Contractor shall have the gear drive manufacturer furnish a matching key taped to the shaft for shipment.

2.06 DRIVE CHAINS

A. Power drive chains shall be commercial type roller chains meeting ASME Standards.

B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

C. A minimum of one connecting or coupler link shall be provided in each length of roller chain.

D. Chain and attachments shall be of the manufacturer's best standard material and be suitable for the process fluid.

2.07 SPROCKETS

A. General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

B. Materials: Unless otherwise indicated, materials shall be as follows:

1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.

2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.

C. Sprockets shall be accurately machined to ASME Standards. Sprockets shall have deep hardness penetration in tooth sections.

D. Finish bored sprockets shall be furnished complete with key seat and set screws.

E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with Taper-Lock bushings as required.

F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.08 V-BELT DRIVES

A. V-belts and sheaves shall be of the best commercial grade and shall conform to ASME, MPTA, and RMA Standards.

B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.

C. Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.

D. To facilitate installation and disassembly, sheaves shall be provided complete with Taper-Lock or QD bushings as required.

E. Finish bored sheaves shall be complete with key seat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.09 DRIVE GUARDS

A. Power transmission trains, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform to the Division of Industrial Safety General Industrial Safety Orders latest edition. OSHA Safety and Health Standards (29CFR1910). The guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.10 BEARINGS

A. General: All bearings shall be selected and sized by the equipment manufacturers and reviewed by bearing manufacturers. Bearing life calculation shall be submitted and reviewed by bearing manufacturer. Bearing shall conform to the standards of the American Bearing Manufacturers Association, Inc. (ABMA).

B. To assure satisfactory bearing application, ambient temperature, humidity, internal clearances, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. Re-lubricatable type bearings shall be equipped with hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	**Design Life, years**	**L-10 Design Life, hours**
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide heat exchangers, incluging necessary intrumentation and controls, piping, filters, and valves.

2.11 PIPING CONNECTIONS

A. Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 40 05 07– Hangers and Supports for Process Piping.

B. Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to ASME B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ASME B1.20.1 and Section 40 05 01– Piping General.

C. Flexible Connectors: Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 40 05 01– Piping General. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.

D. Insulating Connections: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the specifications.

2.12 GASKETS AND PACKINGS

A. Gaskets and packings shall be in accordance with the requirements of the specifications. Gaskets and packings in contact with drinking water shall be NSF 61 approved. Elastomeric materials in contact with water with chloramines, or water with ozone residual shall be made of Teflon or Viton-A, or equal.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane Everseal, or equal.

C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the Engineer, in accordance with Section 43 21 00 - Pumps, General.

2.13 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.14 SPECIAL TOOLS AND SPARE PARTS

A. Tools: The Manufacturer shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

B. Spare parts shall be furnished as indicated in the individual equipment sections. Spare parts shall be suitably packaged in a metal box and labeled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

2.15 EQUIPMENT LUBRICANTS

A. The Manufacturer shall provide lubricants for equipment during shipping, storage, and prior to testing, in accordance with the manufacturer’s recommendations. Lubricants that could come in contact with potable water shall be food grade lubricants. After successful initial testing, final testing, and satisfactory completion startup testing per Section 01 75 00- Equipment Testing and Plant Startup, the Contractor shall conduct one complete lubricant change on equipment. In addition, the Contractor shall be responsible for the proper disposal of used lubricants. The Owner will then be responsible for subsequent lubricant changes

PART 3 -- EXECUTION

3.01 SERVICES OF MANUFACTURER

A. Installation Supervision, Inspection, Startup, and Field Adjustment: An authorized, experienced, and competent service representative of the manufacturer shall visit the Site to perform the following:

1. Supervision of the installation of the equipment.

2. Inspection, checking, and adjusting the equipment and approving its installation.

3. Startup and field testing for proper operation, efficiency, and capacity.

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements.

5. Verify, affirm and certify that the specified equipment performance acceptance criteria and conditions such as temperature and vibration amplitude, have been meet. Submit test certificate signed by the Contractor and witnessed by the Engineer representative.

6. Certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

7. Unless otherwise indicated, factory representative shall be present at the job site for the following number of days:

    a. Half a day per equipment for smaller than 500 horsepower.

    b. One day per equipment for 500 horsepower and larger.

B. Owner Staff Training

1. Owner staff training shall be in accordance with Section 01 79 00– Owner Staff Training. An authorized training representative of the Manufacturer shall visit the site for a number of days indicated in those sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step by step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

2. The representative shall have at least two years' experience in training. A resume of the representative shall be submitted.

3. Unless otherwise indicated, a minimum of one day of training shall be provided for each type of equipment.

3.02 TESTING

A. General requirements

1. All mechanical equipment shall undergo factory and field performance and functional test to demonstrate that the process equipment system meet the requirement of the Contract Document. Detailed testing requirement are specified in each equipment specification sections.

2. Unless otherwise specified, equipment factory testing procedure shall follow the Industry Standard test procedure that applies to that equipment.

3. Submit test procedures for review by the Engineer one month prior to the scheduled test.

B. Test sequence

1. Factory functional and performance testing

2. Component tests

3. System tests

4. Individual system or train test

5. Overall facility operational tests

3.03 STARTUP AND COMMISSIONING

A. Startup and commissioning test shall be as specified in Division1, Section 01 75 00 – Equipment Testing and Plant Start-up

3.04 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate space and structural requirements, clearances, utility connections, signals, and outputs with Subcontractors to avoid later change orders.

B. If the packaged system has any additional features (such as safety interlocks, etc.) other than required by the Contract Documents, the Contractor shall coordinate such features with the Engineer and provide material and labor necessary for a complete installation as required by the manufacturer.

3.05 FIELD ASSEMBLY

A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with Never Seize compound or equal.

3.06 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Operational Readiness Tests (ORT)

a. Check equipment for proper installation, baseplates leveled, grouted and anchor bolts properly torqued to manufacturer’s specifications and rotating assemblies balanced and shafts aligned.

b. Install all instruments and their associated components, controls panels, wirings are installed, calibrated and termination checked.

c. Install and check all PLC’s, Input/output wires and all terminations.

d. Install all power cables from MCC to motors and checked.

2. Perform trial operation. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable standards.

3. Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.

4. Operate equipment indicated in Section 01 75 00- Equipment Testing and Plant Startup.

C. The Engineer shall witness field-testing. The Contractor shall notify the Engineer of the test schedule 3 Days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

END OF SECTION

SECTION 46 76 27– DEWATERING SCREW PRESS

PART 1 -- GENERAL

1.01 SUMMARY

A. The Manufacturer shall furnish two sludge dewatering screw press(es) as indicated on the contract drawings. Each screw press shall be manufactured from AISI 316L stainless steel shapes. Fabrication and assembly shall be in conformance with these specifications and drawings.

B. Each dewatering system shall include a screw press, drive motors, gear reducers, support legs, anchor bolts, piping and wiring, controls, and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

C. The Manufacturer shall coordinate all details of the equipment with other related parts of the work. The Manufacturer shall verify that all structures, piping, wiring, and equipment components are compatible. Manufacturer shall be responsible for all structural and other alterations required to accommodate equipment differing in dimensions, weight, or other characteristics from these specifications and drawings. The Manufacturer shall provide all work to properly install, adjust, and place in operation a complete working system.

D. The Contractor shall install the equipment according to instructions and recommendations of the equipment Manufacturer.

E. The main power supply is 240 V, 60 Hz, 3-phase. The power supply for the air compressor shall be 120 V, 60 Hz, 1-phase.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

1. Section 01 33 00 – Submittal Procedures

2. Section 01 75 00 – Equipment Testing and Plant Startup

3. Section 01 78 36 – Warranties

4. Section 01 79 00 – Owner Staff Training

5. Section 46 10 00 – Equipment General Provisions

B. REFERENCE STANDARDS

1. America Society of Mechanical Engineers (ASME)

2. American Society for Testing and Materials (ASTM)

a. Section A322: Carbon and Alloy Steel Bar Specifications.

b. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled

3. ISO 281:2007 Calculation Method for Fatigue Life for Roller Bearings.

4. American Institute of Steel Construction (AISC) Publications

5. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

6. American Welding Society (AWS), European Welding Federation (EWF), and International Institute f Welding (IIW) Publications

7. American Structures Painting Council (ASPC) Publications

8. International Organization for Standardization (ISO) Publications.

9. National Electric Code (NEC)

10. National Electrical Manufacturers Association (NEMA)

11. American National Standards Institute (ANSI)

12. All Federal, State and Local Building Codes

1.03 SUBMITTALS

A. Shop drawings and product data shall be submitted for all items to be furnished in accordance with provisions of the Contract Documents. Contract Documents include Pre-Purchase Specifications and 30% Design Drawings. The Manufacturer will be provided with updated design drawings at the design deliverables.

B. Product Data:

1. Submit data completely describing product including literature, brochures, catalogs, cut-sheets, listing of materials of construction and supplementary material to define the equipment.

2. Motor characteristics and performance information.

3. Gear reducer data including service factor, efficiency, torque rating, and materials.

4. Parts list including a list of recommended spare parts.

5. Submit surface preparation and finished to be applied to all equipment.

C. Shop Drawings:

1. Complete Manufacturer fabrication/assembly drawings stamped by a registered Professional Engineer in the State of Idaho.

2. Certified drawings showing dimensions, weights, loading information and location of all components. Include details on interconnecting piping, supports and control panel.

3. Wiring, control schematics, and control logic diagrams for all electrical and control components furnished.

D. Structural Calculations:

1. Structural anchor points to concrete foundation.

2. Seismic loads on frame and anchor bolts.

E. Resume of field technician to perform in-field adjustments, inspections, observations of test operations, supervision of functional and performance testing, and training.

F. Operator Training Manual outline.

G. Operation and Maintenance Manuals: Include complete lubrication, maintenance, and operation instructions, including initial start-up instructions, and unloading and handling methods.

H. Quality Control Submittals:

1. Special shipping, storage, protection, and handling instructions, including equipment weight and lifting points

2. Manufacturer's installation instructions.

3. Factory test results.

4. Manufacturer's warranty

5. A copy of documents proving certification of the Manufacturer's Quality Management System according to ISO 9001 and Environmental Protection Management System according to ISO 14001.

1.04 QUALITY ASSURANCE

A. To ensure quality, conformance, reliability, and environmental practices with regard to the manufacturing and production of the machinery described in this section, the equipment manufacturer shall meet the requirements listed in this section.

1. Manufacturer shall have established an ISO 9001 certified quality management system. Manufacturers without an ISO 9001 certified quality management program must provide complete documentation of their existing quality management system with supplemental information clarifying why areas do not meet ISO 9001 standards. Meeting national quality management standards alone shall not be considered an acceptable substitute because ISO standards exceed national quality management standards.

B. Manufacturer shall have established an ISO 14001 certified environmental protection management system. Manufacturers without an ISO 14001 certified environmental protection management system must provide complete documentation of their existing environmental protection management system with supplemental information clarifying why areas do not meet ISO 14001 standards. Meeting national or local environmental protection management standards alone shall not be considered an acceptable substitute because ISO standards exceed national and local environmental protection management standards.

C. All stainless steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid (pickling bath) to remove any residues that may be present on the material because of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer, which is critical to the long life of the stainless steel.

D. No stainless steel components may be fabricated or assembled in a factory isolated from where carbon steel products are fabricated, in order to prevent contamination by rust.

E. The manufacturer shall have a minimum of 5 years' experience producing dewatering screw presses and upon request will submit to the Engineer documentation of 15 installations similar or larger than specified herein, that have been in operation for at least 5 years.

F. All welding is performed in accordance with American Welding Society (AWS), European Welding Federation (EWF), International Institute of Welding (IIW), or equivalent.

G. Manufacturer shall provide screw press, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

H. Manufacturer shall provide services by a factory-trained service technician, specifically trained on the type of equipment specified. Service technician requirements include, but are not limited to the following:

    1. Manufacturer shall have a minimum of 10 service technicians based in the United States for field service of the equipment. Manufacturer shall have multiple service locations with a minimum of one dedicated service location for both the eastern and western regions of the US.

    2. Service technician shall be present during initial energizing of equipment to determine directional testing.

    3. Service technician shall inspect and verify location of anchor bolts, placement, leveling, alignment and field erection of equipment, as well as control panel operation and electrical connections.

    4. Service technician shall provide classroom and/or field training on the operation and maintenance of the equipment to operator personnel.

    5. Manufacturer shall state field service rates for a service technician to Owner and Contractor. In the event that the field service time required by this section should not be sufficient to properly place the equipment into operation, additional time shall be purchased by Contractor to correct deficiencies in installation, equipment, or material without additional cost to Owner.

I. Manufacturer shall guarantee all equipment against faulty or inadequate design, improper assembly or installation, defective workmanship or materials, and breakage or other failure. Materials shall be suitable for service conditions.

J. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service prior to delivery, except as required by testing.

K. Each major component of equipment shall have the manufacturer's name, address and product identification on a nameplate securely affixed to the equipment.

1.05 WARRANTY

A. The dewatering screw press manufacturer's scope of supply shall be provided with a minimum 1-year warranty, guaranteeing all parts, workmanship and performance. The warranty shall include replacement of parts and labor. This warranty will commence upon performance testing of the products and will expire on the earlier to occur of one (1) year from initial operation of the product or 18 months from delivery thereof (the "Warranty Period").

PART 2 -- PRODUCTS

2.01 APPROVED MANUFACTURERS

A. HUBER Sludge Dewatering System Model Q-Press 620.2 from Huber Technology, Inc.

2.02 GENERAL

A. Equipment, for the Dewatering Screw Press System (System), provided under this section includes but is not limited to the following:

1. Horizontal or Inclined screw press for dewatering wastewater sludge

2. Control panel for the dewatering system

3. Air compressor

4. All hardware and anchor bolts require for installation

5. Spare parts identified in this section

6. Any special tools required for equipment operation

B. The Equipment for the System shall be designed to extract water (dewater) from the wastewater sludge specified herein after conditioning of the sludge with a solution of emulsion polymer. Dewatering by a screw press shall be accomplished by slowly squeezing the flocculated sludge and allowing the liquid to escape through perforated or wedge-wire screens surrounding the screw while retaining the solids inside the press. The function of the screw press shall be to generate dewatered sludge such that the discharged cake solids concentration, polymer usage, and solids capture comply with the Guaranteed Performance Requirements specified herein.

C. Two independent dewatering screw press units shall be furnished. The equipment shall be fully assembled, and factory tested as far as practical prior to shipment. The Owner may elect to inspect the System prior to shipment at own cost. The shipment shall be delivered to the jobsite as a completely assembled package and ready for service after connection of piping, wiring, and utilities.

D. All moving wetted parts, or all wetted parts on which moving parts ride, shall be fully corrosion resistant.

E. All parts of the mechanisms shall be amply proportioned for all stresses that may occur during fabrication, shipment, erection, and operation.

F. Sufficient room for inspection, maintenance, repair and adjustment shall be provided. Contractor shall provide hoisting equipment to facilitate installation and maintenance work.

G. All parts shall be designed and manufactured to handle the forces that may be exerted on the screw press during fabrication, shipping, erection, and proper operation according to the O&M manual.

H. All components shall be balanced so that jamming at any point will not result in structural failure, but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.

2.03 GUARANTEED PERFORMANCE REQUIREMENTS

A. The Equipment shall be capable of operating as a Sludge Dewatering System, as shown on the Drawings to meet the following guaranteed performance requirements:

1. The System shall receive and dewater the feed sludge specified herein, and neatly discharge the dewatered sludge cake into an existing conveyor belt as shown on the Plans.

2. The System shall operate continuously or intermittently on demand. The System shall be suitable for dewatering the specified sludge and shall perform the required dewatering operations at the loading and operating conditions specified herein.

3. The System shall achieve the following minimum Guaranteed Performance Requirements on sludge produced at the Wastewater Treatment Plant. The System furnished and commissioned by the Manufacturer shall perform at the operating conditions and meet the performance requirements specified below and based on the pilot test results specified below:

a. Design Criteria: Sludge Characteristics

Criteria	**Value**
Sludge Type	Digested Sludge (WAS and Primary Sludge)
Design Feed	24,000 gpd
Feed Sludge Concentration	1.5%
Sludge Total Dissolved Solids (TDS)	1,600 mg/L
Sludge Volatile	76.54%

Sludge pH	7.5
Chloride Concentration	459 mg/L
Phosphate Concentration	15 mg/L

b. Design Criteria: Performance Requirements

Criteria	**Value**
Number of Units (Duty, Standby)	1 +1 (Duty, Standby)
Hydraulic Loading Rate	28.6 gpm at 1.5% solids
Solids Loading Rate	214 lb/hr at 1.5% solids
Operational Hours per Day	14 hours
Operational Days per Week	7 days
Acceptable Cake Solids	16-19%
Capture Rate	95%
Estimated Polymer Consumption	40 - 53 lb active polymer/dry ton of sludge
Average Spray Wash Water Requirement	55 gph at 90 psi

2.04 SLUDGE DEWATERING SCREW PRESS

A. Materials

1. Sludge dewatering press shall be manufactured from AISI 316L stainless steel shapes (rods, angles, and channels), pipes, and sheets. In particular, wedge wire basket, screw, shaft, support legs, fasteners and anchor bolts shall be made of this material. Presses with carbon steel components shall not be acceptable because of corrosive wastewater environments.

2. Press access covers shall be either stainless steel or a composite of acrylonitrile butadiene styrene (ABS) and poly(methyl methacrylate) (PMMA). Materials other than stainless steel shall be acceptable if the material meets the following requirements:

   a. Is not a structural load-bearing component.

   b. Is equal to or exceeds stainless steel’s resistance to wastewater environment chemicals.

   c. Is resistant to heat degradation up to 185°F (85°C).

   d. Is equal to or exceeds stainless steel’s resistance to UV degradation.

   e. Is resilient to impact

3. Wipers for helical screw flights shall be of wear resistant polyurethane (PU) material. Wipers must have a basket contact width of at least 0.315 in (8 mm) to provide sufficient basket cleaning. The wiper is held in place by stainless steel clamps and set screws which can be easily removed. The wiper shall have a self-contained a dampening mechanism to maintain constant contact with the basket while limiting wear. Wiper self-contained dampening mechanism shall compensate for up to 4mm of radial wiper wear. Equipment using brushes or wipers without this functionality shall provide service trips and replacement parts for the first two (2) brush or wiper replacements to account for additional maintenance time. Equipment without wipers or brushes shall provide four (4) replacement baskets and augers to account for additional equipment wear. Equipment with moving and fixed ring systems shall provide service trips and replacement parts for the first four (4) replacement intervals to account for both the additional maintenance time and additional equipment wear.

B. SCREW PRESS DESIGN

1. The screw press shall be installed inclined. Units shall provide a diverter chute to prevent wet material from discharging into the downstream process during startup.

2. Dewatering of the sludge takes place in a basket, which consists of three sections of wedge wire baskets. Basket openings shall vary in each of the three sections, from wider openings to tighter openings, to facilitate optimum release of water from the sludge. The overall basket length shall be 120 in (3,050 mm). The basket diameter shall be 25 in (620 mm). Baskets with constant basket opening sizes must provide a minimum basket length of 197 in (5,000 mm) to facilitate additional detention time in the unit for water release.

3. The screw press support legs shall be capable of field adjustment for ease of installation.

4. The screw press shall be enclosed to prevent odor emission. The whole dewatering section and basket area shall be easily accessible through an inspection lids, which are mounted via hinges on the side of the machine.

5. The wedge wire basket where the wet sludge enters the basket shall provide a minimum free surface area of 18.2% of the active wedge wire surface area to facilitate free water drainage. Flanges and reinforcement bars or supporting structures around the basket blocking the drainage of water shall be deducted from the active surface area. Baskets without this minimum free surface area must provide additional length of basket until they achieve this minimum free surface area.

6. Each section of the wedge wire basket shall be split in half along the length of the basket to allow for easy separation of the basket into halves for servicing of the wiper. The basket shall be fastened together using bolt fasteners made of stainless steel. The screw press shall be provided with alignment pins for ease of basket alignment during reassembly. The bottom half of the wedge wire basket shall remain inside of the machine during servicing of the wiper for ease of maintenance. Designs which require the bottom half of the basket to be removed from the machine for servicing the wiper will not be accepted because of additional service requirements.

7. A screw shall be installed inside of the screen basket. The screw transports the sludge from the inlet to the discharge area at the end of the pressure zone. Its shaft diameter shall be conical towards the discharge section of the machine. The flights of the helical screw shall be provided with a PU wiper to clean the wedge wire screen from the inside.

8. The screw shall be shafted and shall be made of stainless steel. A shaft-less screw is not acceptable because of the pressure and torque involved with dewatering. A bearing shall support the feed end of the screw shaft. Wear strips are not acceptable because of the frequent requirement for service. Grease lubricated ball or spherical roller type bearings shall be designed to withstand all stresses of the service specified. Main bearings shall have a minimum B-10 life rating of 100,000 hours at standard operating speeds

9. A screw drive shall be provided at the discharge side of the press. The nominal motor power shall be 3.0 hp. The motor speed shall be controlled with a Variable Frequency Drive (VFD). The drive unit shall be directly coupled to the screw shaft through a planetary gearbox.

10. A pressure sensor shall be installed at the inlet housing of the screw press. The pressure sensor provides a signal which is used to control the speed of the auger. The pressure in the inlet box shall automatically adjust the speed of the screw via the control system and the range for the pressure shall be adjustable at the HMI. Designs which do not control the screw speed based on the inlet pressure are not acceptable because they require frequent operator attention.

11. The cleaning of the wedge wire screen from the outside shall be performed by a rotating spray bar washing system utilizing a single drive (drive: 0.25 hp, 240 V, 3 phase) made of stainless steel piping and PVDF spray nozzles. The spray wash system shall be split into four sections, upper feed, lower feed, upper discharge, and lower discharge, to cover the entire area of the basket by rotating around the circumference of the basket. Its spraying shall cover the entire area of the screen and also cover the interior of the screw press housing. In total four solenoid valves control the flow to each section of the spray bar washing system. The spray bar washing sections shall have the ability to operate independently. Designs which do not rotate around the circumference of the basket over the entire length of the basket will not be accepted because they fail to clean the entire basket.

12. To optimize wash water consumption, the spray bar system shall have the ability to perform a quick wash of only the lower basket and/or an extended wash of the entire basket. Designs which do not have the quick wash ability shall not be accepted. Contractor shall provide water supply piping to the manifold of the spray system that shall have a 1-¼ inch female threaded connection. The system shall include 2 proximity switches to prevent over travel of the spray bar system.

13. Spray water supply shall be designed for a minimum flow of 44 gpm (can be filtered non-potable water, allowed particle size 800 microns at maximum 200 ppm) at a minimum pressure of 70 psig. Water pressure at each nozzle of the spray bar shall be a minimum of 70 psig. Average spray water consumption shall not exceed 112 gallons at 70 psig per wash cycle. Spray washing systems that operate at pressures less than 70 psig shall provide any necessary basket cleaning services at the Owner's request for the first 10 years of operation to account for insufficient cleaning of the basket.

14. A pneumatically actuated cone that serves for adjusting the pressure in the pressure zone shall be provided at the discharge end of the screening basket. The pressurized air supply shall be provided by the Contractor.

15. The pneumatically actuated cone is controlled by a 5-2-way solenoid valve. The solenoid directs the pressurized air to the ports which engage or disengage the cone at the discharge of the screw press. The control valve shall be installed in a local control station which also houses the pressure control valve and the pressure switch. The switch monitors the availability of pressurized air. If the supply of pressurized air is interrupted, the switch shall send a signal to the PLC and an alarm message will be generated.

16. Sludge cake shall be automatically discharged through a rectangular sludge discharge opening. The discharge height shall be minimum 37 in above floor level. Designs with standard discharge height lower than this minimum level must include provisions to interface properly with downstream equipment and a platform to allow proper service access to the equipment.

17. Screw press shall not exceed 7,300 lb operational weight.

18. Contractor shall provide a 6” diameter drain line for the filtrate and connect it to the bottom drain connection of the screw press. Contractor shall provide a 4” diameter sludge line for sludge inlet and connect into screw press inlet connection.

19. Any couplings and other high speed rotating parts shall be provided with OSHA approved guards, unless otherwise enclosed by design (e.g., direct coupled).

20. All piping connections shall be either ANSI, class 150, standard raised face flanges or NPT threaded.

2.05 INTERNAL PIPING

A. Contractor shall provide sludge feed pipe from the existing sludge feed pump (with VFD) through a magnetic-inductive flow meter through a polymer mixing device.

B. The flocculation pipe will be designed per the Manufacturer’s required retention time. The flocculation pipe will be provided by the Contractor

2.06 DRIVES

A. The press screw shall be driven by a shaft mounted gearbox and motor assembly. The gearbox shall be bolted to a machined flange welded to the upper end of the press.

B. The gearbox shall be driven by a motor with the following characteristics:

1. 3.0 hp

2. VFD sized for 3-phase, 60 Hz, 240 V

3. 0-2100 rpm

4. Continuous Duty

5. Permanent magnet motor

6. 40°C environmental temperature

7. Insulation Class F

8. Motor efficiency class IE4

9. Non-hazardous environment

10. The gearbox shall have the following outputs:

11. 24,000 Nm output torque

12. 1.1 rpm output speed

13. Chain-drives, belt drives, hydraulic drives or a separate upper bearing for the transport screw will not be acceptable for this project.

2.07 AIR COMPRESSOR

A. Provide 2 air compressor as manufactured by **Speedaire, model #52YM09** or equivalent.

B. Air compressor shall use an induction type motor rated for 2.0 Hp, 120 V, 60 Hz, 15 Amps.

C. Shall have a NPT outlet of 1/4 in.

D. Air tank shall be a minimum 15 gallons with drain.

2.08 CONTROLS AND INSTRUMENTATION

A. The entire control system shall be provided by the Manufacturer of the screw press.

B. The Contractor shall provide wiring between all system components as require.

C. The Contractor shall provide separate power supplies as followed:

1. 240 V, 60 Hz, 3 phase power supply to the main control panel

2. 120 V, 60 Hz, single phase power supply to the air compressor.

D. The dewatering system shall be full-automatic and shall include the following:

1. Main control panel for screw press

2. Magnetic-inductive flow meter for thin sludge feed

3. Automatic control for the pneumatic pressure cone

E. A 240-V main control panel shall be provided in a NEMA 4X Stainless Steel Enclosure. The enclosure shall be suitable for wall mounting in climate controlled room, shall have hinged covers which swing horizontally and shall be held closed with 3-Point Latch , and shall include the following:

1. Main power disconnect switch (pad-lockable)

2. Control power transformer

3. Surge arrester

4. Door Mounted Operators:

    a. Press HOA

    b. Press FOR (Spring Return from Reverse to Off)

    c. Wash Water SOV HOA

    d. System Reset

    e. E-Stop

F. Door Mounted Status and Warning Lights for the following:

    a. Power on

    b. Dewatering system in operation

    c. System Disturbance

    d. Lights to be incandescent type, 30.5mm from Allen-Bradley or equal

G. For each screw press, a 5.0 hp Allen-Bradley PowerFlex 525 VFD, with Ethernet, shall be provided to control the screw press main drive.

H. For each screw press, a 0.25 hp reversing motor starter including over-current and over-heat protection for the wash water spray drive.

I. Programmable logic controller (PLC) Allen Bradley CompactLogix with on-board Ethernet.

J. Operator Interface Unit (OIU), Allen Bradley PanelView Series 7, 6” with color touch screen. The OIU shall have Ethernet and be protected with hinged window.

K. Unmanaged Ethernet switch, 5-Port Phoenix or equal

L. The OIU shall have the capability to work as a data logger. The data logger shall document all important process parameter but not limited to the following list:

    1. Operation mode: OFF, dewatering, back wash, shutdown

    2. Drive operation: forward, reverse

    3. Sludge flow (GPM)

    4. Screw Speed

    5. Polymer pacing signal

    6. Pressure screw press inlet

7. Press Motor amperage draw

8. Set points: feed solids, polymer consumption, solid loading

M. The OIU shall provide maintenance reminder alarms for mechanical components which require replacement over-time. The OIU shall have a maintenance summary screen that displays the remaining hours of runtime until each mechanical component is recommended to be replaced. The OIU should produce an alarm banner for the specific component that needs replacement once the system has operated for the amount of hours the equipment manufacturer recommends. The maintenance summary screen shall also include the option to reset the alarm banner once the component has been replaced. Manufacturers not providing this functionality shall provide service trips every two years for maintenance operations.

N. Text messages displayed on touch screen:

1. Over-current indications

2. Spray bar washing system on

3. Polymer dosing station status

4. Running time meter for screw press and spray drive

5. Door mounted nametags shall be provided for the name of the control panel and all disconnects, switches, lights, and meters.

O. Terminal connections for interfacing with remote systems, shall include the following:

1. Remote Polymer Injection System:

a. Inputs to Dewatering Control Panel:

1) 120VAC Rated, 2 amp Minimum

a) Polymer System In Remote

b) Polymer System Running

c) Polymer System Common Fault

2) Outputs from Dewatering Control Panel:

a) Dry 120VAC Rated, 2 amp Minimum

(a) Polymer System Call to Run

b) 4 – 20 mA Analog Output

(a) Polymer Pacing Signal

P. SCADA Status: The screw press will not be connected to SCADA at installation, but shall have the ability to connect into SCADA in the future.

2.09 ANCHORAGE AND SUPPORTS

A. ANCHOR BOLTS

1. All anchor bolts shall be made of type 316 stainless steel. Supplier shall furnish all anchor bolts, nuts, and washers required for the equipment installation. Anchor bolts shall be either adhesive epoxy type or expansion type.

B. SUPPORTS

1. Where shown on drawings, supports shall be provided by the installing Contractor to elevate screw press per the design drawings to permit feed into a belt press underneath the screw press.

C. FASTENERS

1. All fasteners shall be made of type 316 stainless steel. The equipment supplier shall furnish fasteners required for the assembly of the equipment.

2.10 PROTECTIVE COATING

A. Screw Press shall be coated according to the Manufacturer's standard system for the application as listed below for all steel parts. Stainless steel surfaces shall be unpainted and treated per ASTM A967.

1. Surface Preparation: Near white blast cleaning according to SSPC-SP10 for equipment. SSPC-SP8 for piping.

2. Primer: High built epoxy resin with 6 mil min dry thickness

3. Finish Coat: Polyurethane with 2 mils min per coat for two coats

2.11 SAFETY ITEMS

A. All equipment furnished shall be manufactured to comply with the most recent safety standards of the Federal Occupational Safety Health Act and all other applicable safety codes.

2.12 TESTING

A. FACTORY TESTING

1. All major system components shall be factory tested for proper function, and a certification of the results of these tests shall be submitted to the Engineer prior to shipment.

B. PERFORMANCE TESTING

1. Performance testing will occur at such time as the installation work is complete and available for operations.

2. During the performance testing, the Contractor, with the assistance of the Owner's trained personnel and the Manufacturer's representative, shall startup and operate the equipment; for the purpose of demonstrating conformance to the Guaranteed Performance Requirements specified herein in Section 2.03. Performance test shall be 6 hours in duration of continuous dewatering. The performance test shall be run to determine the actual system operating conditions and verify that the systems meet the Guaranteed Performance Requirements of this Specification.

3. In the case of unacceptable performance, the Manufacturer shall have 30 days in which to perform, at the Manufacturer's sole expense, all equipment modifications to meet the Guaranteed Performance Requirements and request a retest performance testing. If the modified equipment does not meet the Guaranteed Performance Requirements, the Manufacturer shall have 30 days in which to perform, at the Manufacturer's sole expense, all equipment modifications to meet the Guaranteed Performance Requirements. No more than 2 performance retests shall be performed.

4. The Owner will provide all sludge feed, water, electrical power, and sludge disposal necessary to conduct the performance testing, at no cost to the Contractor.

5. Owner shall provide polymer as recommended by the screw press manufacturer.

6. All laboratory tests for the performance testing shall be performed by the Owner in conformance with the applicable portions of the most recent edition of the Standard Methods.

7. The warranty period is defined in Section 1.05.

8. Any defects in the equipment or failure to meet requirements of the Specification shall be promptly corrected by the Manufacturer.

2.13 SPARE PARTS

A. The following spare parts shall be included and supplied with the equipment:

1. 1 set of wipers with mounting hardware

2. 1 bearing assembly for shaft

3. 1 solenoid valve, 110V for spray bar washing system

4. 10 nozzles for spray bar washing system

5. Any additional spare parts as recommended by the Manufacturer

B. Spare parts shall be packaged with labels including a description of the contents.

PART 3 -- EXECUTION

3.01 GENERAL

A. The equipment shall be manufactured and tested in accordance with the best applicable trade practices and in compliance with state, OSHA, and other governing code requirements.

B. The equipment shall be installed to provide a complete working system. Installation shall follow the Manufacturer's recommendations and as shown on the Drawings.

3.02 DELIVERY, STORAGE, AND HANDLING

A. All equipment shall be factory assembled, skid mounted, crated and delivered to protect against damage during shipment as practical to suit shipment and installation requirements.

B. Equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.

C. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected with factory applied corrosion inhibiting coating, CRC SP-400 or equal.

D. All equipment delivered to the site shall be stored as specified in accordance with the Manufacturer's instructions.

E. Contractor shall be responsible for unloading and shall have equipment on-site at the time of delivery permitting proper hoisting of the equipment.

3.03 INSTALLATION

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations.

C. After installation, touch-up paint shall be applied to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting. Contractor shall passivate all field welds.

3.04 MANUFACTURER'S REPRESENTATIVE

A. In addition to the performance testing requirements (Section 2.12(B)), the Contractor shall include the Manufacturer services of a factory-trained field engineer for the purposes of installation inspection, making field adjustments necessary to ensure proper system operation, equipment start-up, polymer selection, and training of plant personnel regarding proper operation and maintenance of the equipment.

B. The Contractor will provide a Manufacturer's representative (factory trained) for the equipment specified herein shall be present at the job site for the minimum days (8-hour day) listed for the services hereunder, travel time excluded.

1. 8 days, 2 trips for installation, inspection, certification and testing per screw press.

a. Equipment shall not be energized, or "bumped" to check the electrical connection for motor rotation without the service technician present.

b. The service technician shall make all necessary adjustments and settings to the controls.

c. The service technician shall demonstrate proper and sequential operation of the dewatering system. The dewatering system shall be able to operate fully automatically.

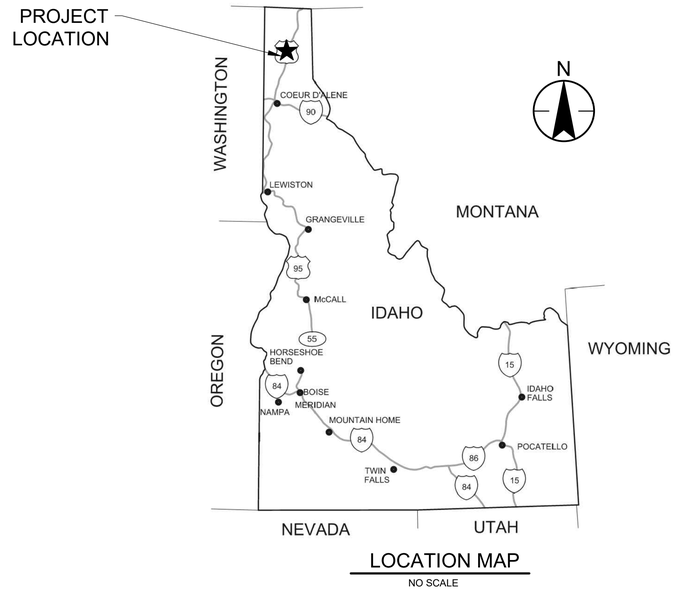
2. Training of the Owner's personnel shall be conducted during commissioning service interval noted above.

C. The Owner and Engineer shall be notified by the Contractor two weeks in advance of the Manufacturer's representative's scheduled visits on site. Cost of these services shall not be included in the pre-purchase agreement.

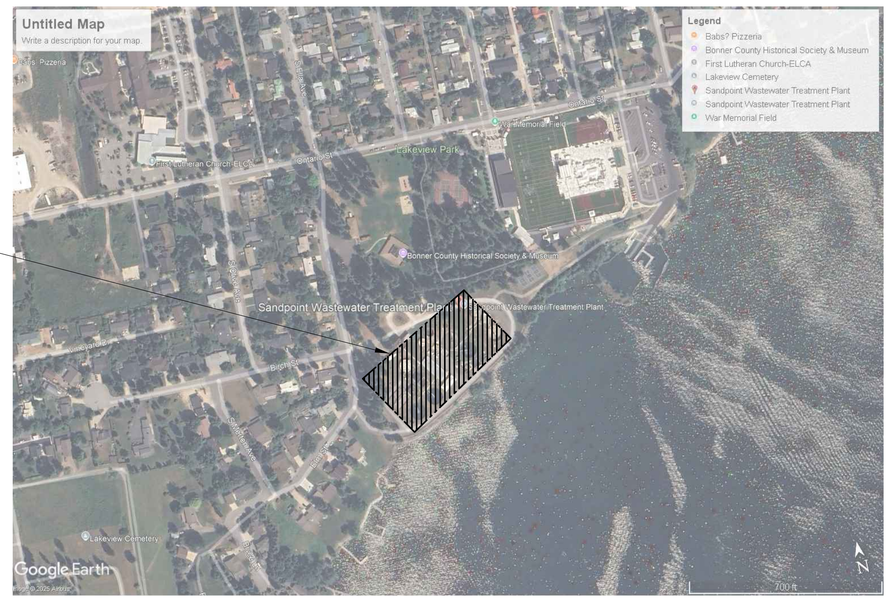
END OF SECTION

SANDPOINT, ID

SANDPOINT WWTP SCREW PRESS UPGRADE



LOCATION MAP
NO SCALE



PROJECT LOCATION

VICINITY MAP
NO SCALE

IFC SUBMITTAL
JANUARY 2026
PROJECT NUMBER: 2002003233

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Portland, Oregon, 97204
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Revision	By	Appd	YYYY.MM.DD
C IFC	DP	NS	2026.01.23
B 90% DESIGN REVIEW	DP	NS	2025.11.21
A 30% DESIGN REVIEW	DP	NS	2025.07.14

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED Danielle Philbrick 1171771 02/09/2025 STATE OF IDAHO DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: G-001

Scale: NO SCALE

GG	PD	2025.07.14
Dwn.	Dsgn.	Chkd. YYYY.MM.DD

Title
COVER, LOCATION, AND VICINITY MAPS

Revision:

Drawing No.
G-001

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ORIGINAL SHEET - ANSI D

PAGE NO	DRAWING NUMBER	SHEET TITLE
	GENERAL	
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2	G-002	DRAWING INDEX
3	G-003	COMMON SYMBOLS
4	G-004	COMMON ABBREVIATIONS
5	G-005	PIPE SCHEDULE
	INSTRUMENTATION	
6	GI-001	SYMBOLS AND ABBREVIATIONS - I
7	GI-001	SYMBOLS AND ABBREVIATIONS - II
8	GI-001	SYMBOLS AND ABBREVIATIONS - III
9	GI-001	SYMBOLS AND ABBREVIATIONS - IV
10	I-601	PROCESS & INSTRUMENTATION DIAGRAM - SCREW PRESS
	PROCESS MECHANICAL	
11	D-001	PROCESS MECHANICAL STANDARD DETAILS
12	DD101	DEMOLITION PLAN
13	DD301	DEMO SECTION AND VIEWS
14	D-101	SCREW PRESS PLAN
15	D-301	SCREW PRESS SECTIONS
	ELECTRICAL	
16	E-001	GENERAL NOTES, SYMBOLS, AND ABBREVIATIONS
17	E-601	SOLIDS HANDLING SINGLE LINE DIAGRAM
	HVAC	
18	H-001	GENERAL NOTES AND ABBREVIATIONS
19	H-002	HVAC DESIGN SUMMARY
20	H-003	STANDARD DETAILS - I
21	H-004	STANDARD DETAILS - II
22	H-005	STANDARD DETAILS - III
23	H-006	CONTROL SEQUENCE OF OPERATIONS
24	H-601	HVAC EQUIPMENT SCHEDULE
25	HD-101	LOWER LEVEL - HVAC DEMO PLAN
26	HD-102	UPPER LEVEL - HVAC DEMO PLAN
27	HD-103	ROOF PLAN - HVAC DEMO PLAN
28	H-101	LOWER FLOOR HVAC PLAN
29	H-102	UPPER FLOOR HVAC PLAN
30	H-103	HVAC ROOF PLAN
31	H-301	SECTION VIEWS - I
32	H-302	SECTION VIEWS - II
33	H-901	SOLIDS HANDLING BUILDING - 3D ISOMETRIC VIEW
	STRUCTURAL	
34	S-001	STRUCTURAL GENERAL NOTES AND DESIGN CRITERIA
35	S-002	STRUCTURAL STATEMENT OF SPECIAL INSPECTIONS - I
36	S-103	STRUCTRUAL FLOOR PLAN AND SECTIONS - I
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38	S-105	STRUCTURAL SECTIONS AND DETAILS
39	S-106	STRUCTURAL DETAILS - I
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41	S-108	STRUCTURAL DETAILS - III

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No.	By	Appd	YYYY.MM.DD

Revision

No.	By	Appd	YYYY.MM.DD
C	DP	NS	2026.01.23
B	DP	NS	2025.11.21
A	DP	NS	2025.07.14

Issued
A 30% DESIGN REVIEW
B 90% DESIGN REVIEW
C IFC

Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
Danielle Philbrick
1171771
02/09/2025
STATE OF IDAHO
DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: G-002

Scale:NO SCALE

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Title
DRAWING INDEX

Revision:

Drawing No.
G-002

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GENERAL SYMBOLOGY

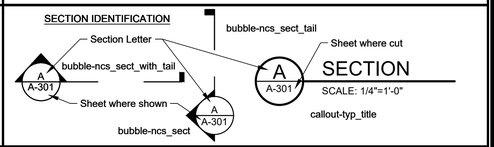
- NEW CONSTRUCTION
- EXISTING (SCREENED)
- FUTURE (PHANTOM)
- EXISTING TO BE REMOVED OR DEMOLISHED

MATERIAL SYMBOLOGY

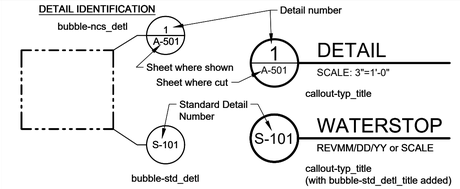
- CONCRETE (PLAN AND SECTION)
- GROUT OR SAND (PLAN AND SECTION)
- BRICK (PLAN AND SECTION)
- CMU (PLAN AND SECTION)
- STEEL/METAL/FRP (SMALL SCALE SECTION)
- CHECKER PLATE OR SOLID FRP GRATING (PLAN)
- CHECKER PLATE (SECTION)
- GRATING (PLAN)
- GRATING OR SOLID FRP GRATING (SECTION)
- SAFETY GRATING (PLAN)
- SAFETY GRATING (SECTION)
- RAILING (PLAN)
- WOOD (PLAN OR ELEVATION)
- LUMBER/ FRAMING - NOMINAL
- LUMBER - TRIMMED (BLOCKING OR SHIMS)
- OR — GLULAM (SECTION)
- GLULAM (ELEVATION)
- OR — PLYWOOD (SMALL SCALE)
- FINISHED GRADE
- GRAVEL/ DRAINROCK/ AGGREGATE BASE

REFERENCE SYMBOLS

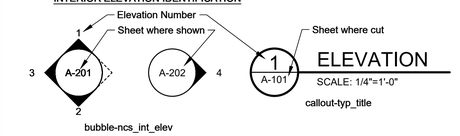
SECTION IDENTIFICATION



DETAIL IDENTIFICATION



INTERIOR ELEVATION IDENTIFICATION

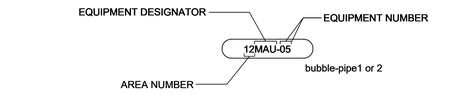


EXTERIOR ELEVATION IDENTIFICATION



EQUIPMENT IDENTIFICATION

SEE EQUIPMENT SCHEDULE/SPECIFICATIONS



PLEASE NOTE:

DISCIPLINE SPECIFIC SYMBOLS ARE SHOWN ON THE DISCIPLINE GENERAL DRAWINGS.

FOR WELDING SYMBOLS USE AMERICAN WELDING SOCIETY STANDARD SYMBOLS.

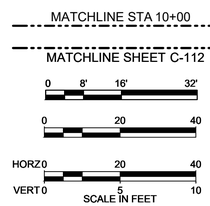


NORTH ARROW SYMBOLS



MISCELLANEOUS

- SHEET KEY SYMBOL
- 1 — REVISION TRIANGLE SYMBOL
- BREAK SYMBOL
- ANGLE SYMBOL
- ℄ — CENTERLINE SYMBOL



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No.	Revision	By	Appd	YYYY.MM.DD

No.	Issued	By	Appd	YYYY.MM.DD
A.	30% DESIGN REVIEW	DP	NS	2024.01.23
B.	90% DESIGN REVIEW	DP	NS	2025.11.21
C	IFC	DP	NS	2025.07.14

Permit/Seal



Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: G-003

Scale: NO SCALE

GG	PD		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
COMMON SYMBOLS

Revision:

Drawing No.
G-003

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ORIGINAL SHEET - ANSI D

A

A	AIR/ AMPERE
A/C	AIR CONDITIONING
A/R	AIR RELEASE
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY & TRANSPORTATION OFFICIALS
AB	ANCHOR BOLT
ABAN	ABANDON
ABND	ABANDONED
ABBR	ABBREVIATION
ABS	ABSOLUTE TEMPERATURE
AC	ACTIVATED CARBON/ ASPHALTIC CONC/ ALTERNATING CURRENT
ACI	AMERICAN CONCRETE INTERNATIONAL
ACOUS	ACOUSTIC/ ACOUSTICAL
ACP	ASBESTOS CEMENT PIPE/ ASPHALTIC CONCRETE PAVEMENT
ADD	ADDITIONAL
ADH	ADHESIVE
ADJ	ADJUSTABLE
AFF	ABOVE FINISHED FLOOR
AISC	AMERICAN INSTITUTE OF STEEL CONST
ALT	ALTERNATE
ALUM	ALUMINUM/ ALUM
AMB	AMBIENT
ANSI	AMERICAN NATIONAL STANDARDS INST
API	AMERICAN PETROLEUM INSTITUTE
APPD	APPROVED
APPROX	APPROXIMATE
APPURTS	APPURTENANCES
ARCH	ARCHITECTURE
ASME	AMERICAN SOCIETY OF MECHANICAL ENG
ASPH	ASPHALT
ASTM	AMERICAN SOCIETY FOR TEST & MATERIALS
AT	ACOUSTICAL TILE
ATM	ATMOSPHERE
AV/AR	AIR VACUUM AND AIR RELEASE VALVE
AVE	AVENUE
AWPA	AMERICAN WOOD PRESERVERS ASSOC
AWS	AMERICAN WELDING SOCIETY
AWWA	AMERICAN WATER WORKS ASSOCIATION

B

B&S	BELL AND SPIGOT
B/W	BACK OF WALL/ BACK OF WALK
BC	BEGIN CURVE/ BOLT CIRCLE/ BETWEEN CENTERS/ BACK OF CURVE
BCR	BEGIN CURB RETURN
BD	BOARD
BDRY	BOUNDARY
BF	BLIND FLANGE/ BOTTOM OF FOOTING
BFP	BACK FLOW PREVENTER
BFV	BUTTERFLY VALVE
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BLK	BLACK/ BLOCK
BLKG	BLOCKING
BLVD	BOULEVARD
BM	BEAM/ BENCH MARK
BO	BLOW-OFF ASSEMBLY
BOD	BIOCHEMICAL OXYGEN DEMAND
BOP	BOTTOM OF PIPE
BOT	BOTTOM
BPV	BACK PRESSURE VALVE
BRK	BRICK/ BREAK
BSMT	BASEMENT
BT	BOLT
BTU	BRITISH THERMAL UNIT
BV	BALL VALVE
BVC	BEGIN VERTICAL CURVE
BWV	BACK WATER VALVE

C

C	CENTIGRADE/ CHANNEL/ CEMENT
C&G	CURB AND GUTTER
CAB	CABINET/ CRUSHED AGGREGATE BASE
CAP	CAPACITY
CATS	CASING TEST STATION
CATV	CABLE TELEVISION
CB	CATCH BASIN/ CHALKBOARD/ CURB
CC	CLOSED CIRCUIT TV/ CENTER TO CENTER
CD	CEILING DIFFUSER
CEM	CEMENT
CF	CURB FACE/ CUBIC FOOT
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHEM	CHEMICAL
CHG	CHANGE
CHKD	CHECKERED
CI	CAST IRON
CIP	CAST IRON PIPE/ CAST IN PLACE
CIPP	CAST IN PLACE PIPE
CJ	CONSTRUCTION JOINT
CL	CENTERLINE
CL2	CHLORINE
CLF	CHAIN LINK FENCE
CLG	CEILING
CLOS	CLOSET
CLR	CLEAR/ CLEARANCE
CMB	CRUSHED MISCELLANEOUS BASE
CMC	CEMENT MORTAR-COATED
CML	CEMENT MORTAR-LINED
CML&C	CEMENT MORTAR-LINED AND COATED
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CO	CLEANOUT
COL	COLUMN
COMM	COMMUNICATIONS CABLE
COMP	COMPRESSOR
CONC	CONCRETE/ CONCENTRIC
COND	CONDENSER/ CONDENSATE
CONN	CONNECTION
CONST	CONSTRUCT/ CONSTRUCTION
CONT	CONTINUED/ CONTINUOUS
CONTR	CONTRACTOR
COORD	COORDINATE
COR	CORNER
COTG	CLEANOUT TO GRADE
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CAST STEEL
CSP	CORRUGATED STEEL PIPE
CSTS	CURRENT SPAN TEST STATION
CT	CERAMIC TILE
CTR	CENTER
CTS	CORROSION TEST STATION
CTSK	COUNTERSUNK
CU	COPPER/ CUBIC
CULV	CULVERT
CV	CHECK VALVE
CY	CUBIC YARD
CYL	CYLINDER

D

d	PENNY
DAD	DOUBLE ACTING DOOR
DAFT	DISSOLVED AIR FLOTATION THICKENER
DB	DIRECT BURY
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DET	DETAIL
DF	DRINKING FOUNTAIN/ DOUGLAS FIR
DG	DOOR GRILL
DH	DOUBLE HUNG
DI	DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL
DIAPH	DIAPHRAGM
DIFF	DIFFUSER/ DIFFERENTIAL
DIP	DUCTILE IRON PIPE
DIR	DIRECTION
DISCH	DISCHARGE
DISP	DISPENSER
DL	DEAD LOAD
DMH	DROP MANHOLE
DN	DOWN
DO	DISSOLVED OXYGEN/ DITTO
DR	DOOR/ DRAIN
DS	DRENCH SHOWER AND EYE WASH
DT	DRAIN TILE
DWG	DRAWING
DWLS	DOWELS
DWY	DRIVEWAY

E

E	EAST
E/O	EAST OF
EA	EACH
EB	EXPANSION BOLT OR ANCHOR
EC	END CURVE
ECC	ECCENTRIC
ECR	END CURB RETURN
EF	EACH FACE/ EXHAUST FAN
EFF	EFFLUENT
EG	EXIST GRADE/ EDGE OF GUTTER/ EXHAUST GRILLE
EGL	ENERGY GRADE LINE
EL	ELEVATION
ELEC	ELECTRICAL/ ELECTRONIC
EN	EDGE NAILING
ENCL	ENCLOSURE
ENG	ENGINE
ENGR	ENGINEER
ENT	ENTRANCE
EP	EDGE OF PAVEMENT
EPT	ETHYLENE PROPYLENE
EQ	EQUAL
EQUIP	EQUIPMENT
ESMT	EASEMENT
ETB	EMULSION TREATED BASE
ETC	ET CETERA
EVAP	EVAPORATOR
EVC	END VERTICAL CURVE
EW	EACH WAY/ EYE WASH
EX	EXISTING
EXC	EXCAVATION
EXH	EXHAUST
EX-HY	EXTRA HEAVY
EXIST	EXISTING
EXP	EXPANSION
EXT	EXTERIOR/ EXTENSION
EXTR	EXTRUDED

F

F	FAHRENHEIT/ FINISH
F TO F	FACE TO FACE
F&C	FRAME AND COVER
F&I	FURNISH AND INSTALL
FAB	FABRICATE/ FABRICATION/ FABRICATED
FAI	FRESH AIR INTAKE
FB	FLAT BAR/ FLOOR BEAM/ FIELD BOOK
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FDR	FEEDER
FE	FIRE EXTINGUISHER/ FINAL EFFLUENT
FEM	FEMALE (PIPE THREAD)
FF	FLAT FACE/ FAR FACE/ FINISHED FLOOR
FG	FINISHED GRADE
FH	FIRE HYDRANT/ FLAT HEAD
FIG	FIGURE
FIN	FINISHED
FIX	FIXTURE
FL	FLOWLINE/ FLOOR
FLEX	FLEXIBLE
FLG	FLANGE/ FLOORING
FLGD	FLANGED
FLOCC	FLOCCULATOR/ FLOCCULATION
FLR	FLOOR
FLSG	FLASHING
FM	FACTORY MUTUAL (LAB APPRVD)/ FORCE MAIN
FMH	FLEXIBLE METAL HOSE
FN	FIELD NAILING
FND	FOUNDATION
FOC	FACE OF CONCRETE/ FIBER OPTIC CABLE
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FOW	FACE OF WALL
FPC	FLEXIBLE PIPE COUPLING
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FPTS	FOREIGN PIPE TEST STATION
FR	FRAME
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FINISHED SURFACE/ FAR SIDE/ FLOOR SINK / FORGED STEEL
FT	FEET/ FOOT
FTG	FOOTING
FUR	FURRING
FUT	FUTURE
FV	FIELD VERIFY
FWD	FORWARD

G

G	GAS
GA	GAGE / GAUGE
GAL	GALLON
GALV	GALVANIZED
GANC	GUY ANCHOR
GB	GRADE BREAK
GEN	GENERAL / GENERATOR
GFA	GROOVED FLANGE ADAPTER
GI	GALVANIZED IRON
GIP	GALVANIZED IRON PIPE
GL	GLASS / GROUND LINE / GRADE LINE
GLB	GLUE LAMINATED BEAM / GLULAM
GLV	GLOBE VALVE
GM	GAS METER
GP	GUY POLE
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GR	GRADE
GRD	GRADE / GROUND
GRTG	GRATING
GSP	GALVANIZED STEEL PIPE
GV	GATE VALVE
GYP	GYPSUM

H

H	HIGH / HEIGHT
H&V	HEATING AND VENTILATING
H/B	HOSE BIBB
HC	HOUSE CONNECTION
HDR	HEADER
HDW	HARDWARE
HDWL	HEADWALL
HEX	HEXAGONAL
Hg	MERCURY
HGL	HYDRAULIC GRADE LINE
HGR	HANGER
HM	HOLLOW METAL
HORZ	HORIZONTAL
HP	HIGH POINT / HORSE POWER / HIGH PRESSURE
HPG	HIGH PRESSURE GAS
HR	HEAT RETURN / HOUR
HSL	HORIZONTALLY SLOTTED
HSS	HOLLOW STRUCTURAL SECTION
HTG	HEATING
HTR	HEATER
HV	HORIZONTAL AND VERTICAL CONTROL POINT
HVAC	HEATING, VENTILATION AND AIR CONDITIONING
HW	HOT WATER / HEADWORK
HWD	HARDWOOD
HWL	HIGH WATER LEVEL
HWO	HANDWHEEL OPERATED
HYD	HYDRAULIC / HYDRANT

I

I/O	INPUT/OUTPUT
I&O	INSIDE AND OUTSIDE
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IF	INSIDE FACE
IJTS	INSULATING JOINT TEST STATION
IN	INCH
INCL	INCLUDE / INCLUDING
INFL	INFLUENT
INSL	INSULATION / INSULATING / INSULATED
INSP	INSPECTION
INST	INSTRUMENT
INT	INTERIOR
INV	INVERT
IP	IRON PIPE
IPS	IRON PIPE SIZE
IRRG	IRRIGATION

J

JAN	JANITOR
JC	JUNCTION CHAMBER
JCT	JUNCTION
JS	JUNCTION STRUCTURE
JSTS	JOISTS
JT	JOINT

K

k	KILO
K	KELVIN/ KARAT
kg	KILOGRAM
km	KILOMETER
kV	KILOVOLT
KVA	KILOVOLT AMPERE
kW	KILOWATT
kWh	KILOWATT HOUR

L

L	LITER/ LENGTH/ ANGLE
LAB	LABORATORY
LAM	LAMINATED
LAT	LATERAL
LAV	LAVATORY
LB	POUND
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LD	LOCAL DEPRESSION
LDG	LANDING
LEV	LEVEL
LF	LINEAR FOOT
LG	LENGTH/ LONG
LH	LAMP HOLE/ LEFT HAND
LL	LIVE LOAD
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LOC	LOCATION
LOL	LAYOUT LINE
LONG	LONGITUDINAL
LP	LOW POINT/ LOW PRESSURE/ LAMP POST
LPG	LIQUID PETROLEUM GAS
LT	LEFT/ LIGHT
LTS	LIME TREATED SOIL
LW	LOW WATER
LWL	LOW WATER LEVEL
LWR	LOWER

M

m	METER
M	MALE (PIPE THREAD)
mA	MILLIAMPS
MACH	MACHINE
MAG	MAGNETIC
MAINT	MAINTENANCE
MAN	MANUAL
MAS	MASONRY
MAT	MATERIAL
MAX	MAXIMUM
MB	MAIL BOX/ MACHINE BOLT
MCC	MOTOR CONTROL CENTER
MCR	MIDDLE OF CURB RETURN
MEAS	MEASURE
MECH	MECHANICAL
MED	MEDIUM
MEMB	MEMBER
MFR	MANUFACTURER
MFRD	MANUFACTURED
MGD	MILLION GALLONS PER DAY
MH	MANHOLE/ MAINTENANCE HOLE
MHT	MEAN HIGH TIDE
MHW	MEAN HIGH WATER
MI	MALLEABLE IRON/ MILE
MICRON	1/1,000,000 METER
MIL	MILITARY/ 1/1,000TH INCH
MIN	MINIMUM/ MINUTE
MIR	MIRROR
MISC	MISCELLANEOUS
MK	MARK
MLW	MEAN LOW WATER
mm	MILLIMETER
MO	MOTOR OPERATED/ MASONRY OPENING
MOD	MODEL
MON	MONUMENT
MOR	MORTAR
MS	MOP SINK
MSL	MEAN SEA LEVEL
MTC	MECHANICAL-TYPE COUPLING
MTD	MOUNTED
MTG	MOUNTING
MTL	METAL
MTR	MOTOR

N

N	NORTH
NaOCl	SODIUM HYPOCHLORITE
NaOH	SODIUM HYDROXIDE (CAUSTIC SODA)
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NF	NEAR FACE
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NG	NATURAL GRADE/ NATURAL GAS
NIC	NOT IN CONTRACT
NO	NUMBER/ NORMALLY OPEN
NOM	NOMINAL
NPS	NOMINAL PIPE SIZE
NPT	NATIONAL PIPE THREAD
NRCP	NON-REINFORCED CONCRETE PIPE
NRS	NON-RISING STEM
NS	NEAR SIDE
NTS	NOT TO SCALE

O

OBJ	OBJECT
OC	ON CENTER/ OVER-CROSSING
OD	OUTSIDE DIAMETER/ OVERALL DIMENSION
OE	OUTER EDGE
OF	OVERFLOW/ OUTSIDE FACE
OFD	OVERFLOW DRAIN
OFF	OFFICE
OH	OVER HEAD
OHW	OVERHEAD WIRES
OPER	OPERATOR/ OPERATING
OPNG	OPENING
OPP	OPPOSITE
ORIG	ORIGINAL
OS&Y	OUTSIDE SCREW AND YOKE
OSA	OUTSIDE AIR
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
OWG	OIL, WATER, GAS
OZ	OUNCE

P

P	POLE/ PAGE/ PIPE
P/S	POLE AND SHELF
PA	PLANTING AREA
PART	PARTITION
PAVMT	PAVEMENT
PB	POLYBUTYLENE/ PULL BOX
PC	POINT OF CURVATURE/ PRIMARY CLARIFIER/ PORTLAND CEMENT
PCC	PORTLAND CEMENT CONCRETE/ POINT OF COMPOUND CURVE
PCOTG	PRESSURE CLEANOUT TO GRADE
PCVC	POINT OF COMPOUND VERTICAL CURVE
PE	PLANT EFFLUENT/ POLYETHYLENE/ POLYELECTROLYTE POLYMER
PG	PRESSURE GAGE
pH	RECIPROCAL LOG OF HYDROGEN ION CONCENTRATION
PI	PLANT INFLUENT/ POINT OF INTERSECTION
PK	PARKING
PL	PLATE/ PROPERTY LINE/ PLACE
PLAS	PLASTER/ PLASTIC
PLT	PLANT
PLWD	PLYWOOD
PM	PRESSED METAL

P CONT'D

PNEU	PNEUMATIC
PNL	PANEL
POB	POINT OF BEGINNING
POC	POINT OF CONNECTION
POT	POINT OF TANGENT
PP	POWER POLE/ POLYPROPYLENE
PPD	POUNDS PER DAY
PPH	POUNDS PER HOUR
PPM	POUNDS PER MINUTE
PR	PAIR
PRC	POINT OF REVERSE CURVE
PRCT	PRECAST
PREFAB	PREFABRICATED
PRESS	PRESSURE
PROF	PROFILE
PRV	PRESSURE REGULATING, RELIEF OR REDUCING VALVE
PRVC	POINT OF REVERSE VERTICAL CURVE
PS	PRESSURE SWITCH
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
PT	POINT OF TANGENCY/ PAINT/ PRESSURE
PTFE	POLYTETRAFLUOROETHYLENE (TEFLON)
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE
PVDF	POLYVINYLIDENE FLUORIDE (KYNAR)
PW	POTABLE WATER

Q

QT	QUARRY TILE
QTY	QUANTITY
QUAD	QUADRANGLE/ QUADRANT

R

R	RADIUS/ RISER / RATE OF SLOPE
R&O	ROCK AND OIL
R/W	RIGHT OF WAY
RAC	RECYCLED ASPHALT CONCRETE
RAG	RETURN AIR GRILLE
RAP	RECLAIMED ASPHALT PAVEMENT
RAS	RETURN ACTIVATED SLUDGE
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD/ ROOF DRAIN/ ROUND
RED	REDUCER/ REDUCING
REF	REFERENCE/ REFER/ REFRIGERATOR
REG	REGULATING
REINF	REINFORCE/ REINFORCED
REQD	REQUIRED
RESIL	RESILIENT
RET	RETAINING/ RETURN
REV	REVISION
REW	RECLAIMED WATER
RF	ROOF/ RAISED FOUNDATION/ ROUGH FACE
RFG	ROOFING
RGE	REGISTERED GEOTECHNICAL ENGINEER
RH	REDHEAD / RIGHT HAND
RM	ROOM
RO	ROUGH OPENING
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RS	RISING STEM
RSL	RAW SLUDGE
RT	RIGHT
RTP	REINFORCED THERMOSETTING PLASTIC
RTU	REMOTE TERMINAL UNIT
RW	REDWOOD
RWL	RAINWATER LEADER

S

S	SOUTH/SCUM/SINK/SECOND/SLOPE
S/O	SOUTH OF
SAM	SAMPLE
SAN	SANITARY
SBR	STYRENE BUTADIENE (RUBBER)
SC	SECONDARY CLARIFIER
SCCP	STEEL CYLINDER CONCRETE PIPE
SCD	SCREWED
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SD	SANITARY DRAIN/ SMOKE DETECTOR
SDR	STANDARD THERMOPLASTIC PIPE DIMENSION RATIO/STORM DRAIN
SEC	SECONDARY/ SECTION
SER	SERIES
SETT	SETTING
SF	SQUARE FOOT
SH	SHOWER
SHELV	SHELVING
SHT	SHEET
SHTG	SHEATHING
SIM	SIMILAR
SL	SLUDGE
SLDG	SLIDING
SLG	SLUICE GATE
SOG	SLAB ON GRADE
SOLN	SOLUTION
SP	STATIC PRESSURE/ SPARE CHEMICAL
SPEC	SPECIFICATION
SPK	SPIKE
SQ	SQUARE
SS	STAINLESS STEEL/ SANITARY SEWER/ SERVICE SINK
SSB	SELECT SUB-BASE
SSPWC	STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION
SSU	SECONDS SAYBOLT UNIVERSAL
ST	STREET/ STATE
STA	STATION
STC	SLEEVE-TYPE COUPLING
STD	STANDARD
STK	STAKE
STL	STEEL
STM	STEAM
STR	STRAIGHT/ STRUCTURAL
SU	STEAM LINE
SUCT	SUCTION
SV	SOLENOID VALVE
SW	SIDEWALK
SWD	SIDEWALK DRAIN
SWGR	SWITCHGEAR
SWR	SIDEWALL REGISTER
SY	SQUARE YARD
SYM	SYMMETRICAL/ SYMBOL
SYS	SYSTEM

T

T	THERMOSTAT/ TREAD OF STAIR/ TANGENT
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TAN	TANGENT
TB	TACK BOARD
TBE	THREAD BOTH ENDS
TBM	TEMPORARY BENCH MARK
TC	TOP OF CURB
TCV	TEMPERATURE CONTROL VALVE
TEL	TELEPHONE
TEMP	TEMPERATURE/ TEMPORARY
TF	TOP OF FOOTING
TH	TEST HOLE
THK	THICK/ THICKNESS
THR	THRESHOLD
THR'D	THREADED
TK	TANK/ TACK
TL	TRAVERSE LINE
TOC	TOP OF CONCRETE
TOE	THREAD ONE END
TOL	TOILET
TOM	TOP OF MASONRY
TOP	TOP OF PIPE
TOPO	TOPOGRAPHIC
TOS	TOP OF STEEL
TOW	TOP OF WALL
TP	TELEPHONE POLE
TR	TREAT
TRANS	TRANSMITTER/ TRANSITION /TRANSMISSION
TS	TRAFFIC SIGNAL
TSB	TOP SET BASE
TSC	TRAFFIC SIGNAL CONDUIT
TV	THERMOSTATIC VALVE/ TELEVISION
TW	THERMOMETER WELL /TRAVELED WAY
TYP	TYPICAL

U

UB	UNION BONNET
UBC	UNIFORM BUILDING CODE
UC	UNDER-CROSSING
UG	UNDERGROUND
UGC	UNDERGROUND CONDUIT
UH	UNIT HEATER
UL	UNDERWRITERS LABORATORIES
UNID	UNIDENTIFIED
UNO	UNLESS NOTED OTHERWISE
UOI	UNLESS OTHERWISE INDICATED
UPS	UNINTERRUPTABLE POWER SUPPLY
UR	URINAL
USA	UNDERGROUND SERVICE ALERT
USGS	UNITED STATES GEOLOGICAL SURVEY
UV	ULTRAVIOLET
UW	UTILITY WATER

V

V	VALVE/ VERTICAL/ VENT/ VOLT/ VOLUME
VAC	VACUUM
VAR	VARIES/ VARIABLE
VB	VALVE BOX
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
VOL	VOLUME
VPI	VERTICAL POINT OF INTERSECTION
VSL	VERTICALLY SLOTTED
VTC	VENT TO CEILING
VTR	VENT THROUGH ROOF
VWC	VINYL WALL COVERING
VWM	VERIFY WITH MANUFACTURE

W

W	WEST/ WASTE/ WIDTH/ WIDE FLANGE/ WATER
W/	WITH
W/O	WEST OF / WITHOUT
WC	WATER COLUMN / WATER CLOSET
WCO	WALL CLEANOUT
WD	WOOD
WDW	WINDOW
WH	WATER HEATER
WI	WROUGHT IRON
WM	WATER METER
WOG	WATER, OIL, OR GAS
WP	WATERPROOFING/ WORKING PRESSURE/ WORK POINT
WPJ	WEAKEN PLANE JOINT
WS	WATER SURFACE
WSTP	WATERSTOP
WT	WEIGHT
WWF	WELDED WIRE FABRIC
WWP	WATER WORKING PRESSURE

X

XCONN	CROSS CONNECTION
XS	EXTRA STRONG
XSEC	CROSS SECTION
XXS	DOUBLE EXTRA STRONG

Y

YD	YARD
YR	YEAR

Z

Z	ZERO/ ZONE
ZN	ZINC
#	POUND
&	AND
@	AT

FOR ADDITIONAL ABBREVIATIONS SEE:

GENERAL: PIPING SCHEDULES (MATERIAL AND FLUID)
CIVIL: GENERAL CIVIL SHEET
INSTRUMENTATION: GENERAL I&C SHEETS
BUILDING MECHANICAL: GENERAL HVAC, PLUMBING AND FIRE PROTECTION SHEETS
ELECTRICAL: GENERAL ELECTRICAL SHEETS

OTHER ABBREVIATIONS CONFORM TO ANSI STANDARD ABBREVIATIONS Z32.2.3

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Permit/Seal

PROFESSIONAL ENGINEER LICENSED Danielle Philbrick 11771 02/09/2025 STATE OF IDAHO DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: G-004

Scale:NO SCALE

GG	PD		2025.07.14
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Title
COMMON ABBREVIATIONS

Revision:

Drawing No.
G-004

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ORIGINAL SHEET - ANSI D

FLUID ABBREVIATION	FUNCTION THIS LIST INCLUDES SOME LINES NOT USED IN THIS PROJECT Ⓓ	PIPING MATERIALS (SEE GENERAL NOTES AT THE RIGHT AND PIPE MATERIAL SHEET)				FIELD TEST REQUIREMENTS ⒷⒸ		
		EXPOSED PIPING Ⓕ		BURIED PIPING Ⓔ		MINIMUM TEST PRESSURE (PSI)	TEST MEDIUM	LEAKAGE ALLOWANCE Ⓐ
		4" DIA AND SMALLER	6" DIA AND LARGER	4" DIA AND SMALLER	6" DIA AND LARGER			
DSL	DIGESTED SLUDGE	--	DI03	--	DI03	50	WATER	(A)
PA	PLANT AIR	CU01,AL01	--	CU01,AL01	--	300	AIR	(A)(D)
PEC	CATIONIC POLYMER	SS01, PE01, PV02	SS01, PE01, PV02	SS01, PE01, PV02	SS01, PE01, PV02	125	WATER	(A)
NPW	UTILITY WATER (NON-POTABLE WATER)	CS02, DI01, SS01, SS02, PV01, CU01	CS02, CS08, DI01, SS01, SS02, PV01	CS02, DI01, SS01, SS02, PV01, CU01	CS02,CS08,DI01, PV03, PV04	125	WATER	CS02,DI01,CU01(A) PV03,PV04(B)
WW	WASH WATER	--	PV01	--	PV01	125	WATER	(A)

PIPING MATERIAL SCHEDULE Ⓗ

GROUP NO	PIPE Ⓙ	FITTINGS	VALVES, 6" AND SMALLER ⒼⒾ
AL01	RIGID ALUMINUM - PARKER HANNIFIN TRANSAIR BLUE PIPE.	PARKER HANNIFIN TRANSAIR PIPE CONNECTORS.	PARKER HANNIFIN TRANSAIR PIPE CONNECTORS.
CS02	STEEL, ASTM A53, SCH 40, WELDED, GALVANIZED.	2 1/2" AND SMALLER, MALLEABLE IRON, ASME B16.3, THREADED, BANDED, GALVANIZED 150 PSI. 3" AND LARGER, CAST IRON, ASME B16.1, 125 PSI FLANGED OR MECHANICAL COUPLING.	2 1/2" AND SMALLER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED: DEZURIK PEC, CAST IRON, OR MILLIKEN 603E. BALL: JAMESBURY FIG 351 OR WATTS #B-6080. 3" AND LARGER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED: DEZURIK PEC, CAST IRON, OR MILLIKEN 601. GATE: AWWA C500. BUTTERFLY: AWWA, FLANGED.
CS08	WELDED STEEL, AWWA C200, LINED.	WELDED STEEL, AWWA C208, LINED, FABRICATED.	AS INDICATED ON DRAWINGS.
CU01	COPPER, ASTM B88, TYPE K, SOFT TEMPERED WHERE BURIED, HARD TEMPERED WHERE EXPOSED.	WROUGHT COPPER OR CAST BRONZE, ASME B16.22, SILVER SOLDER JOINT, 150 PSI, OR COMPRESSION FITTINGS.	BRONZE, SILVER SOLDER JOINT, GLOBE: CRANE #1310 OR STOCKHAM B-14T. CHECK: CRANE #1342 OR 36, OR STOCKHAM B-309Y OR B-345. GATE: CRANE #426 OR STOCKHAM B-104 OR B-105.
DI01	DUCTILE IRON, ANSI A21.51, (AWWA C151), ENDS BELL AND SPIGOT, MECHANICAL JOINTS OR 125 PSI FLANGED. (TYPICAL SERVICE - WATER LINES).	DUCTILE IRON AWWA C110, BELL AND SPIGOT JOINTS (RESTRAINED OR NON-RESTRAINED), MECHANICAL COUPLINGS, ASME B16.1 FLANGES, OR MECHANICAL JOINTS.	GATE: AWWA C500, O-RING SEALS, MECHANICAL JOINT ENDS, CLOW F-5065. BUTTERFLY: AWWA. ECC PLUG DEZURIK PEC, CAST IRON OR MILLIKEN 603E. BALL: PRATT OR APCO-WILLAMETTE.
DI03	DUCTILE IRON, ANSI A21.51, (AWWA C151), ENDS BELL AND SPIGOT, MECHANICAL JOINTS OR 125 PSI FLANGED, GLASS-LINED OR STEEL ASTM A53, SCH 40, GLASS-LINED. (TYPICAL SERVICE - PRIMARY DIGESTED SLUDGES AND SCUM).	DUCTILE IRON AWWA C110, BELL AND SPIGOT JOINTS (RESTRAINED OR NON-RESTRAINED), MECHANICAL COUPLING, ASME B16.1 FLANGES, OR MECHANICAL JOINTS, GLASS-LINED OR STEEL, ASME B16.9, SCH 40, GROOVED WITH MECHANICAL COUPLING, GLASS-LINED.	ECCENTRIC PLUG, SYNTHETIC RUBBER FACED: DEZURIK PEC, CAST IRON OR MILLIKEN 601. SWING TYPE CHECK: CRANE #383 OR POWELL FIG 559. BALL: PRATT OR APCO-WILLAMETTE.
PE01	POLYETHYLENE PIPE, ASTM D3350, SDR AS SPECIFIED.	THERMAL BUTT-FUSED FLANGE CONNECTIONS AT ALL VALVES AND TRANSITIONS.	AS INDICATED ON DRAWINGS.
PV01	POLYVINYL CHLORIDE (PVC), ASTM D1785, SCH 80, TYPE I.	PVC, SCH 80, TYPE I, SOCKET SOLVENT WELD JOINTS, ASTM D2467. SOLVENT SHALL BE COMPATIBLE WITH FLUID SERVICE.	PVC, BALL, DIAPHRAGM, BUTTERFLY, OR LIFT CHECK: NIBCO/CHEMTROL, MCCANNA-MARPAC, OR GEORGE FISCHER SLOANE.
PV02	CHLORINATED POLYVINYL CHLORIDE (CPVC), ASTM D1784, CLASS 23447-B, SCH 80.	CPVC, SCH 80, SOCKET AND SOLVENT WELD JOINTS, SOLVENT SHALL BE COMPATIBLE WITH FLUID SERVICE.	CPVC, BALL, DIAPHRAGM, BUTTERFLY, OR LIFT CHECK: NIBCO/ CHEMTROL, MCCANNA-MARPAC, OR GEORGE FISCHER SLOANE.
SS01	STAINLESS STEEL, TYPE 316L, ASTM A312, SCH 40S.	STAINLESS STEEL, TYPE 316L, THREADED, WELDED SLIP-ON FLANGE ASME B16.3, OR SOCKET WELDED FITTINGS SCH 40S.	STAINLESS STEEL, TYPE 316, BALL, FLANGED: CONTROMATICS SERIES 2801 OR JAMESBURY SERIES 7150. CHECK: LADISH 5275 OR CRANE FIG 377 OR AS SHOWN ON DRAWINGS.
SS02	STAINLESS STEEL, TYPE 316L, ASTM A312, SCH 10S.	STAINLESS STEEL, TYPE 316L, WELDED SLIP-ON FLANGE, ASME B16.3, OR SOCKET WELDED FITTINGS, SCH 10S.	STAINLESS STEEL, TYPE 316, AS INDICATED ON DRAWINGS.

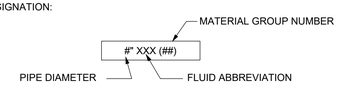
GENERAL SHEET NOTES

1. ALTHOUGH SEVERAL PIPE MATERIAL GROUPS MAY BE LISTED ON THIS SHEET FOR A GIVEN FLUID SERVICE, CONTRACTOR SHALL PROVIDE ONLY THE PIPE MATERIAL GROUP SHOWN ON THE DRAWINGS AND SPECIFIED FOR THAT FLUID SERVICE.
2. CHANGE IN PIPING MATERIAL GROUP NUMBER IS INDICATED THUS: ——◆
3. PROVIDE DOUBLE CONTAINMENT FOR ALL CHEMICAL PIPING PER CODE REQUIREMENTS.
4. FOR SHEET KEY NOTES, SEE SHEET X-XX.

LIST OF SAMPLE LINES

PIPE DESIGNATION	SAMPLE POINT

TYPICAL PIPE DESIGNATION:



SHEET KEYNOTES

A. LEAKAGE ALLOWANCE IS AS FOLLOWS:
   (A) PIPES SO DESIGNATED SHALL SHOW ZERO LEAKAGE.
   (B) PIPES SO DESIGNATED SHALL SHOW ZERO LEAKAGE FOR UNBURIED PIPE AND NOT MORE THAN 0.02 GALLON PER HOUR PER INCH DIAMETER PER 100 FEET OF BURIED PIPE.
   (C) PIPES SO DESIGNATED SHALL NOT SHOW A LEAKAGE OF MORE THAN 0.15 GALLON PER HOUR PER INCH OF DIAMETER PER 100 FEET OF PIPE.
   (D) PIPES SO DESIGNATED SHALL NOT SHOW A LOSS OF PRESSURE OF MORE THAN 5 PERCENT.
   (E) PIPE SO DESIGNATED SHALL NOT SHOW A LOSS OF VACUUM OF MORE THAN 4 INCHES MERCURY COLUMN.

B. FOR FIELD TEST PROCEDURES AND ADDITIONAL TEST REQUIREMENTS, SEE PIPING SECTION OF SPECIFICATIONS.

C. NO SUBSTITUTIONS UNLESS ACCEPTED BY THE ENGINEER PER THE SPECIFICATIONS.

D. PIPING GROUP NUMBER SHOWN THUS * SHALL BE INSULATED. SEE PIPING SECTION OF SPECIFICATIONS FOR INSULATING MATERIALS.

E. FOR PIPE LINING AND COATING, SEE SPECIFICATIONS.

F. EXPOSED PIPING SHALL BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS. COLORS TO BE SELECTED BY ENGINEER.

G. PROPRIETARY NAMES HAVE BEEN QUOTED FOR IDENTIFICATION PURPOSES ONLY. SUBSTITUTIONS WILL BE PERMITTED SUBJECT TO PROVISIONS OF THE SPECIFICATIONS.

SHEET KEYNOTES

H. NO SUBSTITUTIONS UNLESS ACCEPTED BY THE ENGINEER PER THE SPECIFICATIONS.

I. FOR VALVES 8" AND LARGER, SEE VALVE SCHEDULE. FOR SPECIAL VALVES, SEE SPECIFICATIONS. FOR PIPE LINING AND COATING, SEE SPECIFICATIONS.

J. PIPE MATERIALS SHALL BE PER THE REFERENCE STANDARDS AS MODIFIED BY THE CONTRACT SPECIFICATIONS. FOR PIPE LINING AND COATING, SEE SPECIFICATIONS.

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B	90% DESIGN REVIEW	DP	NS	2025.11.21
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Issued

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PROFESSIONAL ENGINEER LICENSED Danielle Philbrick 1171771 02/09/2025 STATE OF IDAHO DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: G-005

Scale: NO SCALE

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Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PIPE SCHEDULE

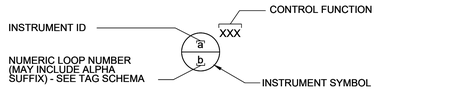
Revision:

Drawing No.
G-005

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ORIGINAL SHEET - ANSI D

INSTRUMENTATION CALL - OUT



INSTRUMENT SYMBOLS

- FIELD MOUNTED INSTRUMENT
- FIELD MOUNTED SHARED DISPLAY/CONTROL
- FRONT OF PANEL INSTRUMENT
- CONTROL SYSTEM SHARED DISPLAY/CONTROL (ACCESSIBLE VIA OI / HMI)
- INSTRUMENT MOUNTED WITHIN PANEL
- CONTROL SYSTEM SHARED DISPLAY/CONTROL (ACCESSIBLE FROM WITHIN PANEL)
- SINGLE INSTRUMENT WITH MULTIPLE FUNCTIONS
- RELAY INTERLOCK LOGIC
- GENERIC SOFTWARE INTERLOCK / CONTROL LOGIC (NORMALLY ACCESSIBLE TO OPERATOR) *
- GENERIC SOFTWARE INTERLOCK / CONTROL LOGIC (OPERATOR INACCESSIBLE) *
- DATA ROUTING ARROW
- CONTROL RELAY
- ON-PAGE LOGIC LINK REFERENCE
- LIGHTNING SURGE ARRESTOR
- a — INSTRUMENT IDENTIFICATION / TAG NUMBER (SEE MODIFIED ISA TABLE FOR MORE INFO)
- b — INSTRUMENT LOOP NUMBER
- XXX — CONTROL FUNCTION
- XXXV — PRIMARY ELECTRICAL POWER (e.g. 24VDC, 120VAC, 220VAC, 480VAC)

NOTE: IF INSTRUMENT POWER NOT INDICATED, REFER TO INSTRUMENT SCHEDULE FOR CONFIRMATION.

* REFER TO SPEC SECTION 409300 (PROJECT CONTROL PHILOSOPHY) FOR DETAILS.

PLC / REMOTE I/O POINTS

ANALOG INPUT · DISCRETE INPUT · DATA SIGNAL ANALOG INPUT · DATA SIGNAL DISCRETE INPUT

ANALOG OUTPUT · DISCRETE OUTPUT · DATA SIGNAL ANALOG OUTPUT · DATA SIGNAL DISCRET OUTPUT

* FIELD NETWORK INTERFACE. SEE SPECIFICATION FOR MORE INFORMATION

COMPUTING OR CONVERTING FUNCTIONS

COMPUTING

SUMMING	DERIVATIVE	EXPONENTIAL	
MULTIPLYING	AVERAGING	BIAS	
DIVIDING	RATIO	HIGH LIMITING	
SQ ROOT EXTRACTION	DIFFERENCE	LOW LIMITING	
PROPORTIONAL	HIGH SELECTING	LINEARIZER	
INTEGRAL	LOW SELECTING		

CONVERTING

E	VOLTAGE
I	CURRENT
P	PNEUMATIC
R	RESISTANCE (ELECT)
D	DIGITAL
A	ANALOG
B	BINARY
H	HYDRAULIC

CONTROL FUNCTION DESIGNATIONS

AHC	AUTO / HOLD / CLOSE	OLH	OFF / LOW / HIGH
AM	AUTO / MANUAL	O/O	ON / OFF
AS	AIR SUPPLY	O/R	OVERRIDE
BEAR	BEARING	OOR	OUT OF RANGE
CLSD	CLOSED	OSC	OPEN / STOP / CLOSE
CV	CONTROL VARIABLE	PID	PROPORTIONAL / INTEGRAL / DERIVATIVE
DEV	DEVIATION	POT	POTENTIOMETER
E-STOP	EMERGENCY STOP	PV	PROCESS VARIABLE
ETM	ELAPSED TIME METER	RDY	READY
FOR	FORWARD /OFF /REVERSE	R/L	RAISE / LOWER
HML	HIGH / MID / LOW	RSL	RAISE / STOP / LOWER
HOA	HAND / OFF / AUTO	RST	RESET
HOR	HAND / OFF / REMOTE	RTD	RESISTANCE TEMPERATURE DETECTOR
LEAK	MOISTURE INTRUSION	SD	SHUTDOWN
LOR	LOCAL / OFF / REMOTE	SEL	SELECT
L/R	LOCAL / REMOTE	SP	SET POINT
LSR	LOCAL / STOP / REMOTE	S/R	START / RESET
MOA	MANUAL / OFF / AUTO	S/S	START / STOP
MN	MAINTENANCE / NORMAL	STR	START
O/C	OPEN / CLOSE	STP	STOP
OCA	OPEN / CLOSE / AUTO	TMR	TIMER
OL	OVERLOAD	WIND	WINDING

NOTE:

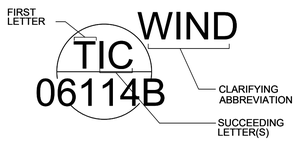
1. REFER TO DRAWING GI-2 FOR ANALYTICAL INSTRUMENT DESIGNATIONS.

ISA TABLE (MODIFIED)

	FIRST LETTER		SUCCEEDING LETTER(S)		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION				
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			FORWARD
G			GAUGE, GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		ISOLATE	ISOLATOR	
O			ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		REVERSE
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	INTRUSION	X AXIS			
Y	EVENT, STATE, OR PRESENCE	Y AXIS		COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, FINAL CONTROL ELEMENT	

TAG SCHEMA

TYPICAL INSTRUMENT & CONTROL VALVE TAGGING

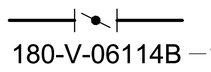


TYPICAL EQUIPMENT TAG FORMAT



180-P-06114B

TYPICAL VALVE TAG / SPEC FORMAT



TYPICAL INSTRUMENT & CONTROL VALVE TAGGING

6640-180-TIC-06114B - - INSTRUMENT SCHEDULE (FULL TAG)
TIC-06114B - - P&ID (PARTIAL TAG)
6640 — — — — — — — — — PLANT ID
180 — — — — — — — — PROCESS AREA
TIC — — — — — INSTRUMENT / VALVE ID
06114 — — TAG NUMBER
B - - SUFFIX

NOTE: REFER TO GENERAL SHEET GI-4 FOR STANDARD VALVE CALLOUTS.

TYPICAL EQUIPMENT TAG FORMAT

6640-180-P-06114B - - EQUIPMENT SCHEDULE (FULL TAG)
180-P-06114B - - P&ID (PARTIAL TAG)
6640 — — — — — — — — — PLANT ID
180 — — — — — — — — PROCESS AREA
P — — — — — EQUIPMENT ID
06114 — — TAG NUMBER
B - - SUFFIX

NOTE: REFER TO GENERAL SHEET GI-4 FOR STANDARD EQUIPMENT CALLOUTS.

TYPICAL MANUAL VALVE TAG FORMAT

6640-180-V-06114B — MANUAL VALVE SCHEDULE (FULL TAG)
180-V-06114B — P&ID (PARTIAL TAG)
6640 — — — — — — — — — PLANT ID
180 — — — — — — — PROCESS AREA
V — — — — — VALVE
06114 — — TAG NUMBER
B - - SUFFIX

NOTE: REFER TO GENERAL SHEET GI-4 FOR STANDARD VALVE CALLOUTS.

SHEET NUMBER TAG FORMAT

6640-180I-01_A - - - SHEET SCHEDULE (FULL TAG)
180I-01 — — — — P&ID BORDER (PARTIAL TAG)
6640 - - - - - - - - - PLANT ID
180 — — — — — — PROCESS AREA
I — — — — — — DISCIPLINE CODE
01 — — — — SHEET NUMBER
A - - - REVISION

TYPICAL PIPE LINE TAG FORMAT

6640-12-RW-CS08-1234 — PIPE LINE SCHEDULE (FULL TAG)
6640 - - - - - - - - - - - PLANT ID
12 — — — — — — — — — NOMINAL PIPE DIAMETER
RW - - - - - - - - - FLUID CODE
CS08 — — — — PIPE SPEC
1234 — LINE NUMBER

VALVE SPECIFICATION TAG FORMAT

150VF4101 — SPECIFICATION NUMBER
150 - - - - - - VALVE SIZE
VF — — — — VALVE TYPE
41 — — — VALVE SUB-TYPE
01 - - VALVE ENDS

EQUIPMENT SKID TAG FORMAT

6640-X-017 - - - SKID TAG
6640 — — — — — — PLANT ID
X — — — — — SKID
017 - - - SKID NUMBER

TIE-IN POINT TAG FORMAT

6640-TP-0123 — SPECIFICATION NUMBER
6640 — — — — — — PLANT ID
TP — — — — TIE-IN POINT
0123 — TAG NUMBER

GENERAL INSTRUMENTATION NOTES

1. THE SYMBOLS AND NOMENCLATURE SHEETS ARE REPRESENTATIVE OF A GENERAL STANDARD. THEREFORE, IT SHOULD BE UNDERSTOOD THAT NOT ALL INFORMATION PRESENTED WILL BE RELEVANT TO THIS PROJECT.
2. ADDITIONAL INSTRUMENTATION AND CONTROL SYMBOLS MAY BE USED AS REQUIRED. SYMBOLS AND NOMENCLATURE WILL BE EITHER BASED ON ISA STANDARD 5.1-INSTRUMENTATION SYMBOLS AND IDENTIFICATION OR DEFINED ELSEWHERE IN THE P&ID SET.
3. SEE ELECTRICAL AND PROJECT GENERAL SHEETS FOR ADDITIONAL SYMBOLS AND ABBREVIATIONS.
4. TO CAPTURE THE COMPLETE PROCESS CONTROL INTENT, THE P&IDS MUST TO BE REVIEWED IN CONJUNCTION WITH THE PROJECT CONTROL PHILOSOPHY (SPEC SECTION 409300), THE PROJECT I/O AND INSTRUMENT SCHEDULES AND OTHER SECTIONS REFERENCED HEREIN.

INSTRUMENTATION LINE SYMBOLOGY

- NEW WORK (UNSCREENED)
- EXISTING (SCREENED)
- EXISTING TO BE DEMOLISHED
- FUTURE EQUIPMENT (DASH)
- VENDOR SKID LIMIT

INSTRUMENT LINE DEFINITIONS
(UNLESS SPECIFICALLY NOTED OTHERWISE PER DRAWING LEGEND)

- DATA LINK OR SYSTEM BUS BETWEEN DEVICES
- ELECTRIC (PULSE SIGNAL)
- ELECTRICAL SIGNAL
- ULTRASONIC SIGNAL
- HYDRAULIC SIGNAL
- MECHANICAL LINK
- PNEUMATIC SIGNAL
- PROCESS
- AIR SUPPLY — AS

COMMUNICATION LINE DEFINITIONS
(UNLESS SPECIFICALLY NOTED OTHERWISE PER DRAWING LEGEND)

- UTP (CAT 5e OR CAT 6 AS NOTED)
- PROFIBUS — P
- FOUNDATION FIELD BUS — F
- MODBUS (RS485) — M
- SINGLE MODE FIBER
- MULTIMODE FIBER — X
- VENDOR SIGNAL CABLE
- DEVICENET (THIN - DROP) — D
- DEVICENET (THICK - TRUNK) — D

SIGNAL AND PROCESS OFF-PAGE CONNECTORS

- PROCESS OR LOGIC CONNECTION TO DRAWING I-02 — I-02 (A)
- PROCESS OR LOGIC CONNECTION FROM DRAWING I-02 — I-02 (A)
- PROCESS OR LOGIC CONNECTION TO/FROM DRAWING I-02 — I-02 (A)
- PROCESS OR LOGIC CONNECTION CONTINUES TO UNREPRESENTED DRAWING

NOTE: REFER TO INSTRUMENTATION LINE SYMBOLOGY FOR PROCESS AND LOGIC LINESTYLE DEFINITION.

REV 010119

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No.	By	Appd	YYYY.MM.DD

Revision

No.	By	Appd	YYYY.MM.DD
A	MG	JD	2023.07.14
B	AB	JD	2023.11.21
C	JD	JD	2024.01.23

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSE 16665 STATE OF IDAHO JOHN C. DEERKOP

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: 03233I-0XX

Scale: NO SCALE

MG	MG		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SYMBOLS AND ABBREVIATIONS - I

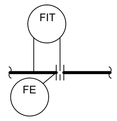
Revision: A Sheet: 1 of XX

Drawing No.
GI-001

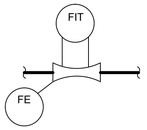
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ORIGINAL SHEET - ANSI D

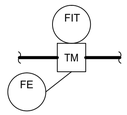
FLOW INSTRUMENTS



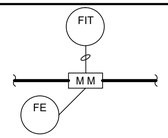
ORIFICE PLATE WITH VENA CONTRACTA, RADIUS, OR PIPE TAPS CONNECTED TO DIFFERENTIAL-PRESSURE -TYPE FLOW TRANSMITTER



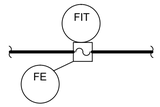
VENTURI TUBE WITH (DIFFERENTIAL PRESSURE) FLOW TRANSMITTER



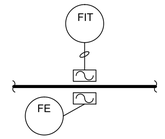
THERMAL MASS FLOW METER



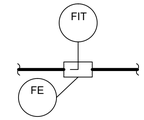
MAGNETIC FLOWMETER WITH REMOTE FLOW TRANSMITTER



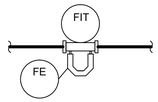
SONIC FLOWMETER DOPPLER OR TRANSIT TIME



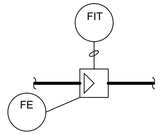
SONIC FLOWMETER CLAMP ON TYPE



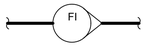
SINGLE PORT PITOT TUBE OR PITOT-VENTURI TUBE



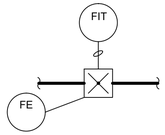
CORIOLIS FLOWMETER



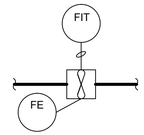
VORTEX FLOW METER



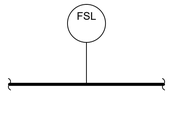
VARIABLE AREA FLOW INDICATOR (ROTAMETER)



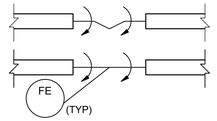
PADDLE WHEEL FLOW METER



TURBINE OR PROPELLER TYPE FLOW METER

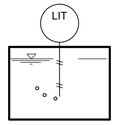


FLOW DETECTION SWITCH THERMAL TYPE

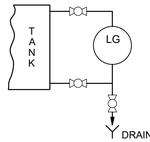


WEIR

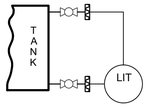
LEVEL INSTRUMENTS



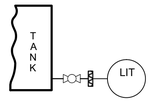
LEVEL TRANSMITTER BUBBLER TYPE



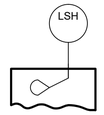
GAUGE GLASS (EXTERNALLY CONNECTED)



LEVEL TRANSMITTER, SEALED DIFFERENTIAL PRESSURE TYPE (MOUNTED ON TANK)



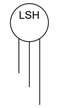
LEVEL TRANSMITTER PRESSURE ACTUATED



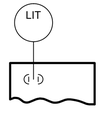
LEVEL DETECTION SWITCH FLOAT ACTUATED TYPE



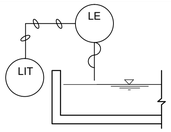
LEVEL DETECTION SWITCH VIBRATING FORK TYPE



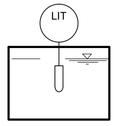
LEVEL DETECTION SWITCH CONDUCTANCE TYPE



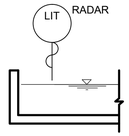
LEVEL TRANSMITTER CAPACITANCE OR DIELECTRIC OR RF ADMITTANCE TYPE



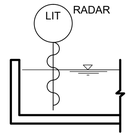
LEVEL TRANSMITTER NON-CONTACTING ULTRASONIC TYPE REMOTE MOUNTED



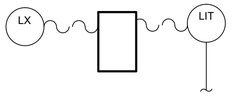
LEVEL TRANSMITTER HYDROSTATIC TYPE



LEVEL TRANSMITTER NON-CONTACTING RADAR TYPE

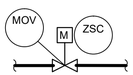


LEVEL TRANSMITTER GUIDED WAVE RADAR TYPE

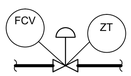


LEVEL TRANSMITTER RADIOACTIVE OR SONIC TYPE WITH INTEGRAL SENSOR

POSITION INSTRUMENTS

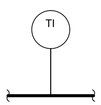


LIMIT SWITCH ON MOTORIZED VALVE INDICATING CLOSED POSITION

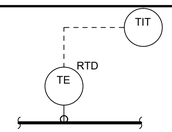


VALVE POSITION TRANSMITTER ON PNEUMATIC ACTUATED VALVE

TEMPERATURE INSTRUMENTS

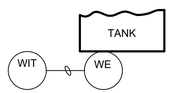


BIMETALLIC TYPE THERMOMETER, GLASS THERMOMETER, OR OTHER LOCAL UNCLASSIFIED TEMPERATURE INDICATOR

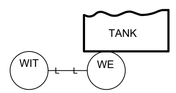


THERMOCOUPLE, RESISTANCE BULB (RTD) OR THERMISTOR (TH) TEMPERATURE TRANSMITTER WITH THERMOWELL

WEIGHT INSTRUMENTS

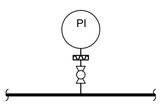


STRAIN GAUGE CONNECTED TO SEPARATE WEIGHT TRANSMITTER (TAG STRAIN GAUGE WE)

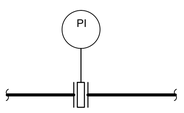


HYDRAULIC ACTUATED WEIGHT TRANSMITTER

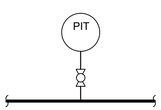
PRESSURE OR VACUUM INSTRUMENTS



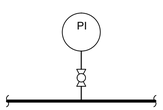
PRESSURE GAUGE WITH DIAPHRAGM SEAL



PRESSURE GAUGE WITH LIQUID FILLED ANNULAR SEAL SYSTEM

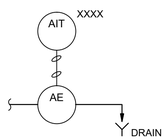


PRESSURE INDICATING TRANSMITTER



PRESSURE INDICATOR DIRECT - CONNECTED

ANALYTICAL INSTRUMENTS



FLOW THROUGH ANALYZING ELEMENT WITH REMOTE TRANSMITTER

ALK	ALKALINITY
CL_2	CHLORINE CONCENTRATION
COMB	COMBUSTIBLE GAS
COND	CONDUCTIVITY
COD	CHEMICAL OXYGEN DEMAND
DO	DISSOLVED OXYGEN
HC	HYDROCARBON
H_2O_2	HYDROGEN PEROXIDE
H_2S	HYDROGEN SULFIDE
LEL	LOWER EXPLOSIVE LIMIT
NO_3 / NO_2	NITRATE / NITRITE
NH_3 / NH_4	AMMONIA / AMMONIUM
O_2	OXYGEN CONCENTRATION
O_3	OZONE
ORP	OXIDATION - REDUCTION POTENTIAL
PC	PARTICLE COUNTER
pH	HYDROGEN ION CONCENTRATION
SCU	STREAMING CURRENT UNIT
SO	SULFUR DIOXIDE
TH ^{2}	TOTAL HARDNESS
TKN	TOTAL KJELDAHL NITROGEN
TN	TOTAL NITROGEN
TOC	TOTAL ORGANIC CARBON
TURB	TURBIDITY
TSS	TOTAL SUSPENDED SOLIDS
UVI	ULTRA VIOLET INTENSITY
UVT	ULTRA VIOLET TRANSMITTANCE

NOTE : IN THE CASE WHERE MULTIPLE SENSORS ARE TIED TO A SINGLE TRANSMITTER OR IN THE CASE OF GAS DETECTION, THE ANALYTIC CALLOUT WILL BE ASSIGNED TO THE SENSOR.

REV 010119

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No.	Revision	By	Appd	YYYY.MM.DD
A	30% DESIGN REVIEW	JD	JD	2024.01.23
B	90% DESIGN REVIEW	AB	JD	2025.11.21
C	IFC	MG	JD	2025.07.14

Issued

Permit/Seal



2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: 03233I-0XX

Scale: NO SCALE

Dwn.	Dsgn.	Chkd.
MG	MG	2025.07.14

YYYY.MM.DD

Title
SYMBOLS AND ABBREVIATIONS - II

Revision: A Sheet: 1 of XX

Drawing No.
GI-002

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ORIGINAL SHEET - ANSI D

VALVES

- 3 WAY MULTI-PORT VALVE
- 4 WAY MULTI-PORT VALVE
- AIR VACUUM, AIR RELEASE, OR COMBINATION AIR VACUUM AND AIR RELEASE ASSEMBLY
- ANGLE VALVE
- BACK-PRESSURE VALVE
- BACKFLOW PREVENTER VALVE
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- CONE VALVE
- DIAPHRAGM VALVE
- FLAP VALVE
- GATE VALVE
- GLOBE VALVE
- HOSE BIBB VALVE
- NEEDLE VALVE
- PINCH VALVE
- PLUG VALVE
- PRESSURE REGULATING VALVE
- PRESSURE RELIEF VALVE
- SLEEVE VALVE
- TELESCOPING VALVE
- FLOAT VALVE

VALVE AND GATE ACTUATORS

- DIAPHRAGM ACTUATOR
- E/H = ELECTROHYDRAULIC
P = PNEUMATIC
S = SOLENOID
- MOTOR ACTUATOR
- PISTON ACTUATOR
- WEIGHT BALANCED ACTUATOR

GATES

- SLIDE GATE
- STOP GATE OR SHEAR GATE

WASTEWATER EQUIPMENT

- BELT FILTER PRESS
- SHAFTLESS CONVEYOR
- SCREW CONVEYOR
- CENTRIFUGE
- GRAVITY BELT THICKENER
- BELT CONVEYOR
- SLUDGE GRINDER

HVAC

- AIR CONDITIONING UNIT
- DUCT AIR FILTER
- AIR HANDLING UNIT
- NON-MOTORIZED DAMPER
- MOTORIZED DAMPER
- DEHUMIDIFIER
- DUCT SMOKE DETECTOR
- EVAPORATIVE COOLER
- HEATER
- HVAC BOILER
- HVAC FAN
- VENT FAN
- HVAC LOUVER
- THERMOSTAT
- STEAM GENERATOR
- UNIT HEATER
- WATER HEATER
- AFTER COOLER

PUMPS & COMPRESSORS

- SLUDGE DIAPHRAGM PUMP
- HORIZONTAL CENTRIFUGAL PUMP
- GENERIC PUMP
- CHEMICAL METERING PUMP
- DRUM PUMP
- ROTARY GEAR PUMP
- SPLIT-CASE PUMP
- HOSE / PERISTALTIC PUMP
- PLUNGER / PISTON PUMP
- PROGRESSIVE CAVITY PUMP
- ROTARY LOBE PUMP
- SUBMERSIBLE SUMP PUMP
- SUBMERSIBLE TURBINE PUMP
- VERTICAL TURBINE PUMP
- VERTICAL CENTRIFUGAL PUMP
- INCLINED ARCHIMEDES SCREW PUMP
- VERTICAL SUMP PUMP
- RECIPROCATING COMPRESSOR
- ROTARY SCREW COMPRESSOR

PIPING ACCESSORIES

- ANNULAR SEAL
- ATMOSPHERIC VENT
- BLIND FLANGE
- CAP - BREATHER
- CAP - SCREW / THREADED
- CAP - WELDED
- CAP - QUICK DISCONNECT
- CHLORINE INJECTOR OR CHEMICAL EDUCTOR
- DIAPHRAGM SEAL
- DRAIN
- EXPANSION CHAMBER WITH RUPTURE DISK
- EDUCTOR
- FLANGED
- FLEXIBLE CONNECTION - BELLOWS TYPE
- FLAME ARRESTOR
- FLOOR CLEANOUT
- FILTER
- HUB DRAIN
- INLINE MIXER
- PIPE MATERIAL CHANGE
- PULSATION DAMPENER
- REDUCER - CONCENTRIC
- REDUCER - ECCENTRIC
- REMOVABLE SPOOL PIECE
- UNION
- RUPTURE DISK
- STRAINER - BASKET TYPE
- STRAINER - DUPLEX BASKET TYPE
- STRAINER - WYE TYPE
- SLOPE
- TRAP
- WALL CLEANOUT
- TIE-IN POINT

BLOWERS

- AERATOR
- BLOWER
- POSITIVE DISPLACEMENT BLOWER
- SINGLE STAGE CENTRIFUGAL BLOWER

MISCELLANEOUS

- BRIDGE CRANE
- CALIBRATION COLUMN
- CONTAINER SCALE
- CARTRIDGE FILTER
- DEMISTOR
- FIRE HYDRANT
- GAS BOTTLE
- HEAT EXCHANGER - PLATE TYPE
- HEAT EXCHANGER - STRAIGHT TYPE
- HEAT EXCHANGER - U TUBE
- HEATER
- HORN
- PANEL-MOUNTED HORN
- BEACON
- MISCELLANEOUS EQUIPMENT
- MIXER
- MOTOR SYMBOL
- HORIZONTAL PRESSURE VESSEL
- VERTICAL PRESSURE VESSEL
- RADIO ANTENNA
- REFRIGERATOR DRYER
- SAMPLE COOLER
- AUTO-BACKWASHING STRAINER
- TANK WITH CONE SHAPED ROOF
- TANK WITH DOME ROOF
- TANK WITH FLOATING COVER
- TANK, VESSEL, OR BIN
- TEMPERING TANK
- TOTE TANK
- WATER LEVEL
- GENERATOR

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No.	By	Appd	YYYY.MM.DD

Revision

No.	By	Appd	YYYY.MM.DD
A	MG	JD	2024.01.23
B	AB	JD	2025.11.21
C	JD	JD	2025.07.14

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 16665 STATE OF IDAHO JOHN C. DEERKOP

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: 03233I-0XX

Scale: NO SCALE

MG	MG		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SYMBOLS AND ABBREVIATIONS - III

Revision: A Sheet: 1 of XX

Drawing No.
GI-003

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ORIGINAL SHEET - ANSI D

PROCESS ABBREVIATIONS

AERATION	A
ALUMINUM SULFATE (LIQUID ALUM)	ALS
AMMONIUM HYDROXIDE (AQUEOUS AMMONIA)	AMH
AUTOMATIC SPRINKLER RISER	ASR
BLEND	B
BALLASTED FLOCCULATION POLYMER	BFP
BALLASTED FLOCCULATION SOLIDS	BFS
BLENDED PRODUCT	BP
CONDENSATE	C
CALCIUM HYDROXIDE (HYDRATED LIME)	CAH
CALCIUM OXIDE (QUICK LIME)	CAO
CHANNEL AGITATION WATER	CAW
MEMBRANE CLEANING CONCENTRATE RETURN	CCR
CHEMICAL DRAIN	CD
CONDENSER WATER RETURN	CDR
CONDENSER WATER SUPPLY	CDS
CHILLED WATER RETURN	CHR
CHILLED WATER SUPPLY	CHS
CORROSION INHIBITOR	CI
CHLORINE (GAS OR LIQUID)	CL
CHLORINE SOLUTION	CLS
CHLORINE GAS UNDER VACUUM	CLV
CENTRATE	CN
CONDENSATE DRAIN	CND
CHEMICAL CONTAINMENT	CP
MEMBRANE CLEANING PERMEATE RETURN	CPR
CIRCULATED SLUDGE	CSL
CITRIC ACID	CTA
CALCIUM THIOSULFATE	CTH
CHLORINATOR VENT AND DETECTION	CV
CHEMICAL DRAIN VENT	CVT
COAGULATED WATER	CW
COOLING WATER RETURN	CWR
COOLING WATER SUPPLY	CWS
DEFOAMING CHEMICAL	DC
DOMESTIC COLD WATER	DCW
DIESEL FUEL OIL	DFO
DEMINERALIZED WATER	DMW
DECANT	DN
DRAIN	DR
DIGESTED SLUDGE	DSL
DOMESTIC HOT WATER RETURN	DWR
DOMESTIC HOT WATER SUPPLY	DWS
ENGINE EXHAUST	EE
ENGINE COOLING WATER RETURN	EWR
ENGINE COOLING WATER SUPPLY	EWS
FOUL AIR	FA
FILTER AIR WASH	FAW
FILTER BACKWASH	FBW
FINAL EFFLUENT	FE
FERRIC CHLORIDE	FEC
FERRIC SULFATE	FES
FILTER INFLUENT	FI
FILTERED WATER	FLW
FORCE MAIN	FM
FUEL OIL RETURN	FOR
FUEL OIL SUPPLY	FOS
FIRE PROTECTION	FP
FROTH	FR
FROTH SPRAY	FS
FILTER SURFACE WASHWATER	FSW
FILTER TO WASTE	FTW
FINISHED WATER	FW
FILTER WASTE WASHWATER	FWW
GRIT	G
GRANULAR ACTIVATED CARBON	GAC
GASEOUS OXYGEN	GOX
HYDROCHLORIC ACID	HCA
HYDROGEN PEROXIDE	HDP
HYDROFLUOSILICIC ACID	HFA
HEATING WATER RETURN	HWR
HEATING WATER SUPPLY	HWS
INSTRUMENT AIR	IA
INTERMEDIATE EFFLUENT	IE
LANDFILL GAS	LFG
LUBE OIL	LO
LIQUID OXYGEN	LOX
LIQUEFIED PETROLEUM GAS	LPG
LIME SLURRY	LS
LANDSCAPING SPRINKLER SYSTEM	LSP
MEMBRANE CONCENTRATE	MC
MEMBRANE CLEANING RETURN	MCR
MEMBRANE CLEANING SUPPLY	MCS
MEMBRANE CLEANING WASTE	MCW
MECHANICAL DEWATERING POLYMER	MDP
MEMBRANE FEED	MF
METHANE GAS	MG
MIXED LIQUOR	ML
MIXED LIQUOR RECYCLE	MLR
MEMBRANE PERMEATE	MP
MURIATIC ACID	MRA
NATURAL GAS	NG
NON-LEADED GASOLINE	NLG
OVERFLOW	OF
OFFGAS	OG
OXIDATION TOWER EFFLUENT	OTE
OZONE	OZG
OZONATED WATER	OZW
PLANT AIR	PA
POWDERED ACTIVATED CARBON	PAC
POLYALUMINUM CHLORIDE	PCL
PLANT DRAIN	PDR
PRIMARY EFFLUENT	PE
PLANT INFLUENT	PI
PLANT EFFLUENT	PLE
PLANT OVERFLOW	PO
ANIONIC POLYMER	POA
CATIONIC POLYMER	POC
FILTER AID POLYMER	POF
NONIONIC POLYMER	PON
THICKENER POLYMER	POT
PRESSURIZED RECYCLE	PRR
PRESSATE	PRS
POTASSIUM PERMANGANATE	PTP
POTABLE WATER	PW
RETURN ACTIVATED SLUDGE	RAS
RECLAIMED WATER	REW
REFRIGERANT LIQUID	RFL
REFRIGERANT SUCTION	RFS
REFRIGERANT SUCTION	RSL
RETURN SECONDARY SLUDGE	RSS
RAW WATER	RW
RAINWATER LEADER	RWL
RAINWATER LEADER OVERFLOW	RWO
SCUM	S
SAMPLE	SAM
SUBNATANT	SBN
SUBNATANT OVERFLOW	SBO
SCAVENGER SYSTEM DISCHARGE	SCV
SANITARY DRAIN	SD
SODIUM BISULFITE	SDB
SODIUM HYDROXIDE (CAUSTIC SODA)	SDH
STORM DRAIN	SDR
SANITARY DRAIN VENT	SDV

REV 010119

PROCESS ABBREVIATIONS

SECONDARY EFFLUENT	SE
SLUDGE FILTRATE	SF
SULFURIC ACID	SFA
SLUDGE GAS	SG
SODIUM HYPOCHLORITE	SHC
SCALE INHIBITOR	SI
SLUDGE	SL
SUPERNATANT	SN
SAND SLURRY	SND
SULFUR DIOXIDE (GAS OR LIQUID)	SO
SULFUR DIOXIDE SOLUTION	SOS
SULFUR DIOXIDE GAS UNDER VACUUM	SOV
SPARE CHEMICAL	SP
SUMP PUMP DISCHARGE	SPD
SANITARY SEWER	SS
SODIUM SILICOFLUORIDE	SSF
STEAM	STM
STRUCTURE UNDERDRAIN	SU
STRUCTURE UNDERDRAIN COLLECTOR	SUC
SETTLED WATER	SW
SCRUBBER WATER RETURN	SWR
TRICKLING FILTER EFFLUENT	TFE
TRICKLING FILTER INFLUENT	TFI
TRICKLING FILTER RECYCLE	TFR
THICKENED SLUDGE	TSL
TREATED WATER	TW
UNDERDRAIN	UD
UTILITY WATER (NON-POTABLE WATER)	UW
VACUUM	V
VENT	VT
WASTE ACTIVATED SLUDGE	WAS
WASTE LUBE OIL	WLO
WASTE SECONDARY SLUDGE	WSS

EQUIPMENT ABBREVIATIONS

AIR HANDLING UNIT	AHU
AIR RELEASE VALVE	ARV
BACK FLOW PREVENTER	BFP
BACK PRESSURE SUSTAINING VALVE	BPV
BEACON	BCN
BLENDING UNIT	BLU
BLOWER	BLW
BULK STORAGE TANK	BTK
CARTRIDGE FILTER	CF
CHECK VALVE	CV
CLEAN IN PLACE	CIP
CONVEYOR	CN
DAY TANK	DTK
DEGASIFIER	DG
EXHAUST FAN	EF
FILTER (GENERAL)	F
HEATER	HTR
HIGH SERVICE PUMP	HSP
LOUVER	LOU
MECHANICAL EQUIPMENT (GENERAL)	ME
MIXER	MX
MOTOR OPERATOR VALVE	MOV
PNEUMATIC OPERATOR VALVE	POV
PRESSURE REDUCING VALVE	PRV
PRESSURE SAFETY VALVE	PSV
PUMP (GENERAL)	P
RUPTURE DISK	RD
SAMPLE PUMP	SP
SAND SEPARATOR	SS
SLIDE GATE	SG
SOLENOID OPERATOR VALVE	SOV
TANK	TK
TRANSFER PUMP	TP
VALVE (MANUAL)	V

VALVE ABBREVIATIONS

GATE VALVE	VG
BALL VALVE	VB
BUTTERFLY VALVE	VF
CHECK VALVE	VC
DIAPHRAGM VALVE	VD
GLOBE VALVE	VO
NEEDLE VALVE	VN
PLUG VALVE	VP
SPECIALITY VALVES	VX

CONTROL EQUIPMENT ABBREVIATIONS

ATMOSPHERE	ATM
AUTO TRANSFER CONTROLLER	ATC
CONTACT TIME	CT
CONTROL PANEL	CP
DISTRIBUTED CONTROL SYSTEM	DCS
DIRECT ONLINE STARTER	DOL
FAIL CLOSED	FC
FIBER OPTIC CABLE	FOC
FIBER OPTIC TRANSCEIVER	FOT
FULL VOLTAGE NON-REVERSING STARTER	FVNR
HUMAN MACHINE INTERFACE	HMI
LOCKED CLOSED	LC
LOCAL CONTROL PANEL	LCP
LOCAL CONTROL STATION	LCS
LOCKED OPEN	LO
LIGHTNING SURGE ARRESTOR	LSA
MOTOR CONTROL CENTER	MCC
MAIN CONTROL PANEL	MCP
MULTIMODE FIBER	MMF
MOTOR STARTER	MS
MOTOR	MTR
NOT APPLICABLE	N/A
NORMALLY CLOSED	NC
NOT IN CONTRACT	NIC
NORMALLY OPEN	NO
OWNER FURNISHED	OF
OPERATOR INTERFACE	OI
OPERATOR INTERFACE TERMINAL	OIT
PERSONAL COMPUTER	PC
PROGRAMMABLE LOGIC CONTROLLER	PLC
PLANT CONTROL NETWORK	PCN
POWER DISTRIBUTION UNIT	PDU
REMOTE I/O	RIO
REDUCED VOLTAGE SOLID-STATE STARTER	RVSS
REMOTE TERMINAL UNIT	RTU
SINGLE MODE FIBER	SMF
SOLID STATE METER	SSM
SHIELDED TWISTED PAIR	STP
THERMOCOUPLE	TC
UNINTERRUPTIBLE POWER SUPPLY	UPS
UNSHIELDED TWISTED PAIR	UTP
VENDOR CONTROL PANEL	VCP
VARIABLE FREQUENCY DRIVE	VFD
VARIABLE SPEED DRIVE	VSD

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Revision

No.	By	Appd	YYYY.MM.DD
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A	MG	JD	2023.07.14

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B	90% DESIGN REVIEW	AB	JD	2023.11.21
A	30% DESIGN REVIEW	MG	JD	2023.07.14

Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
16665
STATE OF IDAHO
JOHN C. DEERKOP

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: 03233I-0XX

Scale: NO SCALE

MG	MG		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SYMBOLS AND ABBREVIATIONS - IV

Revision: A Sheet: 1 of XX

Drawing No.
GI-004

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ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. SEE THE GENERAL NOTES AND SPECIFICATIONS FOR ADDITIONAL INFORMATION.
2. INFORMATION FOR EXISTING EQUIPMENT, CONDUIT AND WIRES WAS PROVIDED BY OTHERS. THE CONTRACTOR SHALL FIELD VERIFY ALL EXISTING CONDITIONS IMPACTED BY THE WORK.

SHEET KEYNOTES

A. DOCUMENT AND DISCONNECT THE EXISTING BELT PRESS CONTROL WIRES TO THE EXISTING SLUDGE TRANSFER PUMPS CONTROLS. CONNECT NEW SCREW PRESS CONTROL PANEL DRY RELAY CONTACTS TO THE EXISTING SLUDGE TRANSFER PUMPS CONTROLS SIMILAR TO THE EXISTING CONTROLS.

POLYMER PUMP CONTROLLER 1 (E)
POLYMER PUMP CONTROLLER 2 (E)
SLUDGE TRANSFER PUMP CONTROLLER 1 (E)
SLUDGE TRANSFER PUMP CONTROLLER 2 (E)

VENDOR CONTROL PANEL
15-GAL AIR COMPRESSOR (OWNER FURNISHED)
1/4"-PA-(AL01)
120VAC
LOOP ISOLATOR
FN
120VAC
LIT
LE
ULTRASONIC TRUCK FILL LEVEL
EXISTING DISCHARGE CHUTE
A
240VAC
4"-DSL-(DI03)
8"-DSL-(DI03)
VENDOR SUPPLIED SCREW PRESS #1 PACKAGE (OF)
FIT
120VAC
POLYMER INJECTION RING
FROM EXISTING SLUDGE TRANSFER PUMPS
FE
1/4"-PA-(AL01)
VENDOR SUPPLIED SCREW PRESS #2 PACKAGE (OF)
FROM EXISTING POLYMER METERING PUMP No. 1
1"-PEC-(PV02)
FROM EXISTING POLYMER METERING PUMP No. 2
1"-PEC-(PV02)
1 1/4"-NPW-(CS02)
6"-WW-(PV01)
EXISTING BELT CONVEYOR
PI
SINGLE INLINE STRAINER
FROM EXISTING UTILITY WATER SUPPLY
4"-NPW-(CS02)
EXISTING FLOOR DRAIN
EXISTING FLOOR DRAIN

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No.	By	Appd	YYYY.MM.DD

Revision

No.	By	Appd	YYYY.MM.DD
C	JD	JD	2024.01.23
B	JD	JD	2023.11.21
A	AB	JD	2023.07.14
-	MG	JD	2023.03.31

Issued
C IFC
B 90% DESIGN REVIEW
A 30% DESIGN REVIEW

Permit/Seal

PROFESSIONAL ENGINEER
16665
STATE OF IDAHO
JOHN C. DEERKOP
2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: 03233I-0XX
Scale: NO SCALE

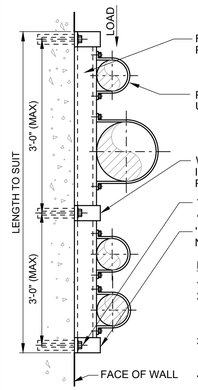
MG	MG		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PROCESS & INSTRUMENTATION DIAGRAM - SCREW PRESS

Revision: A Sheet: 1 of XX
Drawing No.
I-601

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ORIGINAL SHEET - ANSI D



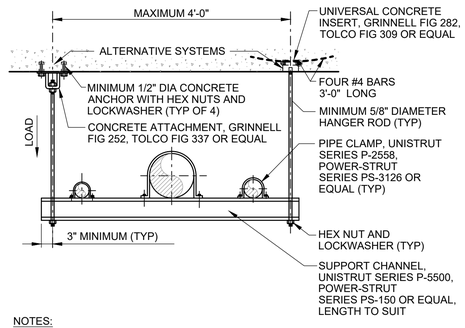
NOTES:

1. HOT DIP GALVANIZE PARTS AFTER FABRICATION.
2. WHERE SUBMERGED, PARTIALLY SUBMERGED, OR LOCATED WITHIN 24 INCHES OF A WATER SURFACE, PARTS SHALL BE TYPE 316 STAINLESS STEEL.
3. WHRE LOCATED IN CHEMICAL OR CORROSIVE AREAS, PARTS SHALL BE FRP OR TYPE 316 STAINLESS STEEL.
4. FOR FLANGED PIPES, USE EXTENDED PIPE SUPPORT AS SHOWN ON STANDARD DETAIL M-103.

D-102 FLUSH MOUNTED PIPE SUPPORT

(FOR PIPE 4" DIAMETER AND SMALLER)

REV 010119



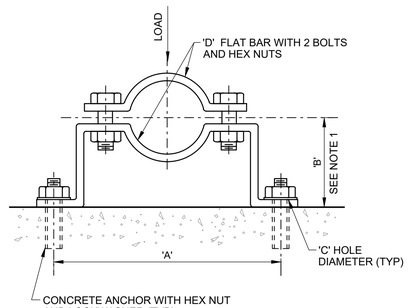
NOTES:

1. HOT DIP GALVANIZE PARTS AFTER FABRICATION.
2. THIS PIPE HANGER IS NOT SUITABLE FOR PRECAST TEE BEAMS.

D-124 TRAPEZE PIPE HANGER

(FOR PIPE 6" DIAMETER AND SMALLER)

REV 010119



DIMENSIONS IN INCHES					LOAD RATING (LBS)
NOMINAL PIPE DIAMETER	'A'	'B'	'C'	'D'	
3/4	5 15/16	2 1/2	7/16	1 1/4 x 3/16	190
1	6 1/4	2 5/8	7/16	1 1/4 x 3/16	190
1 1/4	6 11/16	2 3/4	7/16	1 1/4 x 3/16	190
1 1/2	6 15/16	3	7/16	1 1/4 x 3/16	190
2	8 5/16	3 3/16	7/16	1 1/4 x 1/4	420
2 1/2	8 7/8	3 7/16	7/16	1 1/4 x 1/4	420
3	9 1/8	3 3/4	7/16	1 1/4 x 1/4	420
3 1/2	10 1/16	4	7/16	1 1/4 x 1/4	420
4	10 9/16	4 1/4	9/16	1 1/2 x 1/4	610
5	11 3/4	4 3/4	9/16	1 1/2 x 1/4	610
6	14 3/8	5 5/16	9/16	1 1/2 x 3/8	870
8	16 5/8	6 5/16	9/16	1 1/2 x 3/8	870

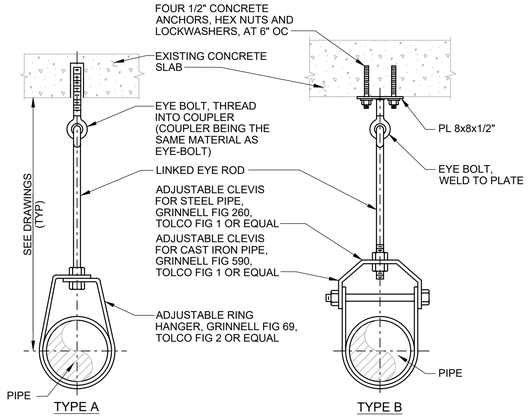
NOTES:

1. HOT DIP GALVANIZE PARTS AFTER FABRICATION.
2. WHERE SUBMERGED, PARTIALLY SUBMERGED, OR LOCATED WITHIN 24 INCHES OF A WATER SURFACE, PARTS SHALL BE TYPE 316 STAINLESS STEEL.
3. WHERE LOCATED IN CHEMICAL OR CORROSIVE AREAS, PARTS SHALL BE FRP OR TYPE 316 STAINLESS STEEL.
4. FOR FLANGED PIPING, INCREASE 'B' DIMENSION AS REQUIRED.
5. FOR PIPE DIAMETERS SMALLER THAN 3/4", SEE STANDARD DETAIL M-142.

D-131 PIPE CLAMP FOR INDIVIDUAL PIPES

(FOR PIPE 8" DIAMETER AND SMALLER)

REV 010119



PIPE HANGER RODS AND SUPPORT SPACING					
PIPE DIAMETER (INCHES)	ROD DIAMETER (INCHES)	MAX SUPPORT SPACING (FEET)		WEIGHT LIMIT (LBS)	
		STEEL PIPE	DI PIPE	TYPE A	TYPE B
1 AND SMALLER	3/8	6	10	300	610
1 1/4 TO 2	3/8	10	10	300	610
2 1/2 TO 3 1/2	1/2	12	10	525	1130
4 TO 5	5/8	14	10	650	1430
6 TO 8	3/4	17	10	1000	1940

NOTES:

1. HOT DIP GALVANIZE PARTS AFTER FABRICATION.
2. DESIGN IS FOR STATIC LOAD, ONLY.

D-152 PIPE HANGER FOR EXISTING CONCRETE

(FOR PIPE 8" DIAMETER AND SMALLER)

REV 010119

Stantec
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Consultant

Issued	By	Appd	YYYY.MM.DD
C IFC	DP	NS	2024.01.23
B 90% DESIGN REVIEW	DP	NS	2023.11.21
A 30% DESIGN REVIEW	DP	NS	2023.07.14

Permit/Seal

PROFESSIONAL ENGINEER LICENSED Danielle Philbrick 1171771 02/09/2025 STATE OF IDAHO DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: D-001

Scale: NO SCALE

GG	PD		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PROCESS MECHANICAL STANDARD DETAILS

Revision:

Drawing No.
D-001

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ORIGINAL SHEET - ANSI D

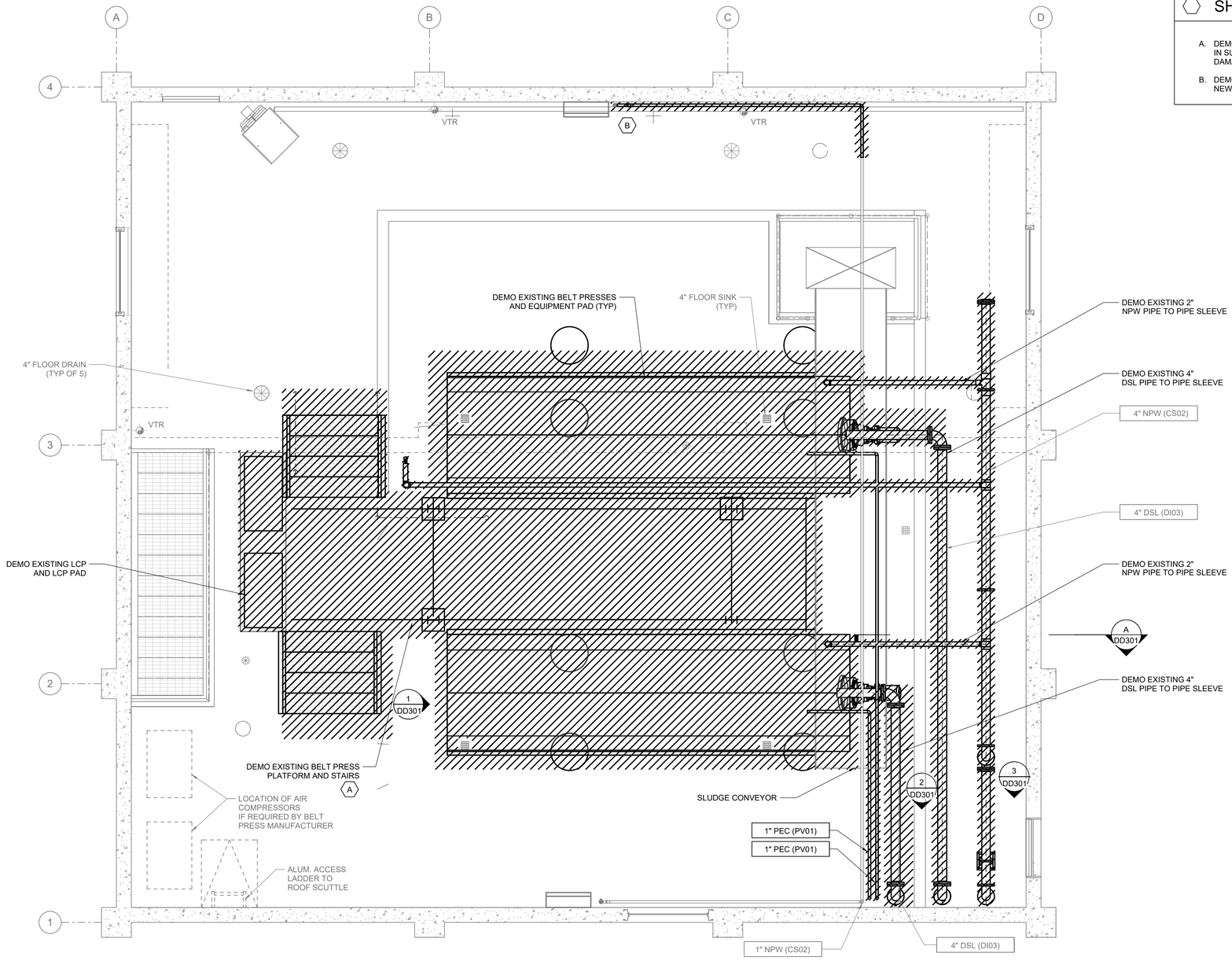
GENERAL SHEET NOTE

1. CONTRACTOR IS RESPONSIBLE TO SUBMIT DEMOLITION SEQUENCING PLAN TO ENSURE THERE IS ONE FUNCTIONAL UNIT ONLINE AT ALL TIMES, INCLUDING ASSOCIATED PIPING

SHEET KEYNOTE

A. DEMO EXIST. BELT FILTER PRESS CONC. SUPPORT (TOTAL OF 8). DEMO SHALL BE IN SUCH A MANNER SO THAT EXIST. CONC. SLAB, AND REINFORCING ARE NOT DAMAGED. SEE SPECIFICATION 01 73 29 FOR ADDITIONAL INFORMATION

B. DEMO THE PORTION OF EXISTING 1" NPW PIPELINE THAT CONFLICTS WITH THE NEW DUCTWORK. INSTALL NEW 1" NPW (CS02) BELOW THE NEW DUCTWORK



UPPER FLOOR PLAN

SCALE: 3/8" = 1'-0"

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C IFC	DP	NS	2024.01.23
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Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
Danielle Philbrick
1171771
02/09/2025
STATE OF IDAHO
DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 3/8" = 1'-0"

GD	PD		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

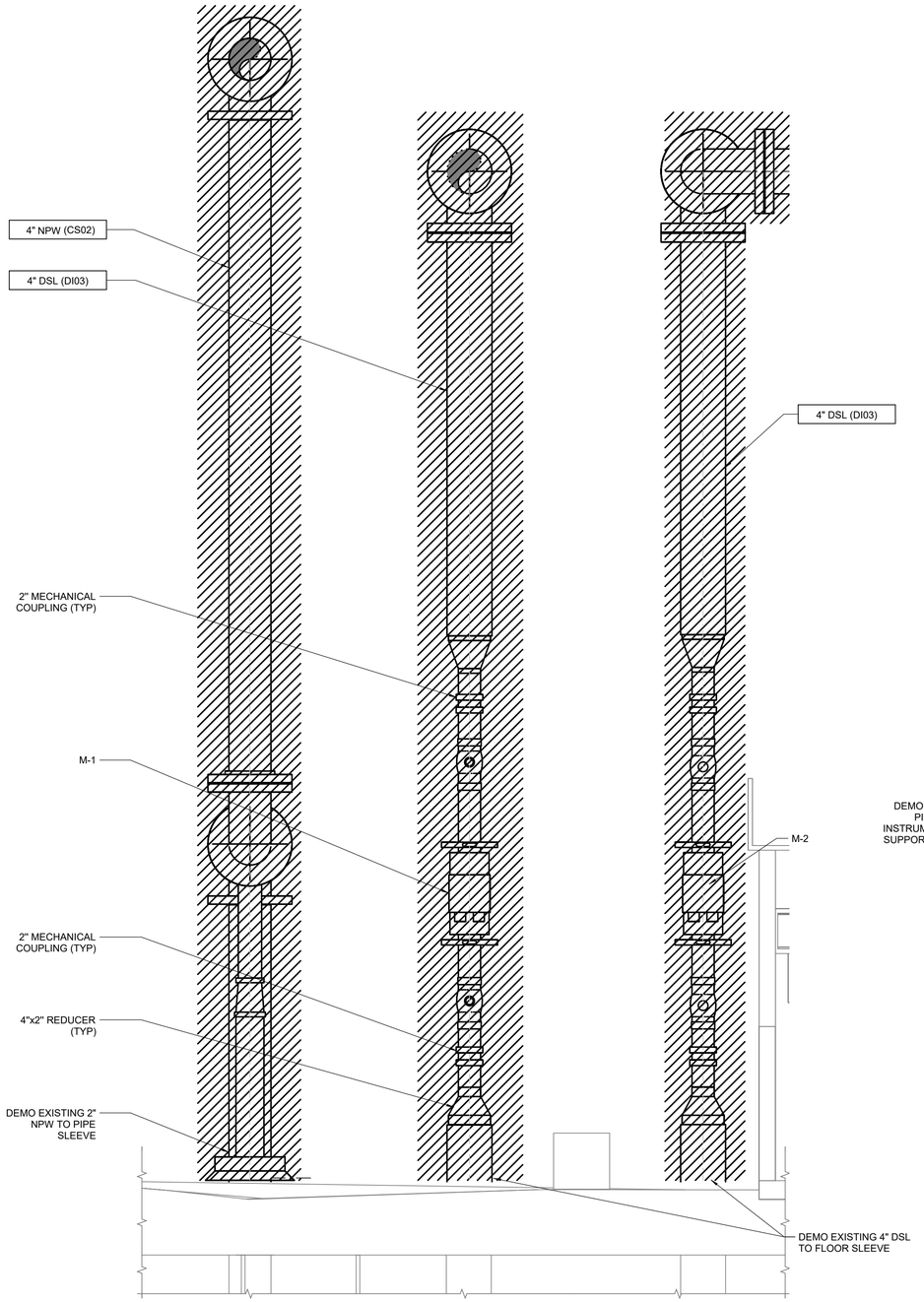
Title
DEMOLITON PLAN

Revision:

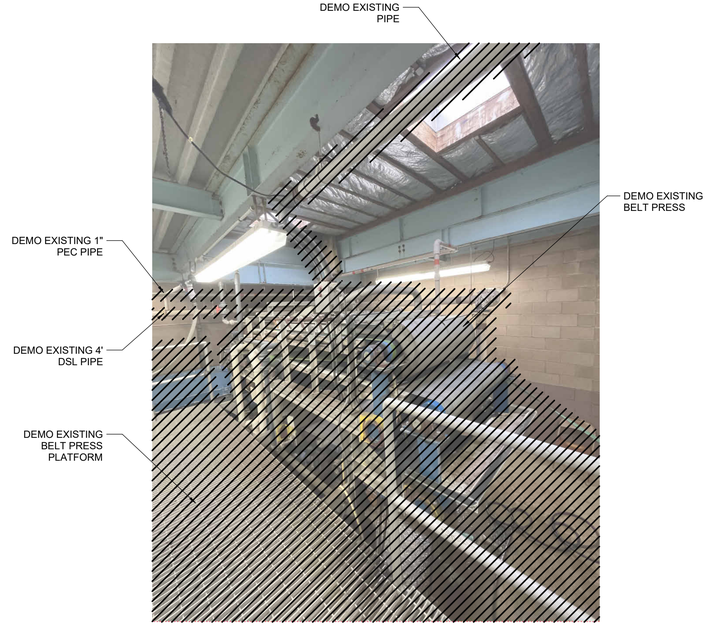
Drawing No.
DD101

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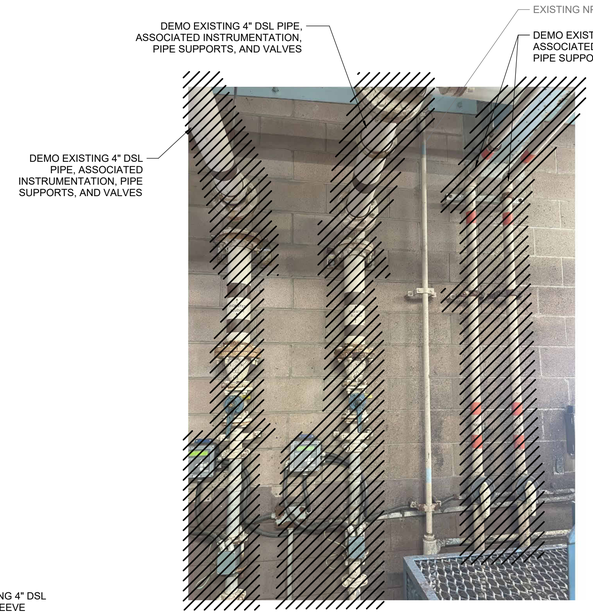
ORIGINAL SHEET - ANSI D



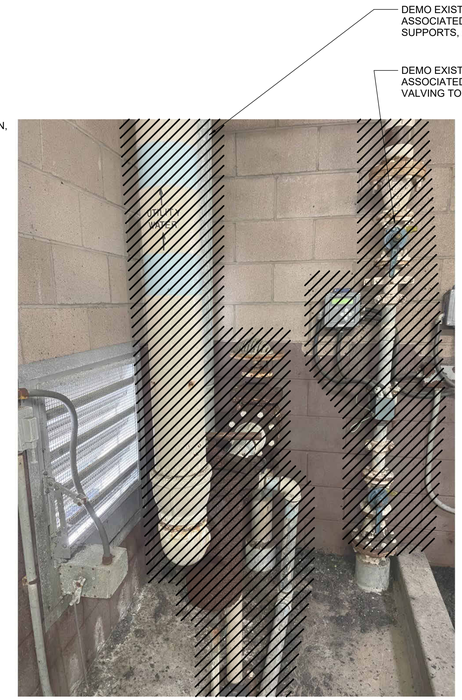
A DD101 SECTION
SCALE: 1 1/2" = 1'-0"



1 DD101 PHOTO
NO SCALE



2 DD101 PHOTO
NO SCALE



3 DD101 PHOTO
NO SCALE

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No.	Revision	By	Appd	YYYY.MM.DD
C	IFC	DP	NS	2024.01.23
B	90% DESIGN REVIEW	DP	NS	2025.11.21
A	30% DESIGN REVIEW	DP	NS	2023.07.14

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED Danielle Philbrick 1171771 02/09/2025 STATE OF IDAHO DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233
File Name: N/A

Scale: As indicated

GD	PD		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
DEMO SECTION AND VIEWS

Revision:

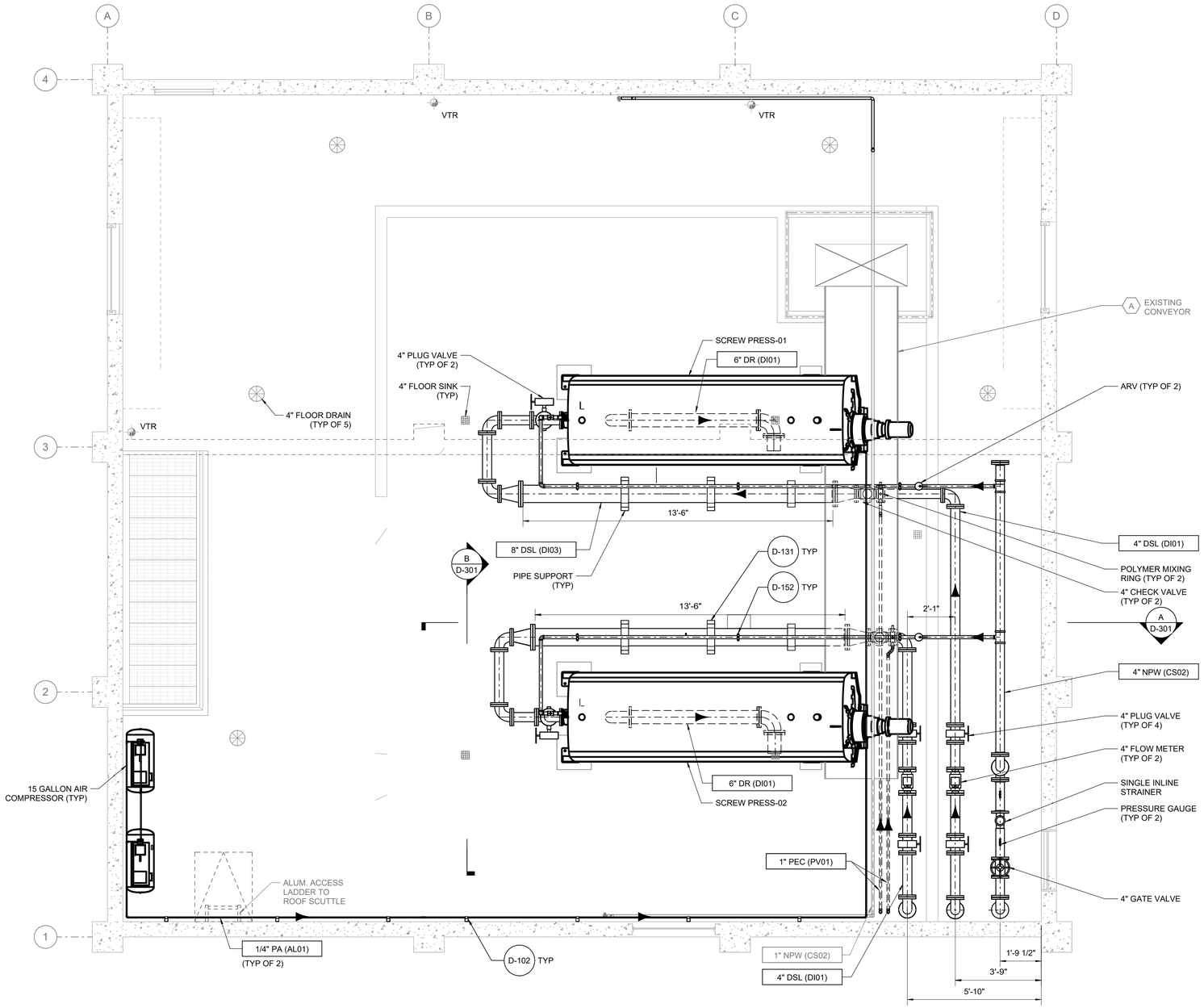
Drawing No.
DD301

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ORIGINAL SHEET - ANSI D

SHEET KEYNOTE

A. CONTRACTOR TO LEAVE THE CONVEYOR BELT AS IS OR PROVIDE ALTERNATIVE METHOD OF SLUDGE CONVEYANCE TO MAINTAIN OPERATIONS.



UPPER FLOOR-PLAN

SCALE: 3/8" = 1'-0"

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No.	By	Appd	YYYY.MM.DD
			Revision

No.	By	Appd	YYYY.MM.DD
A	DP	NS	2024.01.23
B	DP	NS	2025.11.21
C	DP	NS	2025.07.14
			Issued

Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
Danielle Philbrick
1171771
02/09/2025
STATE OF IDAHO
DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 3/8" = 1'-0"

GD	PD		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

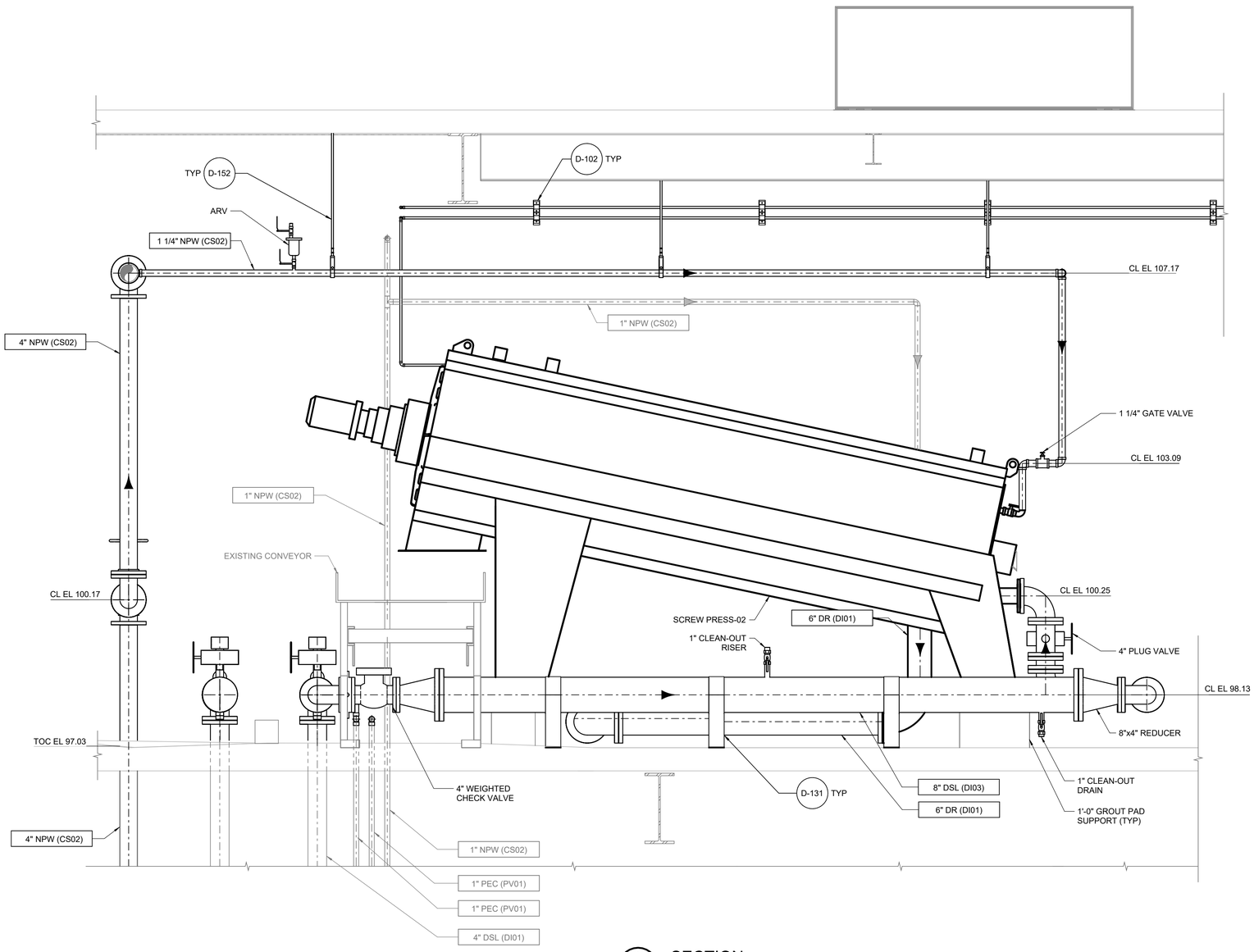
Title
SCREW PRESS PLAN

Revision:

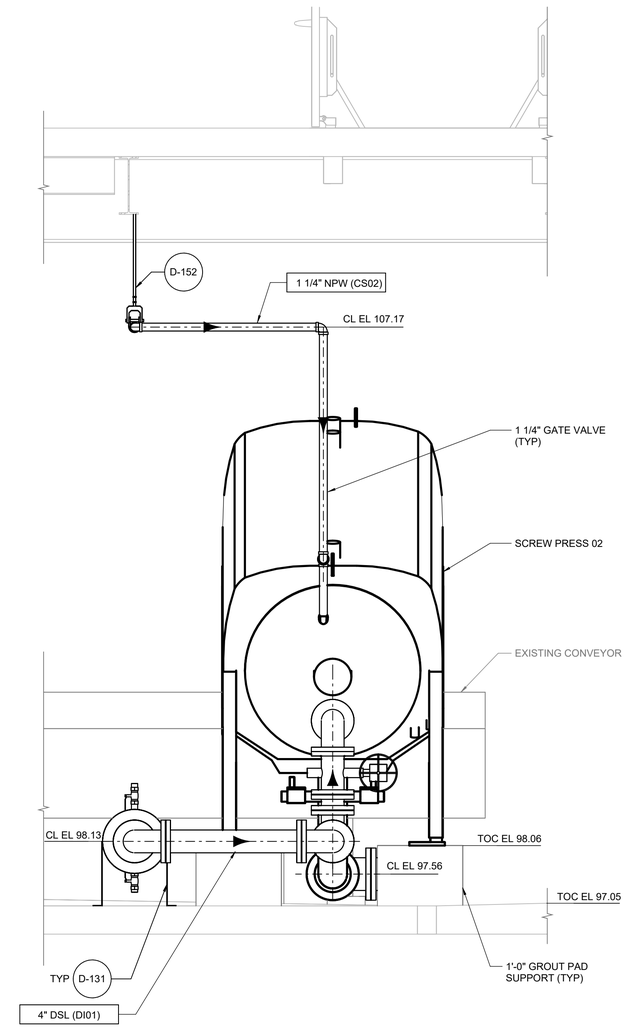
Drawing No.
D-101

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ORIGINAL SHEET - ANSI D



A D-101 SECTION
SCALE: 3/4" = 1'-0"



B D-101 SECTION
SCALE: 3/4" = 1'-0"

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Consultant

No.	By	Appd	YYYY.MM.DD	Revision
C	DP	NS	2024.01.23	IFC
B	DP	NS	2025.11.21	90% DESIGN REVIEW
A	DP	NS	2025.07.14	30% DESIGN REVIEW

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED Danielle Philbrick 1171771 02/09/2025 STATE OF IDAHO DANIELLE PHILBRICK

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 3/4" = 1'-0"

GD	PD	2025.07.14
Dwn.	Dsgn.	Chkd. YYYY.MM.DD

Title
SCREW PRESS SECTIONS

Revision:

Drawing No.
D-301

1/23/2026 12:13:44 PM

ORIGINAL SHEET - ANSI D

SINGLE LINE DIAGRAM, SCHEMATIC DIAGRAM SYMBOLOGY AND PLAN SYMBOLOGY

LOC — THERMAL MAGNETIC CIRCUIT BREAKER
LOC = LOCATION
100 — FRAME (AMPS)
20 — TRIP (AMPS)

LOC — MCP CIRCUIT BREAKER
LOC = LOCATION
100 — CONTINUOUS AMPS
MCP — INSTANTANEOUS TRIP
MOTOR CIRCUIT PROTECTOR

LOW VOLTAGE DRAWOUT CIRCUIT BREAKER
100
20
(LSIGA)

L	LONG TIME
S	SHORT TIME
I	INSTANTANEOUS
G	GROUND FAULT
A	ARC FLASH REDUCTION

X — COMBINATION NEMA RATED STARTER WITH MCP DISCONNECT AND CPT
40 — MCP
ROMAN NUMERAL = NEMA SIZE
X = LOCATION
* = STARTER TYPE

(BLANK)	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
2S2W	TWO SPEED TWO WINDING
2S1W	TWO SPEED ONE WINDING

X — CONT — CONTACTOR
X = AMPERE RATING

X — VFD — VARIABLE FREQUENCY DRIVE
X = AMPERE RATING

X — RVSS — REDUCED VOLTAGE SOLID STATE STARTER
X = AMPERE RATING

X / Y — PACKAGED EQUIPMENT
X = EQUIPMENT SIZE
Y = TYPE (KW, KVA, OR HP AS INDICATED)

GENERATOR
RATINGS AS INDICATED

TRANSFER SWITCH (MANUAL OR AUTOMATIC). RATINGS AS INDICATED

X — METERING DEVICE
X = METER TYPE

WHM	WATT HOUR METER
WM	WATT METER
AM	AMMETER
VM	VOLTMETER
PFM	POWER FACTOR METER

480/120 — (3) — POTENTIAL TRANSFORMER
RATIO AND NUMBER OF PT'S AS INDICATED

100/5 — (3) — CURRENT TRANSFORMER
RATIO AND NUMBER OF CT'S AS INDICATED

GROUND FAULT CURRENT TRANSFORMER
RATIO AS INDICATED

5A — FUSE
SIZE AS INDICATED

X * — MOTOR
X = HORSEPOWER
* = FULL LOAD AMPS

DELTA-WYE TRANSFORMER WITH SECONDARY KVA SIZE AND VOLTAGE RATIO AS INDICATED

MOV — ELECTRICAL MOTOR OPERATED VALVE, WITH INTEGRAL REVERSING STARTER

30A — DISCONNECT SWITCH
SIZE AS INDICATED

30A / 30A — FUSED DISCONNECT SWITCH
SIZE AS INDICATED

SPD — SURGE PROTECTIVE DEVICE

SSM — SOLID STATE METERING DEVICE

SSMP — SOLID STATE MOTOR PROTECTIVE DEVICE

L O R — THREE - POSITION SELECTOR SWITCH

VACUUM OR PRESSURE SWITCH
CLOSE ON RISING PRESSURE

VACUUM OR PRESSURE SWITCH
OPEN ON RISING PRESSURE

FLOAT LEVEL SWITCH
CLOSE ON RISING LEVEL

FLOAT LEVEL SWITCH
OPEN ON RISING LEVEL

NORMALLY OPEN

NORMALLY CLOSED

NORMALLY OPEN HELD CLOSED

NORMALLY CLOSED HELD OPEN

TEMPERATURE SWITCH
CLOSE ON RISING TEMPERATURE

TEMPERATURE SWITCH
OPEN ON RISING TEMPERATURE

FLOW SWITCH
CLOSE ON INCREASING FLOW

FLOW SWITCH
OPEN ON INCREASING FLOW

E-STOP PUSHBUTTON

X — CONTROL RELAY OR COIL
X = DEVICE

CR	CONTROL RELAY
TD	TIME DELAY RELAY (TIMING RANGE AS INDICATED)
M	MOTOR STARTER
PC	PHOTOCELL

NORMALLY OPEN CONTACT

NORMALLY CLOSED CONTACT

TIMED CONTACTS
CONTACT ACTION IS DELAYED AFTER COIL IS:

ENERGIZED

TD1 — NORMALLY OPEN WITH TIME DELAY CLOSING

TD1 — NORMALLY CLOSED WITH TIME DELAY OPENING

DE-ENERGIZED

TD1 — NORMALLY OPEN WITH INSTANT CLOSING AND TIME DELAY OPENING

TD1 — NORMALLY CLOSED WITH INSTANT OPENING AND TIME DELAY CLOSING

START — NORMALLY OPEN PUSHBUTTON (MOMENTARY)

STOP — NORMALLY CLOSED PUSHBUTTON (MOMENTARY)

OFF ON — NO/NC MAINTAINED PUSHBUTTON

SECURITY SYMBOLOGY

VC — VIDEO CAMERA
F FIXED
PTZ PAN-TILT-ZOOM

SECURITY ACCESS DEVICE
* = TYPE
CR CARD READER
PS DIGITAL KEYPAD

X — PILOT LIGHT
X = LENS COLOR

R	RED
G	GREEN
A	AMBER
W	WHITE

X — PILOT LIGHT (PUSH-TO-TEST)
X = LENS COLOR (SEE ABOVE)

HORN

ETM — ELAPSED TIME METER

HEATER

GROUND CONNECTION

CROSSING OF CONDUCTORS - NOT CONNECTED

CROSSING OF CONDUCTORS - CONNECTED

FUSE

VOLTAGE SURGE SUPPRESSOR

RECEPTACLES

X-# — 120V DUPLEX RECEPTACLE, NEMA CONFIGURATION 5-20R (WALL MOUNT)
X = PANELBOARD DESIGNATION
# = CIRCUIT DESIGNATION
* = TYPE

WP	WEATHERPROOF
XP	EXPLOSION PROOF
GFCI	GROUND FAULT CIRCUIT INTERRUPTER

CONDUIT AND RACEWAY SYMBOLOGY

EXPOSED OR CONCEALED CONDUIT

CONDUIT RUN (UNDERGROUND OR IN CONCRETE)

CONDUIT RUN (CHANGE IN ELEVATION)

CONDUIT TURNING UP

CONDUIT TURNING DOWN

CONDUITS GROUPED TOGETHER BUT SHOWN AS A SINGLE LINE FOR CLARITY

CONDUIT FROM FLOOR ABOVE TO FLOOR BELOW

CONDUIT CAPPED, OR SEALED

J — JUNCTION BOX OR FITTING

HH — HAND HOLE (CLOSED BOTTOM)

MISC. ELECTRICAL SYMBOLOGY

POWER PANEL

DISCONNECT SWITCH

M — MOTOR

T — THERMOSTAT

HORN

COMBINATION STARTER

GROUNDING SYMBOLOGY

GROUND ROD AND GROUND WELL

GROUND ROD (3/4" X 10'-0")

GROUND CONNECTION - BOLTED TYPE

GROUND CONNECTION - EXOTHERMIC TYPE

BARE COPPER GROUND TO GROUND WIRE IN SLAB, OR UNDERGROUND GROUND GRID, SIZE AS NOTED

EARTH GROUNDING

ELECTRICAL ABBREVIATIONS

A	AMPERE, AUTOMATIC
AC	ALTERNATING CURRENT
AF	AMPS, FRAME SIZE (CB)
AHF	ACTIVE HARMONIC FILTER
AM	AMMETER
ANN	ANNUNCIATOR
AS	ADJUSTABLE SPEED
AT	AMPERE TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AWG	AMERICAN WIRE GAUGE
BATT	BATTERY
BC	BARE COPPER
BKR	BREAKER
C	CONDUIT, CLOSED
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CLF	CURRENT LIMITING FUSE
COM	COMMON
COMM	COMMUNICATIONS
COMP	COMPARTMENT
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CPU	CLARK PUBLIC UTILITIES
CR	CONTROL RELAY, CARD READER
CS	CONDUIT SEAL
CT	CURRENT TRANSFORMER
DCS	DISTRIBUTED CONTROL SYSTEM
DISC	DISCONNECT
DISTR	DISTRIBUTION
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DS	DISCONNECT SWITCH
E	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
ENCL	ENCLOSURE
ETM	ELAPSED TIME METER
F	FREQUENCY, FUSE, FIXED
FDR	FEEDER
FLA	FULL LOAD AMPS
FLUOR	FLUORESCENT
FM	FREQUENCY METER
FO	FIBER OPTIC
FVR	FULL VOLTAGE REVERSING
FVNR	FULL VOLTAGE NON-REVERSING
GEN	GENERATOR
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
G, GND	GROUND
H	HAND
HD	HEAT DETECTOR
HH	HAND HOLE
HID	HIGH INTENSITY DISCHARGE
HOA	HAND-OFF-AUTOMATIC
HPS	HIGH PRESSURE SODIUM
HS	HAND SWITCH
HZ	HERTZ
IMC	INTERMEDIATE METALLIC CONDUIT
INCAND	INCANDESCENT
IND	INDICATION
INST	INSTANTANEOUS
I/O	INPUT/OUTPUT
Isc	SHORT CIRCUIT CURRENT, AMPS
ISO	ISOLATION
J, JB	JUNCTION BOX
KA	KILO AMPERES
KAIC	KILO AMP INTERRUPTING CURRENT
KCMIL	KILO CIRCULAR MILS
KVA	KILOVOLT AMPERE
L	LOCAL
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LOC	LOCAL
LOR	LOCAL-OFF-REMOTE
LOS	LOCKOUT STOP PUSHBUTTON
LP	LIGHTING PANEL
LRA	LOCKED ROTOR AMPS
LS	LEVEL SWITCH, LONG SWEEP (CONDUIT ELBOW)
LSIG	LONG, SHORT, INSTANTEOUS, GROUND FAULT (CIRCUIT BREAKER SETTINGS)
LTG	LIGHTING
LTS	LIGHTS
M	MOTOR CONTACTOR COIL
mA	MILLIAMPERE
MCP	MOTOR CIRCUIT PROTECTOR
MLO	MAIN LUGS ONLY
MOV	MOTOR OPERATED VALVE
MS	MANUAL MOTOR STARTER
MTS	MANUAL TRANSFER SWITCH
(N)	NEW
NEUT	NEUTRAL
NP	NAMEPLATE
O	OPEN, OFF
OF, CI	OWNER FURNISHED, CONTRACTOR INSTALLED
OL	OVERLOAD
PA	PUBLIC ADDRESS
PB	PUSHBUTTON, PULLBOX
PC	PHOTOCELL
PCM	PROCESS CONTROL MODULE
PF	POWER FACTOR
PFM	POWER FACTOR METER
PH	PHASE
PL	PILOT LIGHT
PN	PANELBOARD
PNLBD	PROFINET
PP	POWER PANELBOARD
POS	POSITION
POT	POTENTIOMETER
PRI	PRIMARY
PT	POTENTIAL TRANSFORMER
PTZ	PAN-TILT-ZOOM
PWR	POWER
R	REMOTE
RECPT	RECEPTACLE
RGS	RIGID GALVANIZED STEEL
RMS	ROOT MEAN SQUARE
RTU	REMOTE TERMINAL UNIT
RVSS	REDUCED VOLTAGE SOLID STATE
SEL SW	SELECTOR SWITCH
SEQ	SEQUENCE
SHC	SODIUM HYPOCHLORITE, NaClO / NaOCl
SHLD	SHIELD / SHIELDED
SIG	SIGNAL
SP	SPARE
SP HTR	SPACE HEATER
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SSM	SOLID STATE METER
SSMP	SOLID STATE MOTOR PROTECTOR
ST, SH	SHUNT TRIP
STR	STARTER
SSTU	SOLID STATE TRIP UNIT
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
TACH	TACHOMETER
TB	TERMINAL BOX
TERM	TERMINAL
TM	REPEAT CYCLE TIMER
TD	TIME DELAY RELAY
TS	TEMPERATURE SWITCH
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTAGE, VOLTS
VA	VOLT AMPERE
VAR	VOLT AMPERE REACTIVE
VFD	VARIABLE FREQUENCY DRIVE
VM	VOLTMETER
VP	VAPOR PROOF
VSD	VARIABLE SPEED DRIVE
W	WATTS, WIRE
WM	WATT METER
WP	WEATHERPROOF
XFMR	TRANSFORMER
XMTR	TRANSMITTER
XP	EXPLOSION PROOF
~ (TILDE)	APPROXIMATE(LY)

GENERAL ELECTRICAL NOTES

1. ALL RACEWAYS AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC) AND APPLICABLE LOCAL CODES. PROVIDE NEUTRAL TO GROUND LINKS AS REQUIRED BY THE AUTHORITY HAVING JURIDICTION (AHJ).
2. THE CONTRACTOR SHALL VERIFY THE EXACT LOCATION OF TERMINAL BOXES AND CONDUIT ENTRANCES OF ALL EQUIPMENT AGAINST APPROVED SHOP DRAWINGS BEFORE STUBBING UP CONDUITS.
3. REFER TO SPECIFICATION SECTION 26 05 33 FOR REQUIREMENTS RELATED TO FLEXIBLE CONDUIT INSTALLATION.
4. CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT OR STRUCTURAL CONDITIONS. EXPOSED CONDUIT SHALL BE INSTALLED PARALLEL OR PERPENDICULAR TO BEAMS AND WALLS.
5. ALL SURFACE MOUNTED PANELS AND PANELBOARDS ON WALLS OR IN OTHER LOCATIONS CONSIDERED DAMP OR WET SHALL BE MOUNTED SO AS TO MAINTAIN AN 1/2-INCH (MINIMUM) AIR SPACE BETWEEN THE ENCLOSURE AND THE WALL.
6. LOCATION OF PULLBOXES ARE APPROXIMATE. THE CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH PIPING AND OTHER UTILITIES. PULLBOXES SHALL BE 6 INCHES (MINIMUM) AWAY FROM PIPING, ETC.
7. THE CONTRACTOR SHALL PROVIDE ADDITIONAL PULLBOXES WHERE REQUIRED TO MAKE A WORKABLE INSTALLATION.
8. THE WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE DETAILS WHETHER OR NOT THEY ARE REFERENCED ON THE DRAWINGS.
9. CONNECTIONS BETWEEN RIGID CONDUIT AND EQUIPMENT SUBJECT TO VIBRATION SHALL BE FLEXIBLE LIQUID-TIGHT CONDUIT.
10. CONDUITS SHALL BE TERMINATED SO AS TO PERMIT NEAT CONNECTION TO EQUIPMENT.
11. ELECTRICAL CONTRACTOR SHALL VISIT THE SITE PRIOR TO BIDDING THE PROJECT TO VERIFY THE SCOPE OF WORK WITH FIELD CONDITIONS. PARTICULAR ATTENTION SHOULD BE GIVEN TO NEW CONDUIT RUNS AT EXISTING SITES.
12. EQUIPMENT LOCKOUTS SHALL BE IN STRICT ACCORDANCE WITH OWNER'S REQUIREMENTS AND PERFORMED BY THE CONTRACTOR.
13. CONTRACTOR SHALL PROVIDE ALL NECESSARY CONDUITS, WIRES,FITTINGS, JUNCTION BOXES AND ALL NECESSARY COMPONENTS SHOWN OR NOT SHOWN ON THE DRAWINGS, TO MAKE THE ELECTRICAL INSTALLATION COMPLETE AND OPERATIONAL. ALL CONDUIT RUNS SHALL BE CONCEALED UNLESS INDICATED OTHERWISE.
14. ALL BELOW GRADE PVC CONDUIT SHALL BE SCHEDULE 80 IN ACCORDANCE WITH SECTIONS 26 05 33 AND 26 05 43.

ELECTRICAL DEMOLITION NOTES

1. BIDDING CONTRACTORS SHALL VISIT THE SITE TO ASSESS THE SCOPE OF DEMOLITION, REMOVAL AND MODIFICATION WORK.
2. ELECTRICAL CONTRACTOR AND THE OWNER SHALL DE-ENERGIZE ALL WIRING PRIOR TO REMOVAL OF EQUIPMENT, DEVICES, MOTORS INSTRUMENTATION, CONTROL PANELS, ETC. CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FROM THE OWNER.
3. EXPOSED RACEWAYS: REMOVE CONDUIT, WIRES, AND BOXES. PATCH TO MATCH EXISTING. FINISH-ALL OPENINGS IN WALLS AND FLOORS.
4. CONCEALED CONDUITS IN THE SLAB: REMOVE EXISTING WIRES TO THE EXTENT POSSIBLE AND ABANDON CONDUITS IN THE SLAB. CUT CONDUIT FLUSH AND PATCH THE FLOOR TO MATCH EXISTING.
5. CONTROL PANEL: ELECTRICAL CONTRACTOR SHALL DE-ENERGIZE AND REMOVE ALL CONDUIT AND WIRE AS DESCRIBED IN NOTE 2. CONTRACTOR SHALL REMOVE PANELS AS NOTED ON THE CONTRACT DRAWINGS. REFER TO NOTE 4 ABOVE FOR DISPOSITION OF ENCASED CONDUITS.
6. MOTOR CONTROL CENTERS: DISCONNECT AND REMOVE ALL CONDUITS AND WIRING TO EXISTING STARTERS AND/OR BREAKERS, PANELBOARDS, BRANCH CIRCUITS, INTERLOCKS AND STATUS WIRING WITHIN MCC. REFER TO SECTION 26 00 00 FOR ADDITIONAL ELECTRICAL DEMOLITION AND REMOVAL REQUIREMENTS.

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No.	Revision	By	Appd	YYYY.MM.DD
0				

Issued	By	Appd	YYYY.MM.DD
C	IFC	JD	JD	2024.01.23
B	90% DESIGN REVIEW	AB	JD	2023.11.21
A	30% DESIGN REVIEW	AB	JD	2023.07.14

Permit/Seal

PROFESSIONAL ENGINEER — LICENSED — 16665 — STATE OF IDAHO — JOHN C. DEERKOP

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: 03233E-0XX

Scale: NO SCALE

JCD	JCD	MG	2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

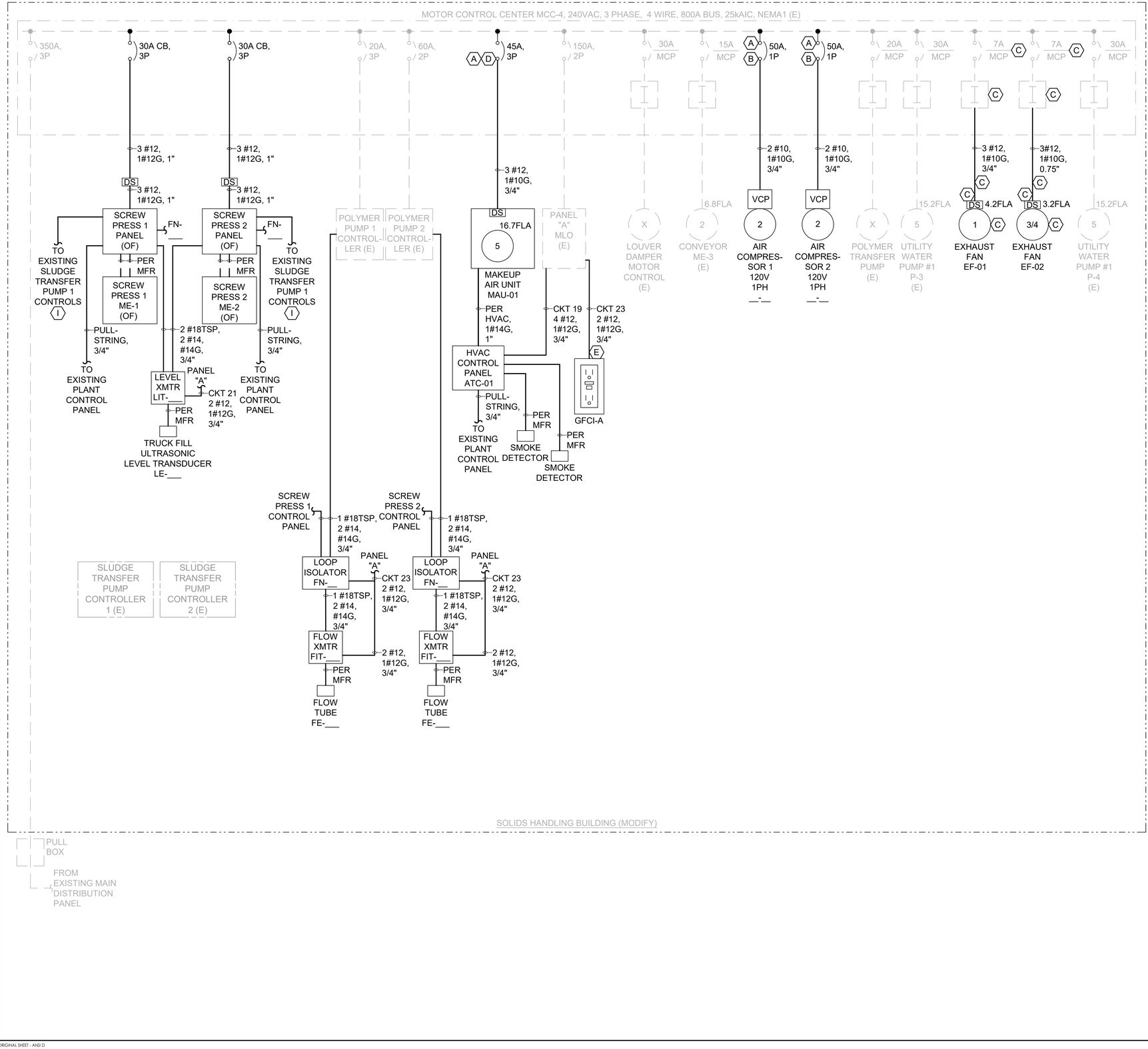
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GENERAL NOTES, SYMBOLS AND ABBREVIATIONS

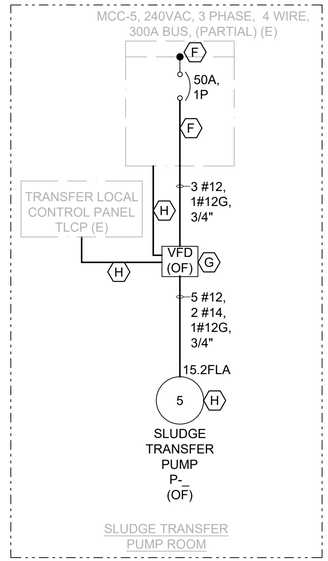
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Drawing No.
E-001

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ORIGINAL SHEET - ANSI D





GENERAL SHEET NOTES

1. SEE THE GENERAL NOTES AND SPECIFICATIONS FOR ADDITIONAL INFORMATION.
2. INFORMATION FOR EXISTING EQUIPMENT, CONDUIT AND WIRES WAS PROVIDED BY OTHERS. THE CONTRACTOR SHALL FIELD VERIFY ALL EXISTING CONDITIONS IMPACTED BY THE WORK.
3. PROVIDE NEW PHENOLIC NAMEPLATES FOR MODIFIED OR DECOMMISIONED MCC BUCKETS.
4. PROVIDE A NEW UPDATED CIRCUIT DIRECTORY FOR PANELBOARD "A".

SHEET KEYNOTES

A. SALVAGE EXISTING CIRCUIT BREAKER OR MCP. PROVIDE NEW CIRCUIT BREAKER AS SHOWN.

B. CONNECT EACH OF THE SINGLE POLE CIRCUIT BREAKERS TO THE 120VAC SINGLE PHASE BUS BARS, NOT TO THE 208V HIGH LEG BUS BAR.

C. REMOVE EXISTING ROOF EXHAUST FANS F-1 AND F-2. PROVIDE CONDUIT, WIRES, CONTROLS AND APPURTENANCES TO CONNECT NEW EXHAUST FANS EF-01 AND EF-02. PROVIDE NEW MOTOR CIRCUIT PROTECTORS AND THERMAL OVERLOADS IN THE EXISTING MCC IF REQUIRED. WIRE THE MOTOR STARTERS TO USE THE "SLOW" SPEED CONTACTOR ONLY. THE FAN SHALL USE THE "HAND/OFF" POSITIONS OF THE H/O/A SWITCH ONLY. SEE THE HVAC DRAWINGS FOR ADDITIONAL INFORMATION INCLUDING EXISTING FIELD DEVICES TO BE REMOVED. FAN DISCONNECTS SHALL BE FURNISHED BY THE FAN SUPPLIER.

D. REPLACE THE EXISTING 50 AMP 3-POLE CIRCUIT BREAKER WITH ONE TO MATCH THE MAU MANUFACTURER'S LISTED MAXIMUM OVERCURRENT PROTECTION.

E. PROVIDE A DUPLEX GFCI-A 120VAC RECEPTACLE WITH A WATERPROOF WHILE-IN-USE COVER ON THE ROOF NEAR THE ACCESS HATCH.

F. SALVAGE EXISTING MCP. PROVIDE NEW CIRCUIT BREAKER AS SHOWN AND BYPASS EXISTING MOTOR STARTER.

G. CONNECT NEW VFD "RUN" AND "SPEED COMMAND" INPUTS TO EXISTING SIMILAR CONTROL CIRCUITS FOR THE EXISTING PUMP.

H. DEMOLISH EXISTING PUMP MOTOR. PROVIDE NEW INVERTER DUTY RATED MOTOR WITH MOTOR WINDING THERMOSTATS AND MOTOR WINDING HEATER. WIRE THERMOSTAT TO VFD ALARM INPUT. WIRE HEATER TO UNUSED CIRCUIT IN PANELBOARD "B" AND CONTROL RELAY SO HEATER IS ENERGIZED WHEN MOTOR IS NOT RUNNING.

I. DOCUMENT AND DISCONNECT THE EXISTING BELT PRESS CONTROL WIRES TO THE EXISTING SLUDGE TRANSFER PUMPS CONTROLS. CONNECT NEW SCREW PRESS CONTROL PANEL DRY RELAY CONTACTS TO THE EXISTING SLUDGE TRANSFER PUMPS CONTROLS SIMILAR TO THE EXISTING CONTROLS. TEST CONDITION OF EXISTING CONTROL WIRES AND REPLACE IF NEEDED.

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Permit/Seal



2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: 03233E-0XX
Scale: NO SCALE

JCD	JCD	MG	2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SOLIDS HANDLING BUILDING SINGLE LINE DIAGRAM

Revision: Sheet: of XX

Drawing No.
1E-601

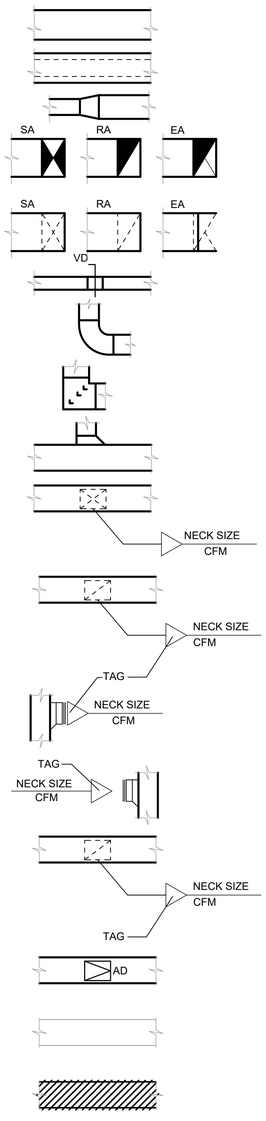
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ORIGINAL SHEET - ANSI D

ABBREVIATIONS

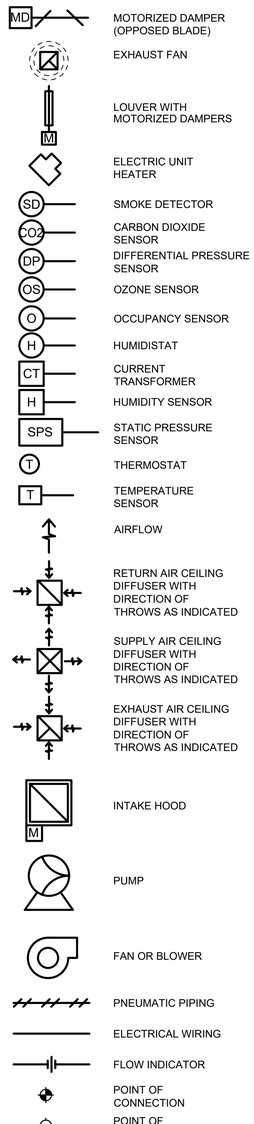
A	
AC	AIR CONDITIONING UNIT
AFF	ABOVE FINISHED FLOOR
AF	AIR FLOW
AI	ANALOG INPUT
ALT	ALTITUDE
AHU	AIR HANDLING UNIT
ARCH	ARCHITECT(URAL)
APD	AIR PRESSURE DROP
AUTO	AUTOMATIC
AUX	AUXILIARY
ATC	AUTOMATIC TEMP CONTROL
B	
B	BOILER
B/	BOTTOM OF
BI	BINARY INPUT
BHP	BRAKE HORSE POWER
BTU	BRITISH THERMAL UNIT
BLDG	BUILDING
BO	BINARY OUTPUT
C	
CDR	CONDENSER WATER RETURN
CDS	CONDENSER WATER SUPPLY
CFM	CUBIC FEET PER MINUTE
CH	CHILLER
CT	COOLING TOWER
CU	CONDENSING UNIT
CWR	CHILLED WATER RETURN
CWS	CHILLED WATER SUPPLY
CA	COMBUSTION AIR
CC	COOLING COIL
COP	COEFFICIENT OF PERFORMANCE
CLR	CENTERLINE RADIUS
CT	CURRENT TRANSFORMER
CD	CONDENSATE DRAIN
D	
DB	DRY BULB TEMPERATURE
DIA	DIAMETER
DISCH	DISCHARGE
DL	DOOR LOUVER
DWG	DRAWING
DSD	DUCT SMOKE DETECTOR
E	
EA	EXHAUST AIR
EAT	ENTERING AIR TEMPERATURE
ECM	ELECTRONICALLY COMMUTATED MOTOR
EER	ENERGY EFFICIENCY RATIO
EF	EXHAUST FAN
EL	ELEVATION
ESP	EXTERNAL STATIC PRESSURE
EAT	ENTERING AIR TEMPERATURE
EFF	EFFICIENCY
ELEC	ELECTRIC(AL)
EMS	ENERGY MANAGEMENT SYSTEM
EWT	ENTERING WATER TEMPERATURE
EXISTING	EXIST (E)
F	
FCU	FAN COIL UNIT
FD	FIRE DAMPER
FRP	FIBER-REINFORCED PLASTIC
°F	DEGREE FAHRENHEIT
FCV	FLOW CONTROL VALVE
FD	FLOOR DRAIN
FL	FLOOR
FLA	FULL LOAD AMPS
FP	FIRE PROTECTION
FPM	FEET PER MINUTE
FT	FEET OR FOOT
G	
GAL	GALLON
GND	GROUND
GPM	GALLONS PER MINUTE
H	
H	HUMIDISTAT
HB	HOSE BIB
HP	HORSEPOWER
HPU	HEAT PUMP UNIT
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HZ	HERTZ
I	
IH	INTAKE HOOD
IN	INCH
INV	INVERT
K	
KW	KILOWATT
L	
LV	LOUVER
LAT	LEAVING AIR TEMPERATURE
LBS	POUNDS
LAT	LEAVING AIR TEMPERATURE
LWT	LEAVING WATER TEMPERATURE
M	
MD	MOTORIZED DAMPER
MAU	MAKE-UP AIR HANDLING UNIT
MBH	THOUSAND BTU PER HOUR
MCA	MINIMUM CIRCUIT AMPACITY
MTD	MOUNTED
MCC	MOTOR CONTROL CENTER
MFR	MANUFACTURE(ER)(ED)
MISC	MISCELLANEOUS
MPD	MEDIUM PRESSURE GAS
N	
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
NTS	NOT TO SCALE
N/A	NOT APPLICABLE
NEG	NEGATIVE
NPSH	NET POSITIVE SUCTION HEAD
O	
OA	OUTSIDE AIR
OAT	OUTSIDE AIR TEMPERATURE
OBD	OPPOSED BLADE DAMPER
OD	OUTDOOR AMBIENT TEMPERATURE
OD	OUTSIDE DIAMETER
P	
P	PUMP
PW	POTABLE WATER
PD	PRESSURE DROP
PH	PHASE
POC	POINT OF CONNECTION
PPM	PARTS PER MILLION
PRES	PRESSURE
PRF	PRE FILTER
PRV	PRESSURE REDUCING VALVE
PSIG	POUNDS PER SQUARE INCH GAGE
PVC	POLY-VINYL CHLORIDE
Q	
QTY	QUANTITY
R	
RA	RETURN AIR
RF	RETURN FAN
RPM	REVOLUTIONS PER MINUTE
REF	REFERENCE
RH	RELATIVE HUMIDITY (PERCENT)
RLA	RATED LOAD AMPS
RPBP	REDUCE PRESSURE BACKFLOW PREVENTOR
S	
SA	SUPPLY AIR
SCR	SILICON CONTROLLED RECTIFIER
SD	SMOKE DETECTOR
SEER	SEASONAL ENERGY EFFICIENCY RATIO
SEN	SENSIBLE HEAT
SF	SUPPLY FAN
SS	STAINLESS STEEL
SCFM	STANDARD CFM
SOV	SHUT OFF VALVE
SP	STATIC PRESSURE
SQFT	SQUARE FEET (OR FOOT)
STD	STANDARD
T	
T	THERMOSTAT
TA	TRANSFER AIR
TBD	TO BE DETERMINED
TYP	TYPICAL
U	
UG	UNDERGROUND
UTR	UP THROUGH ROOF
UH	UNIT HEATER
V	
VD	VOLUME DAMPER
V-PH-C	VOLTS-PHASE-CYCLE
V	VOLT(AGE)
VB	VACUUM BREAKER
VEL	VELOCITY
VTR	VENT THROUGH ROOF
W	
WB	WET BULB
WG	WATER GAUGE
WH	WATER HEATER
W/	WITH
W/O	WITHOUT
WC	WATER COLUMN
WT	WEIGHT

LEGEND



- DUCTWORK
- DUCTWORK WITH DUCT LINING
- REDUCER OR INCREASER
- SUPPLY DUCTWORK RISE UP TO FLOOR ABOVE, RETURN DUCTWORK DROP DOWN FROM FLOOR ABOVE, AND EXHAUST DUCTWORK DROP DOWN FROM FLOOR ABOVE
- SUPPLY DUCTWORK DROP DOWN TO BELOW RETURN DUCTWORK RISE UP FROM BELOW, AND EXHAUST DUCTWORK RISE UP FROM BELOW
- VOLUME DAMPER (VD)
- RADIUS ELBOW (CLR=1.5)
- ELBOW WITH TURNING VANES
- BRANCH DUCT TAKE-OFF
- DIFFUSER
- CEILING RETURN REGISTER OR GRILLE
- SUPPLY AIR GRILLE (G) OR SUPPLY AIR REGISTER (R)
- RETURN AND/OR EXHAUST AIR GRILLE (G) OR REGISTER (R)
- CEILING EXHAUST AIR REGISTER OR GRILLE
- ACCESS DOOR (AD)
- EXISTING DUCT TO REMAIN
- EXISTING DUCT TO BE REMOVED

EQUIPMENT SYMBOLS



- MOTORIZED DAMPER (OPPOSED BLADE)
- EXHAUST FAN
- LOUVER WITH MOTORIZED DAMPERS
- ELECTRIC UNIT HEATER
- SMOKE DETECTOR
- CARBON DIOXIDE SENSOR
- DIFFERENTIAL PRESSURE SENSOR
- OZONE SENSOR
- OCCUPANCY SENSOR
- HUMIDISTAT
- CURRENT TRANSFORMER
- HUMIDITY SENSOR
- STATIC PRESSURE SENSOR
- THERMOSTAT
- TEMPERATURE SENSOR
- AIRFLOW
- RETURN AIR CEILING DIFFUSER WITH DIRECTION OF THROWS AS INDICATED
- SUPPLY AIR CEILING DIFFUSER WITH DIRECTION OF THROWS AS INDICATED
- EXHAUST AIR CEILING DIFFUSER WITH DIRECTION OF THROWS AS INDICATED
- INTAKE HOOD
- PUMP
- FAN OR BLOWER
- PNEUMATIC PIPING
- ELECTRICAL WIRING
- FLOW INDICATOR
- POINT OF CONNECTION
- POINT OF DISCONNECTION
- ℄ CENTERLINE
- ø DIAMETER

DUCTWORK MATERIAL SCHEDULE

LOCATION	MATERIAL	REMARKS
ALL AREAS UNLESS OTHERWISE NOTED	FRP	-

NOTES:
1. GALVANIZED SHEET METAL IS NOT ACCEPTABLE IN ANY AREA

DUCTWORK INSULATION AND LINER

LOCATION	REQUIREMENT	REMARKS
ALL CONCEALED DUCTWORK	INSULATE	
ALL EXTERIOR DUCTWORK	INSULATE	WITH SS JACKET
OUTSIDE AIR DUCTWORK	INSULATE	
SUPPLY AIR DUCTWORK	NONE	ONLY IF IN CONDITIONED SPACE
EXHAUST AIR DUCTWORK	NONE	NONE

NOTES:
1. REFER TO SPECIFICATION FOR THICKNESS. MINIMUM R-VALUES SHALL MEET CURRENT IECC AND LOCAL REQUIREMENTS.
2. FREE INSIDE DUCTWORK DIMENSION SHALL BE MAINTAINED ON LINED DUCTWORK.

GENERAL HVAC NOTES

1. SCOPE OF WORK
   - 1.1. THE HVAC CONTRACTOR IS RESPONSIBLE FOR ALL WORK, MATERIALS, AND LABOR TO SATISFY A COMPLETE WORKING SYSTEM WHETHER SPECIFIED OR IMPLIED.
   - 1.2. ALL WORK IS TO BE PERFORMED IN STRICT COMPLIANCE WITH THE INTERNATIONAL MECHANICAL CODE, ALL LOCAL CODES AND ALL OTHER REGULATIONS GOVERNING THE WORK OF THIS NATURE.
   - 1.3. BEFORE SUBMITTING ANY PROPOSAL, THE HVAC CONTRACTOR SHALL EXAMINE THE PROPOSED SITE AND SHALL DETERMINE THE CONDITIONS THAT MAY AFFECT THE WORK. NO ALLOWANCE SHALL BE MADE BECAUSE THE HVAC CONTRACTOR FAILS TO MAKE SUCH EXAMINATIONS.
   - 1.4. ALL EQUIPMENT AND MATERIALS SHALL BE AS SPECIFIED OR "APPROVED EQUAL" BY THE ENGINEER.THE EQUIPMENT SPECIFIED ON THE DRAWINGS HAVE BEEN SELECTED AS THE BASIS OF DESIGN. THE USE OF REVIEWED OR SPECIFIED EQUALS SHALL BE COORDINATED BY THE CONTRACTOR AS TO SPACE REQUIREMENTS, EQUIPMENT DIMENSIONS AND PERFORMANCE. ANY ADDITIONAL COSTS EITHER DIRECTLY OR INDIRECTLY CAUSED BY EQUALS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR
   - 1.5. DRAWINGS ARE DIAGRAMMATIC AND SHOW THE GENERAL DESIGN INTENT, ARRANGEMENT AND EXTENT OF SYSTEMS. DO NOT SCALE DRAWINGS NOR USE AS SHOP DRAWINGS. THE HVAC CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS OF THE EQUIPMENT AND ENSURE THAT IT WILL FIT IN THE AVAILABLE SPACE. WHERE ALTERNATE ROUTING, OFFSETS AND TRANSITIONS ARE REQUIRED FOR FIELD COORDINATION OF ALL TRADES, THIS CONTRACTOR SHALL MAKE CHANGES WITHOUT ADDITIONAL COSTS.
2. SHOP DRAWINGS
   - 2.1. REFER TO THE SPECIFICATIONS FOR SHOP DRAWING REQUIREMENTS.
3. DUCTWORK
   - 3.1. DUCTWORK MATERIAL SHALL BE PER SCHEDULE ON THIS SHEET.
   - 3.2. DUCTWORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH SMACNA STANDARDS. ALL DUCTWORK SHALL BE THE LOW VELOCITY TYPE, UNLESS SPECIFIED OTHERWISE.
   - 3.3. THE HVAC CONTRACTOR SHALL PROVIDE AND INSTALL APPROVED FIRE DAMPERS AND PANELS IN ALL DUCTWORK THAT PENETRATES A HORIZONTAL OR VERTICAL FIRE PARTITION. UNLESS OTHERWISE SHOWN ON THE DRAWINGS.
   - 3.4. ALL BRANCH DUCTS SHALL HAVE VOLUME DAMPERS.
   - 3.5. WHERE FLOW EXCEEDS 150 CFM, THE CONTRACTOR SHALL USE SMOOTH RADIUS ELBOWS OR TURNING VANES.
   - 3.6. ALL DUCT JOINTS SHALL BE SEALED IN ACCORDANCE WITH SMACNA STANDARDS AND ACCEPTED GOOD PRACTICE.
   - 3.7. ALL DUCT DIMENSIONS ARE NET INSIDE VALUES. DIMENSIONS MAY BE CHANGED PROVIDED THAT THE NET FREE AREA IS MAINTAINED.
4. HVAC CONTROLS
   - 4.1. THE HVAC CONTRACTOR SHALL SUPPLY AND INSTALL ALL CONTROL WIRING AND THERMOSTATS AS REQUIRED.
5. ELECTRICAL
   - 5.1. THE HVAC CONTRACTOR SHALL COORDINATE WITH THE ELECTRICAL CONTRACTOR FOR LOCATION OF POWER WIRING TO EACH HVAC UNIT.
6. DUCTWORK AND PIPE SUPPORTS
   - 6.1. ALL DUCTWORK AND PIPE SHALL BE SUPPORTED FROM THE BUILDING STRUCTURE IN A NEAT AND WORKMANLIKE MANNER. THE USE OF WIRE OR METAL STRAPS TO SUPPORT PIPES WILL NOT BE PERMITTED. SPACING OF PIPE SUPPORTS SHALL NOT EXCEED 8 FEET FOR ALL PIPING. PLASTIC PIPING SHALL BE SUPPORTED EVERY 4 FEET.
7. MISCELLANEOUS
   - 7.1. WIND RESISTANCE: EXTERIOR MECHANICAL EQUIPMENT SHALL BE ANCHORED/TIED DOWN TO STRUCTURE OR CONCRETE PADS TO RESIST THE WIND PRESSURES DETERMINED IN ACCORDANCE WITH THE INTERNATIONAL BUILDING CODE, AND LOCAL REQUIREMENTS.
   - 7.2. SEISMIC RESISTANCE: MECHANICAL SYSTEM SUPPORTS SHALL BE DESIGNED AND INSTALLED FOR THE SEISMIC FORCES IN ACCORDANCE WITH. THE INTERNATIONAL BUILDING CODE. RESTRAINTS SHALL BE DESIGN FOR THE PROJECT'S LOCATION'S SEISMIC DESIGN CATEGORY AND SEISMIC RISK CATEGORY.
   - 7.3. ALL EXTERIOR OPENINGS SHALL BE PROPERLY CAULKED AND SEALED TO PREVENT INFILTRATION OF OUTSIDE AIR INTO THE CONDITIONED SPACE.
   - 7.4. COORDINATE THE INSTALLATION OF ALL ROOF FLASHING AT ROOF PENETRATIONS.
   - 7.5. THE HVAC CONTRACTOR SHALL VERIFY ALL FIGURES, CONDITIONS, AND DIMENSIONS AT THE JOB SITE.
8. TESTING AND BALANCING
   - 8.1. THE HVAC SYSTEMS SHALL BE TESTED AND BALANCED PER SPECIFICATION 23 05 00 - HVAC TESTING AND BALANCING.
9. COMMISSIONING
   - 9.1. THE HVAC SYSTEMS SHALL BE COMMISSIONED PER SPECIFICATION 23 08 00 - HVAC COMMISSIONING
10. GUARANTEE
    - 10.1. MATERIALS, EQUIPMENT, AND INSTALLATION SHALL BE GUARANTEED PER DIVISION 1 SPECIFICATIONS.

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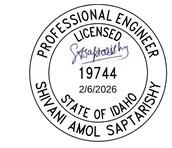
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No.	Revision	By	Appd	YYYY.MM.DD
C	IFC	SG	SS	2026.01.23
B	90% DESIGN REVIEW	SG	SS	2025.11.21
A	30% DESIGN REVIEW	SG	SS	2025.07.14
Issued		By	Appd	YYYY.MM.DD

Permit/Seal



Client/Project
CITY OF IDAHO FALLS

WAS TREATMENT DESIGN

Idaho Falls, Idaho

Project No.: 2002006427

File Name: H-001

Scale: NO SCALE

SG	SG	SHS	2026.01.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
GENERAL NOTES AND ABBREIVATION

Revision: Sheet: of

Drawing No.
H-001

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ORIGINAL SHEET - ANSI D

DESIGN SUMMARY

BUILDING NAME	AREA NAME	AREA (SF)	HEIGHT (F)	SPACE VOLUME (CUFT)	APPLICABLE CODE SECTION	NEC CLASSIFICAITON AFTER VENTILATION	BASIS OF VENTILATION	VENTILATION METHOD	COOLING METHOD	HEATING METHOD	DESIGN SPACE TEMPERATURE (°F)		MINIMUM OUTSIDE AIR (CFM)	NOTES
											WINTER	SUMMER		
SOLID HANDLING	CHEMICAL STORAGE AREA	813	14	11,382	NFPA 820 TABLE 6.2.2 ROW 12 (a)	UNCLASSIFIED	6 AIR CHANGES PER HOUR NORMAL CONTINUOUS VENTILATION	100% OUTSIDE AIR MAKE-UP AIR UNIT WITH EXHAUST FANS	NO MECHANICAL COOLING. 100% OUTSIDE AIR VENTILATION	MAKE-UP AIR HANDLING UNIT WITH INDIRECT GAS HEATING	55	104	1150	1,2
	SLUDGE LOADING AREA	600	14	8,400	NFPA 820 TABLE 6.2.2 ROW 12 (a)	UNCLASSIFIED	6 AIR CHANGES PER HOUR NORMAL CONTINUOUS VENTILATION	100% OUTSIDE AIR MAKE-UP AIR UNIT WITH EXHAUST FANS	NO MECHANICAL COOLING. 100% OUTSIDE AIR VENTILATION	MAKE-UP AIR HANDLING UNIT WITH INDIRECT GAS HEATING	55	104	850	1
	UPPER FLOOR SCREW PRESS AREA	1440	12	17,280	NFPA 820 TABLE 6.2.2 ROW 12 (a)	UNCLASSIFIED	6 AIR CHANGES PER HOUR NORMAL CONTINUOUS VENTILATION	100% OUTSIDE AIR MAKE-UP AIR UNIT WITH EXHAUST FANS	NO MECHANICAL COOLING. 100% OUTSIDE AIR VENTILATION	MAKE-UP AIR HANDLING UNIT WITH INDIRECT GAS HEATING	55	104	1750	1

1. ACCORDING TO SANDPOINT WEATHER STATION DATA, CITY OF SANDPOINT HAS SUMMER CONDITION TEMPERATURE OF 89.8° F DB, 62.5° F WB AND WINTER DESIGN CONDITION OF 6.8° F DB. THESE TEMPERATURES DO NOT REPRESENT UNPREDICTABLE EXTREME WEATHER CONDITIONS THAT MAY OCCUR.
2. THE CHEMICAL AREA IS OPEN TO SLUDGE LOADING AREA, THEREFORE NFPA 820 APPLIES TO BOTH AREAS.

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Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
19744
2/6/2026
STATE OF IDAHO
SHIVANI AMOL SAPTARISHY

Client/Project
CITY OF IDAHO FALLS

WAS TREATMENT DESIGN

Idaho Falls, Idaho

Project No.: 2002006427
File Name: H-002

Scale: NO SCALE

SG	SG	SHS	2026.01.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

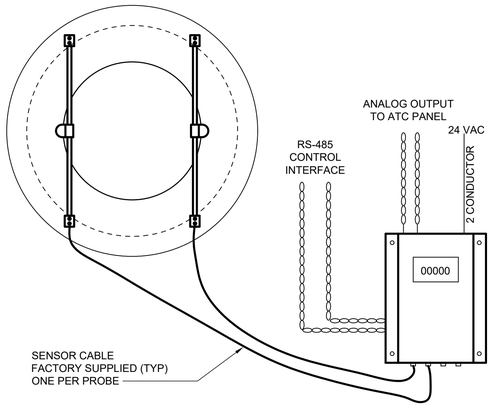
Title
HVAC DESIGN SUMMARY

Revision: Sheet: of

Drawing No.
H-002

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ORIGINAL SHEET - ANSI D



NOTES
1. CONTRACTOR SHALL INSTALL AIR FLOW MEASUREMENT STATION PER THE MANUFACTURES REQUIREMENTS AND INSTRUCTIONS.
2. CONTRACTOR SHALL COORDINATE WITH MANUFACTURE FOR APPROPRIATE REQUIRED MOUNTING STYLE OPTION FOR THE FAN INLET.
3. TRANSMITTER SHALL BE EQUIPPED WITH AN ANALOG AIRFLOW OUTPUT AND TEMPERATURE OUTPUT THAT CAN BE CONFIGURED AS AN ALARM OUTPUT. ALARM CAN BE SET AS ACTIVE HIGH, ACTIVE LOW OR SETPOINT.
4. CONNECT OUTPUT SIGNAL CABLE DRAINS TO EARTH GROUND AT ONE END ONLY.
5. ON MULTIPLE TRANSMITTER INSTALLATIONS WITH A COMMON 24 VAC SOURCE, WIRE 24 VAC POWER TO THE SAME TERMINALS ON ALL TRANSMITTERS (E.G. L1 TO L1, L2 TO L2).
6. ALL WIRING SHALL BE INSTALLED IN CONDUITS
7. CONTRACTOR SHALL INSTALL LABEL OF DESIGN AIR FLOW RATES ABOVE THE LCD DISPLAY

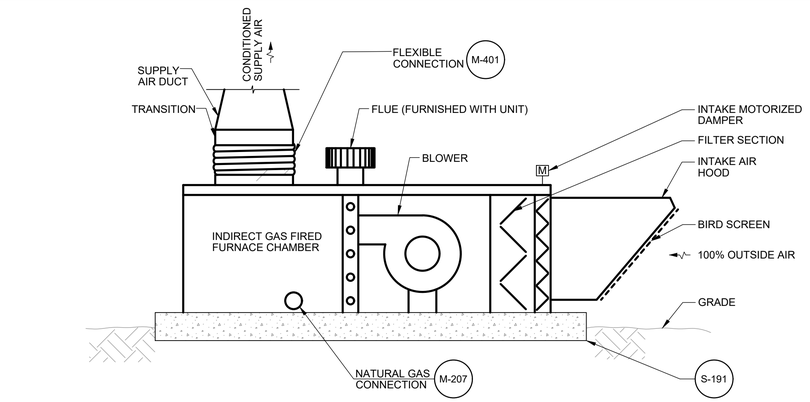
AIRFLOW MEASUREMENT STATION SCHEDULE

EQUIPMENT TAG NUMBER	SERVICE	LOCATION	MANUFACTURER & MODEL (OR EQUAL)	OPTIONS & ACCESSORIES
FS	MAU-01 EF-01, 02	MAU DISCHARGE AND EXHAUST FAN INLET	EBTRON GTX-116P	1, 2, 3, 4, 5, 6

OPTIONS & ACCESSORIES:

1. THE CONTRACTOR SHALL COORDINATE THE ACTUAL FAN THROAT, FORWARD AND FACE DIAMETER WITH THE MANUFACTURER OF THE AIRFLOW MEASURING DEVICE, AFTER THE AIR HANDLING EQUIPMENT HAS BEEN APPROVED BY THE ENGINEER.
2. AIRFLOW MEASURING DEVICE SHALL BE OF THE THERMAL DISPERSION TYPE. (REFER TO SPECIFICATION 23 09 23).
3. TRANSMITTER SHALL BE EQUIPPED WITH AN ANALOG TEMPERATURE AND AIRFLOW OUTPUT AND ETHERNET NETWORK CONNECTION.
4. TRANSMITTER SHALL BE EQUIPPED WITH LCD DISPLAY OF AIRFLOW. CONTRACTOR SHALL PROVIDE LABEL OF DESIGN AIRFLOW ABOVE DISPLAY.
5. THE CONTRACTOR SHALL INSTALL A LABEL ABOVE THE LCD DISPLAY SHOWING THE DESIGNED AIR FLOW REQUIREMENTS.
6. THE AIRFLOW MEASURING DEVICE SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.

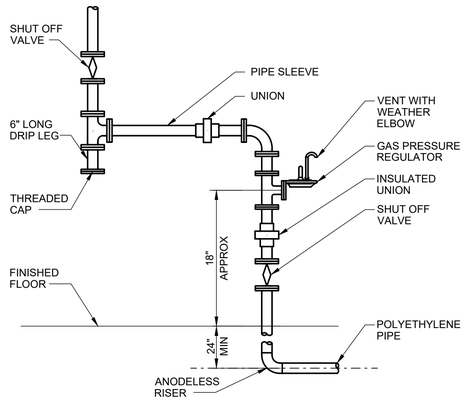
M-120 AIR FLOW MEASUREMENT ON FAN INLET
NO SCALE



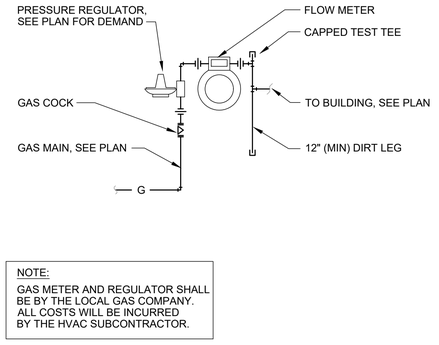
NOTES:

1. UNIT SHALL BE ANCHORED TO CONCRETE SLAB.
2. UNIT SHALL BE SHIMMED OR GROUTED AS REQUIRED TO LEVEL.

M-203 GAS FIRED MAKE UP AIR UNIT
(MOUNTED AT GRADE)
REV 010119

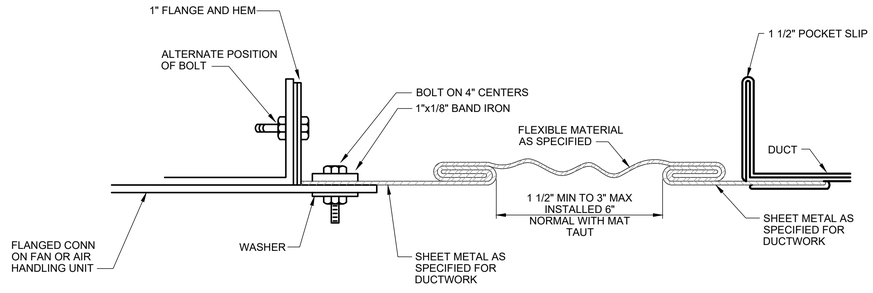


M-207 GAS PRESSURE REGULATOR
REV 010119

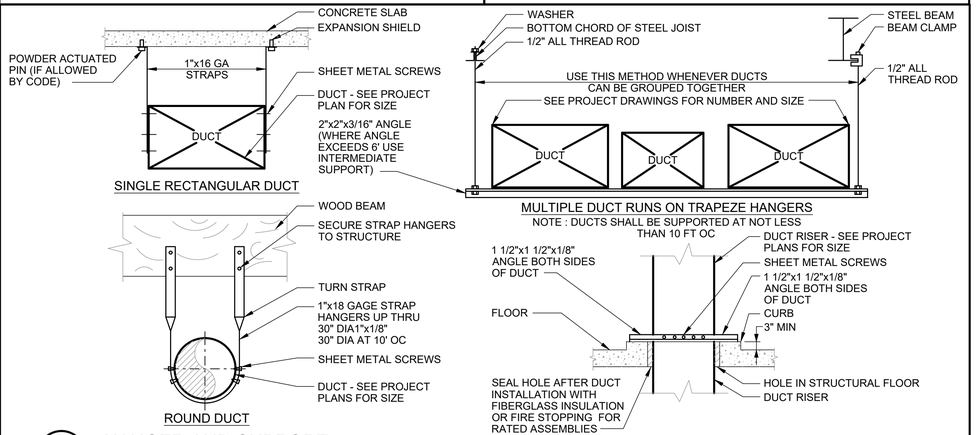


NOTE:
GAS METER AND REGULATOR SHALL BE BY THE LOCAL GAS COMPANY. ALL COSTS WILL BE INCURRED BY THE HVAC SUBCONTRACTOR.

M-208 GAS METER DETAIL
REV 010119



M-401 RECTANGULAR FLEXIBLE CONNECTION
REV 010119



M-410 HANGER AND SUPPORT
(LOW PRESSURE DUCT)
REV 010119

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		SG	SS	2023.11.21
		SG	SS	2023.07.14

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Permit/Seal

PROFESSIONAL ENGINEER LICENSED 19744 2/6/2026 STATE OF IDAHO SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF IDAHO FALLS
WAS TREATMENT DESIGN
Idaho Falls, Idaho

Project No.: 2002006427
File Name: H-003
Scale: NO SCALE

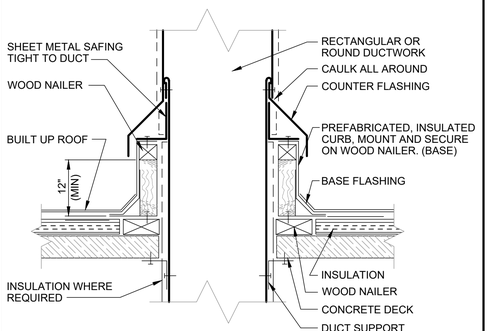
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Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
STANDARD DETAILS- I

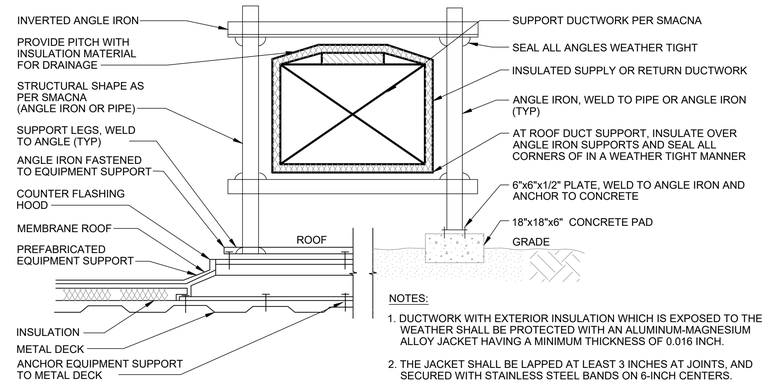
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Drawing No.
H-003

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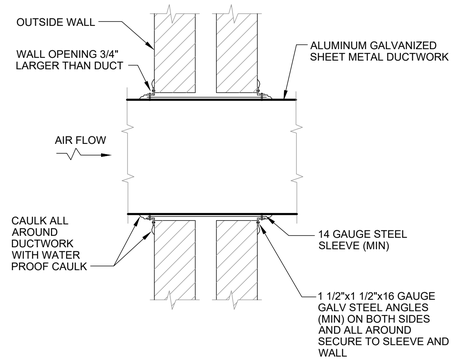


M-409 DUCT PENETRATION
(THROUGH ROOF)
REV 010119

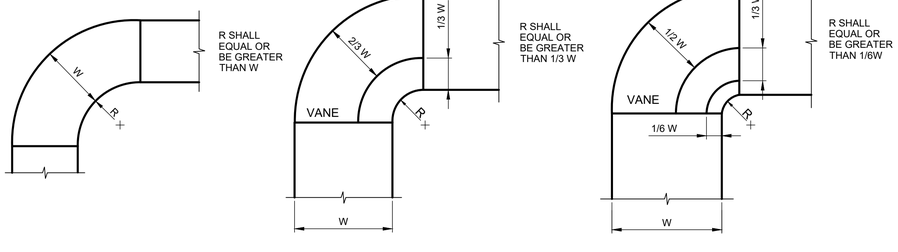


NOTES:
1. DUCTWORK WITH EXTERIOR INSULATION WHICH IS EXPOSED TO THE WEATHER SHALL BE PROTECTED WITH AN ALUMINUM-MAGNESIUM ALLOY JACKET HAVING A MINIMUM THICKNESS OF 0.016 INCH.
2. THE JACKET SHALL BE LAPPED AT LEAST 3 INCHES AT JOINTS, AND SECURED WITH STAINLESS STEEL BANDS ON 6-INCH CENTERS.
3. INSTALL DUCTWORK MINIMUM 2'-0" ABOVE GRADE OR ROOF.

M-412 EXTERIOR DUCT SUPPORT
REV 010119



M-424 DUCT PENETRATION
(THROUGH OUTSIDE WALL)
REV 010119

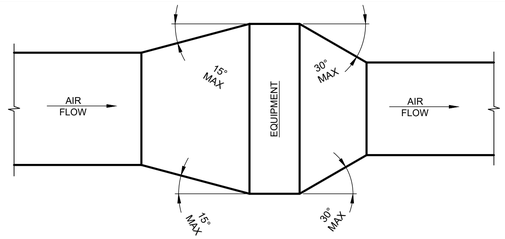


STANDARD RADIUS OR LONG RADIUS ELBOW

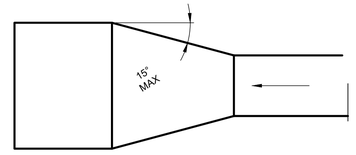
SHORT RADIUS ELBOW WITH ONE VANE

SHORT RADIUS ELBOW WITH TWO VANES

M-430 DUCTWORK RADIUS ELBOWS
REV 030122



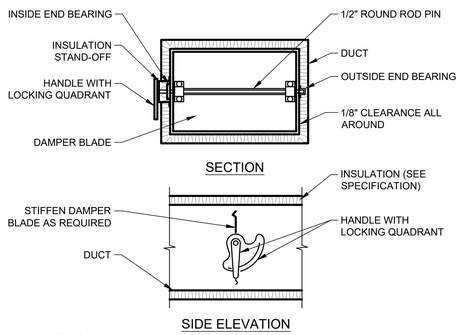
TYPICAL DUCTWORK TRANSITION WITH EQUIPMENT MOUNTED IN DUCT PLAN OR SIDE VIEW



TYPICAL DUCTWORK TRANSITION PLAN OR SIDE VIEW

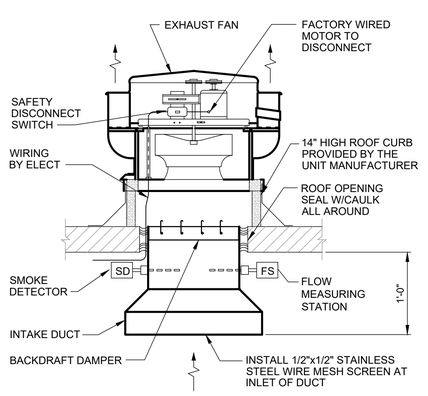
M-432 DUCTWORK TRANSITIONS
REV 030122

NOTE:
1. UNLESS OTHERWISE INDICATED ON PLANS, MAXIMUM ANGLES SHOWN SHALL APPLY.

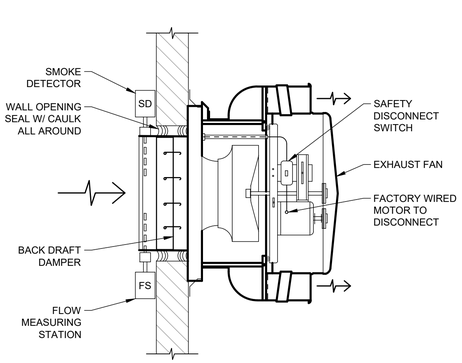


NOTES:
1. DELETE INSULATION STAND-OFF ON DUCTWORK WITHOUT EXTERIOR INSULATION.
2. DETAIL SHOWS SINGLE BLADE DAMPER. DAMPER INSTALLATION SHALL BE SIMILAR FOR MULTI-BLADE DAMPERS AND ROUND DAMPERS.

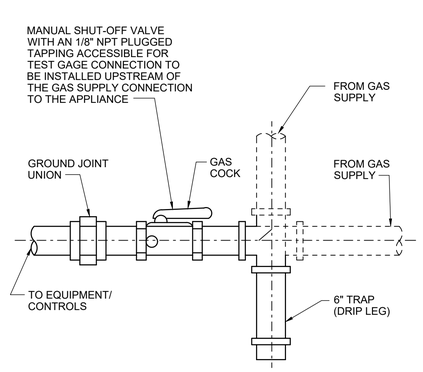
M-444 VOLUME DAMPER
REV 030122



M-513 UPBLAST EXHAUST FAN
REV 010119



M-514 CENTRIFUGAL SIDEWALL EXHAUST
REV 030122



M-901 GAS CONNECTION TO EQUIPMENT DETAIL
REV 010119

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A	30% DESIGN REVIEW	SG	SS	2023.07.14

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PROFESSIONAL ENGINEER LICENSED Signature by 19744 2/6/2026 STATE OF IDAHO SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF IDAHO FALLS
WAS TREATMENT DESIGN
Idaho Falls, Idaho

Project No.: 2002006427
File Name: H-004
Scale: NO SCALE

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
SG	SG	SHS	2026.01.23

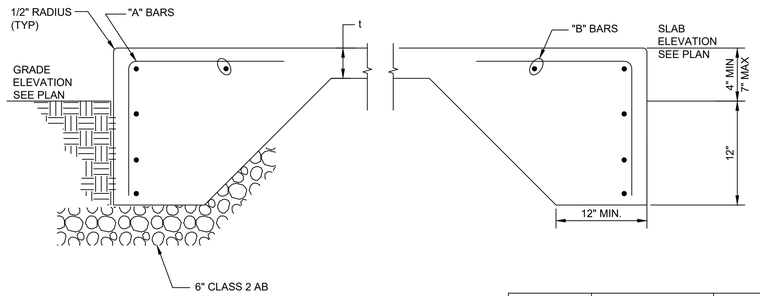
Title
STANDARD DETAILS- II

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Drawing No.
H-004

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ORIGINAL SHEET - ANSI D



THICKNESS t	BARS "A" SIZE/SPACING	BARS "B" SIZE/SPACING
4"	#4 @ 18" CC	#4 @ 18" CC
6"	#5 @ 18" CC	#5 @ 18" CC
8"	#5 @ 12" CC	#5 @ 12" CC
12"	#5 @ 12" CC T&B	#5 @ 12" CC T&B

NOTES:

1. FOR SLAB THICKNESS UP TO 8", REINFORCEMENT SHALL BE PLACED AT SLAB CENTER.

S-190

CONCRETE SLAB ON GRADE

NO SCALE

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A	30% DESIGN REVIEW	SG	SS	2025.11.21
B	90% DESIGN REVIEW	SG	SS	2026.01.14
C	IFC	SG	SS	2026.01.23

Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
19744
2/6/2026
STATE OF IDAHO
SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF IDAHO FALLS

WAS TREATMENT DESIGN

Idaho Falls, Idaho

Project No.: 2002006427

File Name: H-005

Scale: NO SCALE

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
SG	SG	SHS	2026.01.23

Title
STANDARD DETAILS- III

Revision: Sheet: of

Drawing No.
H-005

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ORIGINAL SHEET - ANSI D

GENERAL INFORMATION ABOUT HVAC CONTROLS

HVAC CONTROLS:
HVAC CONTROL LOGIC IS BASED ON STANDALONE HVAC CONTROLS.

FOR ALL AREAS THAT ARE NOT PROTECTED BY THE FIRE ALARM SYSTEM, SMOKE DETECTION SIGNAL SHALL FIRST BE SENT TO THE HVAC CONTROL PANEL ASSOCIATED WITH THE ACTIVATED SMOKE DETECTOR AND THE HVAC CONTROL PANEL SHALL THEN:

A. SHUT DOWN THE INDICATED HVAC EQUIPMENT (SEE SEQUENCE OF OPERATION)

THE HVAC CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING DELIVERY OF ALL HVAC ALARMS AND CONTROLS BETWEEN THE HVAC CONTROL PANEL AND SCADA WITH I&C CONTRACTOR.

CONDUIT AND WIRING OF ALL HVAC CONTROLS INCLUDING 120 VOLTS CONTROLS SHALL BE PROVIDED BY DIVISION 23.

HVAC AUTOMATIC TEMPERATURE CONTROL PANELS (ATC.) SHALL CONTAIN ALL ACCESSORIES NECESSARY TO PROVIDE THE CONTROL SEQUENCES DESCRIBED HEREIN.

ALL AUTOMATIC TEMPERATURE CONTROL PANELS (ATC) SHALL INCLUDE HOA SWITCHES, HIGH AND LOW SPEED CONTROLLERS, AND EXTRA DRY CONTACTS FOR SENDING SIGNALS TO SCADA.

ATC CONTROL PANEL CONSTRUCTION:
PANELS SHALL BE 316 STAINLESS STEEL, NEMA 4X CONSTRUCTION, AND INCLUDE A HINGED FRONT DOOR WITH LOCKING HANDLE.

ALL MANUAL SWITCHES AND DIRECT READING GAUGES SHALL BE FLUSH-MOUNTED ON THE FRONT FACE, AND BE IDENTIFIED BY ENGRAVED AND RIVETED BAKELITE OR LAMINATED PLASTIC NAMEPLATES WITH BLACK LETTERS ON WHITE BACKGROUND.

MANUAL SWITCHES AND PILOT LIGHTS SHALL BE HEAVY DUTY, OIL TIGHT CONSTRUCTION.

ATC PANEL CONSTRUCTION AND COMPONENTS SHALL CONFORM TO SPECIFICATION 26 05 15.

DIVISION 23 SHALL BE RESPONSIBLE FOR ALL HVAC CONTROL PANELS AND WIRING TO AND FROM THE ATCs AND HVAC EQUIPMENT.

DIVISION 23 SHALL BE RESPONSIBLE FOR WIRING ALL 120 V HVAC CONTROLS EQUIPMENT LIKE THERMOSTATS, SENSORS, DAMPERS, AND SMOKE DETECTORS.

SEQUENCE OF OPERATION FOR MAU-01, EF-01 AND EF-02 CONTROLLED BY ATC-01

MAU-01, EF-01 AND EF-02 SHALL BE PROVIDED WITH HOA SWITCHES. MAU-01, EF-01 AND EF-02 WILL RUN AT SINGLE SPEED TO PROVIDE 6 ACH TO THE CHEMICAL STORAGE AREA, SLUDGE LOADING AREA AND UPPER FLOOR AT ALL TIMES.

ALL PROCESS AREAS SHALL BE MAINTAINED AT NEGATIVE PRESSURIZATION AT ALL TIMES BY EXHAUSTING 10% MORE THAN THE SUPPLY AIR.

WHEN THE MAU-01 IS OFF, THE OUTSIDE AIR DAMPER OF MAU-01 SHALL BE OPEN, THE SUPPLY AIR DAMPER OF MAU-01 SHALL BE CLOSED AND PURGE AIR DAMPER OF MAU-01 SHALL BE OPEN. WHEN THE MAU-01 IS ON, THE OUTSIDE AIR DAMPER OF MAU-01 SHALL REMAIN OPEN, THE SUPPLY AIR DAMPER OF MAU-01 SHALL BE OPEN AND PURGE DAMPER OF MAU-01 SHALL BE CLOSED.

PURGE CYCLE :
EACH TIME MAKE-UP AIR HANDLING UNIT MAU-01 IS COMMANDED TO RUN (MANUALLY OR AUTOMATICALLY) A PURGE CYCLE WILL BE ACTIVATED. DURING THE PURGE CYCLE, THE OUTSIDE AIR DAMPER OF MAU-01 SHALL REMAIN OPEN 100%. THE SUPPLY AIR DAMPER OF MAU-01 SHALL REMAIN CLOSED AND THE PURGE AIR DAMPER OF MAU-01 SHALL REMAIN OPEN 100%. ONCE THERE IS PROOF THAT THE DAMPERS ARE OPEN 100%, MAU-01 SHALL START AND RUN A PURGE CYCLE FOR 10 MINUTES (ADJ.). AFTER THE TEN MINUTES OF PURGING, MAU-01 SHALL SWITCH TO NORMAL OPERATION AS DESCRIBED BELOW. AFTER THE PURGE CYCLE HAS BEEN COMPLETED, THE DAMPER POSITIONS SHALL BE SWITCHED TO MAU-01 ON POSITION AS DESCRIBED ABOVE.

WITH THE HOA SWITCHES OF MAU-01, EF-01, EF-02 IN THE "H" POSITION:
AFTER COMPLETING THE PURGE CYCLE AND AFTER ALL DAMPERS ARE IN CORRECT POSITION, MAKE-UP AIR HANDLING UNIT MAU-01 SHALL ENERGIZE FOLLOWING ITS FACTORY BUILT START-UP SEQUENCE. ONCE MAU-01 STARTS, ALLOW 30 SECONDS (ADJ.) TO START EF-01 AND EF-02 .

WITH THE HOA SWITCHES OF MAU-01, EF-01 AND EF-02 IN THE "O" POSITION:
THE FAN OF MAU-01, EF-01 AND EF-02 SHALL DE-ENERGIZE FIRST, AND THEN ALL DAMPERS SHALL SWITCH TO MAU-01 OFF POSITION.

WITH THE HOA SWITCHES OF MAU-01, EF-01 AND EF-02 IN THE "A" POSITION:
THE EXHAUST AIRFLOW SHALL ALWAYS BE 10% GREATER THAN THE MAKE-UP AIRFLOW.

1. SUMMER (COOLING) MODE:

1.1 NORMAL CONTINUOUS VENTILATION (6 AIR CHANGES PER HOUR):
AFTER COMPLETING THE PURGE CYCLE AND AFTER ALL DAMPERS ARE IN CORRECT POSITION, MAU-01 SHALL ENERGIZE FOLLOWING ITS FACTORY BUILT START-UP SEQUENCE AND RUN AT 100% SPEED. ONCE MAU-01 STARTS, ALLOW 30 SECONDS (ADJ.) TO START EF-01 AND EF-02. EF-01 AND EF-02 SHALL RUN AT 100% SPEED.

2. WINTER (HEATING MODE)

2.1 NORMAL CONTINUOUS VENTILATION (6 AIR CHANGES PER HOUR):
AFTER COMPLETING THE PURGE CYCLE AND AFTER ALL DAMPERS ARE IN CORRECT POSITION, MAU-01 SHALL ENERGIZE FOLLOWING ITS FACTORY BUILT START-UP SEQUENCE AND RUN AT 100% SPEED. ONCE MAU-01 STARTS, ALLOW 30 SECONDS (ADJ.) TO START EF-01 AND EF-02.

THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE OF THE MAKE UP AIR HANDLING UNIT AND SHALL MAINTAIN SUPPLY AIR TEMPERATURE SETPOINT BASED ON UNIT'S HEATING REQUIREMENTS:

1. THE SUPPLY AIR TEMPERATURE SETPOINT SHALL RESET FOR HEATING AS FOLLOWS:

1.1 THE INITIAL SUPPLY AIR TEMPERATURE SETPOINT SHALL BE BELOW 55 °F (ADJ.)
1.2 AS HEATING DEMAND INCREASES, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 104 °F (ADJ.)
1.3 AS HEATING DEMAND DECREASES, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 50 °F (ADJ.)

2. THE HEATING SHALL BE ENABLED WHENEVER:

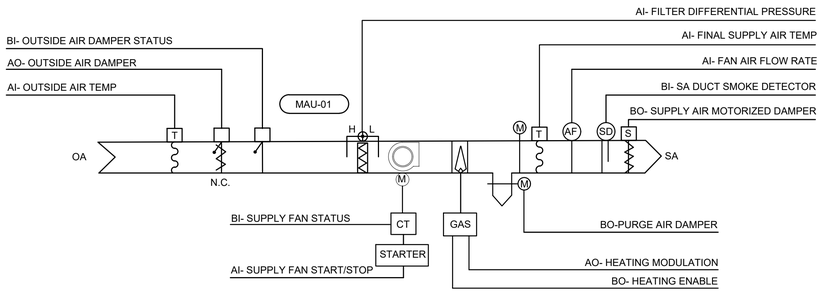
2.1 OUTSIDE AIR TEMPERATURE IS LESS THAN 60 °F (ADJ.)
2.2 AND THE SUPPLY AIR TEMPERATURE IS BELOW THE HEATING SETPOINT
2.3 AND THE MAKEUP AIR HANDLING UNIT FAN STATUS IS ON

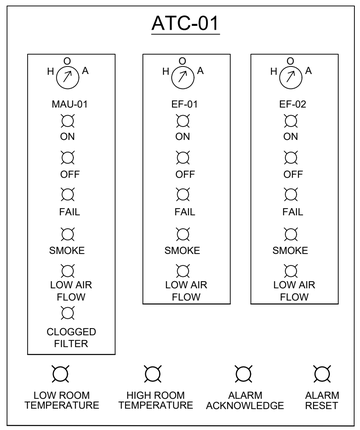
FILTER DIFFERENTIAL PRESSURE MONITOR:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE MAU-01 FILTER.

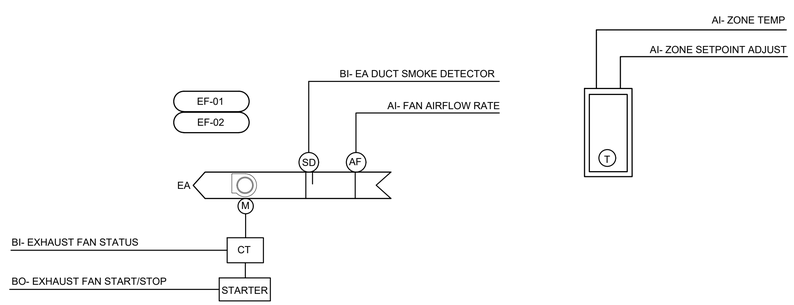
DUCT SMOKE DETECTOR ACTIVATION:
THE MAU-01, EF-01 AND EF-02 SHALL BE INTERLOCKED TO A SAFETY RELAY TO PROVIDE SHUTDOWN UPON SIGNAL FROM THE DUCT SMOKE DETECTORS IF ANY OF THE DUCT SMOKE DETECTORS IS ACTIVATED, AND LOCAL ALARM SHALL BE GENERATED.

A LOCAL AUDIBLE AND VISUAL ALARM SHALL ACTIVATE FOR THE FOLLOWING EVENTS:

1. LOW ROOM TEMPERATURE: ROOM TEMPERATURE IS BELOW 45°F (ADJ.). FOR MORE THAN 30 MINUTES (ADJ.).
2. HIGH ROOM TEMPERATURE: ROOM TEMPERATURE IS ABOVE 104°F (ADJ.) FOR MORE THAN 30 MINUTES (ADJ).
3. ANY SMOKE DETECTOR IS ACTIVATED.
4. MAU-01 SUPPLY OR EF-01 AND EF-02 EXHAUST AIRFLOW IS LESS THAN 90% OF THE DESIGN AIRFLOW FOR MORE THAN 30 MINUTES (ADJ.).
5. MAU-01 IS COMMANDED TO RUN BUT FAILED.
6. EF-01 IS COMMANDED TO RUN BUT FAILED.
7. EF-02 IS COMMANDED TO RUN BUT FAILED.
8. CLOGGED FILTER.







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No.	Revision	By	Appd	YYYY.MM.DD
0	IFC	SG	SS	2024.01.23
A	90% DESIGN REVIEW	SG	SS	2025.11.21
B	30% DESIGN REVIEW	SG	SS	2025.07.14

Issued

Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
SHIVANI AMOL SAPTARSHY
19744
2/6/2026
STATE OF IDAHO

Client/Project
CITY OF IDAHO FALLS
WAS TREATMENT DESIGN
Idaho Falls, Idaho

Project No.: 2002006427
File Name: H-006
Scale:NO SCALE

SG	SG	SHS	2026.01.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
CONTROL SEQUENCE OF OPERATION

Revision: Sheet: of

Drawing No.
H-006

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ORIGINAL SHEET - ANSI D

MAKE UP AIR HANDLING UNIT SCHEDULE

EQUIPMENT TAG	SERVICE	LOCATION	AIRFLOW (CFM)	SUPPLY FAN SECTION				HEATING SECTION (NATURAL GAS)						ELECTRICAL				WEIGHT (LBS)	MANUFACTURER AND MODEL NUMBER	OPTIONS AND ACCESSORIES
				BHP	HP	ESP (IN WC)	SPEED (RPM)	FUEL TYPE	INPUT (MBH)	OUTPUT (MBH)	GAS PRESSURE (IN WC)	TEMP RISE (°F)	TURNDOWN RATIO	V-PH-CY	MOCP	MCA	FLA			
MAU-1	SOLID HANDLING BUILDING	GROUND	3,750	3.08	5	1	1403	NATURAL GAS	275	220	7	54	15:1	240/3/60	45	28.5	24.31	2,100	ENGINEERED AIR DJE60	1-11

OPTIONS AND ACCESSORIES:
1. TEFC MOTOR
2. NEMA 4X DISCONNECT SWITCH
3. BACNET INTERFACE
4. AMBIENT SENSOR TO SWITCH BETWEEN SUMMER AND WINTER MODES
5. AMBIENT LOCKOUT ABOVE 65 DEG F
6. AUTO BYPASS LOW LIMIT SWITCH IF DISCHARGE TEMP IS BELOW 40 DEG F
7. HERESITE COATED SENSORS
8. EPOXY COATED FAN
9. NEMA 4X RATED COMPONENTS
10. PRE-PURGE PLENUM
11. 2" MERV 8 FILTER

FAN SCHEDULE

EQUIPMENT NUMBER	SERVICE	FAN TYPE	DRIVE TYPE	HIGH (CFM)	ESP (IN WG)	FAN RPM	MOTOR					RADIATED SOUND		WEIGHT (LBS)	MANUFACTURER OR EQUAL	MODEL	OPTIONS AND ACCESSORIES
							WINDINGS	HP	EFFICIENCY RATING	V-PH-CY	ENCL	LWA	dBA				
EF-01	CHEMICAL STORAGE AREA & SLUDGE LOADING AREA	CENTRIFUGAL UPBLAST- SIDE WALL MOUNTED	DIRECT DRIVE	2100	0.75	1676	1	1	NEMA PREMIUM EFFICIENCY	240/3/60	TEFC	84	73	131	MK PLASTICS	RBK-15	1-10, 12
EF-02	UPPER SCREW PRESS LEVEL	CENTRIFUGAL UPBLAST- ROOF MOUNTED	DIRECT DRIVE	1800	0.75	1513	1	0.75	NEMA PREMIUM EFFICIENCY	240/3/60	TEFC	81	69	119	MK PLASTICS	RBK-15	1-11

OPTIONS AND ACCESSORIES
1. DIRECT DRIVE
2. WEATHER COVER
3. GRAPHITE LINER
4. HUB SEAL
5. MOTOR STARTER AND DISCONNECT SWITCH BY DIVISION 26
6. STAINLESS STEEL BIRD SCREEN
7. FLANGED DUCT
8. FRP FANS
9. FIBERGLASS GRAVITY BACKDRAFT DAMPER
10. STAINLESS STEEL SHAFT
11. 18" HIGH ROOF CURB
12. WALL MOUNTED ASSEMBLY

GRILLES SCHEDULE

TAG NO	SERVICE	DESCRIPTION	MATERIAL	DAMPER	FINISH	FRAME	MANUFACTURER AND MODEL OR EQUAL
A	SUPPLY	SUPPLY GRILLES	ALUMINUM	OBD	WHITE	FLANGED	TITUS 300 FL
B	EXHAUST	EXHAUST GRILLES	ALUMINUM	OBD	WHITE	FLANGED	TITUS 350 FL

GENERAL NOTES:
1. OBD = OPPOSED BLADE DAMPER

PIPING MATERIAL SCHEDULE

GROUP NO	PIPE	FITTINGS	VALVES, 6" OR SMALLER
CS09	STEEL, ASTM A53, SCH 40, WELDED, BLACK.	2 1/2" AND SMALLER, MALLEABLE IRON, ASME B16.3, THREDED, BANDED, BLACK, 150 PSI. 3" AND LARGER, STEEL, ASME B16.9, BUTT-WELDED.	ECCENTRIC PLUG: DEZURIK PEC, CAST IRON, OR MILLIKEN 603E. CHECK: CRANE 336E OR MILWAUKEE #544. BALL: JAMESBURY FIG 351 OR WATTS #B-6080.

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0		SG	SS	2024.01.23
		SG	SS	2023.11.21
		SG	SS	2023.07.14

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C IFC	SG	SS	2026.01.23
B 90% DESIGN REVIEW	SG	SS	2025.11.21
A 30% DESIGN REVIEW	SG	SS	2025.07.14

Permit/Seal

PROFESSIONAL ENGINEER
LICENSED
SHIVANI AMOL SAPTARISHY
19744
2/6/2026
STATE OF IDAHO

Client/Project
CITY OF IDAHO FALLS

WAS TREATMENT DESIGN

Idaho Falls, Idaho

Project No.: 2002006427
File Name: H-601

Scale: NO SCALE

SG	SG	SHS	2026.01.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

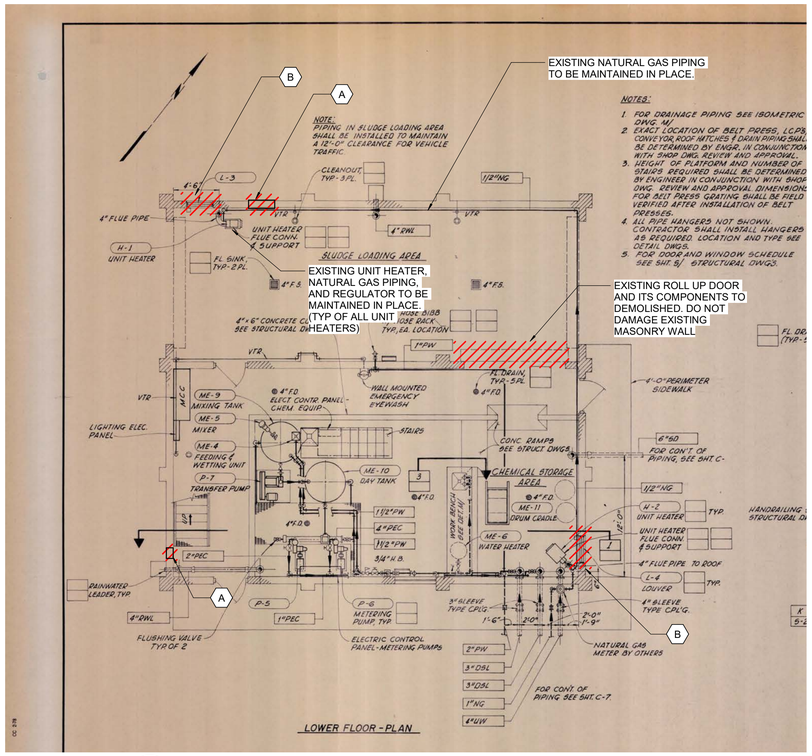
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HVAC EQUIPMENT SCHEDULE

Revision: Sheet: of

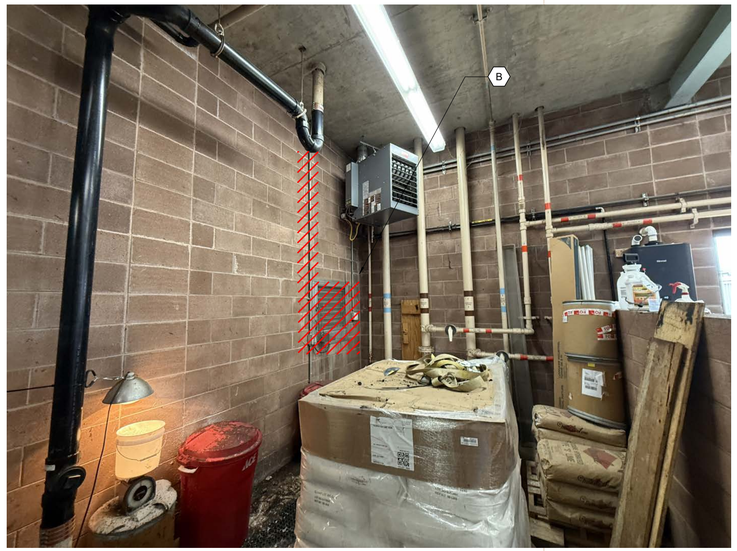
Drawing No.
H-601

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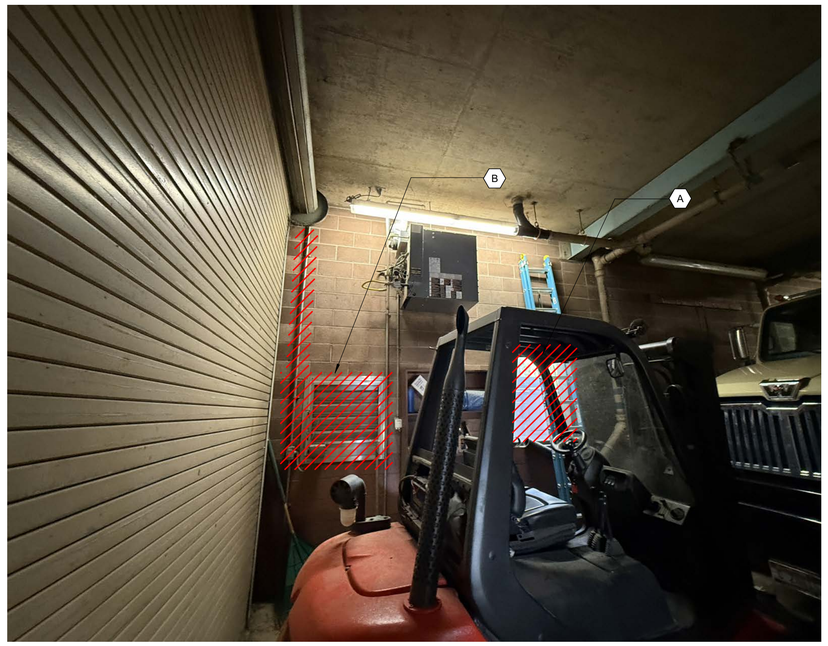
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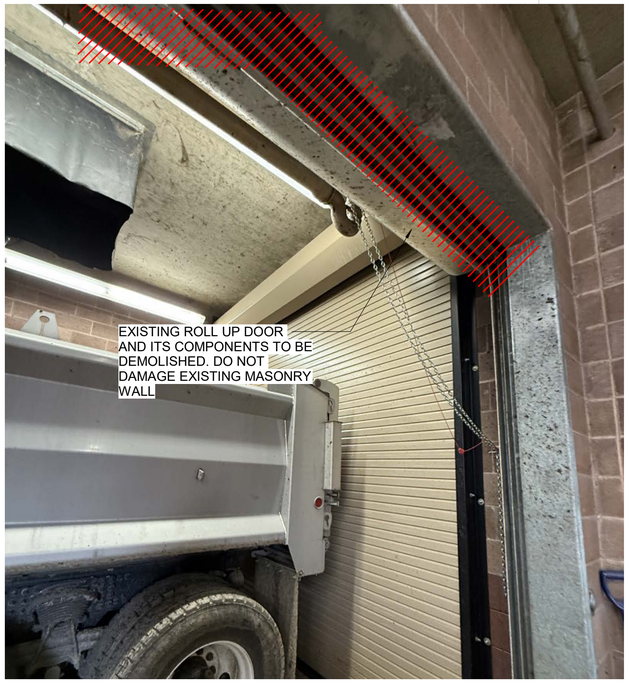
1 LOWER LEVEL- HVAC DEMO PLAN
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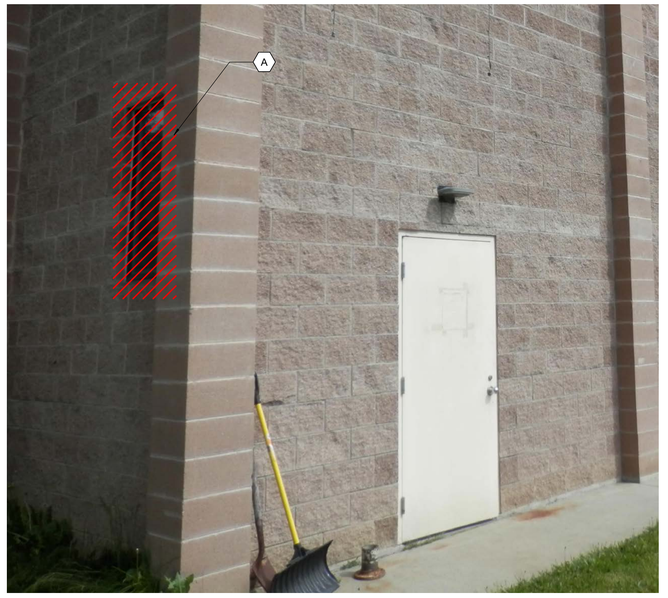
2 EXISTING LOUVER CHEMICAL AREA (EAST WALL)
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3 EXISTING LOUVER- LOADING AREA (NORTH WALL)
NO SCALE



4 EXISTING ROLL UP DOOR- SLUDGE LOADING AREA
NO SCALE



5 LOWER LEVEL-WINDOW OPENING (WEST WALL)
NO SCALE

GENERAL SHEET NOTES

1. ALL EXISTING PLUMBING PIPING AND EQUIPMENT TO BE MAINTAINED IN PLACE. THIS SCOPE OF WORK DOES NOT INCLUDE ANY CHANGE TO THE EXISTING PLUMBING SYSTEM OF THE BUILDING.

SHEET KEYNOTES

A. EXISTING WINDOW TO BE REMOVED AND THE WALL OPENING TO BE USED FOR NEW DUCT PENETRATION. CONTRACTOR SHALL INFILL AND SEAL THE REMAINING WALL OPENING WITH SUITABLE MATERIAL TO MATCH THE SURROUNDING FINISHES. THE COVERING SHALL BE SECURED, MEETING ALL APPLICABLE BUILDING CODES. ENSURE LEAK-PROOF, WEATHER TIGHT SEAL AROUND THE DUCT PENETRATION.

B. EXISTING MOTORIZED DAMPERS AND ITS WIRING TO BE REMOVED. COVER THE EXISTING LOUVER WITH 4" DOUBLE INSULATED BLANK OFF PANEL.

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By	Appd	YYYY.MM.DD
SG	SS	2024.01.23
SG	SS	2025.11.21
SG	SS	2026.10.24

C	IFC	9/26 DESIGN REVIEW	
B	30% DESIGN REVIEW		

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 19744 2/6/2026 STATE OF IDAHO SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

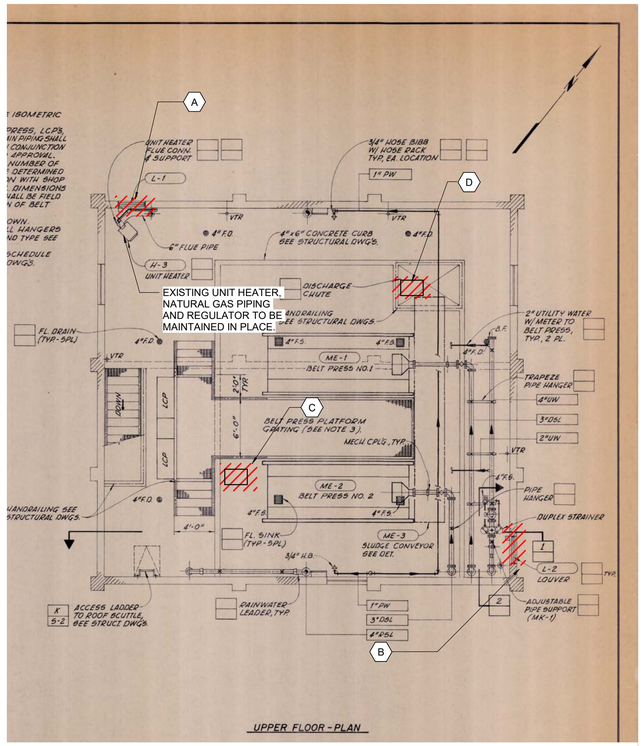
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File Name: N/A
Scale: As indicated

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Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

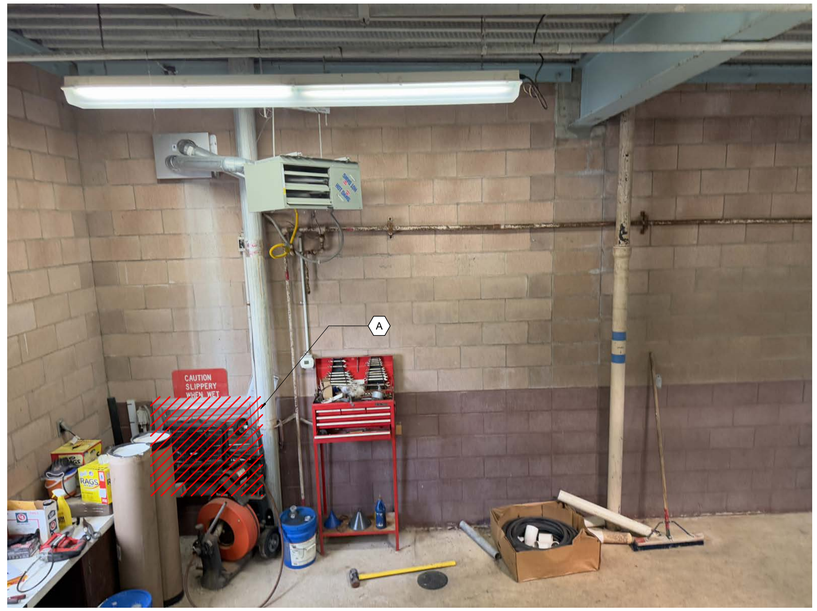
Title
LOWER LEVEL- HVAC DEMO PLAN

Revision:
Drawing No.
HD-101

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ORIGINAL SHEET - ANSI D



1 UPPER LEVEL- HVAC DEMO PLAN
NO SCALE



2 EXISTING LOUVER- UPPER LEVEL (NORTH WALL)
NO SCALE



3 EXISTING LOUVER-UPPER LEVEL (EAST WALL)
NO SCALE



4 EXISTING EXHAUST GRILL- UPPER LEVEL
NO SCALE



5 EXISTING EXHAUST GRILL - UPPER LEVEL
NO SCALE

GENERAL SHEET NOTES

1. ALL EXISTING PLUMBING PIPING AND EQUIPMENT TO BE MAINTAINED IN PLACE. THIS SCOPE OF WORK DOES NOT INCLUDE ANY CHANGE TO THE EXISTING PLUMBING SYSTEM OF THE BUILDING.

SHEET KEYNOTES

A. EXISTING LOUVER TO BE REMOVED AND THE WALL OPENING TO BE USED FOR NEW DUCT PENETRATION. CONTRACTOR SHALL INFILL AND SEAL THE REMAINING WALL OPENING WITH SUITABLE MATERIAL TO MATCH THE SURROUNDING FINISHES. THE COVERING SHALL BE SECURED, MEETING ALL APPLICABLE BUILDING CODES. ENSURE LEAK-PROOF, WEATHER TIGHT SEAL AROUND THE DUCT PENETRATION.

B. EXISTING MOTORIZED DAMPERS AND ITS WIRING TO BE REMOVED. COVER THE EXISTING LOUVER WITH 4" DOUBLE INSULATED BLANK OFF PANEL.

C. EXISTING EXHAUST FAN, ITS WIRING, BACKDRAFT DAMPER, DUCT, GRILLE AND ROOF CURB SHALL BE REMOVED. OPENING SHALL BE MODIFIED FOR THE NEW EXHAUST FAN AND NEW ROOF CURB SHALL BE INSTALLED. PLEASE ENSURE THAT THE EXTRA OPENING IS SECURELY CLOSED TO PREVENT ANY WATER LEAKAGE. PROVIDE TEMPORARY SEAL AND PROTECTION DURING THE CONSTRUCTION TO PREVENT DEBRIS, WATER FROM ENTERING THE BUILDING.

D. EXISTING EXHAUST FAN, ITS WIRING, BACKDRAFT DAMPER, GRILLE SHALL BE REMOVED. OPENING SHALL BE CLOSED WITH APPROPRIATE MATERIAL TO PREVENT WATER LEAKAGE INSIDE THE BUILDING AND PROVIDE A LASTING WEATHER PROOF SEAL.

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B 90% DESIGN REVIEW	SG	SS	2023.11.21
A 30% DESIGN REVIEW	SG	SS	2023.10.24

Revision

Permit/Seal

PROFESSIONAL ENGINEER LICENSED SHIVANI AMOL SAPTARISHY 19744 2/6/2026 STATE OF IDAHO

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233
File Name: N/A

Scale: As indicated

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Title
UPPER LEVEL- HVAC DEMO PLAN

Revision:
Drawing No.
HD-102

1/29/2026 10:38:44 AM
ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. ALL EXISTING PLUMBING PIPING AND EQUIPMENT TO BE MAINTAINED IN PLACE. THIS SCOPE OF WORK DOES NOT INCLUDE ANY CHANGE TO THE EXISTING PLUMBING SYSTEM OF THE BUILDING.

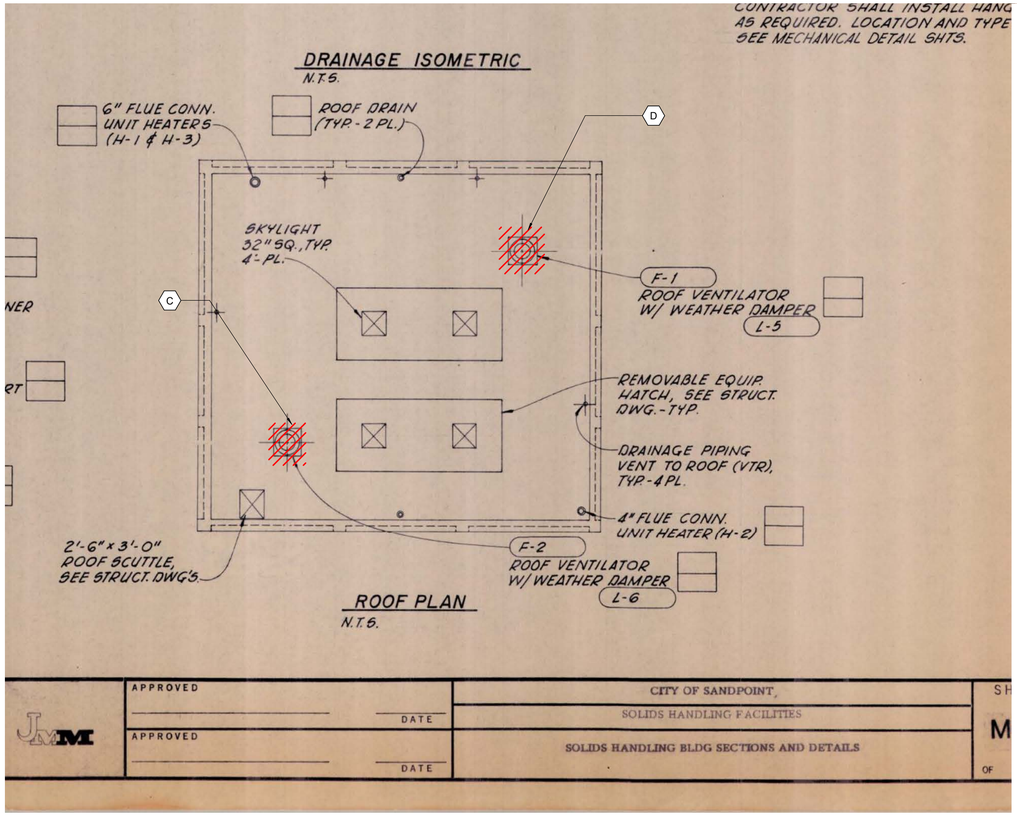
SHEET KEYNOTES

A. EXISTING LOUVER TO BE REMOVED AND THE WALL OPENING TO BE USED FOR NEW DUCT PENETRATION. CONTRACTOR SHALL INFILL AND SEAL THE REMAINING WALL OPENING WITH SUITABLE MATERIAL TO MATCH THE SURROUNDING FINISHES. THE COVERING SHALL BE SECURED, MEETING ALL APPLICABLE BUILDING CODES. ENSURE LEAK-PROOF, WEATHER TIGHT SEAL AROUND THE DUCT PENETRATION.

B. EXISTING MOTORIZED DAMPERS AND ITS WIRING TO BE REMOVED. COVER THE EXISTING LOUVER WITH 4" DOUBLE INSULATED BLANK OFF PANEL.

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D. EXISTING EXHAUST FAN, ITS WIRING, BACKDRAFT DAMPER, GRILLE SHALL BE REMOVED. OPENING SHALL BE CLOSED WITH APPROPRIATE MATERIAL TO PREVENT WATER LEAKAGE INSIDE THE BUILDING AND PROVIDE A LASTING WEATHER PROOF SEAL.



1 HVAC DEMO ROOF PLAN
NO SCALE



2 EXISTING EXHAUST FANS
NO SCALE

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No.	Revision	By	Appd	YYYY.MM.DD
C	IFC	SG	SS	2026.01.23
B	90% DESIGN REVIEW	SG	SS	2025.11.21
A	30% DESIGN REVIEW	SG	SS	2025.10.24

Issued

Permit/Seal

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19744
2/6/2026
STATE OF IDAHO
SHIVANI AMOL SAPTARISHY

Client/Project
CITY OF SANDPOINT, ID
SCREW PRESS UPGRADE
SANDPOINT, ID

Project No.:2002003233
File Name: N/A

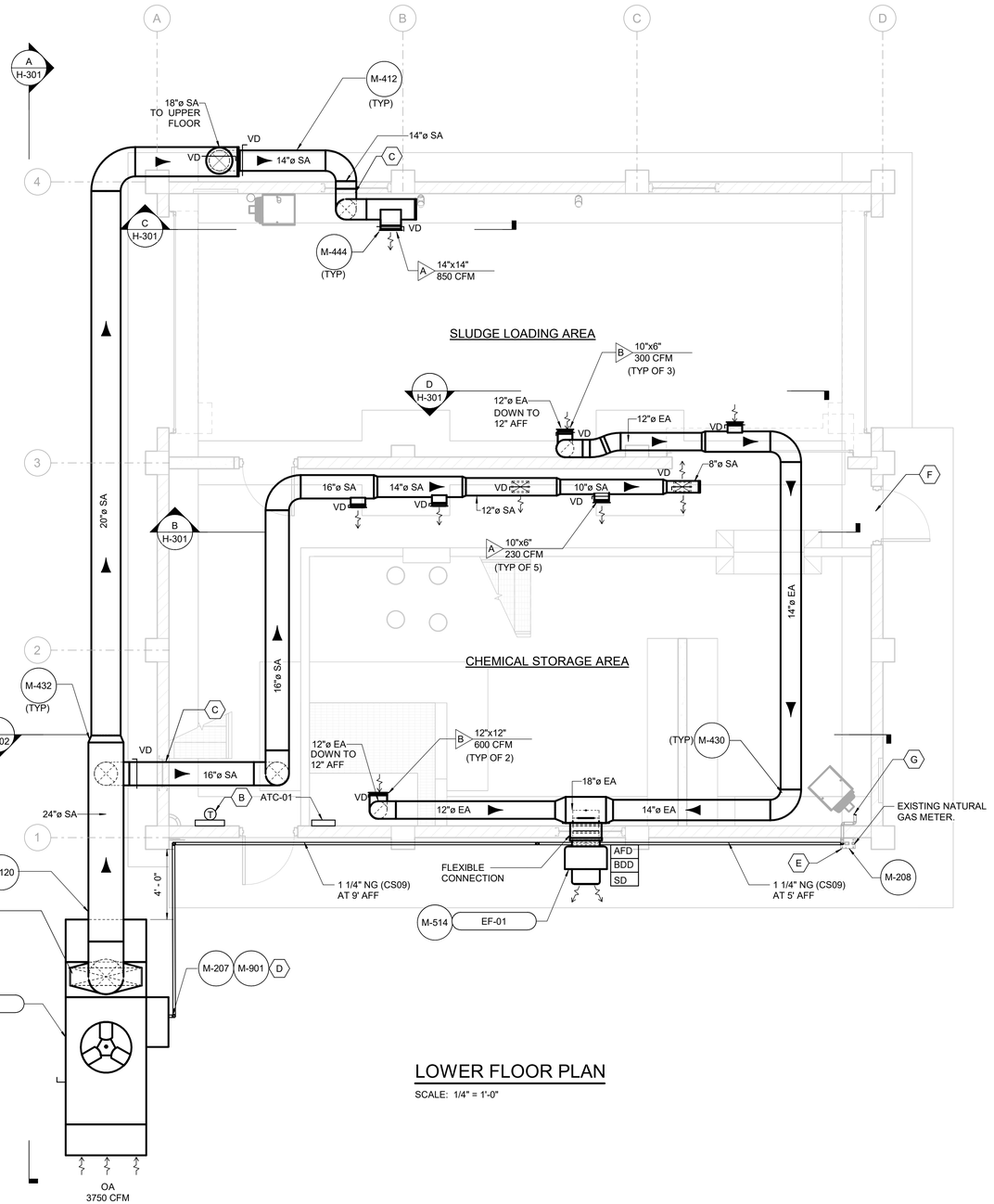
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SG	SG	SHS	2026.01.23
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Title
ROOF PLAN- HVAC DEMO PLAN

Revision:
Drawing No.
HD-103

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ORIGINAL SHEET - ANSI D



LOWER FLOOR PLAN

SCALE: 1/4" = 1'-0"

GENERAL SHEET NOTES

1. ALL DUCT WORK SHALL BE FRP IN CHEMICAL STORAGE ROOM, SLUDGE LOADING AREA AND UPPER SCREW PRESS AREA.
2. EXTERIOR DUCT SHALL BE INSULATED AND JACKETED AS PER SPEC SECTION 23 07 13.
3. THE SCOPE OF WORK OF THIS PROJECT ONLY INCLUDES HVAC UPGRADES FOR THE SCREW PRESS BUILDING AS SHOWN ON THE DRAWINGS. SCOPE DOES NOT INCLUDE THE RECENTLY EXPANDED BUILDING ON THE EAST SIDE OF THE SCREW PRESS BUILDING.

SHEET KEYNOTES

A. INSTALL MAU UNIT 12" ABOVE GROUND CONCRETE EQUIPMENT PAD WITH 1% SLOPE AND EXTENDING AT LEAST 6" ON ALL SIDES.

B. ALL THERMOSTAT ON THE PERIMETER WALLS SHOULD BE INSTALLED ON 2" INSULATED BLOCK.

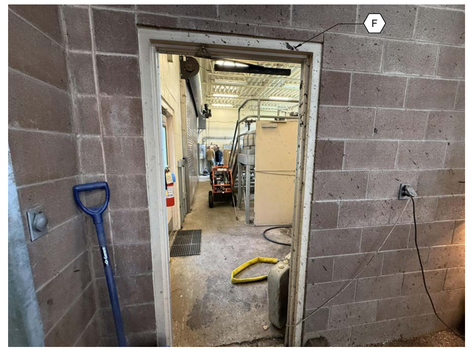
C. DUCT TO BE ROUTED THROUGH THE EXISTING WALL OPENING. CONTRACTOR SHALL MODIFY THE OPENING PER DUCT DIMENSIONS. REFER TO DRAWING HD-101 FOR MORE INFORMATION ON OPENING MODIFICATION.

D. GAS PRESSURE REGULATOR WITH TOTAL CONNECTED LOAD OF 275 CFH AT 7" W.C TO BE PROVIDED.

E. CONTRACTOR SHALL CHECK THE CAPACITY AND DISCHARGE PRESSURE AT THE EXISTING METER AND UPSIZE THE METER AS NEEDED FOR ADDITIONAL LOAD OF 275 CFH AND DISCHARGE PRESSURE OF 1 PSI. RECONFIGURE THE PRESSURE AT ALL EXISTING UNIT HEATERS. UPGRADE THE DISCHARGE PIPING FOR ADDITIONAL LOAD AND CONNECT TO THE EXISTING BRANCH SERVING THE UNIT HEATERS. NATURAL GAS PIPING SERVING THE MAU-01 SHALL BE ROUTED ABOVE GROUND AS SHOWN AT MIN 5' AFF TO CLEAR THE EXISTING WINDOW AND AT MIN 9' AFF TO CLEAR THE MAN DOOR. PIPE SHALL BE SUPPORTED FROM THE WALL AT MAX 8' INTERVALS.

F. CONTRACTOR SHALL PROVIDE AND INSTALL A NEW DOOR ASSEMBLY TO SEPARATE THE EXISTING CHEMICAL STORAGE AREA FROM THE RECENTLY EXPANDED BUILDING ON THE EAST SIDE TO ENSURE THAT TWO BUILDINGS ARE COMPLETELY ISOLATED FROM EACH OTHER. DOOR SHALL BE DESIGNED AND INSTALLED IN ACCORDANCE WITH APPLICABLE CODE REQUIREMENTS.

G. EXISTING NATURAL GAS PIPING TO THE UNIT HEATERS TO BE MAINTAINED AND CONNECTED TO THE NEW DISCHARGE PIPE FROM THE METER.



1 DOOR FRAME
NO SCALE

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19744
2/6/2026
STATE OF IDAHO
SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: As indicated

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Title
LOWER FLOOR HVAC PLAN

Revision:

Drawing No.
H-101

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ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

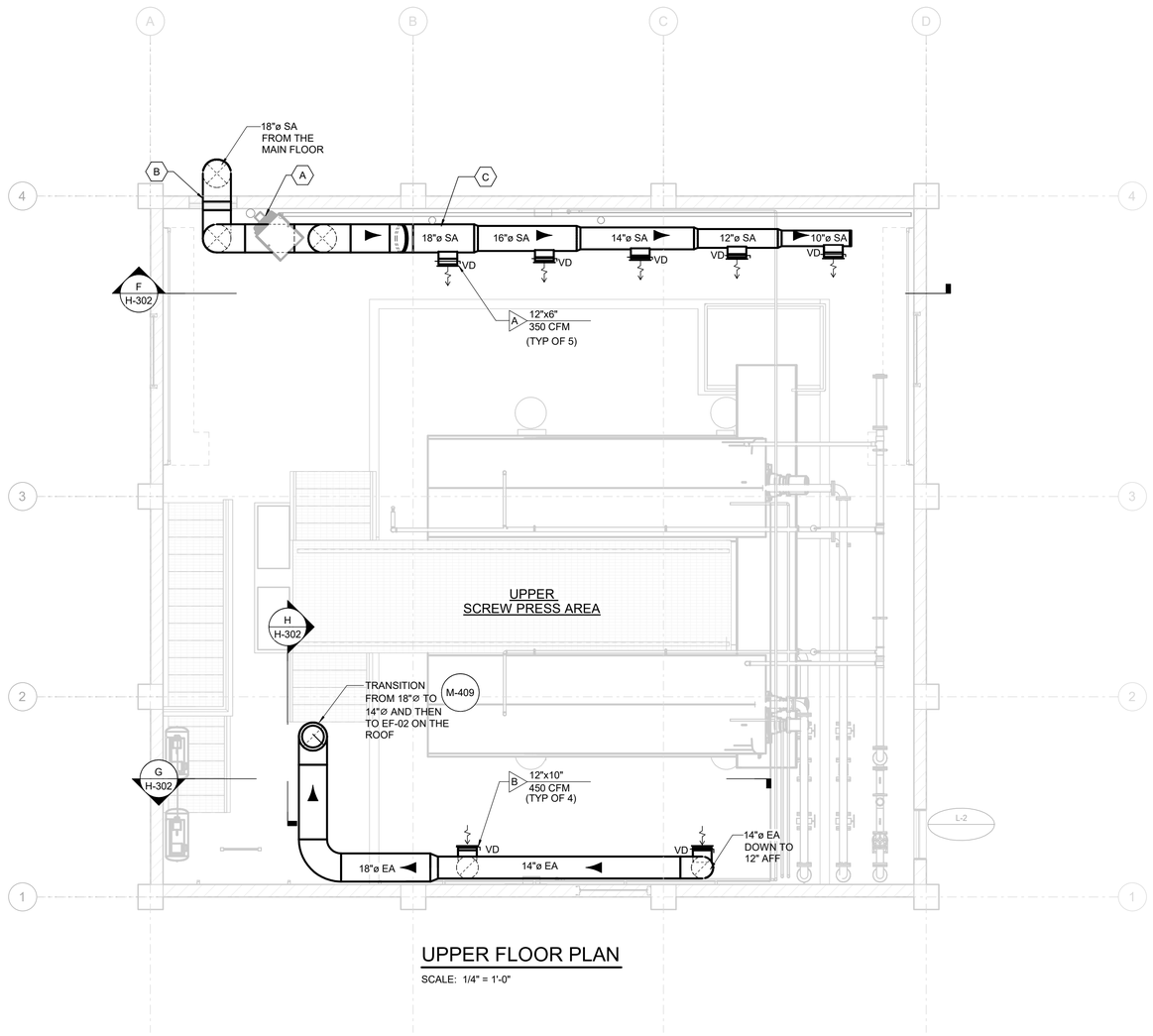
1. ALL DUCTS SHALL BE FRP IN CHEMICAL STORAGE ROOM, SLUDGE LOADING AREA AND UPPER FLOOR.

SHEET KEYNOTES

A. CONTRACTOR SHALL RUN THE DUCTWORK UNDERNEATH THE UNIT HEATER ON THE UPPER LEVEL AND ONCE PASS THE UNIT HEATER RUN THE DUCTWORK ABOVE AND RUN THE DUCTWORK AS SHOWN ON THE DRAWING. DUCTWORK SHALL NOT CLASH WITH PLUMBING PIPING.

B. DUCT TO BE ROUTED THROUGH THE EXISTING WALL LOUVER OPENING ON THE UPPER LEVEL. CONTRACTOR TO INFILL AND SEAL REMAINING WALL OPENING WITH MATERIAL TO MATCH THE SURROUNDING FINISHES. THE COVERING SHOULD BE SECURE, MEETING ALL APPLICABLE BUILDING CODES. ENSURE AIRTIGHT AND WEATHER-TIGHT SEAL AROUND DUCT PENETRATION.

C. DUCTWORK IN THIS AREA SHALL BE ROUTED IN FRONT OF EXISTING PIPING, AS INDICATED. DUCTWORK SHALL NOT BE ROUTED BEHIND, ABOVE, OR THROUGH EXISTING PIPING. EXTENDED SUPPORTS/HANGERS SHALL BE PROVIDED WHERE DUCTWORK IS OFFSET FROM THE WALL TO MAINTAIN REQUIRED CLEARANCES. EXISTING PIPING SHALL REMAIN UNDISTURBED. CONTRACTOR TO FIELD-VERIFY ALL EXISTING CONDITIONS PRIOR TO INSTALLATION.



UPPER FLOOR PLAN

SCALE: 1/4" = 1'-0"

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Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 1/4" = 1'-0"

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Title
UPPER FLOOR HVAC PLAN

Revision:

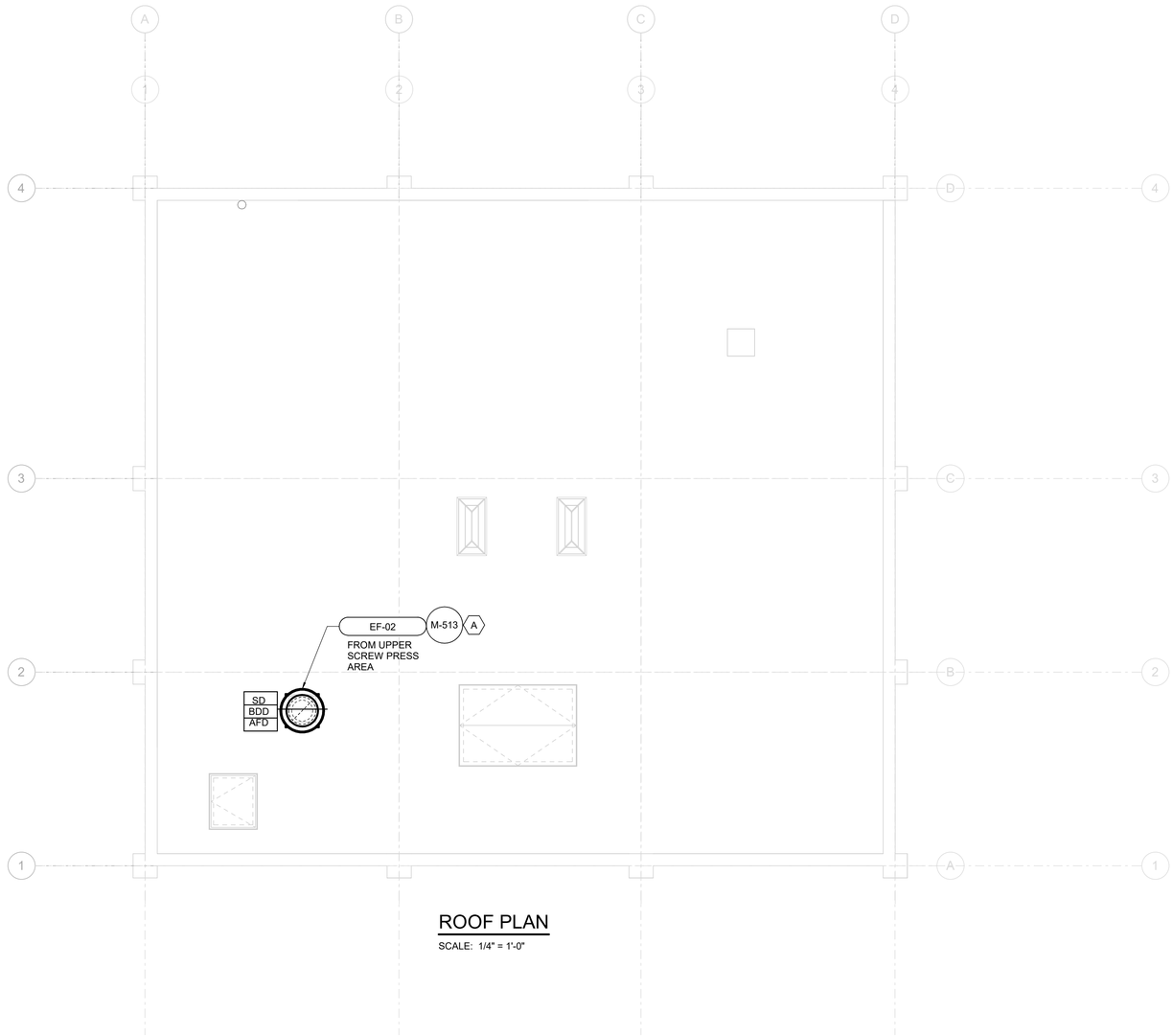
Drawing No.
H-102

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ORIGINAL SHEET - ANSI D

SHEET KEYNOTES

A. CONTRACTOR SHALL MODIFY THE EXISTING ROOF OPENING AND INSTALL FAN ON A NEW 18" HIGH ROOF CURB WHICH MATCHES THE FAN SIZE.



ROOF PLAN

SCALE: 1/4" = 1'-0"

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Project No.:2002003233

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Title
HVAC ROOF PLAN

Revision:

Drawing No.
H-103

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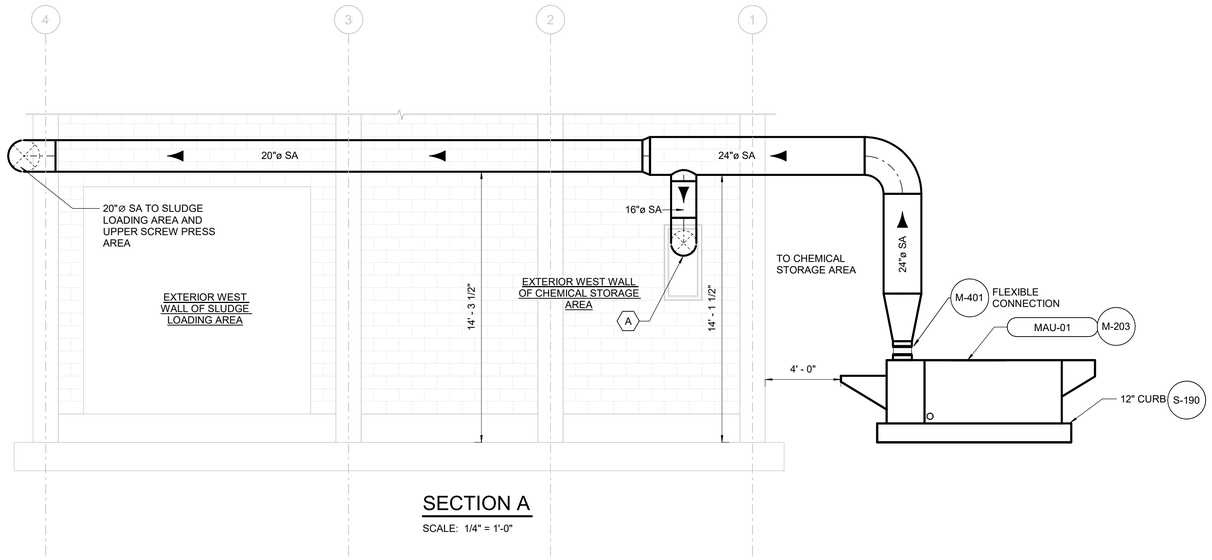
ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. ALL DUCT WORK SHALL BE FRP IN CHEMICAL STORAGE ROOM, SLUDGE LOADING AREA AND UPPER FLOOR.

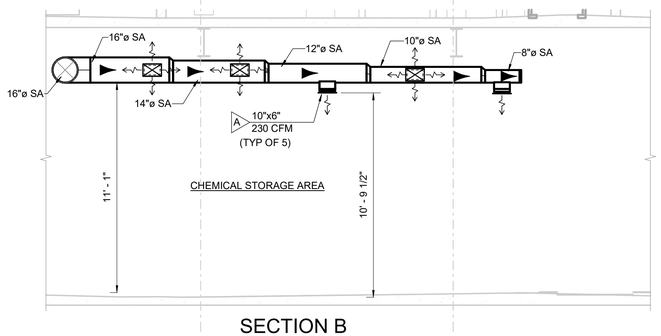
SHEET KEYNOTES

A. PROVIDE 1" PVC DRAIN AT DUCT LOW POINT VIA BALL VALVE AND TERMINATE DRAIN PIPE TO A DRYWELL.



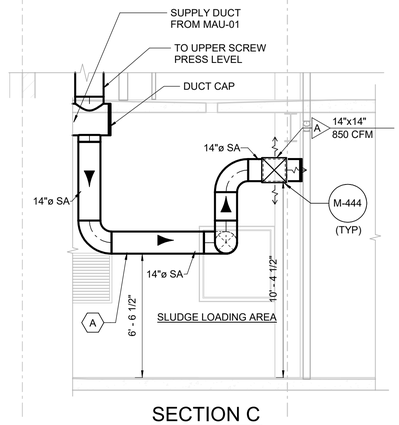
SECTION A

SCALE: 1/4" = 1'-0"



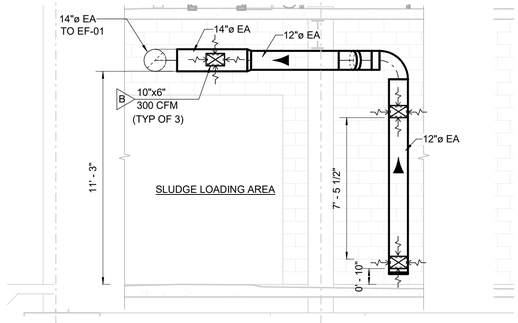
SECTION B

SCALE: 1/4" = 1'-0"



SECTION C

SCALE: 1/4" = 1'-0"



SECTION D

SCALE: 1/4" = 1'-0"

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STATE OF IDAHO
SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 1/4" = 1'-0"

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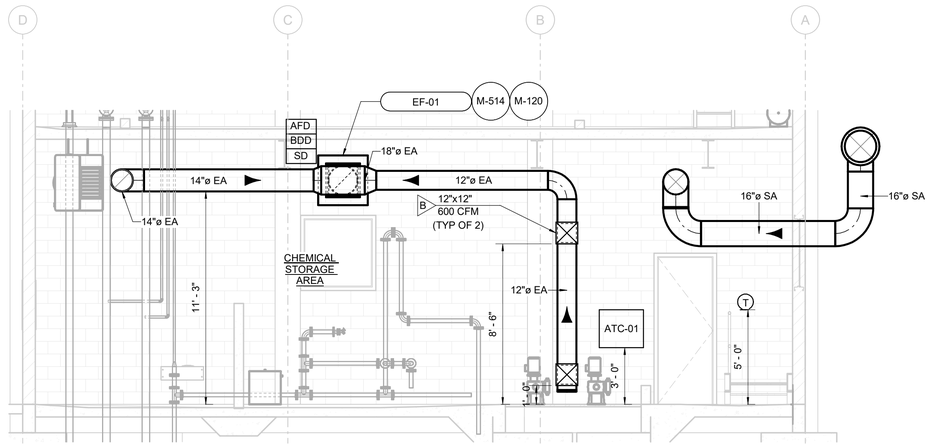
Title
SECTION VIEWS- I

Revision:

Drawing No.
H-301

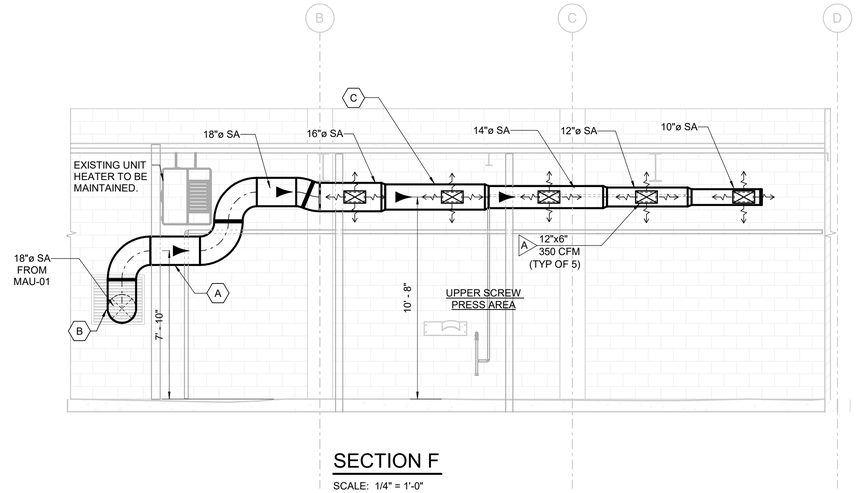
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ORIGINAL SHEET - ANSI D



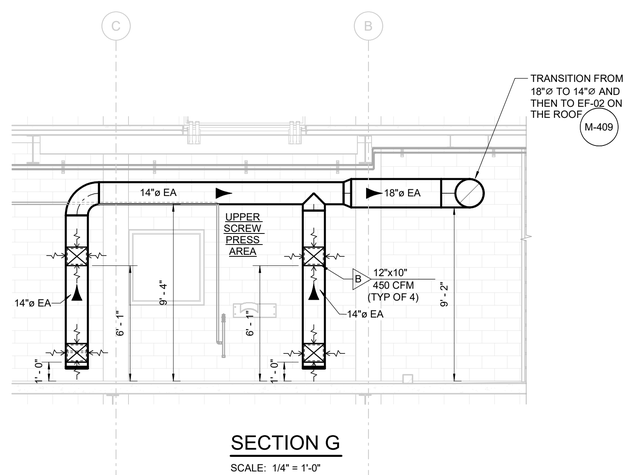
SECTION E

SCALE: 1/4" = 1'-0"



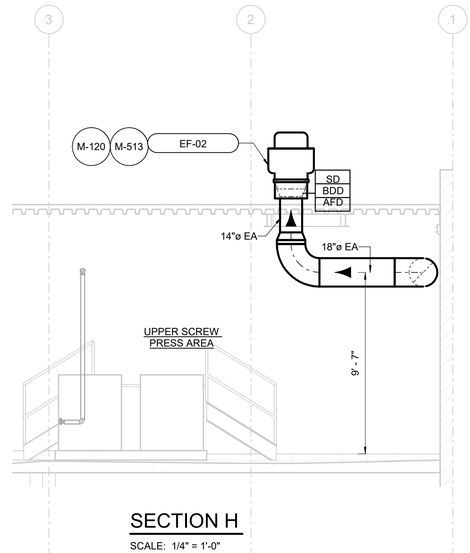
SECTION F

SCALE: 1/4" = 1'-0"



SECTION G

SCALE: 1/4" = 1'-0"



SECTION H

SCALE: 1/4" = 1'-0"

GENERAL SHEET NOTES

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B. DUCT TO BE ROUTED THROUGH THE EXISTING INTAKE WALL LOUVER OPENING ON THE UPPER LEVEL. CONTRACTOR TO INFILL AND SEAL REMAINING WALL OPENING WITH MATERIAL TO MATCH THE SURROUNDING FINISHES. THE COVERING SHOULD BE SECURE, MEETING ALL APPLICABLE BUILDING CODES. ENSURE AIRTIGHT AND WEATHER-TIGHT SEAL AROUND DUCT PENETRATION.

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2/6/2026
STATE OF IDAHO
SHIVANI AMOL SAPTARSHY

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 1/4" = 1'-0"

SG	SG	SHS	2026.01.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

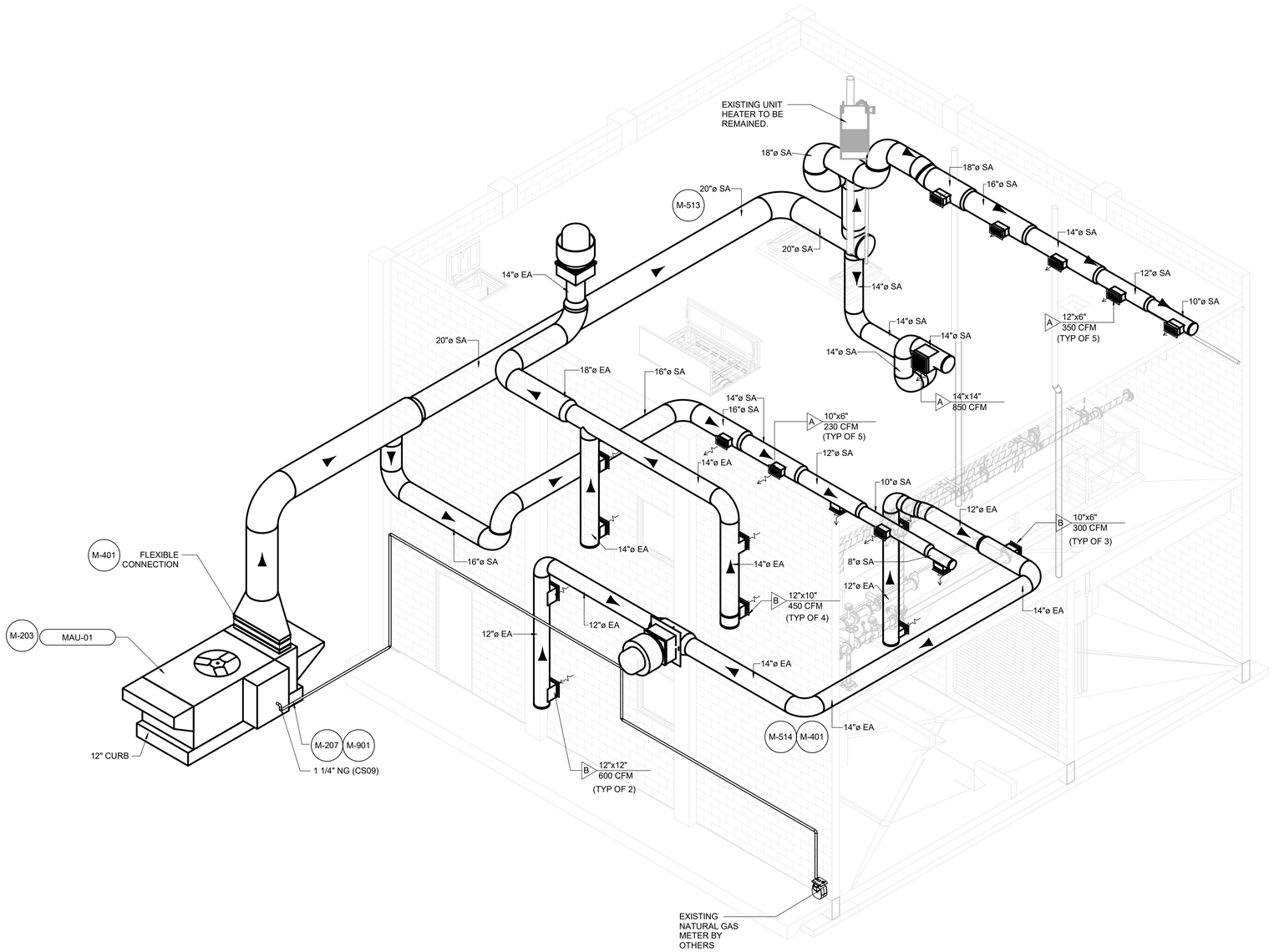
Title
SECTION VIEWS- II

Revision:

Drawing No.
H-302

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ORIGINAL SHEET - ANSI D



HVAC ISOMETRIC VIEW

NO SCALE

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C	IFC		
B	90% DESIGN REVIEW		
A	30% DESIGN REVIEW		

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SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

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Title
SOLID HANDLING BUILDING-3D ISOMETRIC VIEW

Revision:

Drawing No.
H-901

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ORIGINAL SHEET - ANSI D

GENERAL NOTES

GENERAL

THESE NOTES ARE GENERAL AND APPLY TO THE ENTIRE PROJECT EXCEPT WHERE SPECIFICALLY INDICATED OTHERWISE.

STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO MECHANICAL OR ELECTRICAL EQUIPMENT SHALL BE COORDINATED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. BOLT SIZES, TYPES, AND PATTERNS SHALL BE VERIFIED WITH THE MANUFACTURER. ALL BOLT PATTERNS SHALL BE TEMPLATED TO ENSURE ACCURACY OF PLACEMENT.

MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS BUT REQUIRED BY OTHER CONTRACT DRAWINGS, SHALL BE PROVIDED FOR PRIOR TO PLACING CONCRETE.

STRUCTURAL DRAWINGS SHALL BE USED IN COORDINATION WITH MECHANICAL, ELECTRICAL, ARCHITECTURAL, CIVIL DRAWINGS AND SHOP DRAWINGS PROVIDED BY MANUFACTURERS OF EQUIPMENT.

STRUCTURES HAVE BEEN DESIGNED FOR OPERATIONAL, HYDROSTATIC, AND BACKFILL LOADS ON THE COMPLETED STRUCTURES. THE STRUCTURES HAVE NOT BEEN DESIGNED TO RESIST THESE LOADS WHILE ONLY PARTIALLY CONSTRUCTED. DURING CONSTRUCTION, THE STRUCTURES SHALL BE PROTECTED FROM ALL CONSTRUCTION LOADS BY BRACING AND BALANCING UNTIL ALL STRUCTURAL ELEMENTS ARE IN PLACE, AND ALL CONCRETE HAS REACHED THE SPECIFIED 28 DAY COMPRESSIVE STRENGTH. OVERLOADING OF ANY STRUCTURAL ELEMENT IS PROHIBITED.

SEE MECHANICAL, CIVIL, AND ARCHITECTURAL DRAWINGS FOR FINISH GRADE, UNLESS OTHERWISE SHOWN, ON THE STRUCTURAL DRAWINGS.

STRUCTURAL STEEL

STEEL CONSTRUCTION SHALL CONFORM TO THE SPECIFICATIONS AND STANDARDS AS CONTAINED IN THE SIXTEENTH EDITION OF THE AISC STEEL CONSTRUCTION MANUAL.

STRUCTURAL WIDE FLANGE SHAPES SHALL BE STEEL MEETING ASTM A-992 SPECIFICATIONS.

OTHER SHAPES, BARS, PLATES AND SHEETS SHALL BE OF STEEL MEETING ASTM A-36 SPECIFICATIONS.

PIPE, PIPE COLUMNS, AND BOLLARDS SHALL BE OF STEEL MEETING ASTM A-53, TYPE E OR S, GRADE B STANDARD WEIGHT, UNO

HSS SHALL BE OF STEEL MEETING ASTM A-500 GRADE B.

STEEL JOISTS, BEAMS, AND GIRDERS SHALL NOT BE RELOCATED WITHOUT APPROVAL BY THE ENGINEER.

ALL WELDING SHALL BE BY THE SHIELDED ARC METHOD AND SHALL CONFORM TO AWS CODE FOR ARC AND GAS WELDING IN BUILDING CONSTRUCTION. QUALIFICATIONS OF WELDERS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS FOR STANDARD QUALIFICATION PROCEDURE OF THE AWS.

CONCRETE AND REINFORCEMENT STEEL:

1. CONCRETE CONSTRUCTION SHALL CONFORM TO ACI 350-06, ACI 318-19 AND ACI CODE OF STANDARD PRACTICE.
2. UNLESS OTHER NOTED OR SPECIFIED, ALL STRUCTURAL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 psi IN 28 DAYS.
3. CEMENT SHALL CONFORM TO ASTM C-150, TYPE II, MODIFIED/TYPE V.
4. CONCRETE AGGREGATES: NATURAL SAND AND ROCK AGGREGATES CONFORMING TO ASTM C-33.
5. REINFORCING SHALL CONFORM TO ASTM A706 GRADE 60, INCLUDING STIRRUPS AND TIES UNO.
6. WELDING OF REINFORCING STEEL SHALL CONFORM TO AWS D1.4 USING PROPER LOW HYDROGEN ELECTRODES. TACK WELDING TO REBAR IS STRICTLY PROHIBITED. SEE "REBAR WELDING".
7. REINFORCING STEEL SHALL BE DETAILED, FABRICATED, AND INSTALLED ACCORDING TO "MANUAL OF STANDARD PRACTICE FOR REINFORCED CONCRETE CONSTRUCTION" BY CRSI.
8. WIRE FABRIC SHALL CONFORM TO ASTM A-185.
9. DIMENSIONS SHOWN FOR LOCATION OF REINFORCING ARE TO THE FACE OF MAIN BARS AND DENOTE CLEAR COVERAGE. UNLESS OTHERWISE NOTED, CLEAR COVERAGE SHALL BE AS FOLLOWS:

   CONCRETE DEPOSITED DIRECTLY AGAINST GROUND (EXCEPT SLABS) . . . . . 3"
   FORMED CONCRETE EXPOSED TO WEATHER OR GROUND OR LIQUID
   #6 AND LARGER . . . . . 2"
   #5 AND SMALLER . . . . . 2"
   BEAMS (TOP BARS) . . . . . 1½"
   BEAMS (ALL OTHER MAIN REINFORCING) . . . . . 2"
   COLUMN MAIN REINFORCING . . . . . 2"
   SLABS ON GROUND WITH ONE LAYER OF REINFORCEMENT POSITION IN CENTER OF SLAB

10. UNLESS OTHERWISE NOTED ALL BARS SHOWN WITH LAPS OR SPLICES SHALL HAVE CLASS 'B' LAP LENGTH. SEE TABLE BELOW .

CLASS 'B' LAP LENGTH		
BAR SIZE	OTHER	TOP *
#3	1'-7"	2'-0"
#4	2'-1"	2'-8"
#5	2'-7"	3'-4"
#6	3'-1"	4'-0"
#7	4'-6"	5'-11"
#8	5'-2"	6'-9"
#9	5'-10"	7'-7"
#10	6'-7"	8'-6"
#11	7'-3"	9'-6"

* TOP REINFORCING IS HORIZONTAL REINFORCEMENT THAT HAS MORE THAN 12" OF CONCRETE PLACED BELOW IT.

11. DOWEL ALL VERTICAL REBARS IN WALLS AND COLUMNS FROM FOUNDATION WITH SAME SIZE AND SPACING AS WALL VERTICAL BAR U.N.O.
12. SPLICES IN ADJACENT HORIZ. BARS SHALL BE STAGGERED NOT LESS THAN 5'-0" APART.
13. SPLICE CONTINUOUS BARS IN SOIL-BEARING GRADE BEAMS AS FOLLOWS: BOTTOM BARS AT MID-SPAN, TOP BARS AT CENTERLINE OF SUPPORT, UNLESS NOTED OTHERWISE.
14. SPLICE CONTINUOUS BARS IN BEAMS, SPANDRELS, WALL BEAMS ETC. AS FOLLOWS: BOTTOM BARS AT CENTERLINE OF SUPPORT, TOP BARS AT MIDSPAN, UNLESS NOTED OTHERWISE.
15. REINFORCING BARS SHALL BE RUN IN A MANNER THAT FORMS A CONTINUOUS SYSTEM OF BARS TYING ALL PARTS OF THE STRUCTURE TOGETHER. EXTEND ALL REINFORCING BARS AS FAR AS POSSIBLE IN EACH CONCRETE MEMBER AND TERMINATE BAR W/ 90° STD. HOOK TO 2" OF CONCRETE COVER OVER END OF HOOK. FACE OR BEND.
16. BEAM STIRRUPS AND COLUMN TIES SHALL HOOK 135 DEGREES AROUND A CORNER BAR UNLESS NOTED OTHERWISE.
17. NO PIPES OR DUCTS SHALL BE PLACED IN CONCRETE SLABS, BEAMS, WALLS OR GRADE BEAMS UNLESS SPECIFICALLY DETAILED.
18. REFER TO ARCHITECTURAL, STRUCTURAL, ELECTRICAL AND MECHANICAL DRAWINGS FOR ALL OPENINGS, FLANGES, MOULDS, GROOVES, CLIPS AND GROUNDS TO BE CAST IN CONCRETE.
19. CONSTRUCTION JOINTS SHALL BE MADE ROUGH AND ALL LAITANCE REMOVED FROM THE SURFACE. CONCRETE MAY BE ROUGHENED BY CHIPPING THE ENTIRE SURFACE, SANDBLASTING, OR HOSING THE SURFACE 4 TO 6 HOURS AFTER THE POUR WITH A FINE SPRAY.
20. REMOVE ALL DEBRIS FROM THE FORMS BEFORE PLACING ANY CONCRETE.
21. REINFORCING, DOWELS, BOLTS, ANCHORS, SLEEVES, ETC. TO BE EMBEDDED IN CONCRETE SHALL BE SECURELY POSITIONED BEFORE PLACING CONCRETE. OBTAIN APPROVAL OF ALL AFFECTED TRADES PRIOR TO PLACING CONCRETE.
22. MAXIMUM FREE FALL OF CONCRETE SHALL BE 4'-0".
23. CONCRETE FOR WALLS SHALL BE PLACED SO THAT NO PART OF THE LIFT IS MORE THAN 2 FT. HIGHER THAN ANY OTHER PART.
24. CONCRETE IN WALLS, PIERS, OR COLUMNS SHALL SET AT LEAST 2 HOURS BEFORE PLACING CONCRETE IN BEAMS, SPANDRELS, OR SLABS SUPPORTED THEREON.
25. REINFORCE ALL SLABS ON GRADE AS SHOWN ON DRAWINGS.
26. USE #2 SPREADERS APPROXIMATELY EVERY THIRD INTERSECTION EACH DIRECTION FOR ALL DOUBLE LAYER WALLS. PLACE SPREADERS IN VERTICAL LINES WITH FORM TIES.
27. NO WOOD SPREADERS ARE ALLOWED. NO WOOD STAKES ARE ALLOWED IN AREAS TO BE CONCRETED.
28. CONCRETE MIX DESIGN SHALL BE SUBMITTED FOR ENGINEER'S REVIEW PRIOR TO PLACING CONCRETE.
29. NOTIFY THE ENGINEER 48 HOURS PRIOR TO PLACING CONCRETE.

CONCRETE AND REINFORCEMENT STEEL: (Continued)

30. SPACING OF CONST. JOINTS IN WALLS AND SLABS IS 30 FT. MAXIMUM EA. WAY; LENGTH OF WALL POUR FROM CORNER IS 20 FT. MAXIMUM; MAXIMUM AREA OF ONE POUR IS 900 SF. U.N.O. SUBMIT SHOP DRAWINGS FOR APPROVAL.
31. EXCEPT AS OTHERWISE REQUIRED, EXPOSED CONCRETE CORNERS AND EDGES SHALL HAVE 3/4" CHAMFERS. RE-ENTRANT CORNERS SHALL NOT HAVE FILLETS.
32. POST INSTALLED ANCHORS AS APPROVED BY ICC-ES FOR THE USE IN CRACKED CONCRETE SHALL BE USED. THE DESIGN SHALL BE IN ACCORDANCE WITH CHAPTER-17 OF ACI 318-19. PROVIDE ICC-ES REPORT FOR ENGINEERS APPROVAL.
33. IF EXPANSION JOINTS ARE GOING TO BE USED, THEY WILL BE SHOWN ON CONSTRUCTION DRAWINGS.

GENERAL STRUCTURAL DESIGN CRITERIA — REV 080321

DESIGN IN ACCORDANCE WITH THE 2018 EDITION OF THE INTERNATIONAL BUILDING CODE, EXCEPT WHERE OTHER APPLICABLE CODES OR THE FOLLOWING NOTES ARE MORE RESTRICTIVE.

RISK CATEGORY: III

WIND DESIGN DATA:

BASIC WIND SPEED (V, 3 SEC - MPH): 100
WIND EXPOSURE C

EARTHQUAKE DESIGN DATA:

SEISMIC IMPORTANCE FACTOR (Ie): 1.25
MAPPED SPECTRAL RESPONSE PARAMETER (S_S): 0.335
MAPPED SPECTRAL RESPONSE PARAMETER (S_1): 0.113
DESIGN SPECTRAL RESPONSE PARAMETER (S_{DS}): 0.342
DESIGN SPECTRAL RESPONSE PARAMETER (S_{D1}): 0.178
SITE CLASS: D
SEISMIC DESIGN CATEGORY: C

FLOOD DESIGN DATA:

FIRM MAP NUMBER 16017C0718E (EFFECTIVE 11/18/2009)
ZONE X

ABBREVIATIONS:

ADDL	ADDITIONAL
AB	AGGREGATE BASE, ANCHOR BOLT
AC	ASPHALT CONCRETE
ACP	ASBESTOS CEMENT PIPE
AL	ALUMINUM
ALT	ALTERNATE
APPROX	APPROXIMATE (LY)
ARCH	ARCHITECTURAL
@	AT
BETW	BETWEEN
BEV	BEVELED
BLKG	WOOD BLOCKING
BOT	BOTTOM
BRG	BEARING
BLDG	BUILDING
BF	BOTTOM OF FOOTING
B/W	BACK OF WALL
BIT CTD	BITUMINOUS COATED
CHK PL	CHECKERED PLATE
CLR	CLEAR
CL	CENTER LINE
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CC	CENTER TO CENTER
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONC	CONCRETE
CJ	CONSTRUCTION JOINT
CONT	CONTINOUS
CT J	CONTROL JOINT
CR J	CONTRACTION JOINT
CIP	CAST-IN-PLACE
CIDH	CAST-IN-DRILLED-HOLE
CTR	CENTER (ED)
CG	CENTER OF GRAVITY
CONST	CONSTRUCTION
COORD	COORDINATE
CSK	COUNTER SINK
CAB	CRUSHED AGGREGATE BASE
CAP	CORRUGATED ALUMINUM PIPE
D	DEPTH
db	BAR DIAMETER
DF	DOUGLAS FIR
DEMO	DEMOLITION
DIA	DIAMETER
DIM	DIMENSION
DN	DOWN
DWG	DRAWING
DL	DEAD LOAD
DIST	DISTANCE
DD	DOWN DRAIN
DIAPH	DIAPHRAGM
DSA	DIVISION OF STATE ARCHITECT
EXIST, (E)	EXISTING
EA	EACH
EF	EACH FACE
EJ	EXPANSION JOINT
EL, ELEV	ELEVATION
EQ	EQUAL
EQUIP	EQUIPMENT
EXT	EXTERIOR
EMBED	EMBEDMENT
EN	EDGE NAILING
ES	EACH SIDE
EW	EACH WAY
ENGR	ENGINEER, ENGINEERING
EXC	EXCAVATION
EXP	EXPANSION
FAB	FABRICATE
F & I	FURNISH AND INSTALL
FB	FACE OF BLOCK
FC	FACE OF CONCRETE
FD	FLOOR DRAIN
FF	FINISHED FLOOR, FACE OF FRAMING
FDN	FOUNDATION
FG	FINISHED GRADE
FS	FINISHED SURFACE, FACE OF STUD
F/S	FAR SIDE
FLG	FLANGE
FN	FIELD NAILING
FTG	FOOTING
FW	FACE OF WALL
FT	FEET (FOOT)
GA	GAGE
GAF	GALVANIZE AFTER FABRICATION
GALV	GALVANIZED
GS	GALVANIZED STEEL
GR	GUARD RAILING, GRADE
GTR	GUTTER
GRTG	GRATING
GSP	GALVANIZED STEEL PIPE
H	HIGH OR HEIGHT
HA	HEADED ANCHOR
HR	HANDRAIL
HSB	HIGH STRENGTH BOLT
HORIZ	HORIZONTAL
HW	HEAD WALL
HS	HIGH STRENGTH

ABBREVIATIONS (Continued):

ID	INSIDE DIAMETER
INCL	INCLUDING
INSP	INSPECTION
INV	INVERT
IE	INVERT ELEVATION
IF	INSIDE FACE
IN	INCH
JT	JOINT
JCT	JUNCTION
KP	KICK PLATE
KIPS	KILO POUNDS
L	LENGTH
LS	LAG SCREW
LAT	LATERAL
LB	POUND
LF	LINEAR FOOT
LL	LIVE LOAD
LT	LEFT
LONG	LONGITUDE
LONGIT	LONGITUDINAL
LTS	LIME TREATED SOIL
MANUF	MANUFACTURER
MAX	MAXIMUM
MB	MACHINE BOLT
MECH	MECHANICAL
MIN	MINIMUM
MPH	MILES PER HOUR
MISC	MISCELLANEOUS
(N)	NEW
NS	NON-SHRINK
N/S	NEAR SIDE
NTS	NOT TO SCALE
NO., NOS	NUMBER, NUMBERS
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OG	ORIGINAL GROUND
OE	OUTER EDGE
OH	OVERHEAD, OPPOSITE HAND
OPNG	OPENING
OPP	OPPOSITE
O-O	OUT TO OUT
PVMT	PAVEMENT
PL	PLATE
PREFAB	PREFABRICATED
PSI	POUNDS PER SQUARE INCH
P/S	PRESTRESSED
R	RADIUS
REINF	REINFORCEMENT
RC	REINFORCED CONCRETE
RCB	REINFORCED CONCRETE BOX
RCE	REGISTERED CIVIL ENGINEER
RET	RETAINING
RT	RIGHT
REQD	REQUIRED
SEC	SECTION
SF	SQUARE FOOT
SIM	SIMILAR
SPEC	SPECIFICATIONS
SHT	SHEET
STR	STRUCTURE/STRUCTURAL
SG	SUBGRADE
STD	STANDARD
SOG	SLAB ON GRADE
SP	STRUCTURAL PLYWOOD
SS	STAINLESS STEEL
SSB	STAINLESS STEEL BOLT
ST	STEEL
STIFF	STIFFENER
STAG	STAGGERED
STIR	STIRRUPS
SQ	SQUARE
SYMM	SYMMETRICAL
T & B	TOP AND BOTTOM
TF	TOP OF FOOTING
TOB	TOP OF BLOCK
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOS	TOP OF STEEL
TS	TUBE STEEL
TOW	TOP OF WALL
TYP	TYPICAL
TEMP	TEMPORARY
UG	UNDER GROUND
UNO (UON)	UNLESS NOTED OTHERWISE
VERT	VERTICAL
VOL	VOLUME
W	WIDTH
WS	WATERSTOP
WP	WORKING POINT
WH	WEEP HOLE
WM	WIRE MESH
WSP	WELDED STEEL PIPE
WWF	WELDED WIRE FABRIC
W/	WITH
W/O	WITHOUT

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A	30% DESIGN REVIEW	SS	BZ	2024.01.23
B	90% DESIGN REVIEW	SS	BZ	2025.11.21
C	IFC	SS	BZ	2025.07.14

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: S-001

Scale: NOT TO SCALE

SS			2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
STRUCTURAL
GENERAL NOTES AND
DESIGN CRITERIA

Revision:

Drawing No.
S-001

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ORIGINAL SHEET - ANSI D

REQUIRED SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION

1. SPECIAL INSPECTION FOR CONCRETE CONSTRUCTION WILL BE IN ACCORDANCE WITH 2018 IBC SECTION 1705.3 AND THE FOLLOWING TABLE.

REV 080321

VERIFICATION AND INSPECTION	INSPECTION		REFERENCED STANDARD (A)	IBC REFERENCE
	CONTINUOUS	PERIODIC		
INSPECTION OF REINFORCING STEEL, INCLUDING PRESTRESSING TENDONS, AND PLACEMENT.	-	X	ACI 318: CH. 20, 25.2, 25.3, 26.6.1-26.6.3	1908.4
REINFORCING STEEL WELDING: A. VERIFY WELDABILITY OF REINFORCING BARS OTHER THAN ASTM A706; B. INSPECT SINGLE-PASS FILLET WELDS, MAXIMUM 5/16"; AND C. INSPECT ALL OTHER WELDS	- - X	X X -	AWS D1.4 ACI 318: 26.6.4	-
INSPECTION OF ALL ANCHORS CAST IN CONCRETE.	-	X	ACI 318: 17.8.2	-
INSPECTION OF ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS (B). A. ADHESIVE ANCHORS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS. B. MECHANICAL ANCHORS AND ADHESIVE ANCHORS NOT DEFINED DEFINED BY PART A.	X -	- X	ACI 318: 17.8.2.4 ACI 318: 17.8.2	-
VERIFYING USE OF REQUIRED DESIGN MIX.	-	X	ACI 318: CH. 19, 26.4.3, 26.4.4	1904.1, 1904.2, 1908.2, 1908.3
PRIOR TO CONCRETE PLACEMENT, FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE.	X	-	ASTM C172 ASTM C31 ACI 318: 26.5, 26.12	1908.10
INSPECTION OF CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES.	X	-	ACI 318: 26.5	1908.6, 1908.7, 1908.8
INSPECTION FOR MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES.	-	X	ACI 318: 26.5.3-26.5.5	1908.9
ERECTION OF PRECAST CONCRETE MEMBERS	-	X	ACI 318: 26.9	-
INSPECT PRESTRESSED CONCRETE FOR: A. APPLICATION OF PRESTRESSING FORCES. B. GROUTING OF BONDED PRESTRESSING TENDONS.	X X	-	ACI 318: 26.10	-
VERIFY IN-SITU CONCRETE STRENGTH PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE AND PRIOR TO REMOVAL OF SHORES AND FORMS FROM BEAMS AND STRUCTURAL SLABS.	-	X	ACI 318: 26.11.2	-
INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED.	-	X	ACI 318: 26.11.1.2(B)	-

(A) WHERE APPLICABLE, SEE ALSO IBC SECTION 1705.12, SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE.

(B) SPECIFIC REQUIREMENTS FOR SPECIAL INSPECTION SHALL BE INCLUDED IN THE RESEARCH REPORT FOR THE ANCHOR ISSUED BY AN APPROVED SOURCE IN ACCORDANCE WITH 17.8.2 IN ACI 318 OR OTHER QUALIFICATION PROCEDURES. WHERE SPECIFIC REQUIREMENTS ARE NOT PROVIDED, SPECIAL INSPECTION REQUIREMENTS WILL BE AS SPECIFIED BY THE REGISTERED DESIGN PROFESSIONAL AND WILL BE APPROVED BY THE BUILDING OFFICIAL PRIOR TO COMMENCEMENT OF THE WORK.

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C	SS	BZ	2026.01.23	IFC
B	SS	BZ	2025.11.21	90% DESIG REVIEW
A	SS	BZ	2025.07.14	30% DESIG REVIEW

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PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: S-002

Scale: NOT TO SCALE

SS			2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
STRUCTURAL
STATEMENT OF
SPECIAL INSPECTIONS -I

Revision:

Drawing No.
S-002

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ORIGINAL SHEET - ANSI D

NOTES:
TYPICAL MASONRY WALL REINF. UNLESS OTHERWISE NOTED. #5 @ 32" O.C. VERT. #6 @ 48" HORIZ. IN BOND BMS. FOR OTHER DETAIL SEE DWG S-1. GROUT ALL CELLS EXCEPT EXTERIOR WALLS. FOR EXTERIOR WALLS ONLY, FILL CELLS WITHOUT REINFORCING BARS WITH BLOCK INSULATION. SEE SPECS. PROVIDE CONTINUOUS INSPECTION FOR ALL MASONRY WORK.

FOUNDATION AND GROUND FLOOR PLAN
SCALE: 1/4" = 1'-0"

UPPER FLOOR PLAN
SCALE: 1/4" = 1'-0"

NOTE:
DESIGN LIVE LOAD - 150 PSF

WALLS PAINTED UPPER FLOOR TO 4'-0" HEIGHT FOR SLUDGE SPLASH

NOTE:
SUMP CONSTRUCTION JTS. SHOWN IN SECTS. 3 AND 5 SHALL BE APPROVED BY THE ENGINEER

NOTES:
1. FOR EQUIP PADS SEE MECH DWGS & DET N & Q/S-2.
2. FOR DOOR SCHEDULE, SEE DWG S-6

DETAIL A
SCALE: 3/4" = 1'-0"

DETAIL B
SCALE: 3/4" = 1'-0"

SECTION 1 TYP
SCALE: 1/2" = 1'-0"

SECTION 2 TYP
SCALE: 1/2" = 1'-0"

SECTION 3
SCALE: 1/2" = 1'-0"

SECTION 4
SCALE: 1/2" = 1'-0"

SECTION 5
SCALE: 1/2" = 1'-0"

SECTION 6 TYP @ 2 PLACES
SCALE: 1/2" = 1'-0"

RECORD DRAWING
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No.	Issued	By	Appd	YYYY.MM.DD
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C	IFC	SS	BZ	2025.07.14

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: S-103
Scale: NOT TO SCALE

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Title
STRUCTURAL
FLOOR PLAN AND
SECTIONS - I

Revision:

Drawing No.
S-103

REGISTERED PROFESSIONAL ENGINEER 4472 STATE OF IDAHO YOGESH B. PATEL

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ORIGINAL SHEET - ANSI D

NOTES:
1. DESIGN LIVE OR SNOW LOAD - 40 PSF
2. ROOF SYSTEM. SEE SPECS.
3. STEEL DECK SEE SPECS.
4. 2-½"Ø PUDDLE WELDS PER DECK UNIT OF 24" WIDE @ TRANSVERSE SUPPORTS. SIDE LAP CONNECTION 1½" SEAM WELD @ 24" O.C.
5. FOR LOCATION OF OPNGS SEE MECH. DWG. PROVIDE CURB AND BASE FLASHING @ OPNGS

ROOF PLAN
SCALE: ¼"=1'-0"

PLAN - ROOF HATCH DETAIL
SCALE: ⅜"=1'-0"

SECTION 1/S-3
SCALE: ½"=1'-0"

SECTION 2
SCALE: ¾"=1'-0"

SECTION 3 TYP
SCALE: ¾"=1'-0"

SECTION 4 TYP
SCALE: ¾"=1'-0"

SECTION 5 TYP
SCALE: 1"=1'-0"

SECTION 6
SCALE: 1"=1'-0"

SECTION 7
SCALE: 1"=1'-0"

SECTION 8
SCALE: 1"=1'-0"

SECTION 9
SCALE: ¾"=1'-0"

SECTION 10
SCALE: 1"=1'-0"

DETAIL A
SCALE: 1½"=1'-0"

NOTE:
ALL WOOD DF. No 2. OR BETTER, UNLESS NOTED OTHERWISE

NOTE:
USE SIMILAR DETAIL FOR C8 & W8

NOTE:
ALL BOLTS ¾"Ø A325 x

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C	SS	BZ	2024.01.23
B	SS	BZ	2023.11.21
A	SS	BZ	2023.07.14

Revision

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PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: S-104
Scale: NOT TO SCALE

Dwn.	Dsgn.	Chkd.	2025.07.14 YYYY.MM.DD

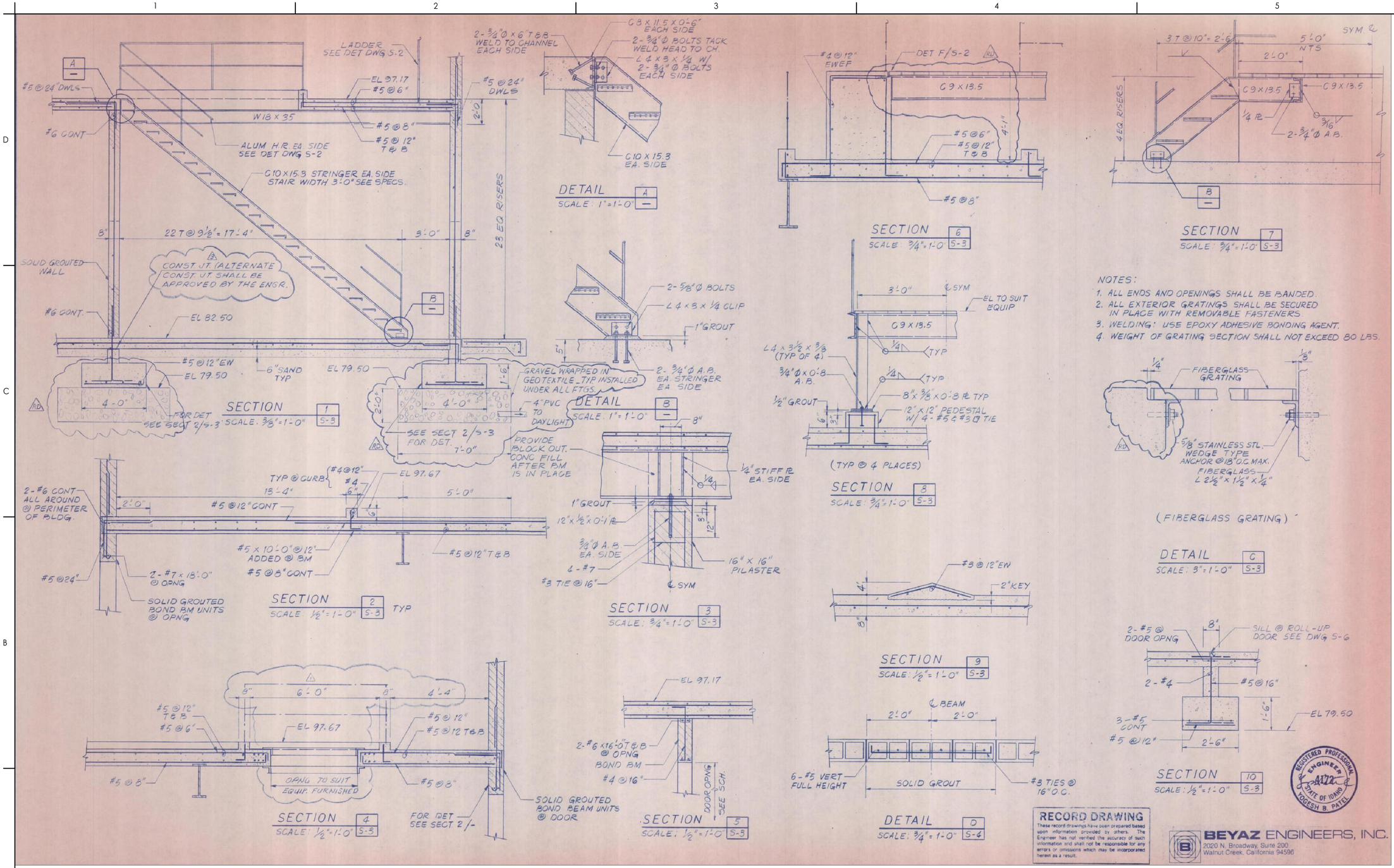
Title
STRUCTURAL
FLOOR PLAN AND
SECTIONS - II

Revision:

Drawing No.
S-104

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A	SS	BZ	2023.07.14	

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C	FC			90% DESIGN REVIEW
B				90% DESIGN REVIEW
A				

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

REGISTERED PROFESSIONAL ENGINEER 21172 STATE OF IDAHO YOGESH B. PATEL

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: S-105

Scale: NOT TO SCALE

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Title
STRUCTURAL SECTIONS AND DETAILS

Revision:

Drawing No.
S-105

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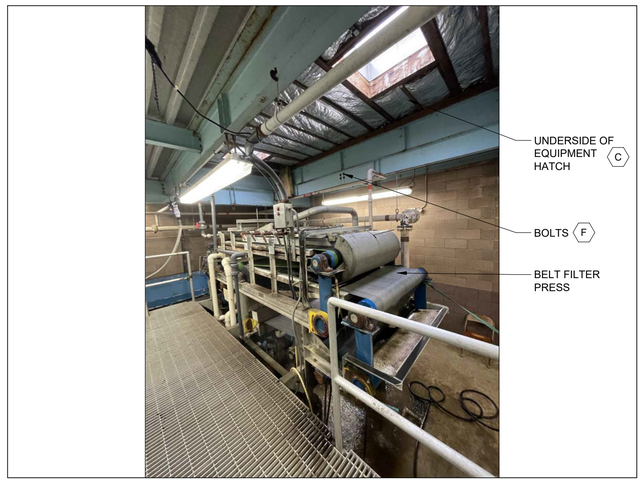
1 S-104 DETAIL NO SCALE



2 S-104 DETAIL NO SCALE



3 S-104 DETAIL NO SCALE



4 S-103 DETAIL NO SCALE

GENERAL SHEET NOTES

1. SEE GENERAL NOTES & TYP. DETAILS.
2. ALL UNCLEAR AND/OR MISSING DETAILS SHALL BE BROUGHT TO THE ENGINEER'S ATTENTION BEFORE PROCEEDING WITH CONSTRUCTION.
3. EXISTING STRUCTURE'S CONDITIONS (DIMENSIONS, DETAL LOCATIONS, ELEVATIONS, ETC.) ARE TO BE FIELD VERFIED PRIOR TO CONSTRUCTION. THE ENGINEER MUST BE NOTIFIED IMMEDIATELY IF ANY CONFLICTS OCCUR BETWEEN EXISTING CONDITIONS AND NEW CONSTRUCTION.
4. ALL EXISTING INFORMATION PROVIDED WITHIN CONSTRUCTION DOCUMENTS WAS TAKEN FROM 'CITY OF SANDPOINT, SANDPOINT, IDAHO CONSTRUCTION OF SOLIDS HANDLING FACILITIES PROJECT NO. C-160167-01 1982 JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC. THESE CONSTRUCTION DOCUMENTS (SPECIFICATIONS AND DRAWINGS) ARE AVAILABLE, SEE APPENDIX A.
5. PRIOR TO BIDDING, A PRE-BID WALKTHROUGH WILL BE CONDUCTED. DURING THIS WALKTHROUGH, THE CONTRACTOR SHALL OBTAIN ALL NECESSARY INFORMATION TO PREPARE AN ADEQUATE BID FOR THE REQUIRED WORK. THIS INFORMATION AND EXISTING CONSTRUCTION DOCUMENTS (SEE NOTE 4) SHALL BE USED FOR BIDDING PURPOSES.

SHEET KEY NOTES

A. DEMO. EXIST. ROOFING AND RE-ROOF, SEE SPECIFICATIONS. DEMO. AND RE-ROOF INCLUDES ALL APPURTENANCES REQUIRED FOR A COMPLETE ROOFING SYSTEM, INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING: EMBEDMENT OF SHEET METAL NAILERS, FLASHING, CANTS, VENTING OF ROOF, EXPANSION JOINTS, ROOFING, ETC. SEE ROOFING SPECIFICATIONS 07 52 00 FOR ADDITIONAL INFORMATION.

B. DEMO. EXIST. ROOF SCUTTLE AND REPLACE IN LIKE KIND. EXIST. ROOF SCUTTLE IS A SINGLE LEAF CURB MOUNTED 2'-6"x3'-0" BILCO TYPE "S", BABCOCK-DAVIS ASSOCIATES OR APPROVED EQUAL ACCORDING TO THE JAMES M MONTGOMERY CONSULTING ENGINEERS, INC. 1982 AS-BUILT DOCUMENTS. CONTRACTOR SHALL ALSO REPLACE CURB, IN LIKE KIND, SUPPORTING THE ROOF SCUTTLE.

C. EXIST. ROOF HATCHES (TOTAL OF 2) SHALL BE REMOVED FOR REMOVAL OF EXIST. BELT PRESSES (TOTAL OF 2) AND PLACEMENT OF NEW SCREW PRESSES (TOTAL OF 2), NEW ROOF HATCH SHALL BE CONSTRUCTED IN LIKE KIND WITH SPECIFICATION 06 10 00 AND AS-BUILT DOCUMENTS. SEE PLAN - ROOF HATCH DETAIL, SECTION 1/- AND SECTION 8/- ON SHEET S-4 OF THE JAMES M MONTGOMERY CONSULTING ENGINEERS, INC. 1982 AS-BUILT DOCUMENTS. REVISION TO REFERENCED DETAILS SHALL BE THE USE OF SIMPSON STRONG-TIE SOLID SAWN LUMBER FACE MOUNT HANGERS LUS28 AT SINGLE JOIST AND LUS28-2 AT DOUBLE JOIST. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS, ELEVATIONS, PLYWOOD, LUMBER, HARDWARE, INSULATION, STRUCTURAL STEEL, PLATES, ETC. PRIOR TO CONSTRUCTION OF THE ROOF HATCHES.

D. EXIST. SKYLIGHTS ON EXIST. ROOF HATCHES, SEE KEY NOTE 4, SHALL BE DEMO. AND REPLACED ON NEW ROOF HATCHES, IN LIKE KIND.

   a. THE EXIST. SKYLIGHTS ARE BOHEM MANUFACTURING CO., CONSHOHOCKEY, PA., MODEL BD, APCO, HAWTHORNE, N.J. MODEL JDP, OR EQUAL CONFORMING TO OSHA AND UBC REQUIREMENTS (THIS WILL NOW BE CONFORMING TO OSHA AND THE 2018 IBC).

   b. SKYLIGHTS SHALL BE FACTORY-ASSEMBLED OF THE DOUBLE-DOME TYPE, DESIGNED TO MEET OSHA AND UBC REQUIREMENTS (THIS WILL NOW BE CONFORMING TO OSHA AND THE 2018 IBC). SKYLIGHTS SHALL BE WEATHERTIGHT ASSEMBLE. THE SKYLIGHT UNIT SHALL BE DESIGNED TO ACCOMMODATE WITHOUT DISTRESS IN ASSEMBLE, FASTENERS, OR GLAZING TEMPERATURE CHANGE OF 100°F.

   c. SKYLIGHTS SHALL INCLUDE A 6063-T5 EXTRUDED ALUMINUM CURB FRAME WITH AN INTEGRAL SLOPING GUTTER AND DOME ELEVATION LEG WITH CONTINUOUS VINYL OR NEOPRENE SUPPORT GASKET AND RETAINING FRAME.

   d. THE PREFABRICATED CURB SHALL BE ALUMINUM CONSTRUCTION, INSULATED WITH FIBERGLASS AND BE 9 INCHES IN HEIGHT.

   e. OUTER DOME SHALL BE FORMED OF ONE-PIECE (WHITE) TRANSLUCENT CAST ACRYLIC TO WITHSTAND A MINIMUM LIVE LOAD OF 40 PSF.

   f. INNER DOME SHALL BE FORMED OF ONE-PIECE (WHITE) TRANSLUCENT CAST ACRYLIC.

   g. ACCORDING TO THE JAMES M MONTGOMERY CONSULTING ENGINEERS, INC. 1982 AS-BUILT DOCUMENTS.

E. EXIST. RAIN GUTTERS AND DOWN SPOUTS SHALL BE DEMO. AND REPLACED IN LIKE KIND.

F. EXIST. METAL DECKING AND BOLTS SHALL BE CLEANED, TREATED WITH RUST INHIBITORS, AND COATED IN ACCORDANCE WITH SPECIFICATION 09 96 00. THE CONTRACTOR SHALL DETERMINE THE QUANTITY OF WORK REQUIRED FOR BIDDING PURPOSES DURING THE PRE-BID WALKTHROUGH, IN ACCORDANCE WITH SPECIFICATION 01 10 00.

G. DEMO EXIST. BELT FILTER PRESS CONC. SUPPORTS (TOTAL OF 8). DEMO SHALL BE IN SUCH A MANNER SO THAT EXIST. CONC. SLAB, AND REINFORCING ARE NOT DAMAGED. SEE SPECIFICATION 01 73 29 FOR ADDITIONAL INFORMATION.

H. CONTRACTOR TO PROVIDE 8 NEW EQUIPMENT CONCRETE BASE SUPPORTS, SEE DETAIL 10/S-8.

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No.	By	Appd	YYYY.MM.DD
C	SS	BZ	2026.01.23
B	SS	BZ	2025.11.21
A	SS	BZ	2025.07.14

Revision

No.	By	Appd	YYYY.MM.DD
C	SS	BZ	2026.01.23
B	SS	BZ	2025.11.21
A	SS	BZ	2025.07.14

Issued

IFC 90% DESIGN REVIEW
30% DESIGN REVIEW

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: S-106

Scale: NOT TO SCALE

Dwn.	Dsgn.	Chkd.	2025.07.14 YYYY.MM.DD

Title
STRUCTURAL
DETAILS -I

Revision:

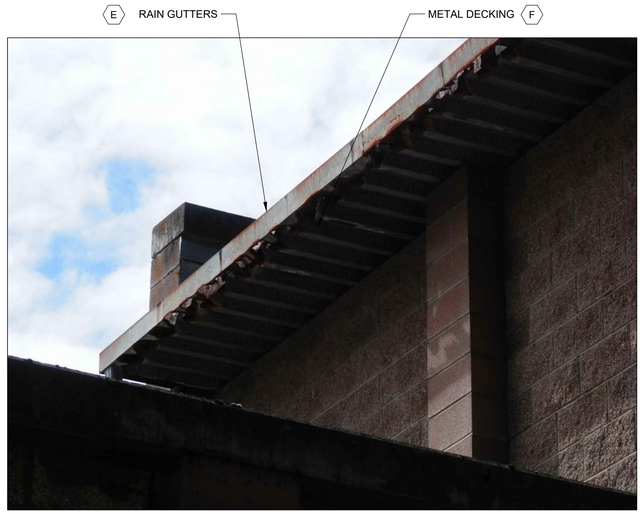
Drawing No.
S-106

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ORIGINAL SHEET - ANSI D



5 S-104 DETAIL NO SCALE



6 S-104 DETAIL NO SCALE



7 S-104 DETAIL NO SCALE



8 S-103 DETAIL NO SCALE

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ORIGINAL SHEET - ANSI D

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Consultant

No.	By	Appd	YYYY.MM.DD

Revision

No.	By	Appd	YYYY.MM.DD
A.	SS	BZ	2024.01.23
B.	SS	BZ	2025.11.21
C	IFC	SS	SS	BZ	2025.07.14

Issued

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233

File Name: S-107

Scale: NOT TO SCALE

Dwn.	Dsgn.	Chkd.	2025.07.14 YYYY.MM.DD

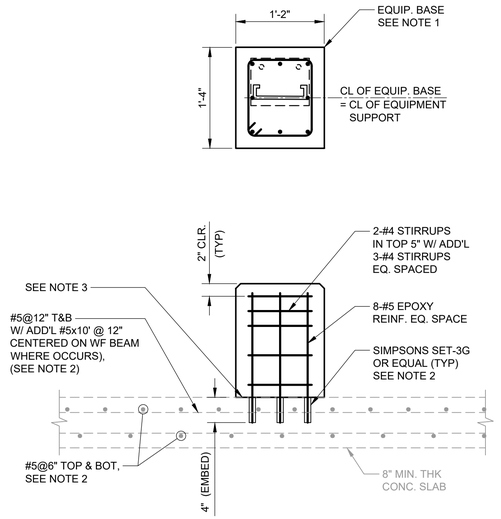
Title
STRUCTURAL DETAILS -II

Revision:

Drawing No.
S-107



9 S-103 DETAIL
NO SCALE



10 S-103 EQUIP. CONC. BASE DETAIL (TYP OF 8)
NO SCALE

NOTES:

1. CONTRACTOR TO COORD. W/ EQUIPMENT MANUFS. SIZE, ELEVATION AND LOCATION OF EQUIPMENT BASES. SIZE OF EQUIPMENT BASES TO TAKE INTO ACCOUNT EDGE DIST. REQUIREMENTS FOR EQUIP. ANCHORAGE DESIGN. EQUIPMENT MANUFS. TO PROVIDE DETAILS AND CALCULATIONS STAMPED AND SIGNED BY A REGISTERED IDAHO STRUCTURAL OR CIVIL ENGINEER. SEE SPECS. 01 33 17 FOR ADD'L INFO. SUBMIT DRAWINGS AND CALCULATIONS FOR REVIEW PRIOR TO DRILLING FOR EPOXY REINFORCING AND POURING OF EQUIPMENT BASES.
2. PRIOR TO DRILLING FOR EPOXY REINFORCING (SEE NOTE 1 ABOVE), CONTRACTOR TO LOCATE EXISTING 8" THICK CONCRETE SLAB REINFORCING WITH X-RAY OR OTHER NON-DESTRUCTIVE MEANS. EXISTING REINFORCING SHALL NOT BE DAMAGED WHILE DRILLING FOR EPOXY REINFORCING. IF REQUIRED ADJUST EQUIPMENT BASE EPOXY REINFORCING, SO THAT EXISTING REINFORCING WILL NOT BE DAMAGED. IF REQUIRED ADJUST EQUIPMENT BASES DIMENSIONS TO ACCOMMODATE REINFORCING ADJUSTMENTS. IF WHILE DRILLING FOR EPOXY REINFORCING EXISTING REINFORCING IS ENCOUNTERED, STOP DRILLING IMMEDIATELY AND FILL HOLE PER WITH NON-SHRINK GROUT.
3. ROUGHEN EXISTING CONCRETE TO A ¼" AMPLITUDE AND APPLY EPOXY BONDING AGENT PRIOR TO EQUIPMENT BASE POUR. PER MANUF. REQUIREMENTS.
4. SEE KEY NOTE (H).

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No.	By	Appd	YYYY.MM.DD
A	SS	BZ	2024.01.23
B	SS	BZ	2024.11.21
C	SS	BZ	2025.07.14

Revision

No.	By	Appd	YYYY.MM.DD
A	SS	BZ	2024.01.23
B	SS	BZ	2024.11.21
C	SS	BZ	2025.07.14

Issued
- A 30% DESIGN REVIEW
- B 90% DESIGN REVIEW
- C IFC

Permit/Seal

PROFESSIONAL ENGINEER LICENSED 17947 STATE OF IDAHO STEVEN DAVID STOLL

2/4/2026

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: S-108

Scale:

Dwn.	Dsgn.	Chkd.	2025.07.14 YYYY.MM.DD

Title
STRUCTURAL DETAILS -III

Revision:

Drawing No.
S-108

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ORIGINAL SHEET - ANSI D

Stantec

SUBMITTAL REVIEW COMMENT SHEET

OWNER: City of Sandpoint
PROJECT: Sandpoint Screw Press Upgrade

DATE: 2/27/2026
REVIEWER: Danielle Philbrick, Chris Deerkop, Nick Smith

SUBMITTAL No.: Rev 0
DESCRIPTION: Q-Press 620.2

GENERAL

CORRECTIONS OR COMMENTS MADE ON CONTRACTOR'S SUBMITTAL DURING THE REVIEW DO NOT RELIEVE THE CONTRACTOR FROM COMPLIANCE WITH CONTRACT DRAWINGS AND SPECIFICATIONS. THIS SUBMITTAL HAS BEEN REVIEWED FOR CONFORMANCE WITH THE DESIGN CONCEPT AND GENERAL COMPLIANCE WITH THE CONTRACT DOCUMENTS ONLY. CONTRACTOR IS RESPONSIBLE FOR CONFIRMING AND CORRELATING ALL QUANTITIES AND DIMENSIONS, FABRICATION PROCESS AND TECHNIQUES, COORDINATING WORK WITH OTHER TRADES AND SATISFACTORY AND SAFE PERFORMANCE OF THE WORK.

MARK	DESCRIPTION
	AMEND AND RESUBMIT (A&R)
	FOR INFORMATION ONLY (FIO)
	MAKE CORRECTIONS NOTED (MCN)
	NO EXCEPTIONS TAKEN (NET)
X	PARTIAL APPROVAL, RESUBMIT AS NOTED (PAR)
	REJECTED (R)
	VOID (V)

REVIEW COMMENTS:

Overall Comment: The comments below are all considered "make corrections noted" except for the request to resubmit the O&M Manual based on the provided comment. The equipment can be fabricated without the need for a resubmittal. We are only requesting a resubmittal for the O&M Manual and deferred submittal of resumes for field technician and factory test results.

Electrical Comments:

The summary is that many places that list the main power feed into the control panel incorrectly as 460vac 3 phase (480vac nominal). The available power at the plant is 230vac 3 phase (240vac nominal). It appears that they intended to change it all to 230vac (240vac), but missed a bunch of instances where it lists 460vac (480vac).

1. Page 15/71; Equipment Detailsincorrectly lists "Spraywash Motor Data 0.25 hp spraywash motor, 460 vac, 60 Hz, 3 ph".

2. Page 32/71; Dwg No. HBR10366A02, 2 of 16 correctly shows 240 vac and 230 vac

3. Page 33/71; Dwg No. HBR10366A03, 3 of 16correctly shows 240vac 3ph, 60Hz power input to the control panel. The 16.5 amps works with the 30 amp circuit breaker being installed in the MCC. It correctly shows the motors as 3/60/230vac.

4. Page 39/71; Dwg No. HBR10366A09, 9 of 16 incorrectly shows 480vac 3ph 60Hz power input to the control panel. Though it does have a note about how to jumper the motors for 240vac supply.

5. Page 42/71; Device Settings. PFR1 incorrectly lists 480 volts. Parameter 31 correctly lists 230 VAC.

6. Page 46/71; Dwg No. HBR10366A16, 16 of 16. Correctly shows 240VAC-3PH-60HZ.

7. Page 51/71; Bill of Materials, Page 1 of 5. Items 10 and 19 incorrectly list 480vac as the power supply. Items 20, 21 and 22 correctly list 240vac 1 pole circuit breakers.

8. Page 52/71; Bill of Materials, Page 2 of 5. Item 59 correctly lists 200-240vac.

9. Page 53/71; Bill of Materials, Page 3 of 5. Item 77 correctly lists 240vac 3PH.

10. Page 54/71; Bill of Materials, Page 4 of 5. Item 92 correctly lists 480/240vac.

11. Page 58/71; Datasheet Main Motor, 3 phase-motor. Lists 230 V as one of the options.

12. Pages 60-61/71; Gearmotors. Incorrectly lists 265/460 V [277/480 V].

13. Pages 62/71; Motor Performance curve. Incorrectly lists 460 V.

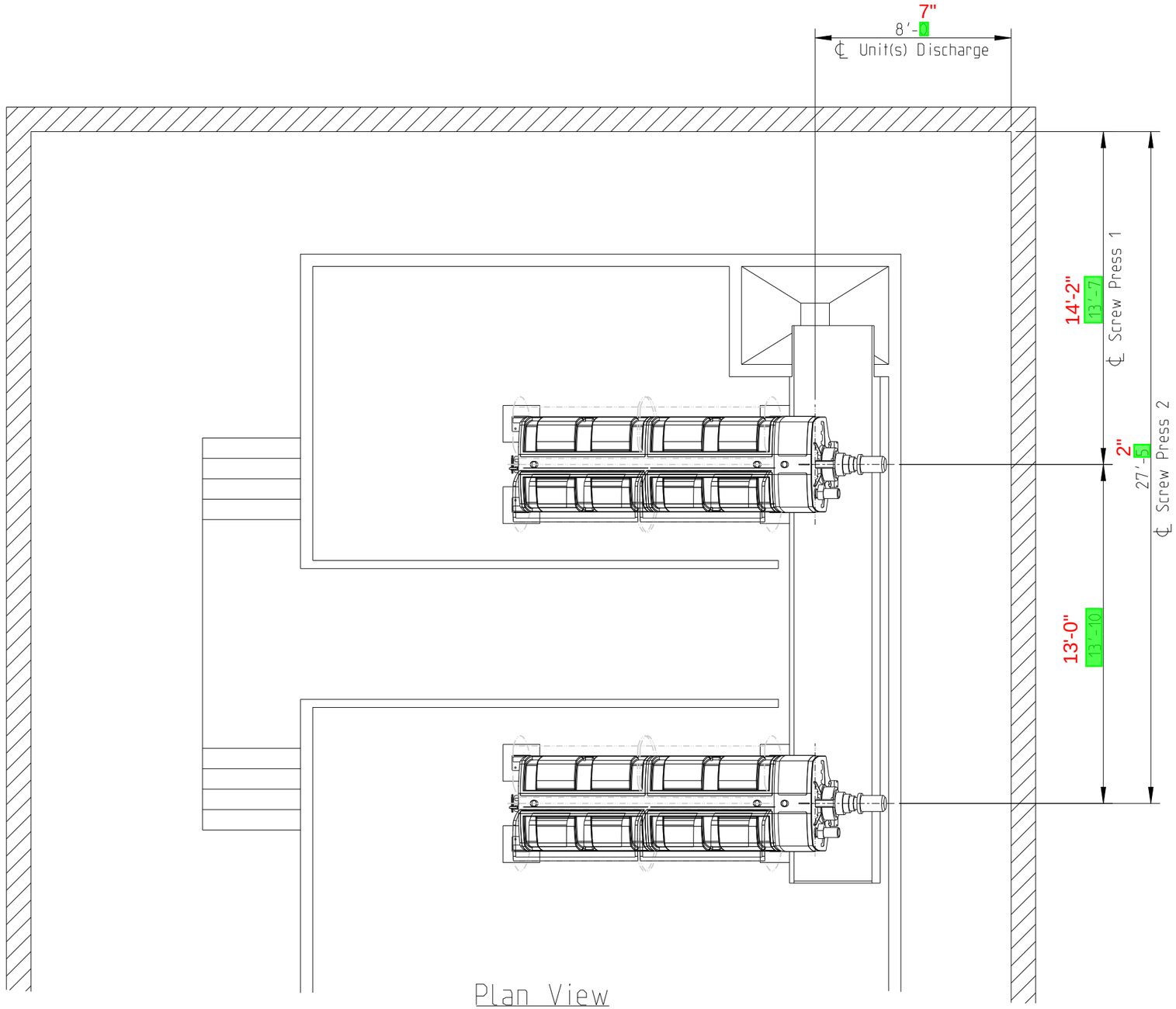
Process Comments:

1. Estimated polymer consumption is 40 – 53 lb active Polymer/dry ton sludge per Huber comment on 30% design.
2. The screw press support legs shall be capable of field adjustment for ease of installation per Specification 46 76 27, Section 2.04.B.3
3. Main bearings shall have a minimum B-10 life rating of 100,000 hours at standard operating speeds per Specification 46 76 27, Section 2.04.B.8
4. To optimize wash water consumption, the spray bar system shall have the ability to perform a quick wash of only the lower basket and/or an extended wash of the entire basket per Specification 46 76 27, Section 2.04.B.12
5. There are discrepancies in the size of the flowmeter. Quote states 2” flowmeter, but mechanical datasheet has 3” flowmeter highlighted. Provide 2” flowmeter per quote.
6. Dimensions updated on installation drawing. Refer to the attachment.
7. Operational manual should include tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices. Please provide in O&M Manual Resubmittal.
8. Provide Resume of Field Technician and factory test results as a deferred submittal. This can be provided prior to installation.

ATTACHMENTS:

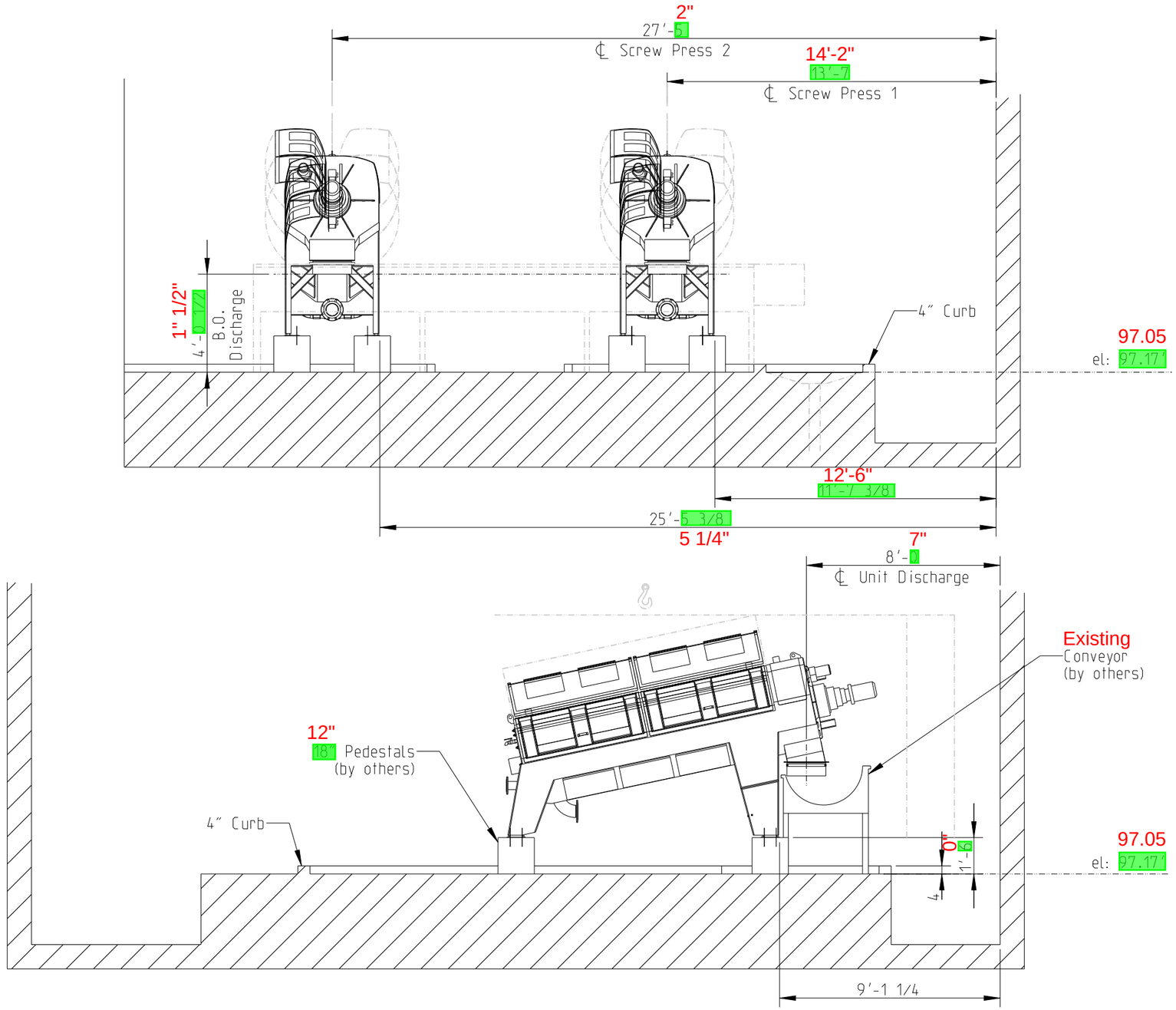
1. Marked up installation drawings.

END OF COMMENTS



Plan View

Intellectual property of HUBER Technology, Inc. Technical Information subject to change.			HUBER TECHNOLOGY WASTE WATER Solutions 1009 Airlie Parkway Denver, NC 28037	Huber Screw Press		
	Name	Date		Q-Press 620.2		
Designed:	us-ic	11.19.2025				
Approved:	II	II		Scale: 5:288	Fig. No.: 3/6	Installation drawing	Size: B
Modified:	-	-				
-	-			73013257 Sandpoint, ID WWTP Screw Press GSA		Drawing No.: 52480778
Rev.	Modification					



Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

	Name	Date
Designed:	us-ic	11.19.2025
Approved:	II	II
Modified:	-	-
-	-	
Rev.	Modification	

HUBER TECHNOLOGY
WASTE WATER Solutions
1009 Airlie Parkway Denver, NC 28037

Huber Screw Press

Q-Press 620.2

Scale:	Fig. No.:		Size:
5:288	4/6	Installation drawing	B

73013257 Sandpoint, ID WWTP Screw Press GSA

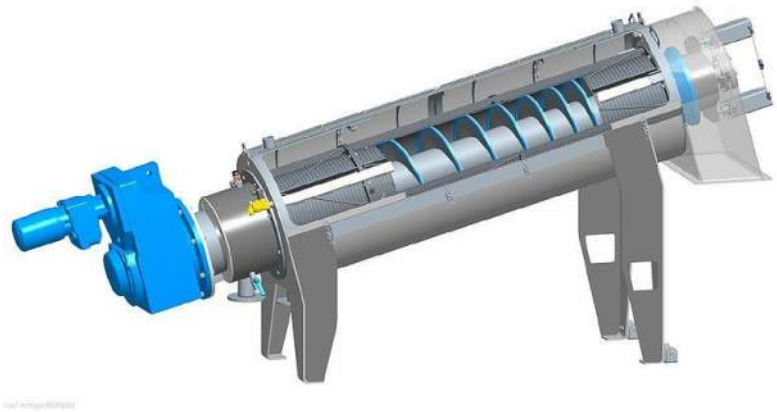
Drawing No.: 52480778

HUBER TECHNOLOGY
WASTE WATER Solutions

Equipment & Controls Submittal

Sandpoint, ID

Q-Press 620.2



Project: **7301**3257

Date: 2/20/26

Revision: **00**

Submittal Content:
-Q-Press 620.2
-Controls

Project Manager: Nick Kolsch; nick.kolsch@hhusa.net

HUBER TECHNOLOGY INC.
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Appendix Contents

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	- Q-Press 620.2 Anchor Bolts
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	- Electrical components data sheets
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APPENDIX E:	Certifications
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	- ISO 14001
	- Pickling and Passivation
APPENDIX F:	Warranty Information
APPENDIX G:	Service
	- Special tools and materials
APPENDIX H:	Spare Parts
	- Spare Parts Included
APPENDIX I:	Long Term Storage
	- Long term storage instructions

SECTION 1
REVISION HISTORY

HUBER TECHNOLOGY INC.
1009 Airlie Parkway, Denver, NC 28037
Phone: 704.949.1010 – Fax: 704.949.1020
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Project: Sandpoint, ID	Project #: 73013257

Submittal Revision History

Rev	Date	Changes	By
0	2/20/2026	Initial submission to Sandpoint, ID	NK
	Date		
	Date		
	Date		
	Date		
	Date		
	Date		
	Date		
	Date		

HUBER TECHNOLOGY INC.
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SECTION 2
PROJECT MILESTONES

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Sandpoint Project Milestones

PID: 73013257

	Duration		Planned			
Project Milestones	Work Days	Weeks	Start	End	Owner	*Notes*
PO Received	1	0.2	10/27/25	10/28/25	Client	
Contract Review	30	6	10/28/25	12/09/25	HUBER	
PO T&C Agreed	1	0.2	12/09/25	12/10/25	Client	
Handover/Project KO	5	1	12/10/25	12/17/25	HUBER	
Submittal Development	47	9.4	12/17/25	02/20/26	HUBER	
Submittals Sent	1	0.2	02/20/26	02/23/26	HUBER	
Submittal Review/Approval	10	2	02/23/26	03/09/26	Client	*Assumes Comments and Review within 4 weeks.*
Submittal Update	10	2	03/09/26	03/23/26	HUBER	*If required.*
Re-Submittals Sent	1	0.2	03/23/26	03/24/26	HUBER	*If required*
Submittals Approved	10	2	03/24/26	04/07/26	Client	*Assumes Review and Approval within 2 weeks*
Engineering Component Drawings	20	4	04/07/26	05/05/26	HUBER	
Release	5	1	05/05/26	05/12/26	HUBER	
Procurement	60	12	05/12/26	08/04/26	HUBER	
Manufacturing	60	12	08/04/26	10/27/26	HUBER	*Includes cutting, forming, welding, passivation and assembly*
Approval to Ship	2	0.4	10/27/26	10/29/26	Client	
Shipping to Site	5	1	10/29/26	11/05/26	HUBER	

Items in blue are milestones driven by customer approval. HUBER Technology reserves the right to adjust project schedule based on customer delays to these milestones. Please note, each day late can result in up to a 2 day delay to project delivery. Example: 4 weeks (20 work days) can result in a 8 week (40 work day) shift to the delivery schedule. Delays exceeding 6 weeks are subject to re-quote.

SECTION 3
OPEN ISSUES/SCOPE CLARIFICATION

HUBER TECHNOLOGY INC.
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Project: 73013257 Product: Q-Press 620.2
Open Issue Deck (OID)

#	Priority	Status	Owner	Type	Date Created	Days Open	Date Closed	Title	Action	Notes
1	Select	Select	Select	Select					n/a	
2	Select	Select	Select	Select					n/a	
3	Select	Select	Select	Select					n/a	
4	Select	Select	Select	Select					n/a	
5	Select	Select	Select	Select					n/a	
6	Select	Select	Select	Select					n/a	
7	Select	Select	Select	Select					n/a	
8	Select	Select	Select	Select					n/a	
9	Select	Select	Select	Select					n/a	
10	Select	Select	Select	Select					n/a	
11	Select	Select	Select	Select					n/a	
12	Select	Select	Select	Select					n/a	
13	Select	Select	Select	Select					n/a	
14	Select	Select	Select	Select					n/a	
15	Select	Select	Select	Select					n/a	

SECTION 4
KEY CONTACTS

HUBER TECHNOLOGY INC.
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Sales
HUBER Technology Director of Sales
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simon.randle@hhusa.net

Contract Administration
HUBER Technology Contract Administrator
Josey Chan
PH: 704-990-2052
josey.chan@hhusa.net

Service and Aftermarket
HUBER Technology Service Manager
Christian Reyer
PH: 704-990-2045
christian.reyer@hhusa.net

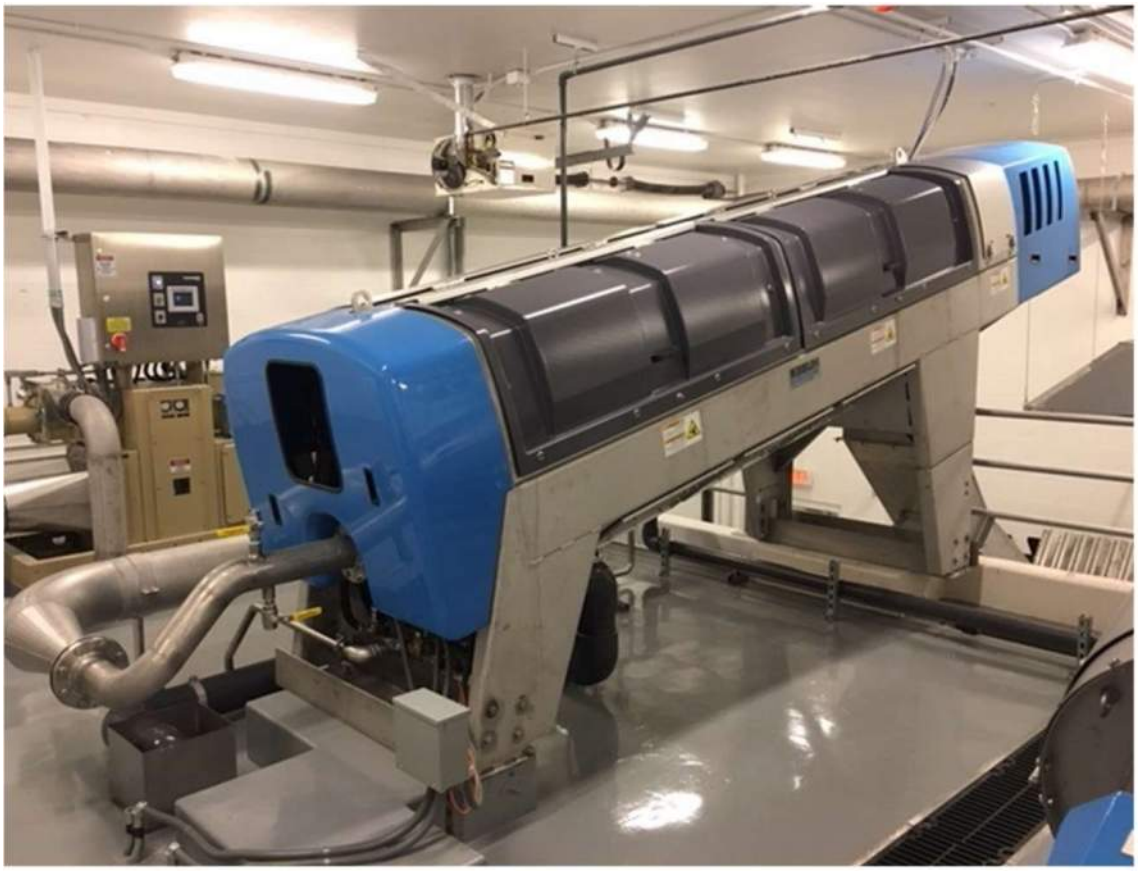
HUBER Technology Technical Support Manager
Patrick Sheehan
PH: 704-949-1015
patrick.sheehan@hhusa.net

HUBER Technology Aftermarket Sales Manager
Mike Suddreth
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mike.suddreth@hhusa.net

SECTION 5
SCOPE OF SUPPLY

HUBER TECHNOLOGY INC.
1009 Airlie Parkway, Denver, NC 28037
Phone: 704.949.1010 – Fax: 704.949.1020
huber@hhusa.net – www.hubertechnology.com

BUDGET PROPOSAL



Sandpoint, ID

HUBER Screw Press Q-PRESS 620.2®

Represented by:
Goble Sampson Associates
Ryan Spanton
(801) 268-8790
rspanton@goblesampson.com

Regional Sales Director:
Ron Maiorana
704-718-4477
Ron.Maiorana@hhusa.net

Project Number:	516373
Revision:	0
Date:	6/17/2025
Prepared for:	Stantec

HUBER Technology, Inc.
1009 Airlie Pkwy, Denver, NC 28037
704-949-1010 | www.huber-technology.com

Design Information

Technical Data		
Sludge Type	**Waste Activated Sludge**	
Design Feed Rate (given)	**24,000**	**gpd**
Feed Sludge Concentration	**1.5**	**%**
Sludge TDS	**1600**	**mg/L**
Sludge VSS	**76.54**	**%**
Sludge pH	**7.5**	**SU**
Chloride Concentration	**459**	**mg/L**
Phosphate Concentration	**15**	**mg/L**
Calculated Hydraulic Loading Rate (per unit)	**28.6 at 1.5% feed solids**	**gpm**
Calculated Solids Loading Rate (per unit)	**214 at 1.5% feed solids**	**lb/hr**
Operational Hours Per Day	**14**	**hr/day**
Operational Days Per Week	**7**	**day/week**
Estimated Cake Solids[1]	**16-19**	**%**
Capture Rate[1]	**95**	**%**
Estimated Polymer Consumption[1]	**26-32 lb active polymer/dry ton of sludge**	
Average Spray Wash Water Requirement[2]	**55 gph at 90 psi**	
Spray Water Connection	**1.25**	**inch**
Sludge Inlet Diameter	**4**	**inch**
Approximate Screw Press Empty Weight	**6000**	**lbs**
Approximate Screw Press Full Weight	**7300**	**lbs**

[1]Estimated performance is based on HUBER pilot testing results.

[2]Wash water cycle runs at approximately 35 gpm for 152 seconds. Typical applications experience 1-2 wash cycles per hour.

Pilot Testing Results

Pilot Testing Conducted from 09/09/2024 through 09/13/2024	Optimum Running Conditions	Maximum Range
Feed Solids Concentration	1.6%	1.8%
Hydraulic Throughput	16.8 gpm	16.8 gpm
Solids Loading Rate	135 lb/hr	155 lb/hr
Cake Solids	18%	22%
Polymer Consumption	40 lb active/dry ton	53 lb active/dry ton

Equipment Details

Model	HUBER Screw Press Q-PRESS 620.2®
Quantity	2 (including 1 standby unit)
Material	316L stainless steel construction; pickled and passivated in acid bath
Basket Material	Wedge wire; 316L stainless steel
Auger Inclination	12°
Support Legs	316L stainless steel
Wiper Material	Wear resistant polyurethane
Anchor Bolts	M12, 316L stainless steel
Motor Data	4 hp drive motor, 3 ph
Spraywash Motor Data	0.25 hp spraywash motor, 460 VAC, 60 Hz, 3 ph

Ancillary Equipment	
Polymer Injection Ring	2, DN50 injection rings
Polymer Mixing Device	2, DN50 mixing valves
Sludge Flow Meter	2, 2-inch sludge flow meter
Air Compressor	2, 15 gal

Controls	Two (2) Main Control Panel
Enclosure	NEMA 4X, Stainless Steel
PLC	Allen Bradley CompactLogix
HMI	Allen Bradley PanelView 7 inch
Pre-programmed and Factory Tested	

Freight and Startup Services	
6 days and 2 trips	8 days and 2 trips to be purchased via contractor.
Freight to jobsite.	

Pricing

Equipment	Model	Quantity	Pricing
HUBER Screw Press	Q-PRESS 620.2®	2	Included
Ancillary Equipment			Included
HUBER Control Panel		2	Included
Freight and Startup Services			

Optional Adders

Equipment	Type	Quantity	Pricing
HUBER's Standard Polymer Blending System	Velodyne VM-2P-300-D	1	**$43,263.00**
HUBER's Standard Sludge Feed Pump	Netzsch NM038BY01L06B	1	**$9,507.00**
HUBER Screw Conveyor (Cake)	Ro8T 273, 12 ft length	1	**$34,500.00**
Aesthetic Motor Cover (per piece)	HUBER Standard	1	**$11,813.90**

Standard delivery is 27-29 weeks from approval of submittals.

Thank you for your interest in HUBER Technology, Inc. If you have any questions, please do not hesitate to contact our Regional Sales Director or our local sales representative.

This proposal has been reviewed for accuracy and approved for issue by: AJ

Notes and Technical Clarifications

1. Equipment specification and drawings are available upon request.
2. If there are site-specific hydraulic constraints that must be applied, please consult the manufacturer's representative to ensure compatibility with the proposed system.
3. Electrical disconnects required per local NEC code are not included in this proposal.
4. All electrical interconnections, wirings, junction boxes, and terminations between the equipment and electrical components are to be provided by installing contractor.
5. Huber Technology warrants all components of the system against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever occurs first.
6. Budget estimate is based on Huber Technology's standard Terms & Conditions and is quoted in US dollars unless otherwise stated.
7. Equipment recommendations are based on information provided to Huber Technology. Subsequent information which differs from what has been provided may alter the equipment recommendation.
8. Any item not specifically listed is not considered part of this scope of supply. Please contact the HUBER Technology representative listed for further clarification.
9. Sludge feed pump and flow meter shall be controlled by the Huber control panel even if provided by others.
10. Pricing shown in this proposal is valid for 30 days from the date shown on this proposal.
11. Blue motor covers are aesthetic only, and have been included as an optional adder to HUBER's scope.
12. Flocculation pipe is to be provided others. Please reference accompanying flocc pipe calculation page for sizing information.
13. Polymer injection/mixing equipment is sized based on maintaining a specific flow velocity through these components. For the feed sludge flowrate in this application, HUBER is offering polymer injection/mixing equipment with DN50 (2 inch) flanges. Reducers, if required, to connect polymer injection/mixing equipment to upstream and downstream piping are to be supplied by others.

Additional Information Pertinent to HUBER Quotation

Special Information and Exceptions

- Price does not include any unloading or any applicable fees or taxes (Local, Federal, or Final Destination)
- Prices are in U.S. Dollars unless noted otherwise
- Freight is delivered with duty paid (D.D.P.) to Job site
- Price does not include installation or building modifications
- This Budgetary Pricing Quotation is valid for thirty (30) days from the date of this Scope or until withdrawn by HUBER Technology, Inc. (hereinafter "HUBER").

Submittals

HUBER will provide documentation to the Purchaser per the following schedule:

- Five (5) copies or the quantity stipulated in the equipment specification of submittal shop drawings 4-6 weeks after acceptance of a written purchase order.
- Three (3) copies or the quantity stipulated in the equipment specification of HUBER O&M manuals prior to equipment start-up.

Shipment

HUBER will make all reasonable efforts to maintain the following schedule:

- Submittals 4-6 weeks after acceptance of a written purchase order.
- Please consult HUBER Technology, Inc. for current fabrication lead times on the proposed equipment.
- O&M manuals prior to equipment start-up.

Accessories

This Proposal includes only those items specifically mentioned in the equipment descriptions. Any items which may be necessary for the operation of the equipment, but are not specifically mentioned, such as motors, drives, controls, or supports, are to be supplied via additional quotation separate from this offering.

Abrasion or Corrosive Materials

All of HUBER's machines and systems are manufactured from 304L or 316L grade stainless steel. The environment or materials the equipment may be exposed to may be abrasive or corrosive. This Proposal makes no representation or warranties concerning the service life of the equipment against such abrasion or corrosion. The concentration of chloride and hydrogen sulfide (H2S) in the equipment operating environment shall be kept below the following values:

• Maximum Chloride for V2A (304, 304L)*	100	mg/L
• Maximum Chloride for V4A (316L, 316Ti)*	400	mg/L
• Maximum Chloride for V4A (316L, 316Ti)**	250	mg/L
• pH Value of the Wastewater/Washwater	>6.5	
• Iron Content in Washwater	<0.50	mg/L

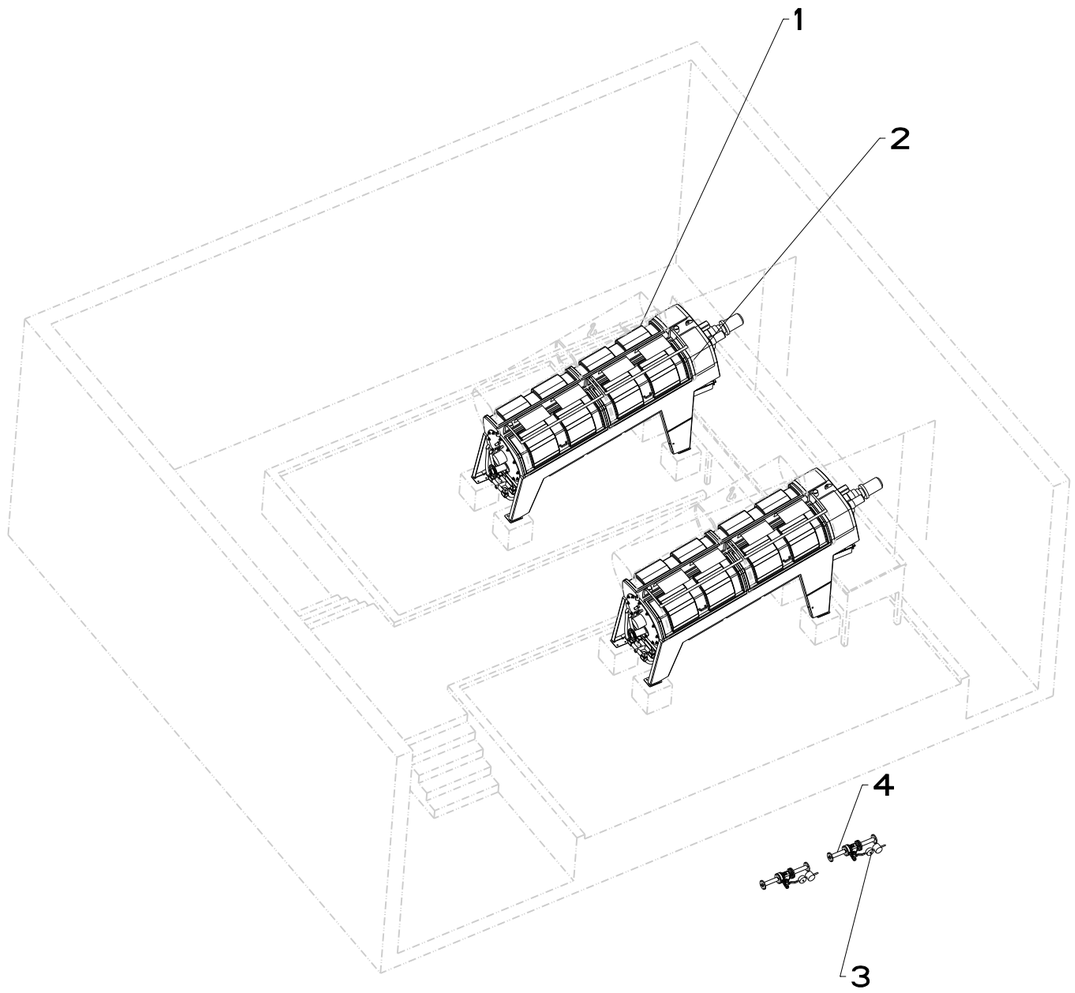
* no hydrogen sulphide in the area of the stainless steel

** with a maximum hydrogen sulphide content of 6 ppm

Machines made from 316 grade stainless steel are available at an additional price for extremely harsh operating environments upon request.

SECTION 6
LAYOUT & MECHANICAL DRAWINGS

HUBER TECHNOLOGY INC.
1009 Airlie Parkway, Denver, NC 28037
Phone: 704.949.1010 – Fax: 704.949.1020
huber@hhusa.net – www.hubertechnology.com



Unit Weight:
Q-Press 620.2 = 5953 lbs. (empty)

Material: Stainless 316L

Note:
Position numbers starting with 50x are not included in the scope of delivery

Pos. No.	Quantity	Description
1	2	HUBER Screw Press Q-PRESS® 620.2
2	2	Chute Q-PRESS® 620.2
3	2	dosing and mixing appliance DN50 PN10
4	4	double flanged pipe DN 50 / ANSI 2"

Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

	Name	Date
Designed:	us-ic	11.19.2025
Approved:	II	II
Modified:	-	-
-	-	
Rev.	Modification	

HUBER TECHNOLOGY
WASTE WATER Solutions
1009 Airlie Parkway Denver, NC 28037

Huber Screw Press

Q-Press 620.2

Scale:	Fig. No.:		Size:
1:96	1/6	Installation drawing	B
73013257 Sandpoint, ID WWTP Screw Press GSA			Drawing No.: 52480778

GENERAL INSTALLATION NOTES:

1.	EQUIPMENT MUST BE LEVEL IN ALL PLANES.
2.	AUTHORIZATION REQUIRED FOR FIELD MODIFICATIONS TO HUBER EQUIPMENT DUE TO SITE INCONSISTANCIES -CONTACT HUBER TECHNOLGY.
3.	REFUSE CONTAINERS SHOWN ON DRAWINGS (IF ANY) ARE FOR REFERENCE ONLY AND ARE SUPPLIED BY OTHERS (UNLESS SPECIFIC TO HUBER's SCOPE OF SUPPLY.)
4.	WELDING: DO NOT WELD UNTIL TEMPORARY MOCK-UP IS VERIFIED AGAINST THE INSTALLATION DRAWINGS AND ALL LEVEL, SQUARENESS, AND/OR ANGLES HAVE BEEN ACHIEVED -REFER TO WELD SPECIFICATIONS THIS DRAWING.
5.	INSTALLATION CONTRACTOR TO VERIFY ALL EXISTING STRUCTURAL DIMENSIONS BEFORE COMMENCEMENT OF WORK. CONTACT ENGINEER AND/OR HUBER IF FIELD DISCREPANCIES PREVENT PROPER INSTALLATION AS SHOWN ON THE INSTALLATION DRAWINGS, AND/OR OPERATIONS AND MAINTENANCE MANUAL.
6.	FIELD VERIFY ALL EXISTING SITE DIMENSIONS AND ELEVATIONS. DIMENSIONS AND ELEVATIONS SHOWN ARE BASED ON ENGINEERING DRAWINGS AVAILABLE AT THE TIME OF DESIGN OR AS BASED ON AVAILABLE PLANT RECORD DRAWINGS -ALL SITE DIMENSIONS SHOWN ON HUBER DRAWINGS ARE FOR "REFERENCE" ONLY. HUBER NOT RESPONSIBLE FOR DISCREPANCIES IN THE FIELD.
7.	INSTALLATION IS BY OTHERS.
8.	ALL REQUIRED ELECTRICAL, FITTINGS, CONDUIT, HAZARDOUS AREA CONDUIT SEALS, WIRING, AND/OR JUNCTION BOXES - ARE SUPPLIED BY OTHERS.
9.	REFER TO PROJECT DRAWINGS OR CONSULT ENGINEER FOR EQUIPMENT CONDUIT RUNS, CONTROL STATION LOCATION, AND FLOOR STUB UPS.
10.	VALVES SUPPLIED SEPARATE (IF ANY) MUST BE FIELD INSTALLED BY INSTALLING CONTRACTOR. ALL PIPE RUNS AND REQUIRED PIPING ARE SUPPLIED BY OTHERS. SEE ENGINEER FOR PIPE LAYOUT/ROUTING.
11.	FLANGE GASKETS, HARDWARE, AUXILLARY PIPING, FITTINGS, OR OTHER RELATED ARE SUPPLIED BY OTHERS (UNLESS SPECIFICALLY INCLUDED AS PART OF HUBER'S EQUIPMENT SUPPLY).
12.	EQUIPMENT ANCHORS AND HARDWARE SUPPLIED BY HUBER ARE METRIC.
13.	REFER TO EQUIPMENT OPERATIONS AND MAINTENANCE MANUAL FOR DETAILED INSTALLATION INSTRUCTIONS AND/OR EQUIPMENT SPECIFIC INFORMATION.
14.	CONSUMABLES ARE NOT PROVIDED BY HUBER

WELDING SPECIFICATIONS:

1.	NO AREA GRINDING OF NON-STAINLESS METALS OR IRON WELDS PERMITTED NEAR HUBER EQUIPMENT. CONTRACTOR TO INSPECT HUBER EQUIPMENT FOR "RUST SPECKS" IF IRON DUST IS SUSPECT. ALL "RUST SPECKS" MUST BE EXPEDIENTLY AND PROPERLY CLEANED.
2.	WELD ELECTRODES (USED ON HUBER EQUIPMENT) MUST BE AS FOLLOWS:
2. a	304L EQUIPMENT USE 308L ELECTRODE OR BETTER.
2. b	316L EQUIPMENT USE 316L ELECTRODE OR BETTER.
3.	REMOVE ALL BURRS AND SHARP EDGES FROM FIELD WELDS.
4.	ALL WELD AREAS TO BE CLEANED WITH SOLVENT MEK OR EQUIVALENT.
5.	WELDING PER AWS & ASME STANDARDS.

ELECTRICAL NOTES:

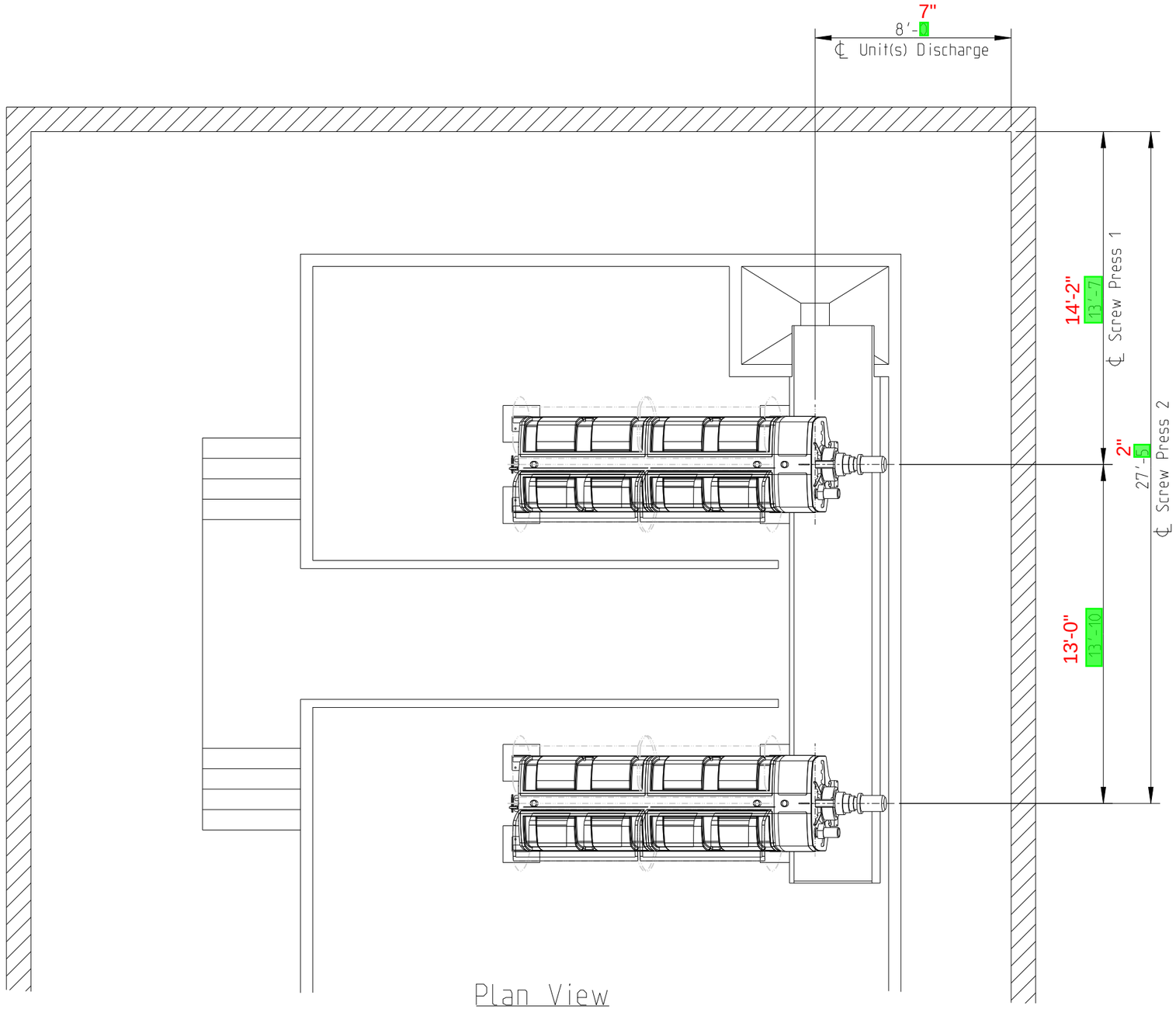
1.	ELECTRICAL FITTINGS, WIRING, FLEX CONDUIT/POWER CABLE, SO-CORD, JUNCTION BOXES, REQUIRED FOR MOTOR POWER ARE SUPPLIED BY OTHERS AND NOT PROVIDED BY HUBER.
2.	EQUIPMENT MOTORS SHOULD BE DIRECT WIRED UTILIZING CLASS 1, DIVISION 1 APPROVED FLEX CONDUIT OR OTHER AS APPROVED BY THE ENGINEER.
3.	EQUIPMENT MOTORS DO NOT COME PREWIRED AND REQUIRE CLASS 1, DIVISION 1 PROCEDURES.
4.	CONTRACTOR IS RESPONSIBLE FOR ALL APPLICABLE ELECTRICAL CODE PROCEDURES AND STANDARDS GOVERNING THE PROJECT LOCAL. FOR HAZARDOUS AREA ELECTRICAL CLASS 1, DIVISION 1, GROUP D, NEC ARTICLE 501 SHALL GOVERN.

Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

	Name	Date
Designed:	us-ic	11.19.2025
Approved:	II	II
Modified:	-	-
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Rev.	Modification	

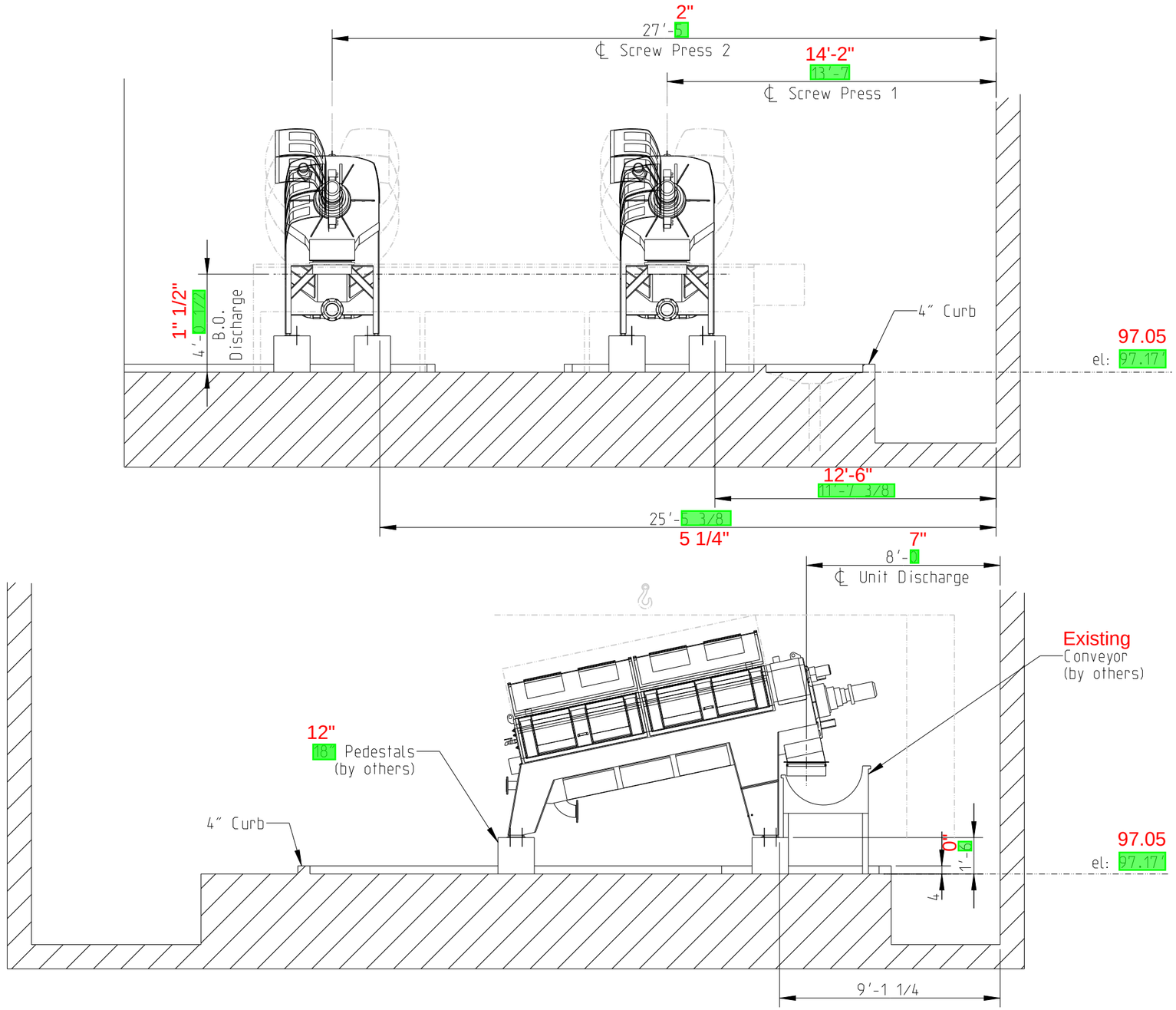
HUBER TECHNOLOGY
WASTE WATER Solutions
1009 Airlie Parkway Denver, NC 28037

Huber Screw Press			
Q-Press 620.2			
Scale: 1:144	Fig. No.: 2/6	Installation drawing	Size: B
73013257 Sandpoint, ID WWTP Screw Press GSA			Drawing No.: 52480778



Plan View

Intellectual property of HUBER Technology, Inc. Technical Information subject to change.			HUBER TECHNOLOGY WASTE WATER Solutions 1009 Airlie Parkway Denver, NC 28037	Huber Screw Press		
	Name	Date		Q-Press 620.2		
Designed:	us-ic	11.19.2025				
Approved:	II	II		Scale: 5:288	Fig. No.: 3/6	Installation drawing	Size: B
Modified:	-	-				
-	-			73013257 Sandpoint, ID WWTP Screw Press GSA		Drawing No.: 52480778
Rev.	Modification					



Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

	Name	Date
Designed:	us-ic	11.19.2025
Approved:	II	II
Modified:	-	-
-	-	
Rev.	Modification	

HUBER TECHNOLOGY
WASTE WATER Solutions
1009 Airlie Parkway Denver, NC 28037

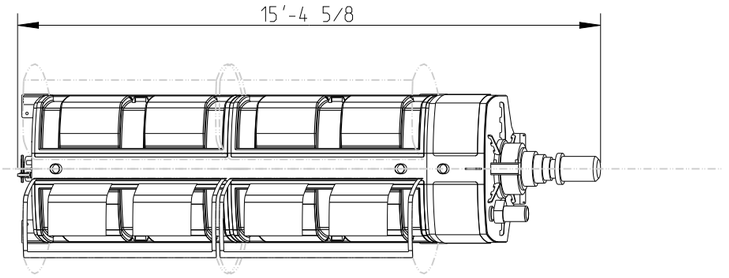
Huber Screw Press

Q-Press 620.2

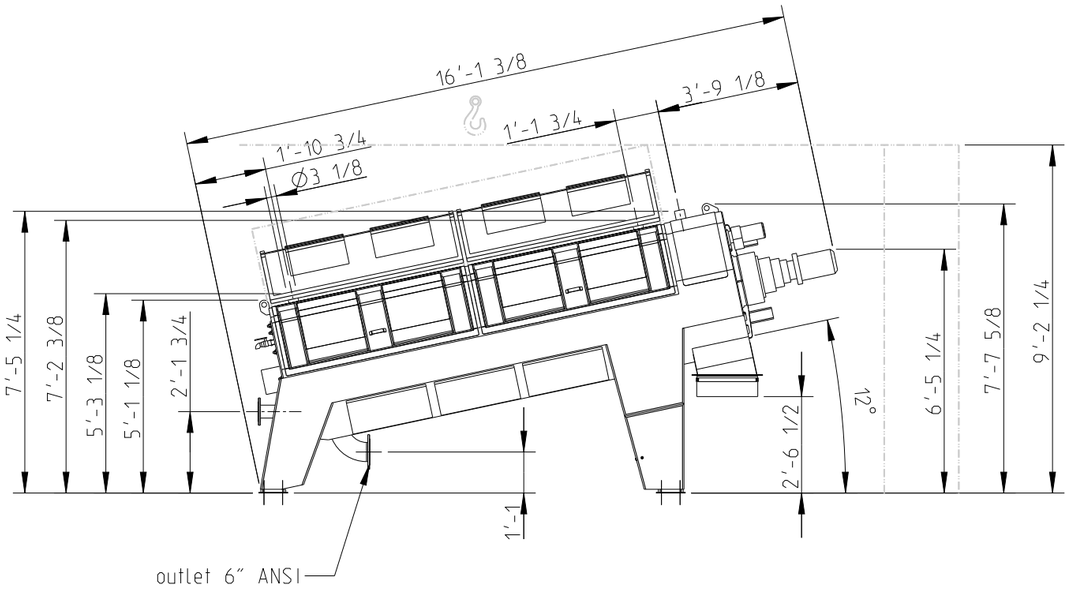
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5:288	4/6	Installation drawing	B

73013257 Sandpoint, ID WWTP Screw Press GSA

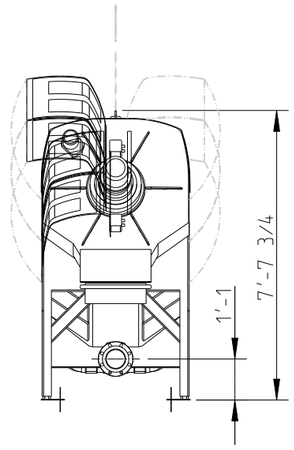
Drawing No.: 52480778



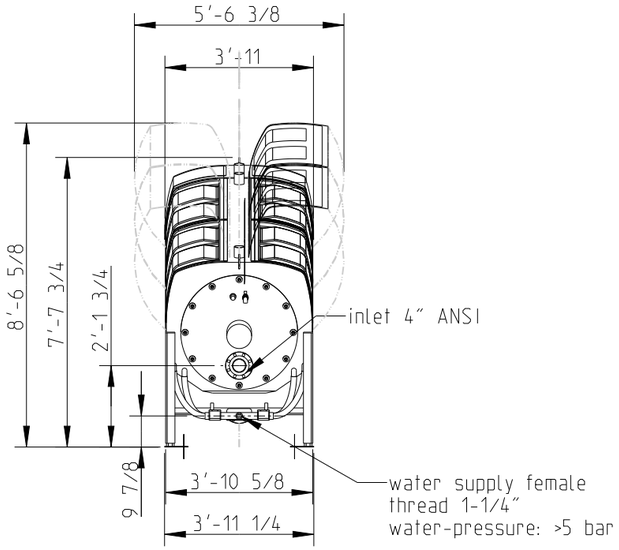
Top View



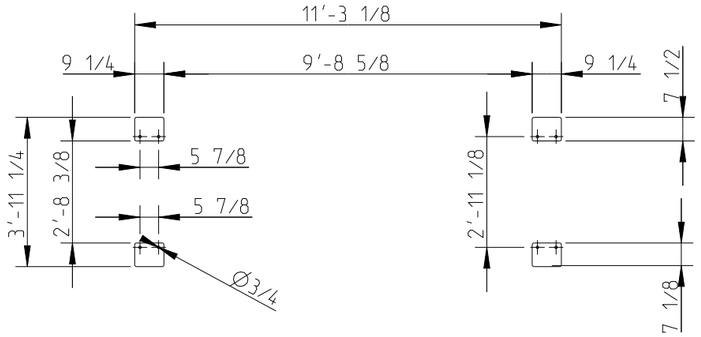
Side View



Front

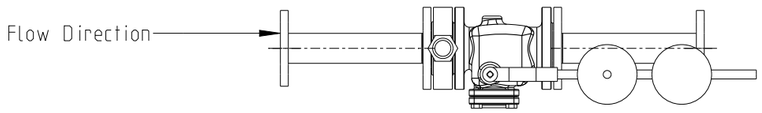


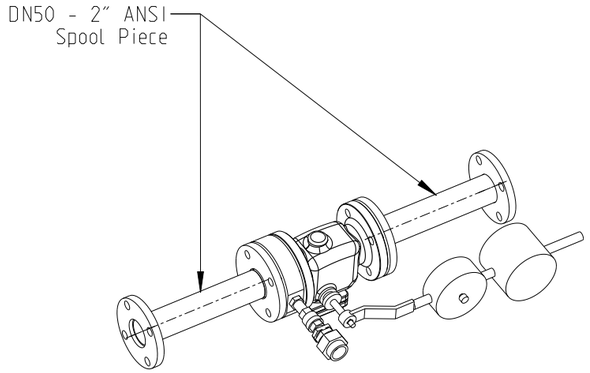
Rear

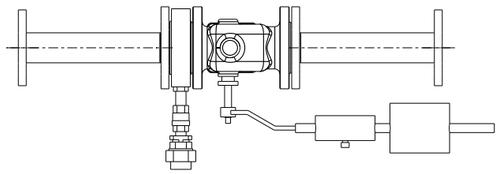


Mounting Plate Drilling Template

Intellectual property of HUBER Technology, Inc. Technical Information subject to change.			HUBER TECHNOLOGY WASTE WATER Solutions 1009 Airlie Parkway Denver, NC 28037	Huber Screw Press			
	Name	Date		Q-Press 620.2			
Designed:	us-ic	11.19.2025					
Approved:	II	II		Scale: 1:48	Fig. No.: 5/6	Installation drawing	Size: B
Modified:	-	-					
-	-			73013257 Sandpoint, ID WWTP Screw Press GSA			Drawing No.: 52480778
Rev.	Modification						







Injector Ring / Mixing Valve

Intellectual property of HUBER Technology, Inc.
Technical Information subject to change.

	Name	Date
Designed:	us-ic	11.19.2025
Approved:	II	II
Modified:	-	-
-	-	
Rev.	Modification	

HUBER TECHNOLOGY
WASTE WATER Solutions
1009 Airlie Parkway Denver, NC 28037

Huber Screw Press			
Q-Press 620.2			
Scale: 1:12	Fig. No.: 6/6	Installation drawing	Size: B
73013257 Sandpoint, ID WWTP Screw Press GSA			Drawing No.: 52480778

SECTION 7
ELECTRICAL & CONTROLS DRAWINGS

HUBER TECHNOLOGY INC.
1009 Airlie Parkway, Denver, NC 28037
Phone: 704.949.1010 – Fax: 704.949.1020
huber@hhusa.net – www.hubertechnology.com

Control System Submittal

Project Name: Sandpoint, ID

Customer: Huber Technology

Specification: Q-Press - Main Control Panel

Job Number: HBR10366

Project Engineer: Adam Juodis

Date: 02-16-2026

Submittal ID: D1036

Revision: 0

SUBMITTAL	D1036
APPROVED	APPROVED AS NOTED
REJECTED	REVISE AND RESUBMIT
BY:	
DATE:	

EleMech INC
2275 White Oak Circle
Aurora, IL 60502
630-499-7080

Table of Contents

A

A - Table of Contents

B - Submittal Comments

C - Electrical Drawings

D - Bill of Materials

E - Catalog Cuts

Submittal Comments

B

ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Section: B	
Section Name: Submittal Comments	Date: 02-16-2026	Job Number: HBR10366	Page # 1/1
	By: AJ		

ELEMECH INC. CONTROL SYSTEMS

Submittal Comments

Project Name: Sandpoint, ID
Project Number: HBR10366
Customer Project: 73013257
Panel Type: Q-Press Control Panels

The control system submittal is provided for your review and approval. It represents a comprehensive response to the provided specifications and materials for the named project. Approval of these documents is requested prior to manufacturing.

The items listed below are specific requests for information or deviations for the project.

1. The control panel drawings are typical of (2) control panels.

2. VFD driven motors are required in the design. If the cable length is expected to exceed 275 feet, additional filtering may need to be provided by the contractor.

3. Specification plan I-601 illustrates that the sludge feed flow meter is hardwired to the polymer pump control panel. For typical Q-Press installations, the Q-Press control panel monitors and provides power to the sludge feed flow meter. The Q-Press control panel design includes provisions to monitor and power the sludge feed flow meter.

4. The control system design includes Ethernet based components. Provide static IP addresses for the following devices:
   a. PLC1 (2 Required)
   b. OIU1 (2 Required)
   c. VFD1 (2 Required)

   If the IP addresses are not received prior to shipment, default IP addresses will be used and further setup of these components will be the responsibility of the Network Administrator/Systems Integrator.

Electrical Drawings

C

ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Section: C	
Section Name: Electrical Drawings	Date: 02-16-2026	Job Number: HBR10366	Page # 1/1
	By: AJ		

SANDPOINT, ID

HBR10366

SPECIFICATION	46 76 27 – DEWATERING SCREW PRESS
REFERENCE	73013257

TABLE OF CONTENTS

DESCRIPTION	DRAWING SHEET NO.
COVER PAGE	HBR10366A01
CONTROL PANEL SPECIFICATION	HBR10366A02
ELECTRICAL SCHEMATICS	HBR10366A03
FIELD WIRING DIAGRAM	HBR10366A09
PLC IO & DEVICE SETPOINTS	HBR10366A10
SEQUENCE OF OPERATION	HBR10366A13
ENCLOSURE LAYOUT	HBR10366A15
NAMEPLATE AND LABEL SCHEDULE	HBR10366A16
PNEUMATIC PANEL	HBR10366B01

DATE	REVISION	NO.	BY	CK	APP

DESIGNED AJ
DETAILED
CHECKED MSN
APPROVED
DATE 01/13/26

HUBER TECHNOLOGY
1009 Airlie Parkway
Denver, NC 28037
Tel. 704-949-1010
info@hhusa.net

Q–PRESS
CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A01

Control Panel Enclosure

Rating:	NEMA TYPE 4X
Material:	316 SS
Disconnect Type:	Door Interlock - Non-Fused

☒ Drip Shield ☒ 3-PT Latch ☐ ☐

Installation Conditions:

☒ Indoor - Unconditioned ☐ Indoor - Conditioned

☐ Outdoor - Direct Sunlight ☐ Outdoor - Shaded

Environment Max Temperature Rating (°F):	122
Internal Device Max Temperature Rating (°F):	122
Climate Control Type:	Air Conditioner with Heater

Panel Construction

Certification:	UL698A
Listing Serial Number:	TBD

Options:

☒ Phase Failure Relay ☒ Alarm Beacon ☐ ☐

Nameplates and Legendplates:

Material Type:			Thermal Printed
Attachment Type:			Adhesive
Colors:	Background:	White	Text: Black

Wire/ Cable Type:

Wiring to be 14 AWG unless otherwise specified. 16 AWG minimum. Wire shall be MTW type, tinned copper, 600VAC, 105°C, UL1015/CSA.

Analog signal wiring shall be 18 AWG shielded twisted pair rated 300V.

Ethernet cables shall be 24AWG rated 600V. Cat6.

Wire Color:

Black - Power
Black - 120VAC Hot
White - 120VAC Neutral
Red - 120VAC Control
Yellow - Foreign Voltage
Green - Ground
Blue - DC Positive
White/Blue - DC Negative

Note: Colors based on UL508A requirements.

Wire Labels:

☒ Adhesive, Self-laminating

☐ Heat Shrink

Local Enclosure

Tag: Pneumatic Panel Rating: NEMA 4X Material: Fiberglass

Power and Motor

Power Feed:

Circuit 1 : 240 VAC 16.5 FLA SCCR 10 KAIC @ 240 VAC

Motor Data:

Motor 1 : 230 VAC 9.39 FLA 4.02 HP Controller: VFD

Motor 2 : 230 VAC 0.8 FLA 0.12 HP Controller: FVR

Networking

Communication Type: Ethernet/ IP

Subnet: 255.255.255.0 Gateway: 0.0.0.0

IP Address:

PLC1:	TBD - (2) Required
OIU1:	TBD - (2) Required
VFD1:	TBD - (2) Required

Programming:

PLC1: CompactLogix 5069-L306ER Software: Studio 5000 Version: Latest

OIU: PanelView Plus 7" Software: FactoryTalk View ME Version: Latest

Notes:

1. PLC shall be programmed with ladder type only.
2. HMI shall be developed using ElcMech's standard Global Object Library.

Instrumentation

Tag: N/A Cable Length: N/A

Rating: ☐ Non-Hazardous ☐ Intrinsically Safe Class 1 Division 1,2

☐ Class 1, Division 2 ☐ Class 1 Division 1,2

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DESIGNED AJ
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APPROVED
DATE 01/13/26

HUBER TECHNOLOGY
1009 Airlie Parkway
Denver, NC 28037
Tel. 704-949-1010
info@hhusa.net

Q-PRESS CONTROL PANEL

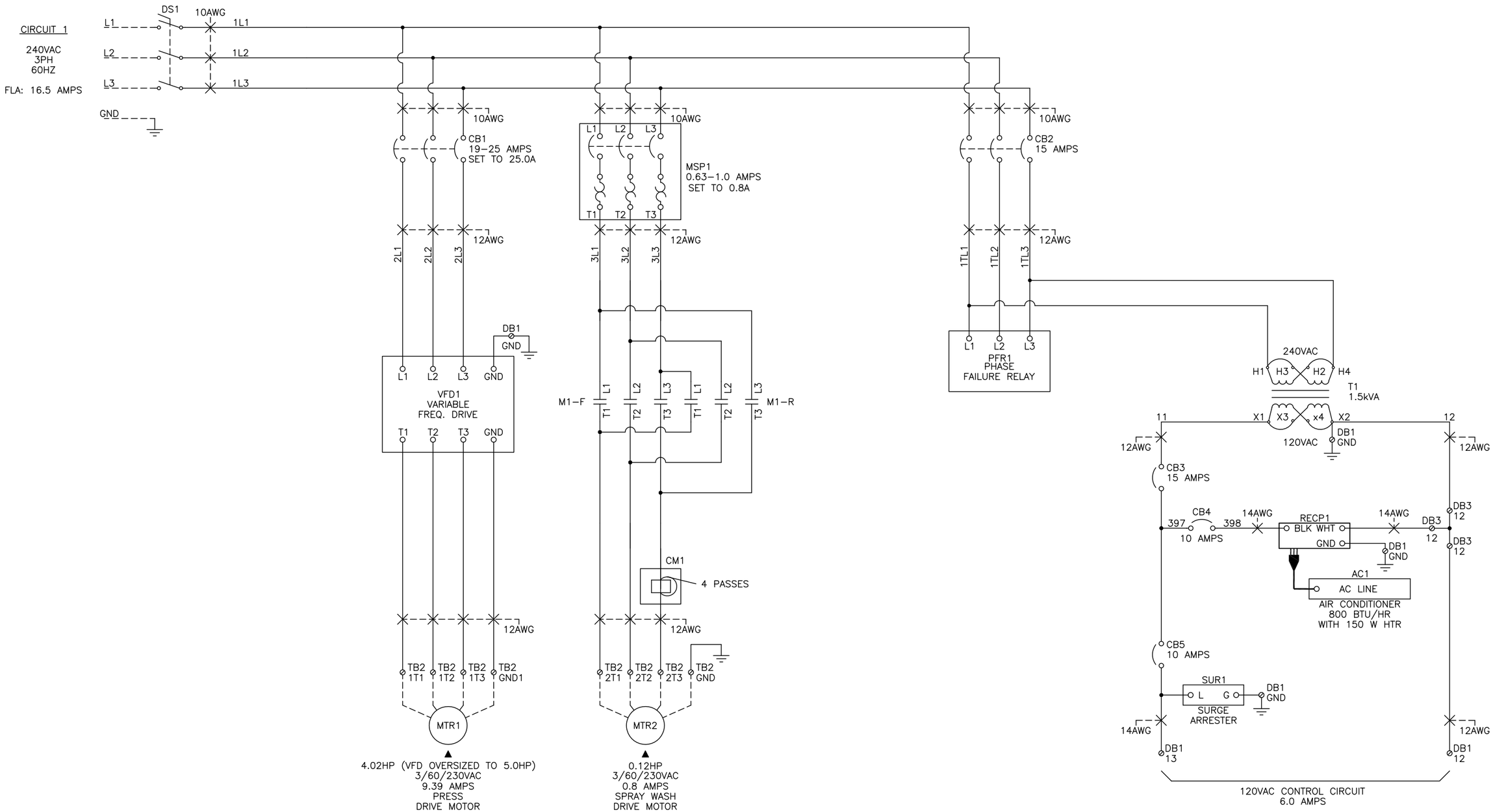
SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A02

2 OF 16



NOTES:
1. ▲ DEVICES LOCATED OUTSIDE CONTROL PANEL.
2. ⊘ TERMINAL BLOCK (TB) OR DISTRIBUTION BLOCK (DB) LOCATED IN CONTROL PANEL.
3. – – FIELD WIRING.
4. ELEMECH RESERVES THE RIGHT TO CHANGE, AS NECESSARY, THE SPACING, ORIENTATION, AND PHYSICAL LOCATION OF DEVICES IN ORDER TO OPTIMIZE THE DESIGN.
5. LOCAL MOTOR DISCONNECT SWITCHES SHALL BE PROVIDED BY OTHERS IF REQUIRED BY LOCAL REGULATIONS.
6. JUNCTION BOXES ARE NOT SHOWN AND SHALL BE PROVIDED BY OTHERS AS NECESSARY.
7. THE CONTROL DRAWINGS ARE TYPICAL OF (2) CONTROL PANELS.

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Q–PRESS
CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A03

3 OF 16

120 VAC, 60HZ, 1PH CONTROL CIRCUIT
ALL CONTROL WIRING 14AWG < 20AMPS

POWER SUPPLY 24VDC

CONTROL POWER ENABLE ISOLATION RELAY 407, 422

POWER FEED OK INPUT

POWER LOSS/E-STOP PRESSED INPUT

CONTROL POWER ON

SYSTEM RESET INPUT

DEWATERING MODE REMOTE START INPUT

DEWATERING MODE ISOLATION RELAY EXT

DEWATERING MODE

SYSTEM DISTURBANCE CONTROL RELAY EXT

SYSTEM DISTURBANCE

E-STOP PRESSED CONTROL RELAY 406

PRESS PERMISSIVE CONTROL RELAY 521

PNEUMATIC CONE SOLENOID VALVE

LOWER WASH 1 SOLENOID VALVE

LOWER WASH 2 SOLENOID VALVE

UPPER WASH 1 SOLENOID VALVE

UPPER WASH 2 SOLENOID VALVE

SPRAY DRIVE REV. MOTOR STARTER 608, EXT, 433

SPRAY DRIVE FOR. MOTOR STARTER 610, EXT, 432

SLUDGE FEED FLOW METER

SLUDGE FLOW SIGNAL 4-20mA SIGNAL

NOTE: GROUND SHIELDED CABLE AT ONE (1) END ONLY.

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Q-PRESS CONTROL PANEL

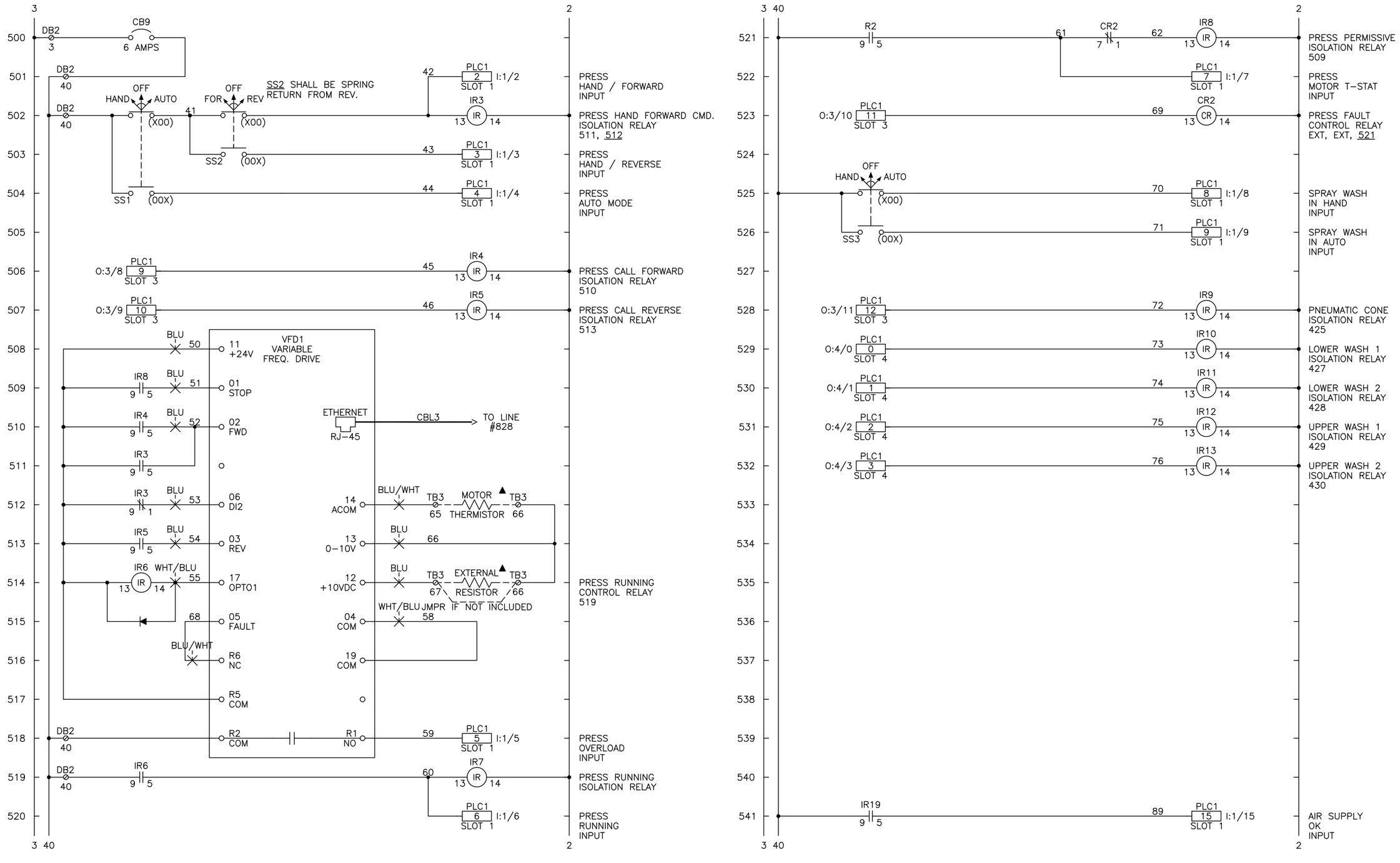
SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A04

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Q-PRESS
CONTROL PANEL

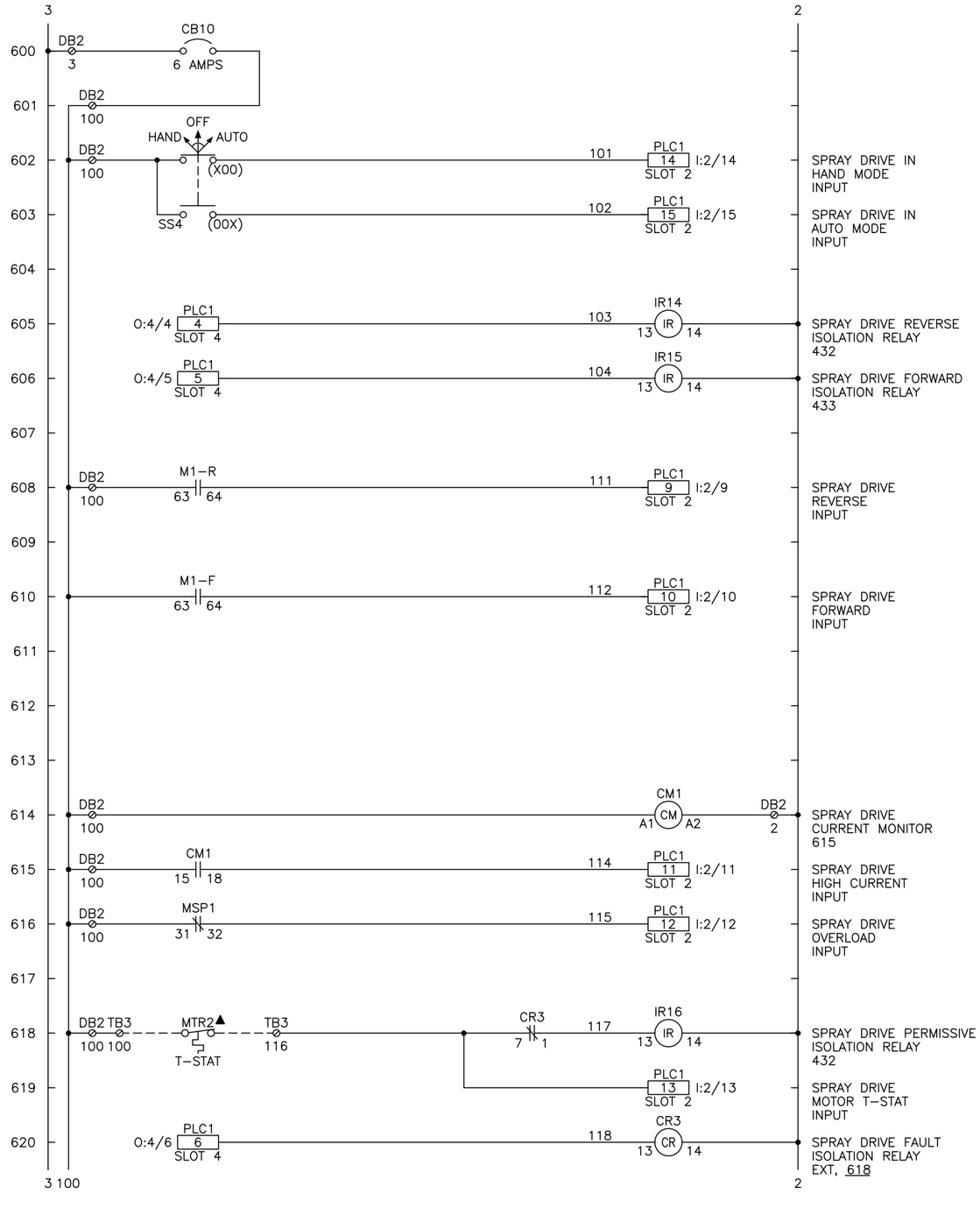
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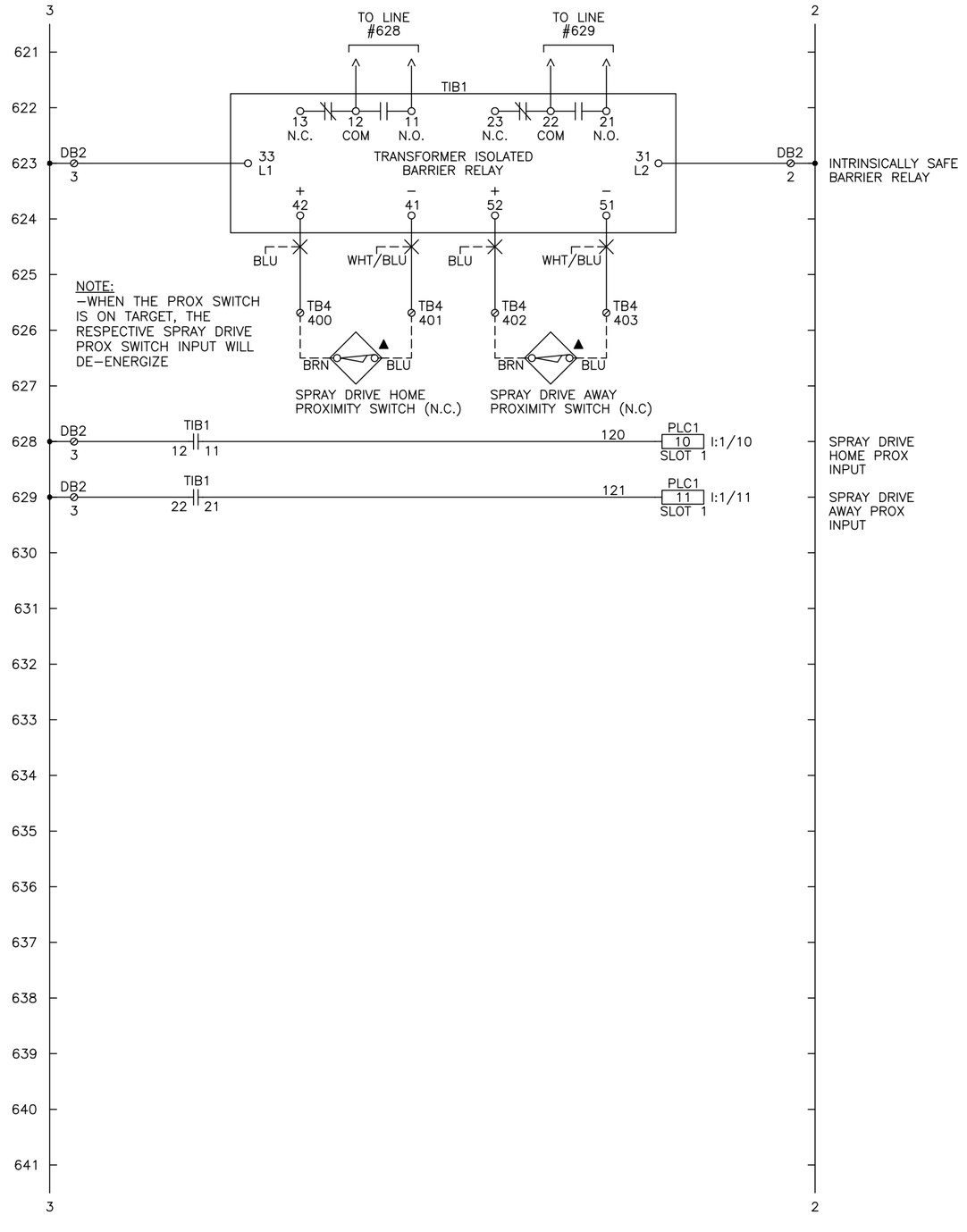
SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A05

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Q–PRESS CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A06

6 OF 16

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Q–PRESS
CONTROL PANEL

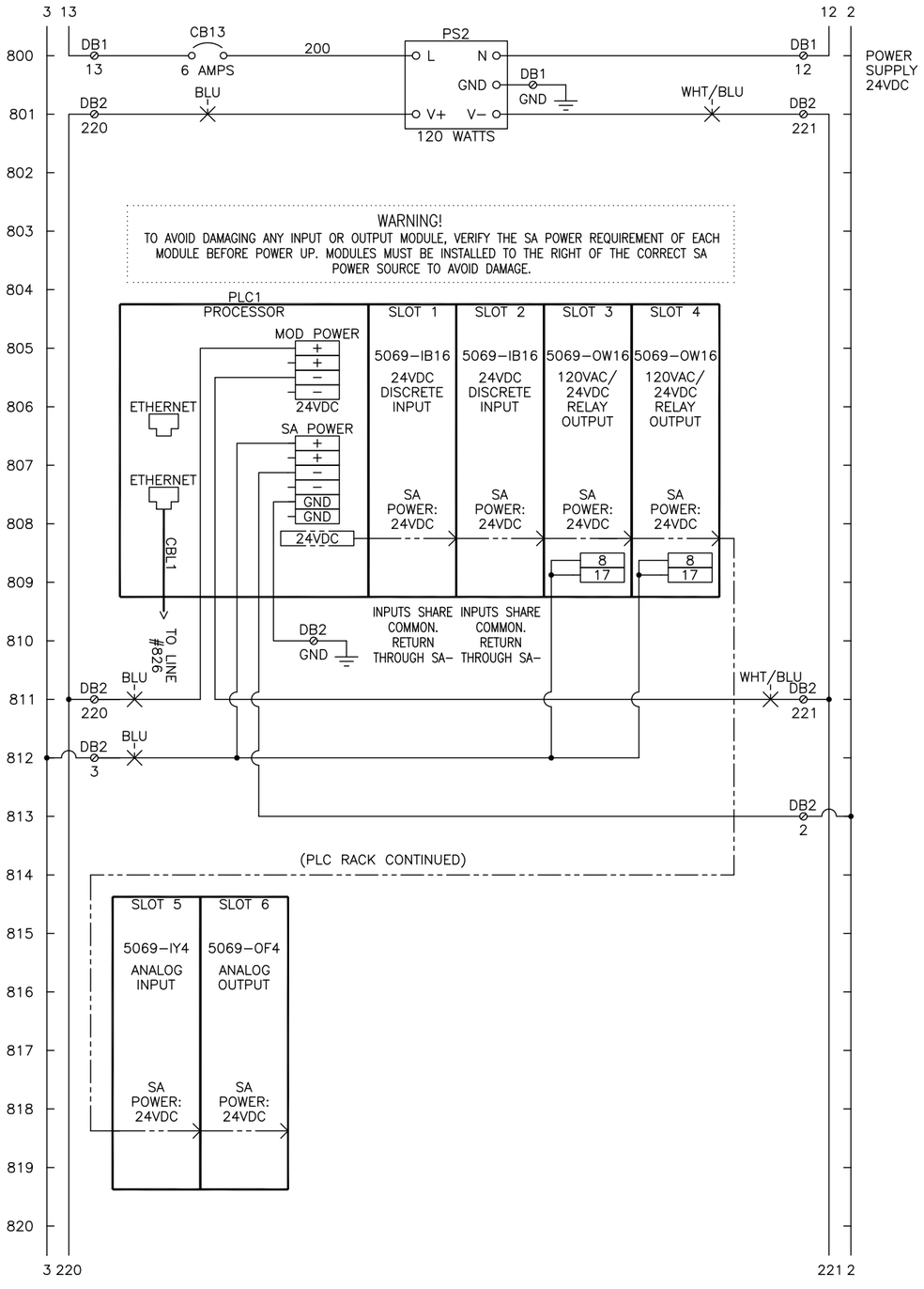
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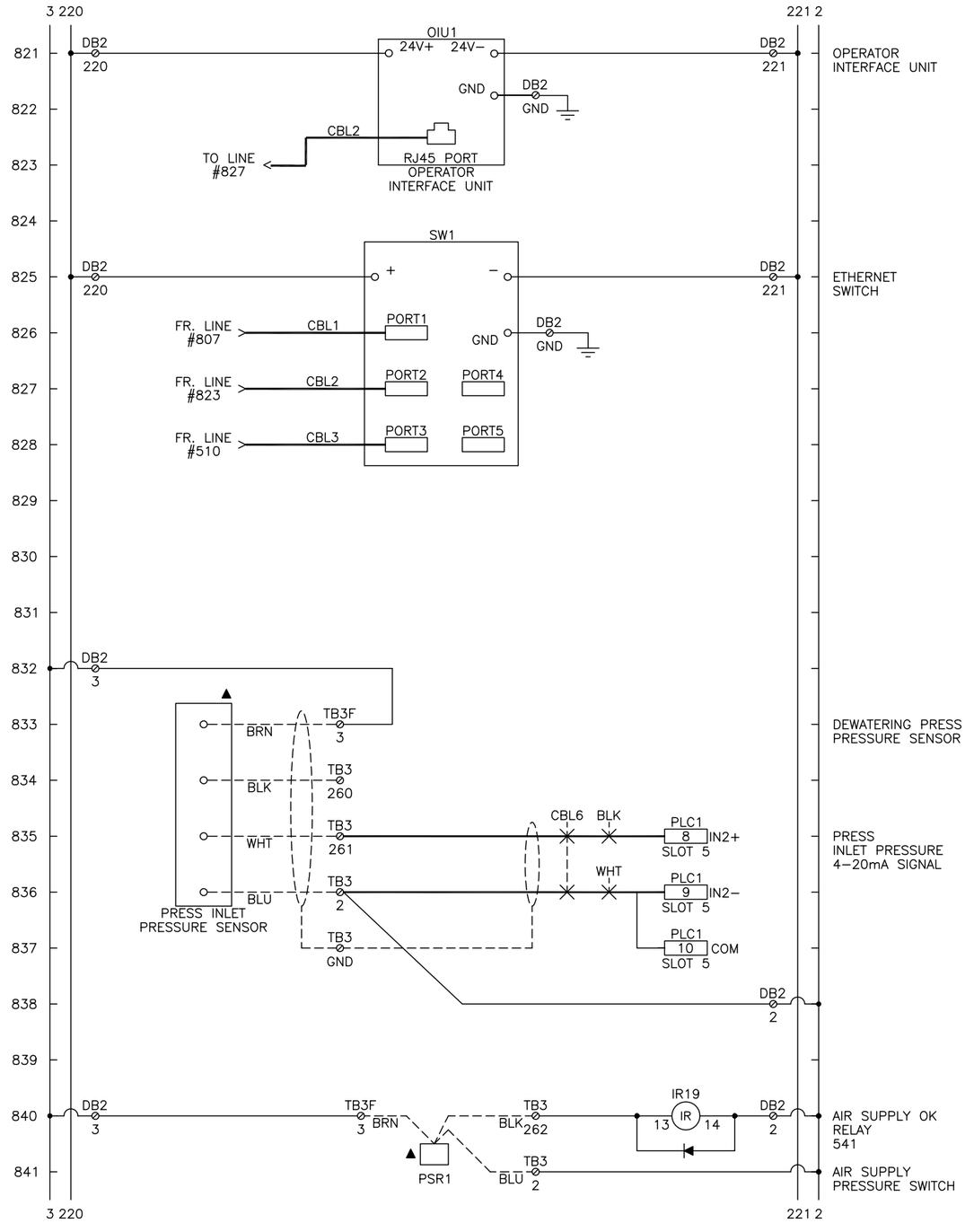
SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A07

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						CHECKED	MSN
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Q−PRESS
CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

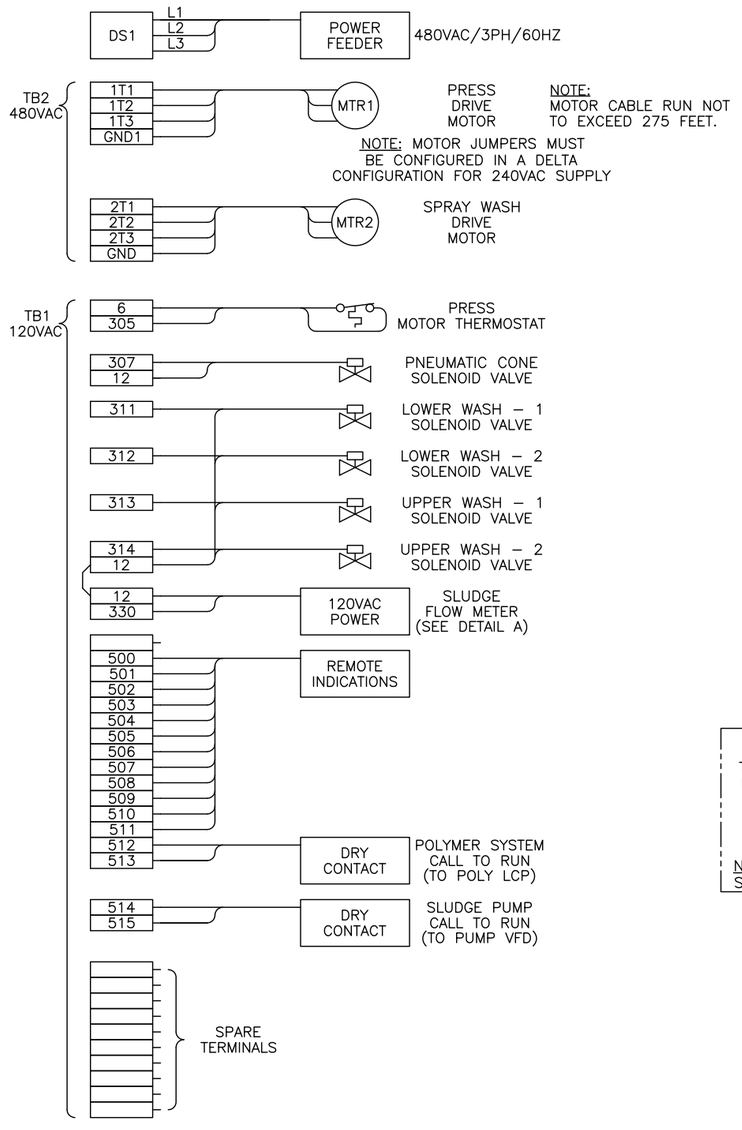
PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A08

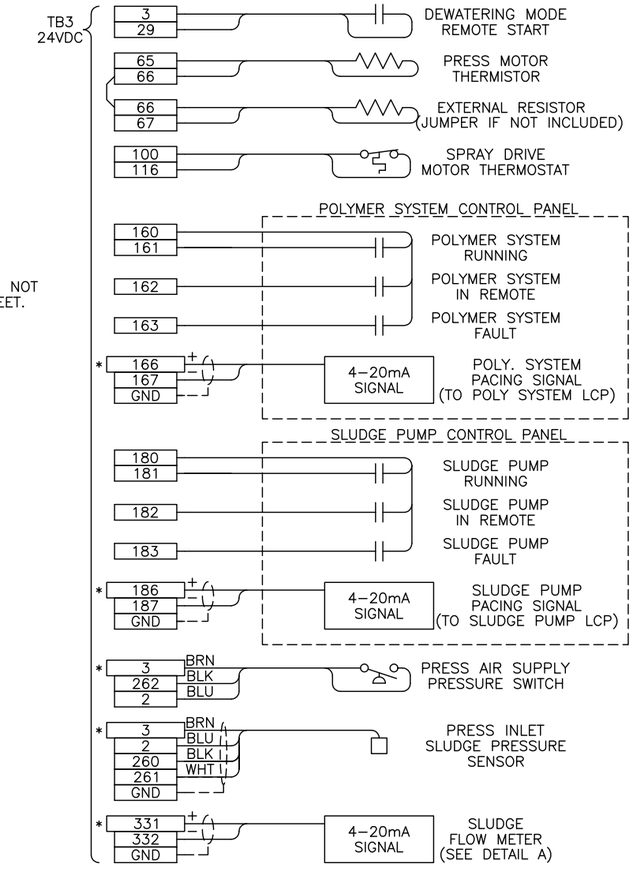
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FIELD WIRING DIAGRAM

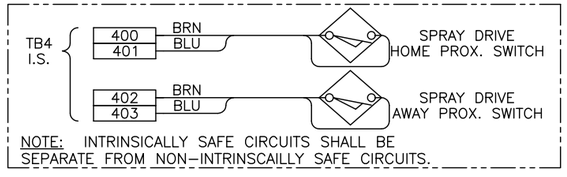
WARNING DAMAGE RESULTING FROM INSTALLATION OF TOP ENTRY CONDUIT WILL VOID WARRANTY.
- AVOID CUTTING HOLES DIRECTLY ABOVE ANY ELECTRICAL COMPONENTS
- PROTECT INTERNAL COMPONENTS FROM METAL SHAVINGS, CUTTING OILS, DEBRIS, AND MOISTURE
- USE PROPER FITTINGS, MYERS TYPE 4 OR EQUAL
- CONDUITS AND FITTING MUST BE WATERTIGHT TO PREVENT WATER ENTRY
- ALL PENETRATIONS MUST BE SEALED OFF TO PREVENT INTRUSION OF MOISTURE, CORROSIVE GASES, AND VAPORS FROM ENTERING THE ENCLOSURE

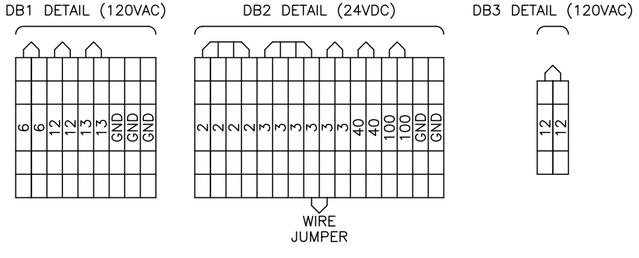


FIELD WIRING DIAGRAM

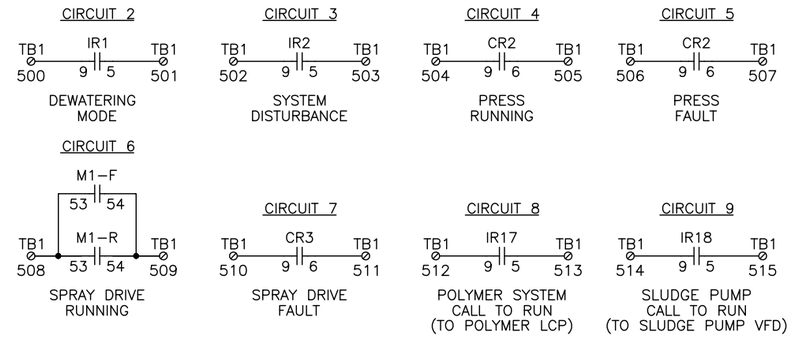


* TERMINAL SHALL CONTAIN 1 AMP FUSE





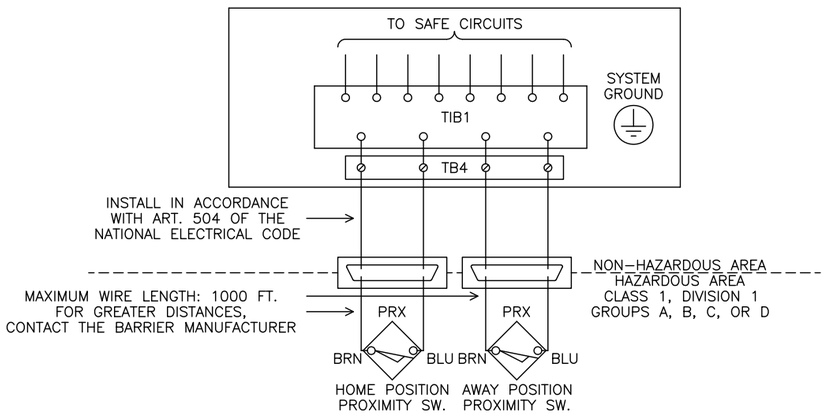
DRY CONTACTS FOR PLANT USE



MAX. CONTROLLED LOAD: 10A @ 120VAC

NOTE: BRANCH CIRCUIT PROTECTION PROVIDED BY OTHERS PER N.E.C.

TIB1 WIRING DETAIL



NOTES:
1. ENSURE CONTROL PANEL IS CONNECTED TO GROUND.
2. CAUTION: MAINTAIN SEPARATION BETWEEN INTRINSICALLY SAFE WIRING AND OTHER WIRING.

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Q–PRESS CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A09

9 OF 16

PLC/OIU SETTINGS

L306ER CPU	DISCRETE IN	DISCRETE OUT	ANALOG IN	ANALOG OUT
	QTY: 2 SLOT 1–2	QTY: 2 SLOT 3,4	QTY: 1 SLOT 5	QTY: 1 SLOT 6

PLC INPUTS – SLOT NO.1

I/0	E–STOP PRESSED
I/1	SYSTEM RESET
I/2	PRESS IN HAND/FORWARD
I/3	PRESS IN HAND/REVERSE
I/4	PRESS IN AUTO
I/5	PRESS OVERLOAD
I/6	PRESS RUNNING
I/7	PRESS MOTOR T–STAT
I/8	SPRAY WASH IN HAND
I/9	SPRAY WASH IN AUTO
I/10	SPRAY DRIVE HOME POSITION
I/11	SPRAY DRIVE AWAY POSITION
I/12	PRESS REMOTE START
I/13	SPARE
I/14	POWER FEED OK
I/15	AIR SUPPLY OK

PLC INPUTS – SLOT NO.2

I/0	POLYMER SYSTEM RUNNING
I/1	POLYMER SYSTEM IN REMOTE
I/2	POLYMER SYSTEM FAULT
I/3	SLUDGE PUMP RUNNING
I/4	SLUDGE PUMP IN REMOTE
I/5	SLUDGE PUMP FAULT
I/6	SPARE
I/7	SPARE
I/8	SPARE
I/9	SPRAY DRIVE RUN REVERSE
I/10	SPRAY DRIVE RUN FORWARD
I/11	SPRAY DRIVE HIGH CURRENT
I/12	SPRAY DRIVE OVERLOAD
I/13	SPRAY DRIVE MOTOR T–STAT
I/14	SPRAY DRIVE IN HAND
I/15	SPRAY DRIVE IN AUTO

PLC OUTPUTS – SLOT NO.3

O/0	CONTROL POWER ENABLE
O/1	PRESS DEWATERING MODE
O/2	PRESS SYSTEM DISTURBANCE
O/3	COMMON ALARM
O/4	SPARE
O/5	SPARE
O/6	SPARE
O/7	SPARE
O/8	PRESS CALL TO RUN FORWARD
O/9	PRESS CALL TO RUN REVERSE
O/10	PRESS FAULT
O/11	PRESS PNUEMATIC CONE ENGAGE
O/12	SLUDGE PUMP CALL TO RUN
O/13	POLYMER SYSTEM CALL TO RUN
O/14	SPARE
O/15	SPARE

PLC OUTPUTS – SLOT NO.4

O/0	PRESS LOWER WASH 1 CALL
O/1	PRESS LOWER WASH 2 CALL
O/2	PRESS UPPER WASH 1 CALL
O/3	PRESS UPPER WASH 2 CALL
O/4	SPRAY DRIVE CALL REVERSE
O/5	SPRAY DRIVE CALL FORWARD
O/6	SPRAY DRIVE FAULT
O/7	SPARE
O/8	SPARE
O/9	SPARE
O/10	SPARE
O/11	SPARE
O/12	SPARE
O/13	SPARE
O/14	SPARE
O/15	SPARE

PLC ANALOG INPUTS – SLOT NO.5

IN0	SLUDGE FEED FLOW RATE
IN1	SPARE
IN2	PRESS INLET PRESSURE
IN3	SPARE

PLC ANALOG OUTPUTS – SLOT NO.6

OUT0	POLYMER SPEED COMMAND
OUT1	SLUDGE PUMP SPEED COMMAND
OUT2	SPARE
OUT3	SPARE

PLC/OIU SETTINGS

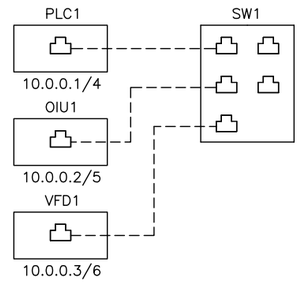
PLC1 – COMMUNICATIONS SETUP

ETHERNET PORT PARAMETERS	VALUE
PANEL 1 IP ADDRESS	10.0.0.1
PANEL 2 IP ADDRESS	10.0.0.4
SUBNET MASK	255.255.255.0
GATEWAY ADDRESS	0.0.0.0
BOOTP ENABLE	NO

OIU1 – COMMUNICATIONS SETUP

ETHERNET PORT PARAMETERS	VALUE
PANEL 1 IP ADDRESS	10.0.0.2
PANEL 2 IP ADDRESS	10.0.0.5
SUBNET MASK	255.255.255.0
GATEWAY ADDRESS	0.0.0.0
BOOTP ENABLE	NO

ETHERNET NETWORK MAP



NOTES:
1. – – – CAT6 ETHERNET CABLE

SUBNET MASK: 255.255.255.0

PLC/OIU SETTINGS

Q–PRESS SYSTEM OIU MAINTENANCE REMINDERS

PART DESCRIPTION	OPERATING TIME (HOURS)
INSPECT WIPER	2000
INSPECT COMPLETE SPRAY CAROUSEL	2000
INSPECT LOWER SHAFT SEALS & BUSHING	2000
INSPECT UPPER AUGER SHAFT BEARING	2000
INSPECT SOLENOID VALVES	100
INSPECT WASH SYSTEM HOSES	2000
REPLACE GEARBOX OIL	10000

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Q–PRESS CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A10

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PLC/OIU SETTINGS

PLC1 – SETPOINTS

REGISTER	DESCRIPTION	UNITS	DEFAULT	MIN	MAX
SP1[0].INT	EQUIPMENT STARTUP DELAY	SEC.	3	0	10
SP1[1].INT	DURATION MODE RUN DURATION	MIN.	900	1	9999
SP1[2].INT	VOLUME MODE PROCESS VOLUME	GAL	100	1	99999
SP1[3].INT	DATALOGGER INTERVAL	SEC.	10	1	999
SP1[10].INT	PRESS SHUTDOWN DURATION	MIN.	10	0	120
SP1[11].INT	PRESS DIRECTION CHANGE DWELL	SEC.	3	1	60
SP1[12].REAL	PRESS HAND–REVERSE SPEED	%	50	1	100
SP1[13].REAL	PRESS SPEED MINIMUM: LOW PRESSURE	%	10	1	100
SP1[14].REAL	PRESS SPEED MINIMUM: HIGH PRESSURE	%	50	1	100
SP1[15].REAL	PRESS SHUTDOWN SPEED	%	100	1	100
SP1[16].REAL	PRESS MAX TORQUE SPEED SETPOINT	%	60	1	100
SP1[17].REAL	PRESS HIGH PRESSURE INTERRUPT SPEED	%	100	1	100
SP1[20].INT	PNEUMATIC CONE AIR FAILURE FAULT DELAY	SEC.	10	1	20
SP1[40].INT	SPRAY WASH CYCLE DELAY	MIN.	15	1	60
SP1[41].INT	SPRAY WASH SHORT CYCLE COUNTER	COUNTS	2	1	10
SP1[42].INT	MAXIMUM TIME BETWEEN PROX. FAULT DELAY	SEC.	1	1	999
SP1[43].REAL	SPRAY DRIVE DIRECTION CHANGE DWELL	SEC.	1	0.5	60
SP1[44].REAL	SPRAY DRIVE INITIAL MOVE PROX. DELAY	SEC.	1	0.1	999
SP1[45].INT	SPRAY DRIVE FINAL FORWARD MOVE TIME	SEC.	5	1	30
SP1[60].REAL	INLET PRESSURE AT MIN SPEED	PSI	3	0	30
SP1[61].REAL	INLET PRESSURE AT MAX SPEED	PSI	15	0	30
SP1[62].REAL	INLET PRESSURE AT 4MA	PSI	0	0	30
SP1[63].REAL	INLET PRESSURE AT 20MA	PSI	14.7	0	30
SP1[64].REAL	HIGH PRESSURE INTERRUPT PRESSURE	PSI	12	0	30
SP1[65].INT	HIGH PRESSURE INTERRUPT OFF DELAY	SEC.	10	1	60
SP1[66].INT	MAINTAINED HIGH PRESSURE SHUTDOWN DELAY	SEC.	10	1	60
SP1[67].INT	HIGH PRESSURE COUNTS BEFORE SHUTDOWN	COUNTS	5	1	10
SP1[68].INT	HIGH PRESSURE COUNT RESET TIME	MIN.	60	1	600
SP1[69].INT	INLET PRESSURE DAMPENING TIME	SEC.	3	0	999
SP1[70].REAL	SLUDGE CONCENTRATION	%	3	0	10
SP1[71].REAL	REQUIRED SLUDGE FLOW RATE	GPM	30	5	150
SP1[72].REAL	SLUDGE PUMP MINIMUM SPEED	%	20	0	100
SP1[73].REAL	SLUDGE PUMP PID INITIAL SPEED	%	20	0	100
SP1[74].INT	SLUDGE PUMP PID ON DELAY	SEC.	10	0	999
SP1[75].REAL	SLUDGE PUMP PID GAIN (P) X 100	N/A	50	1	1000
SP1[76].REAL	SLUDGE PUMP PID TIME (I) X 10	N/A	12	1	1000
SP1[77].INT	SLUDGE ZERO FLOW FAULT DELAY	SEC.	300	1	999
SP1[78].INT	SLUDGE PUMP FAIL TO RUN FAULT DELAY	SEC.	10	1	999
SP1[79].REAL	SLUDGE FLOW AT 4MA	GPM	0	0	500
SP1[80].REAL	SLUDGE FLOW AT 20MA	GPM	100	0	500
SP1[85].INT	GENERAL FAULT DELAY	SEC.	1	0	999
SP1[90].REAL	POLYMER CONCENTRATION	%	100	0.05	100
SP1[91].REAL	LBS POLY PER TON OF SLUDGE	LB/TON	10	0.1	199.9
SP1[92].REAL	POLYMER PUMP MINIMUM CAPACITY	GPH	0	0	9.9
SP1[93].REAL	POLYMER PUMP MAXIMUM CAPACITY	GPH	3	0	999.9
SP1[94].INT	POLYMER PUMP FAIL TO RUN FAULT DELAY	SEC.	10	1	999
SP1[104].INT	GENERAL FAULT DELAY	SEC.	1	0	999
SP1[105].REAL	POLYMER SYSTEM INITIAL SPEED	%	20	0	100
SP1[106].INT	POLYMER SYSTEM DOSING CALC ON DELAY	SEC.	5	1	999
SP1[180].REAL	TORQUE AT MIN SPEED	NM	4.5	0	99.9
SP1[181].REAL	TORQUE AT MAX SPEED	NM	17.9	0	99.9
SP1[182].INT	HIGH TORQUE INTERRUPT TORQUE	NM	19	0	99.9
SP1[183].INT	HIGH TORQUE INTERRUPT OFF DELAY	SEC.	10	1	60
SP1[184].REAL	MAINTAINED HIGH TORQUE SHUTDOWN DELAY	MIN.	15	1	99
SP1[185].INT	HIGH TORQUE COUNTS BEFORE SHUTDOWN	COUNTS	5	1	10
SP1[186].INT	HIGH TORQUE COUNT RESET TIME	MIN.	60	1	600
SP1[187].INT	HIGH TORQUE INTERRUPT SPEED INCREASE	%	1	0	10
SP1[188].INT	TORQUE INTERRUPT SPEED INCREASE INTERVAL	SEC.	3	0	20
SP1[189].REAL	HIGH TORQUE OVERLOAD VALUE	NM	20	0	99.9
SP1[190].INT	TORQUE DAMPENING TIME	SEC.	200	0	999
SP1[191].INT	MOTOR NAMEPLATE POLES	POLES	4	2	8
SP1[192].INT	MOTOR MAX FREQUENCY	HZ	60	50	100

PLC/OIU SETTINGS

PLC1 – SCADA COMMUNICATIONS

REGISTER NUMBER	DESCRIPTION	DATA TYPE	NORMAL STATE	ACTIVE STATE	SCADA FUNCTION
PLC IO STATUS					
S_INT[1]	PLC SLOT 1 DISCRETE INPUTS	(BIT)	0	1	READ
S_INT[2]	PLC SLOT 2 DISCRETE INPUTS	(BIT)	0	1	READ
S_INT[3]	PLC SLOT 3 DISCRETE OUTPUTS	(BIT)	0	1	READ
S_INT[4]	PLC SLOT 4 DISCRETE OUTPUTS	(BIT)	0	1	READ
SCREW PRESS					
S_INT[9].0	PRESS RUNNING FORWARD	(BIT)	0	1	READ
S_INT[9].1	PRESS RUNNING REVERSE	(BIT)	0	1	READ
S_INT[9].2	PRESS IN AUTO	(BIT)	0	1	READ
S_INT[9].3	PRESS FAULT	(BIT)	0	1	READ
S_INT[9].4	PRESS IN DEWATERING MODE	(BIT)	0	1	READ
S_INT[9].5	SPRAY WASH ON	(BIT)	0	1	READ
S_INT[9].6	SPRAY WASH IN AUTO	(BIT)	0	1	READ
S_INT[9].7	SPRAY DRIVE RUNNING	(BIT)	0	1	READ
S_INT[9].8	SPRAY DRIVE IN AUTO	(BIT)	0	1	READ
S_INT[9].9	SPRAY DRIVE FAULT	(BIT)	0	1	READ
S_INT[9].10	SYSTEM DISTURBANCE	(BIT)	0	1	READ
S_REAL[0]	PRESS MOTOR CURRENT (AMPS)	(REAL)	–	–	READ
S_REAL[1]	PRESS INLET PRESSURE (PSI)	(REAL)	–	–	READ
S_REAL[2]	PRESS SPEED FEEDBACK (%)	(REAL)	–	–	READ
S_REAL[3]	PRESS TORQUE (Nm)	(REAL)	–	–	READ
S_INT[100].0	DEWATERING REMOTE START	(BIT)	0	1	WRITE
SLUDGE PUMP					
S_INT[12].0	SLUDGE PUMP RUNNING	(BIT)	0	1	READ
S_INT[12].1	SLUDGE PUMP IN REMOTE	(BIT)	0	1	READ
S_INT[12].2	SLUDGE PUMP FAULT	(BIT)	0	1	READ
S_REAL[11]	SLUDGE FEED FLOW RATE (GPM)	(REAL)	–	–	READ
S_REAL[12]	SLUDGE PUMP SPEED COMMAND (%)	(REAL)	–	–	READ
POLYMER SYSTEM					
S_INT[13].0	POLYMER SYSTEM RUNNING	(BIT)	0	1	READ
S_INT[13].1	POLYMER SYSTEM IN REMOTE	(BIT)	0	1	READ
S_INT[13].2	POLYMER SYSTEM FAULT	(BIT)	0	1	READ
S_REAL[13]	POLYMER SPEED COMMAND (%)	(REAL)	–	–	READ
GENERAL					
S_INT[15].0	E–STOP PRESSED	(BIT)	0	1	READ
S_INT[15].1	POWER FEED OK	(BIT)	0	1	READ

DATE	REVISION	NO.	BY	CK	APP

DESIGNED AJ
DETAILED
CHECKED MSN
APPROVED
DATE 01/13/26

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Q–PRESS
CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A11

DEVICE SETTINGS

CM1 – CURRENT MONITOR

DIP SETTINGS	
1	ON
2	OFF
3	ON
4	OFF
5	OFF
6	ON

DIAL SETTINGS	
HYSTERESIS	0%
LEVEL	FLA
DELAY	0.5s

WIRE PASSES	MAX AMPS	LEVEL RANGE (10–110%)
1	20	2–22A
2	10	1–11A
3	6.6	0.6–7.3A
4	5	0.5–5.5A

* ABOVE VALUES ASSUME 20A MAX DIP SETTNGS

NOTES:
1. FIELD CONFIGURATION SHALL BE PERFORMED BY THE STARTUP TECHNICIAN PER THE APPROPRIATE TECHNICAL DOCUMENTS.
2. MEASURING RANGE MAXIMUM AMPS SET BY DIP SETTINGS 1 AND 2
   SW1 ON/SW2 OFF = 20A; SW1 ON/SW2 ON = 50A; SW1 OFF/SW2 ON = 100A

TIB1 – SETTINGS

JUMPER NUMBER		SET AT
CH1	JP11	1–2 (DIRECT)
	JP12	2–3 (OFF)
CH2	JP21	1–2 (DIRECT)
	JP22	2–3 (OFF)
	JP23	2–3 (IN. 2 ACTIVE)

AL1 – ALARM LIGHT

SWITCH
1 2

FLASH

SINGLE FLASH SETTING
SWITCH 1 = ON
SWITCH 2 = OFF

PFR1 – SETTINGS

DIAL	SETTING
VOLTAGE	480 ON DELAY
Tt	5s
>U	10%
<U	10%

AC1 – SETTINGS

AC ON/OFF	90 °F
HEATER ON/OFF	60 °F

DEVICE SETTINGS

VFD1 – POWERFLEX 525 SETTINGS

PARAMETER NUMBER	DESCRIPTION	DEFAULT	VFD1 SETTING
31	MOTOR VOLTAGE	460 VAC	230 VAC
32	MOTOR FREQUENCY	60 HZ	70 HZ
33	MOTOR OL CURRENT	*	9.4 AMPS
34	MOTOR NP FLA	*	9.4 AMPS
35	MOTOR NP POLES	*	4 POLES
36	MOTOR NP RPM	*	2100 RPM
37	MOTOR NP POWER (kW)	*	4 kW
39	TORQUE PERF MODE	1=SVC	4=PM MOTOR
41	ACCEL TIME 1	10 SEC.	5 SEC.
42	DECEL TIME 1	10 SEC.	5 SEC.
44	MAXIMUM FREQUENCY	60 HZ	70 HZ
45	STOP MODE	0=RAMP	5=COAST
46	START SOURCE	1=KEYPAD	2=DIGIN TRMBLK
47	SPEED REFERENCE 1	1=DRIVE POT	1=DRIVE POT
49	SPEED REFERENCE 2	1=DRIVE POT	15=ETHERNET/IP
TERMINAL BLOCK GROUP			
64	2–WIRE MODE	0=EDGE TRIGGER	1=LEVEL SENSE
65	DIG IN TERM BLK 05	7=PRESET FREQ.	12=AUX FAULT
66	DIG IN TERM BLK 06	7=PRESENT FREQ	1=SPEED REF 2
76	RELAY OUT 1	0=READY	7=ABOVE CURRENT
77	RELAY OUT 1 LEVEL	0%	54%*
81	RELAY OUT 2 SEL	0=READY/FIT	10=ABOVE ANLG V
82	RELAY OUT 2 LEVEL	0	*
COMUNICATIONS GROUP			
125	COMM LOSS ACTION	0=FAULT	1=COAST STOP
128	EN ADDR SEL	0=BOOTP	1=PARAMETERS
129	EN IP ADDR CFG 1	0	10
130	EN IP ADDR CFG 2	0	0
131	EN IP ADDR CFG 3	0	0
132	EN IP ADDR CFG 4	0	3/6
133	EN SUBNET CFG 1	0	255
134	EN SUBNET CFG 2	0	255
135	EN SUBNET CFG 3	0	255
136	EN SUBNET CFG 4	0	0
137	EN GATEWAY CFG 1	0	0
138	EN GATEWAY CFG 2	0	0
139	EN GATEWAY CFG 3	0	0
140	EN GATEWAY CFG 4	0	0
143	EN COMM FLT ACTN	0=FAULT	3=HOLD LAST
144	EN IDLE FLT ACTN	0=FAULT	3=HOLD LAST
157	EN DATA OUT 1	0	3=OUTPUT CURRENT
158	EN DATA OUT 1	0	44=MAX. OUTPUT FREQ.
ADVANCED PROGRAM GROUP			
440	PWM FREQUENCY	4.0 kHZ	6.0 kHZ
501	PM IR VOLTAGE	11.50 V	(AUTOTUNE–NOTE 5)
502	PM IXd VOLTAGE	17.91 V	(AUTOTUNE–NOTE 5)
503	PM IXq VOLTAGE	53.21 V	(AUTOTUNE–NOTE 5)
504	PM BEMF VOLTAGE	1640.0 DRV	(AUTOTUNE–NOTE 5)
541	AUTO RSTRT TRIES	0	9
542	AUTO RSTRT DELAY	1	10

NOTES:
1. THE ABOVE IS A PARTIAL LISTING OF SETPOINTS. ONLY THE SETPOINTS THAT ARE SHOWN ABOVE MARKED WITH A * SHALL BE ALTERED IN THE FIELD. REFER TO THE DRIVE MANUAL FOR A FULL LIST OF SETPOINTS AND ADDITIONAL DETAILS.
2. PARAMETER 77 MUST BE SET TO THE MOTOR OVERLOAD TRIP POINT WHICH IS A PERCENT OF THE MAXIMUM DRIVE OUTPUT CURRENT.
   (MAX DRIVE OUTPUT CURRENT VFD1 = 13A)
3. VERIFY ALL MOTOR PARAMETERS TO THE ACTUAL MOTOR NAMEPLATE.
4. VFD1 IS CONFIGURED FOR A PERMANENT MAGNET MOTOR WITH A DELTA WIRING CONFIGURATION. ENSURE MOTOR JUMPERS ARE SET UP FOR A DELTA CONFIGURATION.
5. PRIOR TO MOTOR START UP, AN AUTOTUNE MUST BE PERFORMED. ONCE MOTOR NAMEPLATE PARAMETERS ARE CONFIRMED, NAVIGATE TO PARAMETER P040 AND CHANGE P040 TO A VALUE OF 1. PROVIDE THE VFD WITH A MAINTAINED MANUAL/HAND MODE CALL TO RUN. DURING THIS TIME, THE VFD WILL DISPLAY "RUN", BUT THE MOTOR WILL NOT OPERATE. ONCE THE AUTOTUNE IS FINISHED "RUN" WILL BE REMOVED FROM THE DISPLAY.

VFD1 – ETHERNET PORT

PARAMETERS	VALUE
PANEL 1 IP ADDRESS	10.0.0.3
PANEL 2 IP ADDRESS	10.0.0.6
SUBNET MASK	255.255.255.0
GATEWAY ADDRESS	0.0.0.0

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Q–PRESS CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A12

SEQUENCE OF OPERATION

CONTROL POWER ON–DELAY:
EACH TIME THE CONTROL PANEL POWER SUPPLY IS CYCLED, THE PLC WILL ALLOW ALL SOLID STATE DEVICES TO FULLY ENERGIZE BEFORE ENABLING THE CONTROL POWER CIRCUIT.

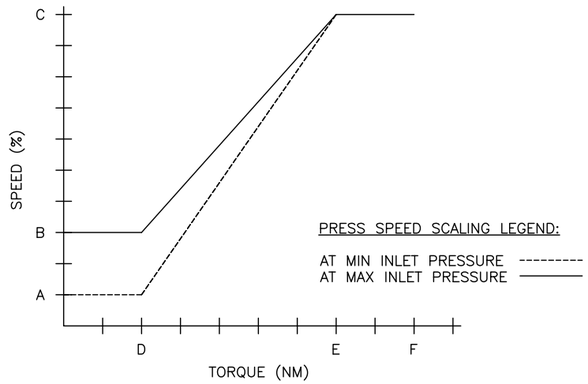
PRESS MODES OF OPERATION:
HAND: WHEN THE PRESS SELECTOR IS IN THE HAND POSITION, THE PRESS WILL RUN IN THE DIRECTION SELECTED BY THE PRESS FOR–OFF–REV SELECTOR AT A CONSTANT SPEED ENTERED BY THE POTENTIOMETER ON THE VFD.

AUTO: WHEN THE PRESS SELECTOR IS IN THE AUTO POSITION THE PRESS WILL BEGIN TO CYCLE IN THE FORWARD DIRECTION AS DESCRIBED IN THE SYSTEM START SEQUENCE. ONCE RUNNING, THE PRESS WILL OPERATE AT SPEED BASED ON THE MEASURED MOTOR TORQUE AND INLET PRESSURE, AS DESCRIBED BELOW. THE PRESS WILL CONTINUE TO CYCLE UNTIL THE SYSTEM ENTERS SHUTDOWN MODE.

PRESS INTERLOCKS:
OPERATING THE PRESS, IN HAND OR AUTOMATIC, WILL REQUIRE THE FOLLOWING:
1. PRESSURIZED AIR SUPPLY TO BE ABOVE THE REQUIRED PRESSURE AS MEASURED BY THE PRESSURE SWITCH IN THE AIR SUPPLY LINE.
2. THE SOLENOID VALVE FOR THE PNEUMATIC ACTUATED CONE MUST ALSO BE ENERGIZED, UNLESS IN SLUDGE DEWATERING SYSTEM SHUTDOWN SEQUENCE.

PRESS SPEED CONTROL:
1. THE PRESS MINIMUM SPEED SETTING WILL BE LINEARLY ADJUSTED BASED ON THE MEASURED PRESS INLET PRESSURE. WHEN THE PRESS INLET PRESSURE IS AT OR BELOW THE INLET PRESSURE AT MINIMUM SPEED SETPOINT, THE PRESS MINIMUM SPEED SETTING WILL BE SET TO THE PRESS SPEED MINIMUM: LOW PRESSURE SETPOINT. WHEN THE PRESS INLET PRESSURE IS AT OR ABOVE THE INLET PRESSURE AT MAXIMUM SPEED SETPOINT, THE PRESS MINIMUM SPEED SETTING WILL BE SET TO THE PRESS SPEED MINIMUM: HIGH PRESSURE SETPOINT.
2. THE OVERALL PRESS SPEED WILL BE LINEARLY ADJUSTED BASED ON THE MEASURED PRESS TORQUE. WHEN THE PRESS TORQUE IS AT OR BELOW THE TORQUE AT MINIMUM SPEED SETPOINT, THE PRESS WILL OPERATE AT THE PRESS MINIMUM SPEED SETTING BASED ON PRESSURE, AS DESCRIBED ABOVE. WHEN THE PRESS TORQUE IS AT OR ABOVE THE TORQUE AT MAXIMUM SPEED SETPOINT, THE PRESS WILL OPERATE AT THE PRESS DEWATERING MODE MAXIMUM SPEED SETPOINT.
3. THE SPEED RATE OF CHANGED BASED ON THE MEASURED INLET PRESSURE AND TORQUE CAN BE AVERAGED OVER A SET TIME BY THE INLET PRESSURE AND TORQUE DAMPENING SETPOINTS.

SPEED VS. MOTOR TORQUE



SPEED / MOTOR TORQUE SCALING SETPOINTS:
A. PRESS SPEED MINIMUM: LOW PRESSURE SETPOINT
B. PRESS SPEED MINIMUM: HIGH PRESSURE SETPOINT
C. PRESS MAXIMUM TORQUE SPEED SETPOINT
D. TORQUE AT MINIMUM SPEED SETPOINT
E. TORQUE AT MAXIMUM SPEED SETPOINT
F. HIGH TORQUE INTERRUPT SETPOINT

NOTES: THE MOTOR TORQUE WILL BE CALCULATED BY THE PLC USING THE FOLLOWING CALCULATION:

MOTOR TORQUE (NM) = MOTOR POWER (W) * 9.5488 / MOTOR SPEED (RPM)

THE MOTOR SPEED (RPM) WILL BE CALCULATED BY THE PLC USING THE FOLLOWING CALCULATION:

MOTOR SPEED (RPM) = COMMANDED SPEED (HZ) * (2 / MOTOR POLES) * 60

THE OPERATOR WILL NEED TO ENTER THE MOTOR NAMEPLATE POLES, POWER, AND MAX FREQUENCY THROUGH THE OIU.

SEQUENCE OF OPERATION

SPRAY DRIVE MODES OF OPERATION:
HAND: WHEN THE SPRAY DRIVE SELECTOR IS IN THE HAND POSITION, THE SPRAY DRIVE WILL DWELL, THEN MOVE IN THE OPPOSITE DIRECTION OF ITS LAST MOVEMENT. IT WILL CONTINUE IN THIS DIRECTION UNTIL THE SPRAY DRIVE PROXIMITY SWITCH IS ACTIVATED. ONCE THE PROXIMITY SWITCH IS ACTIVATED, THE SPRAY DRIVE WILL STOP, DWELL, AND START TO RUN IN THE OPPOSITE DIRECTION. THE DWELL–FORWARD–DWELL–REVERSE CYCLES WILL CONTINUE UNTIL THE SPRAY DRIVE SELECTOR IS PLACED IN THE OFF POSITION.
AUTO: WHEN THE SPRAY DRIVE SELECTOR IS IN THE AUTO POSITION, THE SPRAY DRIVE WILL OPERATE AS DESCRIBED IN THE SPRAY WASH SYSTEM SEQUENCE.

SPRAY WASH MODES OF OPERATION:
HAND: WHEN THE SPRAY WASH SELECTOR IS IN THE HAND POSITION, ALL SPRAY WASH SOLENOID VALVES WILL ENERGIZE AND REMAIN ENERGIZED UNTIL THE SELECTOR IS PLACED IN THE OFF POSITION.
AUTO: WHEN THE SPRAY WASH SELECTOR IS IN THE AUTO POSITION, THE SPRAY WASH SOLENOID VALVES WILL OPERATE AS DESCRIBED IN THE SPRAY WASH SYSTEM SEQUENCE.

POLYMER SYSTEM MODES OF OPERATION:
WHEN THE POLYMER SYSTEM IS IN REMOTE, THE DEWATERING CONTROL PANEL WILL PROVIDE A CALL TO RUN SIGNAL AS WELL AS A CALCULATED PACING SIGNAL. THE CALL TO RUN AND PACING SIGNALS WILL BE ACTIVE WHILE THE SYSTEM IS IN DEWATERING MODE. THE POLYMER SYSTEM WILL START TO OPERATE AT THE INITIAL SPEED SETPOINT FOR THE TIME SET IN THE DOSING CALCULATION ON DELAY TIMER. THE POLYMER SYSTEM SPEED WILL THEN VARY BASED ON THE SLUDGE CALCULATIONS VARIABLES EXPLAINED BELOW. THESE SIGNALS WILL BE DE–ACTIVATED WHEN THE SYSTEM ENTERS SHUTDOWN MODE.

SLUDGE PUMP MODES OF OPERATION:
WHEN THE SLUDGE FEED PUMP IS IN REMOTE, THE DEWATERING CONTROL PANEL WILL PROVIDE A CALL TO RUN SIGNAL AS WELL AS A USER SET PACING SIGNAL. THE CALL TO RUN AND PACING SIGNALS WILL BE ACTIVE WHILE THE SYSTEM IS IN DEWATERING MODE. THE SLUDGE PUMP WILL START TO OPERATE AT THE PID MINIMUM SPEED SETPOINT FOR THE TIME SET IN THE PID ON DELAY TIMER. THE SLUDGE PUMP SPEED WILL THEN VARY BASED ON THE SLUDGE FLOW FEEDBACK RECEIVED FROM THE FLOW METER. THESE SIGNALS WILL BE DE–ACTIVATED WHEN THE SYSTEM ENTERS SHUTDOWN MODE.

SLUDGE CALCULATIONS:
THE USER WILL BE RESPONSIBLE FOR ENTERING THE FOLLOWING PARAMETERS TO ENSURE THE CORRECT AMOUNT OF POLYMER IS DOSED WITH THE SLUDGE:

1. SLUDGE FEED FLOW RATE (GPM)
2. SLUDGE CONCENTRATION (% SOLIDS CONCENTRATION)
3. POLYMER DOSING RATE (LBS. NEAT POLYMER / TON DRY SOLIDS)
4. POLYMER CONCENTRATION (%)

PNEUMATIC PRESSURE CONE:
THE PNEUMATIC PRESSURE CONE IS OPERATED BY A SOLENOID VALVE. PRIOR TO EACH OPERATION OF THE PRESS, THE SOLENOID VALVE WILL BE ENERGIZED. THE ACTIVATION OF THE PNEUMATIC PRESSURE CONE IS REQUIRED PRIOR TO ANY OPERATION OF THE PRESS.

SEQUENCE OF OPERATION

DEWATERING MODE START SEQUENCE:
A DEWATERING MODE WILL BEGIN WHEN THE USER PRESSES THE START PUSHBUTTON ON THE OIU, AND THE EQUIPMENT WILL START UP IN THE FOLLOWING ORDER:

1. LONG WASH CYCLE WILL INITIATE
2. THE PNEUMATIC ACTUATED CONE IS ACTIVATED
3. PRESS WILL START TO RUN
4. POLYMER SYSTEM WILL BE CALLED TO RUN
5. SLUDGE PUMP WILL BE CALLED TO RUN

NOTE:
1. THERE WILL BE A DELAY BETWEEN THE START–UP OF EACH STEP.
2. A DEWATERING SYSTEM MAY ALSO BE STARTED BY RECEIVING A REMOTE START SIGNAL.
3. IF THE SYSTEM HAS STARTED DUE TO A REMOTE START SIGNAL, THE START PUSHBUTTON ON THE OIU WILL BE REPLACED WITH INDICATION THAT THE SYSTEM IS "IN REMOTE".
4. IF POWER IS LOST AND RESTORED TO THE SYSTEM AFTER A DEWATERING MODE HAS STARTED VIA THE START PUSHBUTTON ON THE OIU, THE OPERATOR WILL NEED TO RESTART THE SYSTEM FROM THE OIU ONCE AGAIN.
5. IF POWER IS LOST AND RESTORED TO THE SYSTEM AFTER A DEWATERING MODE HAS STARTED VIA THE REMOTE START SIGNAL AND THE SIGNAL IS STILL PRESENT, THE SYSTEM WILL AUTOMATICALLY START BACK UP.
6. IN THE PRESS SETTING MENU ON THE OIU, THE OPERATOR WILL FIND MULTIPLE MODES OF OPERATION FOR THE DEWATERING MODE WHICH CAN BE ENABLED OR DISABLED:
   - 6.1. START–STOP OPERATION. STARTING AND STOPPING THE SYSTEM BASED OFF PRESSING THE START AND STOP SOFT PUSHBUTTONS.
   - 6.2. TIME ON AND TIME OFF OPERATION. STARTING AND STOPPING THE SYSTEM AT USER SET TIMES OF THE DAY.
   - 6.3. RUN TIME OPERATION. STOPPING THE SYSTEM AFTER A USER SET TIME HAS ELAPSED.
   - 6.4. PROCESSED VOLUME OPERATION. STOPPING THE SYSTEM AFTER A USER SET AMOUNT OF VOLUME HAS BEEN PROCESSED.
7. WHEN THE DEWATERING SYSTEM IS AUTO–READY, THE PRESS CAN BE STARTED BY HOLDING THE RESET PUSHBUTTON FOR 5 SECONDS. ONCE THE DEWATERING MODE HAS STARTED, THE PRESS CAN BE PLACED INTO SHUTDOWN MODE BY HOLDING THE RESET PUSHBUTTON FOR 5 SECONDS.

SPRAY WASH SYSTEM SEQUENCE:
ONCE A SPRAY WASH CYCLE IS INITIATED, LOWER WASH 1 WILL OPEN AND THE SPRAY DRIVE WILL RETURN TO THE HOME POSITION. ONCE AT HOME, A SHORT SPRAY WASH CYCLE WILL BEGIN. AFTER COMPLETING THE SHORT SPRAY WASH CYCLE, A USER ENTERED TIME BETWEEN WASH CYCLES WILL BEGIN TIMING. AFTER THIS TIME HAS EXPIRED, THE SYSTEM WILL INITIATE ANOTHER SHORT SPRAY WASH CYCLE. THESE CYCLES WILL CONTINUE UNTIL THE SYSTEM HAS COMPLETED THE USER ENTERED NUMBER OF SHORT SPRAY WASH CYCLES. ONCE THE NUMBER OF SHORT SPRAY WASH CYCLES HAS REACHED THE USER ENTERED SETTING, AND THE SPRAY WASH DWELL TIMER HAS EXPIRED, THE SYSTEM WILL INITIATE A LONG SPRAY WASH CYCLE. ONCE THE LONG SPRAY WASH CYCLE IS COMPLETE, THE SEQUENCE WILL REPEAT ITSELF.

SHORT SPRAY WASH CYCLE:
THE FIRST LOWER WASH WILL REMAIN OPEN AND THE SPRAY DRIVE WILL DWELL. AFTER DWELLING, THE SPRAY DRIVE WILL ROTATE IN THE FORWARD DIRECTION UNTIL THE AWAY PROXIMITY SWITCH IS ACTIVATED. AFTER ACTIVATING THE AWAY PROXIMITY SWITCH, THE SPRAY DRIVE WILL STOP, LOWER WASH 1 WILL CLOSE, AND THE SECOND LOWER WASH WILL OPEN. THE SPRAY DRIVE WILL AGAIN DWELL. AFTER DWELLING, THE SPRAY DRIVE WILL ROTATE IN THE REVERSE DIRECTION UNTIL THE HOME PROXIMITY SWITCH IS ACTIVATED. AFTER ACTIVATING THE HOME PROXIMITY SWITCH THE SPRAY DRIVE WILL STOP AND LOWER WASH 2 WILL CLOSE. AFTER DWELLING, THE SPRAY DRIVE WILL OPERATE IN THE FORWARD DIRECTION FOR THE TIME SET IN THE FINAL FORWARD MOVEMENT TIMER.

LONG SPRAY WASH CYCLE: A LONG SPRAY WASH CYCLE CONSISTS OF A SHORT SPRAY WASH CYCLE IN ADDITION TO THE FOLLOWING SEQUENCE. ONCE THE SHORT SPRAY WASH CYCLE IS COMPLETE, THE FIRST UPPER WASH WILL OPEN, AND THE SPRAY DRIVE MOTOR WILL DWELL. AFTER DWELLING, THE SPRAY DRIVE WILL ROTATE IN THE FORWARD DIRECTION UNTIL THE AWAY PROXIMITY SWITCH IS ACTIVATED. AFTER ACTIVATING THE AWAY PROXIMITY SWITCH, THE SPRAY DRIVE WILL STOP, UPPER WASH 1 WILL CLOSE, AND THE SECOND UPPER WASH WILL OPEN. THE SPRAY DRIVE WILL AGAIN DWELL. AFTER DWELLING THE SPRAY DRIVE WILL ROTATE IN THE REVERSE DIRECTION UNTIL THE HOME PROXIMITY SWITCH IS ACTIVATED. AFTER ACTIVATING THE HOME PROXIMITY SWITCH THE SPRAY DRIVE WILL STOP AND UPPER WASH 2 WILL CLOSE. AFTER DWELLING, THE SPRAY DRIVE WILL OPERATE IN THE FORWARD DIRECTION FOR THE TIME SET IN THE FINAL FORWARD MOVEMENT TIMER.

NOTES:
1. IF THE SYSTEM IS NOT IN DEWATERING MODE AND THE SPRAY DRIVE AND SPRAY WASH SELECTORS ARE IN THE AUTO POSITION, A SPRAY WASH CYCLE WILL BE INITIATED WHEN THE PRESS IS RUNNING. DURING THIS CYCLE, THE SPRAY DRIVE AND SPRAY WASH WILL BOTH CYCLE THROUGH SHORT AND LONG SPRAY WASH CYCLES AS DESCRIBED IN THE SPRAY WASH SYSTEM SEQUENCE.
2. THE DEWATERING SYSTEM WILL CONTINUE TO INITIATE SPRAY WASH CYCLES WHILE THE SYSTEM IS IN SHUTDOWN MODE.
3. THE HOME POSITION WILL BE DEFINED AS THE FULLY REVERSED PROXIMITY POSITION.
4. THE AWAY POSITION WILL BE DEFINED AS THE FULLY FORWARD PROXIMITY POSITION.
5. THE SPRAY DRIVE OVER TRAVEL FAULT OCCURS WHEN THE HOME PROXIMITY SWITCH IS ACTIVATED WHEN OPERATING IN THE FORWARD DIRECTION, OR THE AWAY PROXIMITY SWITCH IS ACTIVATED WHEN OPERATING IN THE REVERSE DIRECTION.

DATE	REVISION	NO.	BY	CK	APP

DESIGNED AJ
DETAILED
CHECKED MSN
APPROVED
DATE 01/13/26

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Q–PRESS CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A13

13 OF 16

SEQUENCE OF OPERATION

PRESS HIGH PRESSURE FEED INTERRUPT:
WHEN THE PRESS INLET PRESSURE MEASURED EXCEEDS THE HIGH PRESSURE INTERRUPT SETPOINT, THE SLUDGE PUMP AND POLYMER FEED SIGNAL WILL SHUT DOWN IMMEDIATELY AND THE PRESS WILL RUN AT THE PRESS INTERRUPT SPEED SEPOINT. ONCE THE PRESSURE HAS DROPPED PAST THE HIGH PRESSURE INTERRUPT SETPOINT AND HOLDS FOR THE TIME SET IN THE HIGH PRESSURE INTERRUPT OFF DELAY, THE PUMPS WILL AUTOMATICALLY RESTART AND THE PRESS WILL RETURN TO ITS REGULAR SPEED.

PRESS HIGH PRESSURE SHUTDOWN:
HIGH PRESSURE SHUTDOWN WILL OCCUR IF THE NUMBER OF COUNTS OF HIGH PRESSURE INTERRUPTS, SET IN THE HIGH INLET PRESSURE FAULT COUNTER, OCCUR WITHIN A SET AMOUNT OF TIME. A HIGH PRESSURE SHUTDOWN WILL ALSO OCCUR ONCE THE HIGH PRESSURE SIGNAL IS REACHED AND MAINTAINED FOR A TIME SET IN THE MAINTAINED HIGH INLET PRESSURE SHUTDOWN DELAY TIMER. THE SYSTEM WILL ENTER SHUTDOWN MODE IMMEDIATELY WHEN A HIGH PRESSURE SHUTDOWN OCCURS.

NOTE: TO RESET A HIGH PRESSURE SHUTDOWN, PRESS THE RESET PUSHBUTTON.

PRESS HIGH TORQUE INTERRUPT:
WHEN THE PRESS MOTOR TORQUE MEASURED EXCEEDS THE HIGH TORQUE INTERRUPT SETPOINT, THE SLUDGE PUMP AND POLYMER FEED SIGNAL WILL SHUT DOWN IMMEDIATELY AND THE PRESSURE CONE WILL DE–ENERGIZE. THE PRESS WILL CONTINUE TO RUN AND GRADUALLY INCREASE SPEED BY THE % AMOUNT SET IN THE TORQUE INTERRUPT SPEED INCREASE SETPOINT EACH TIME THE TORQUE INTERRUPT SPEED INCREASE INTERVAL TIME SETPOINT HAS ELAPSED UNTIL THE PRESS IS OPERATING AT THE SPEED SET IN THE PRESS INTERRUPT SPEED SETPOINT. ONCE THE MOTOR TORQUE HAS DROPPED PAST THE HIGH TORQUE INTERRUPT SETPOINT AND HOLDS FOR THE TIME SET IN THE HIGH TORQUE INTERRUPT OFF DELAY, THE PUMPS WILL AUTOMATICALLY RESTART, THE PRESSURE CONE WILL BE ENERGIZED, AND THE PRESS WILL RETURN TO ITS REGULAR SPEED.

NOTE: IF THE SPRAY WASH CYCLE DELAY TIMER EXPIRES DURING A PRESS HIGH TORQUE INTERRUPT CONDITION, THE SPRAY WASH CYCLE WILL BE PAUSED UNTIL THE PRESS HIGH TORQUE INTERRUPT CONDITION IS REMOVED AND THE PRESSURE CONE HAS BEEN RE–ENERGIZED.

PRESS HIGH TORQUE INTERRUPT SHUTDOWN:
HIGH TORQUE SHUTDOWN WILL OCCUR IF THE NUMBER OF COUNTS OF HIGH TORQUE INTERRUPTS, SET IN THE HIGH TORQUE INTERRUPT FAULT COUNTER, OCCUR WITHIN A SET AMOUNT OF TIME. A HIGH TORQUE SHUTDOWN WILL ALSO OCCUR ONCE THE HIGH TORQUE SIGNAL IS REACHED AND MAINTAINED FOR A TIME SET IN THE MAINTAINED HIGH TORQUE SHUTDOWN DELAY TIMER. THE SYSTEM WILL ENTER SHUTDOWN MODE IMMEDIATELY WHEN A HIGH TORQUE SHUTDOWN OCCURS.

NOTE: TO RESET A HIGH TORQUE SHUTDOWN, PRESS THE RESET PUSHBUTTON.

SEQUENCE OF OPERATION

DEWATERING SYSTEM SHUTDOWN MODE CONDITIONS:
1. REMOTE CALL TO RUN SIGNAL REMOVED
2. STOP PUSHBUTTON PRESSED ON THE OIU
3. THE SPRAY WASH SELECTOR IS SWITCHED TO THE HAND OR OFF POSITION.
4. THE SLUDGE PUMP IN REMOTE SIGNAL IS LOST.
5. THE POLYMER SYSTEM IN REMOTE SIGNAL IS LOST.

– WHEN SHUTDOWN MODE CONDITIONS 1–5 OCCUR, THE SYSTEM WILL ENTER SHUTDOWN MODE.

6. SLUDGE PUMP FAULT INDICATION RECEIVED
7. SLUDGE PUMP RUNNING INDICATION NOT RECEIVED WHILE CALLED TO RUN FOR THE TIME SET IN THE SLUDGE PUMP FAIL TO RUN FAULT DELAY TIMER
8. POLYMER SYSTEM FAULT INDICATION RECEIVED FOR THE TIME SET IN THE GENERAL FAULT DELAY TIMER
9. POLYMER SYSTEM RUNNING INDICATION NOT RECEIVED WHILE CALLED TO RUN FOR THE TIME SET IN THE POLYMER SYSTEM FAIL TO RUN FAULT DELAY TIMER
10. ZERO SLUDGE FLOW INDICATION RECEIVED WHILE THE SYSTEM IS IN DEWATERING MODE FOR THE TIME SET IN THE SLUDGE ZERO FLOW FAULT DELAY TIMER
11. AIR SUPPLY LOW PRESSURE INDICATION RECEIVED
12. PRESS HIGH PRESSURE SIGNAL MAINTAINED FOR THE TIME SET IN THE HIGH PRESSURE SHUTDOWN DELAY TIMER
13. PRESS HIGH PRESSURE SIGNAL RECEIVED FOR THE AMOUNT OF TIMES SET IN THE HIGH PRESSURE COUNTS BEFORE SHUTDOWN COUNTER
14. PRESS HIGH TORQUE MAINTAINED FOR THE TIME SET IN THE HIGH TORQUE SHUTDOWN DELAY TIMER
15. PRESS HIGH TORQUE RECEIVED FOR THE AMOUNT OF TIMES SET IN THE HIGH TORQUE COUNTS BEFORE SHUTDOWN COUNTER

– WHEN ANY OF SHUTDOWN MODE CONDITIONS 6 – 15 OCCUR, THE SYSTEM DISTURBANCE PILOT LIGHT WILL ENERGIZE AND THE SYSTEM WILL ENTER SHUTDOWN MODE. THE SYSTEM DISTURBANCE PILOT LIGHT WILL REMAIN ENERGIZED UNTIL THE CONDITION IS CORRECTED.

ONCE THE SYSTEM IS IN SHUTDOWN MODE, THE EQUIPMENT WILL POWER DOWN IN THE FOLLOWING ORDER:

1. SLUDGE PUMP AND POLYMER SYSTEM CALL TO RUN SIGNALS WILL BE REMOVED AND THE PNEUMATIC CONE WILL DISENGAGE.
2. THE PRESS AND SPRAY WASH WILL CONTINUE UNTIL THE SHUTDOWN TIMER HAS COMPLETED.
3. ONCE THE SHUTDOWN TIMER HAS EXPIRED THE SPRAY WASH WILL COMPLETE ONE LAST LONG SPRAY WASH CYCLE. DURING THE FINAL SPRAY WASH CYCLE THE PNEUMATIC CONE WILL BE RE–ENGAGED.
4. THE SYSTEM WILL REMAIN OFF UNTIL THE NEXT DEWATERING MODE IS ACTIVATED

SEQUENCE OF OPERATION

SYSTEM FAULTS:
1. PRESS VFD DETECTS OVERLOAD
2. PRESS TORQUE OVERLOAD SETPOINT HAS BEEN REACHED
3. PRESS MOTOR THERMOSTAT IS TRIPPED
4. PRESS RUNNING INDICATION NOT RECEIVED WHILE CALLED TO RUN
5. SPRAY DRIVE HIGH CURRENT DETECTED
6. SPRAY DRIVE MOTOR OVERLOAD DETECTED
7. SPRAY DRIVE MOTOR THERMOSTAT IS TRIPPED
8. SPRAY DRIVE IS RUNNING REVERSE AND TRIGGERS THE AWAY PROXIMITY SWITCH.
9. SPRAY DRIVE IS RUNNING FORWARD AND TRIGGERS THE HOME PROXIMITY SWITCH.
10. SPRAY DRIVE IS RUNNING AND NEITHER PROXIMITY SWITCH IS TRIGGERED IN THE TIME SET IN THE OIU.

– WHEN ANY OF FAULTS 1 THROUGH 7 OCCUR, THE ALARM HORN, BEACON, AND SYSTEM DISTURBANCE PILOT LIGHT WILL ENERGIZE AND THE ENTIRE SYSTEM WILL SHUT DOWN IMMEDIATELY. THE ALARM BEACON AND SYSTEM DISTURBANCE PILOT LIGHT WILL REMAIN ENERGIZED UNTIL THE CONDITION IS CORRECTED.
– WHEN ANY OF FAULTS 8 THROUGH 10 OCCUR, THE ALARM HORN, BEACON, AND SYSTEM DISTURBANCE PILOT LIGHT WILL ENERGIZE AND THE ENTIRE SYSTEM WILL SHUT DOWN IMMEDIATELY. THE ALARM BEACON AND SYSTEM DISTURBANCE PILOT LIGHT WILL REMAIN ENERGIZED UNTIL THE OPERATOR ACKNOWLEDGES THE FOLLOWING PROMPTS:
  –– ALARM ANNUNCIATION MESSAGE
  –– SPRAY DRIVE HAS MANUALLY BEEN ADJUSTED FROM THE OIU TO A SAFE POSITION
  –– HOME AND AWAY PROXIMITY SWITCHES ARE WORKING PROPERLY

NOTES:
1. FOR SYSTEM FAULTS 8–10, THE SYSTEM RESET PUSHBUTTON WILL NOT BE ACTIVE UNTIL THE ABOVE THREE PROMPTS HAVE BEEN ACKNOWLEDGED BY THE OPERATOR.
2. IF THE PRESS OR SPRAY DRIVE SELECTORS ARE SWITCHED TO THE HAND OR OFF POSITION, THE SYSTEM WILL SHUTDOWN IMMEDIATELY AND A MESSAGE WILL BE DISPLAYED ON THE OIU.

ALARM BEACON:
THE ALARM BEACON WILL ENERGIZE IF ANY OF THE SYSTEM FAULTS OCCUR. THE ALARM BEACON WILL REMAIN ENERGIZED UNTIL THE FAULT IS CLEARED AND THE SYSTEM RESET PUSHBUTTON IS PRESSED.

EMERGENCY STOP:
ALL DEWATERING EQUIPMENT WILL STOP IMMEDIATELY IF THE E–STOP PUSHBUTTON IS ACTIVATED. THE DEWATERING SYSTEM WILL NOT RESUME OPERATION UNTIL THE E–STOP IS RESET AND THE SYSTEM RESET PUSHBUTTON IS PRESSED.

OIU – INFORMATION:
1. THE OIU WILL DISPLAY THE ELAPSED MOTOR RUN TIMES.
2. ALL ADJUSTABLE SETPOINTS CAN BE ACCESSED AND ADJUSTED THROUGH THE OIU.
3. THE PRESENT FAULT WILL BE DISPLAYED ON THE OIU.
4. THE HISTORY OF ALL PAST FAULTS CAN BE ACCESSED THROUGH THE OIU.
5. FLOW INDICATION AND AMOUNT SHALL BE DISPLAYED ON THE OIU.
6. RUNNING AND FAULTED STATUS FOR ALL MOTORS AND PUMPS WILL BE DISPLAYED ON THE OIU.
7. VFD SPEEDS MAY BE ADJUSTED THROUGH THE OIU.
8. THE PRESS MOTOR TORQUE WILL BE DISPLAYED ON THE OIU.
9. THE PRESS MINIMUM AND MAXIMUM SPEED RANGE WILL BE DISPLAYED ON THE OIU.
10. THE ALARM HISTORY WILL DISPLAY THE PEAK VALUE OF TORQUE MEASURED WHEN A TORQUE OVERLOAD FAULT OCCURS.

DATE	REVISION	NO.	BY	CK	APP

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DETAILED
CHECKED MSN
APPROVED
DATE 01/13/26

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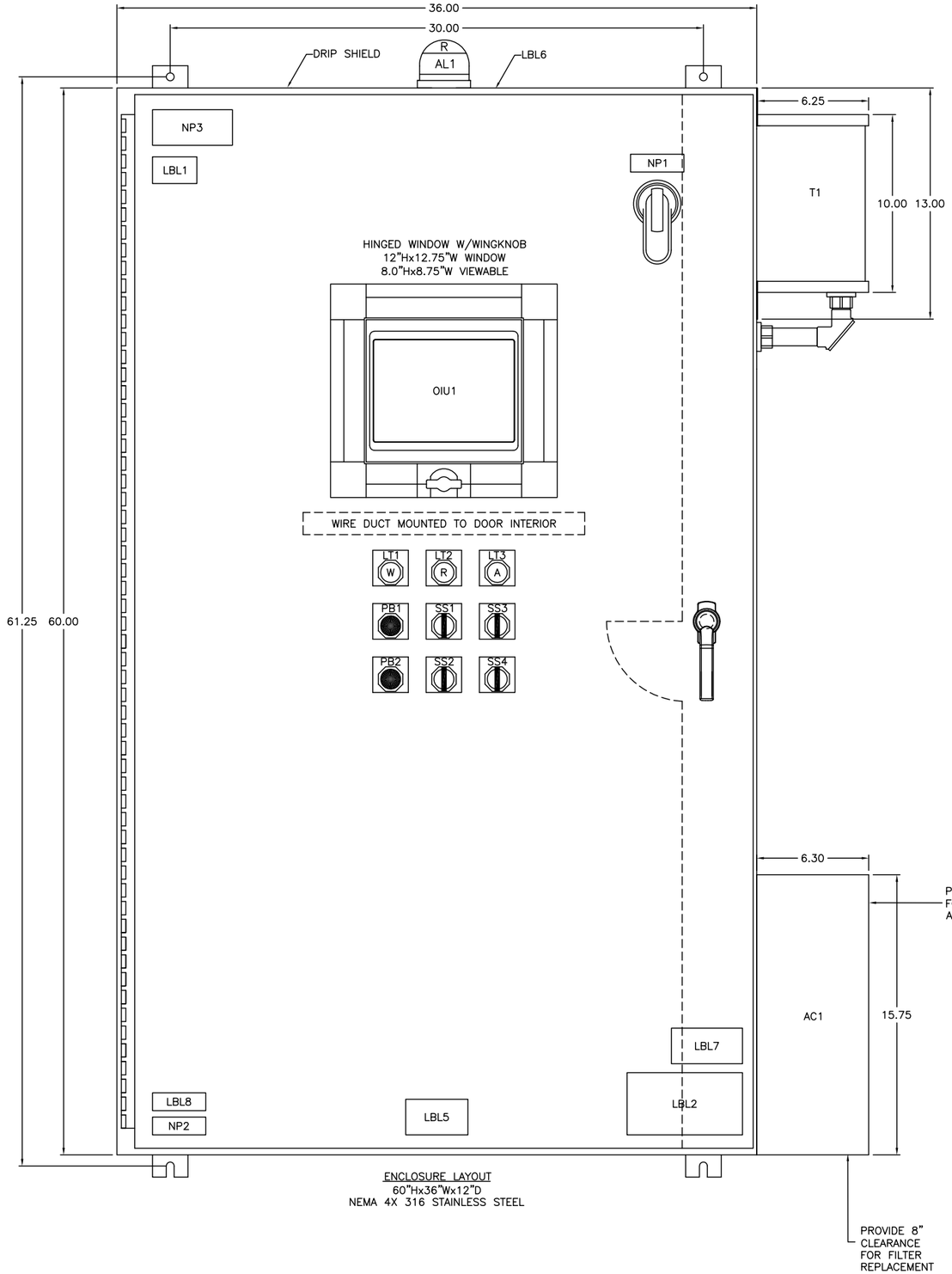
Q–PRESS
CONTROL PANEL

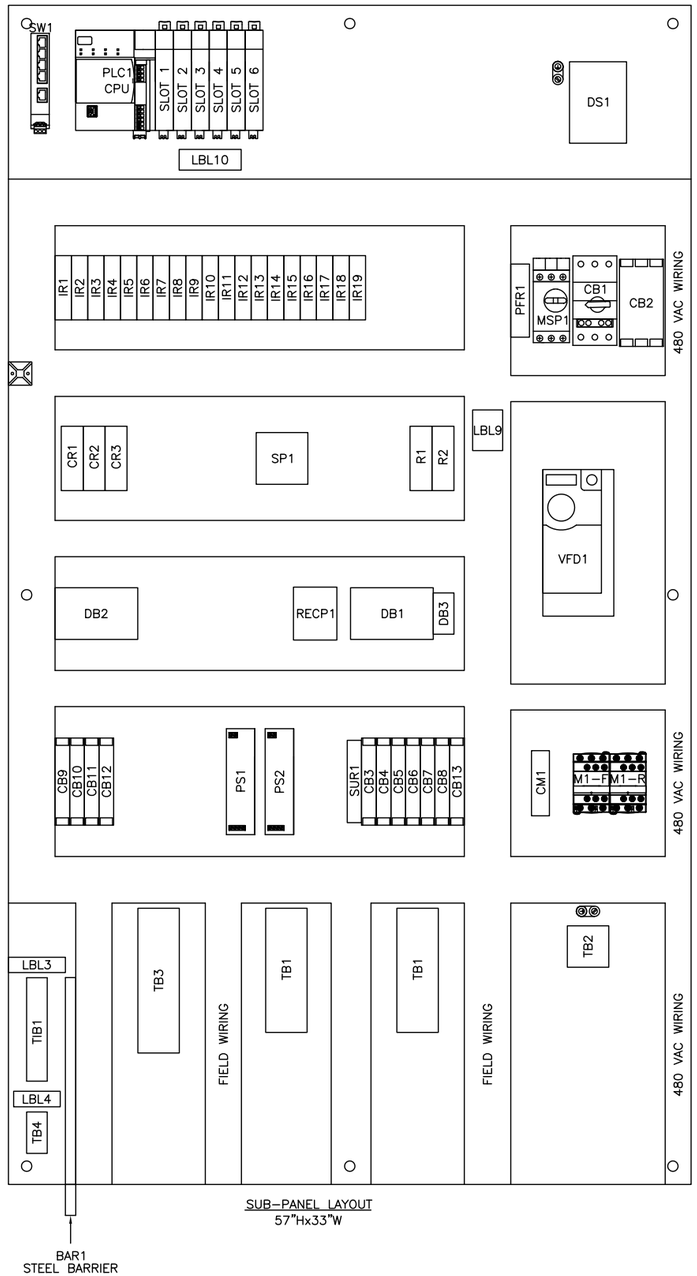
SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A14





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Q-PRESS CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366A15

15 OF 16

PILOT DEVICE LEGENDPLATES (PANEL DOOR)				
DEVICE TAG	DESCRIPTOR LINE 1	DESCRIPTOR LINE 2	DESCRIPTOR LINE 3	
LT1	CONTROL POWER	ON		
LT2	DEWATERING	MODE		
LT3	SYSTEM	DISTURBANCE		
PB1	EMERGENCY	STOP		
PB2	SYSTEM	RESET		
SS1	PRESS	OFF	HAND	AUTO
SS2	PRESS	OFF	FOR	REV
SS3	SPRAY WASH	OFF	HAND	AUTO
SS4	SPRAY DRIVE	OFF	HAND	AUTO
MAX. CHARACTERS	15	15	4	4

LABEL DESCRIPTION	
LBL1	WARNING MULTIPLE SUPPLY SOURCES OPEN ALL DISCONNECTS BEFORE SERVICING EQUIPMENT OR OTHER UNIT WIRING
LBL2	DANGER HIGH VOLTAGE ENTRY BY QUALIFIED PERSON ONLY
LBL3	WARNING SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY
LBL4	INTRINSICALLY SAFE FIELD WIRING TERMINALS
LBL5	ELEMECH ELECTRICAL CONTROL SYSTEMS
LBL6	WARNING DAMAGE RESULTING FROM INSTALLATION OF TOP ENTRY CONDUIT WILL VOID WARRANTY. – AVOID CUTTING HOLES DIRECTLY ABOVE ANY ELECTRICAL COMPONENTS – PROTECT INTERNAL COMPONENTS FROM METAL SHAVINGS, CUTTING OILS, DEBRIS, AND MOISTURE – USE PROPER FITTINGS, MYERS TYPE 4 OR EQUAL – CONDUITS AND FITTING MUST BE WATERTIGHT TO PREVENT WATER ENTRY – ALL PENETRATIONS MUST BE SEALED OFF TO PREVENT INTRUSION OF MOISTURE, CORROSIVE GASES, AND VAPORS FROM ENTERING THE ENCLOSURE
LBL7	DANGER ARC FLASH AND SHOCK HAZARD FOLLOW ALL REQUIREMENTS NFPA 70E FOR SAFE WORK PRACTICES AND FOR PERSONAL PROTECTIVE EQUIPMENT.
LBL8	WARNING TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING.
LBL9	VFD SETUP GUIDE
LBL10	WARNING! TO AVOID DAMAGING ANY INPUT OR OUTPUT MODULE, VERIFY THE SA POWER REQUIREMENT OF EACH MODULE BEFORE POWER UP. MODULES MUST BE INSTALLED TO THE RIGHT OF THE CORRECT SA POWER SOURCE TO AVOID DAMAGE.

NAMEPLATES			
TAG	DESCRIPTOR LINE 1	DESCRIPTOR LINE 2	DESCRIPTOR LINE 3
NP1	240VAC–3PH–60HZ		
NP2	INTRINSICALLY	SAFE CIRCUITS	
NP3	CONTROL PANEL PROVIDES INTRINSICALLY SAFE CIRCUIT EXTENSIONS FOR USE IN CLASS I, DIVISION 1 GROUPS A,B,C,D; CLASS I, ZONE 0 AND 1, GROUP IIC; CLASS II, DIVISION 1 GROUPS E,F,G HAZARDOUS LOCATIONS WHEN CONNECTED PER PR ELECTRONICS INSTALLATION DRAWING NO. 5202QU01		

NAMEPLATES AND LEGENDPLATES CONSTRUCTION					
	PANEL LEGENDPLATES	LCS LEGENDPLATES	NAMEPLATES	UL698 NAMEPLATES	DEVICE TAGS
TEXT COLOR	BLACK	BLACK	BLACK	BLACK	BLACK
BACKGROUND COLOR	WHITE/ YELLOW (E–STOPS)	WHITE/ YELLOW (E–STOPS)	WHITE	YELLOW	WHITE
MATERIAL	THERMAL TRANSFER	THERMAL TRANSFER	THERMAL TRANSFER	PHENOLIC ENGRAVED	THERMAL TRANSFER
ATTACHMENT	ADHESIVE	ADHESIVE	ADHESIVE	ADHESIVE	ADHESIVE
TEXT SIZE	5/32" HIGH	5/32" HIGH	3/16" HIGH	1/8" HIGH	1/8" HIGH
DIMENSIONS	2.375"X2.375"	1.875"X1.875"	2.72"X1"	4"X2"	1"X½"
MAX. CHARACTERS PER LINE	15	15	17	35	7

PANEL DATA LABEL

ELEMECH ELECTRICAL AND MECHANICAL ENGINEERING SERVICES

ELEMECHINC.COM 630–499–7080

WARRANTY NOTICE
NO ALLOWANCE OR PAYMENT WILL BE MADE FOR WARRANTY REPAIR UNLESS PRIOR AUTHORIZATION HAS BEEN REQUESTED AND OBTAINED FROM THE ELEMECH SERVICE DEPT.

SERIAL: HBR10366
REF: # 73013257
DATE: TBD
POWER: 3/60/240
FLA: 30.6A
LGST MOT: 9.39A

SHORT CIRCUIT CURRENT RATING
10 KA RMS SYMMETRICAL @ 240 VOLTS MAX

ENCLOSURE RATING: NEMA TYPE 4X

NAME: SANDPOINT, ID

CIRCUIT 2–9: 10A @ 120VAC

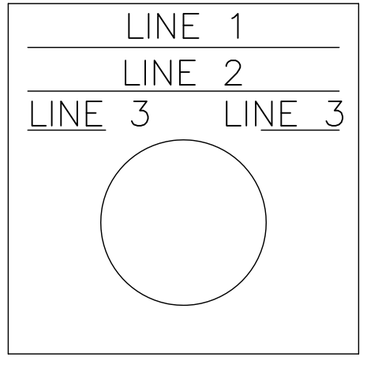
TORQUE SCREWS TO 12 IN–LBS

ALL FIELD WIRING SHALL BE 60°C COPPER CONDUCTOR ONLY

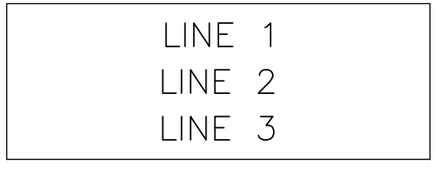
NOTE:
THE CONTROL PANEL WILL ALSO BE LISTED AND LABELED WITH A SERIALIZED LABEL AS OUTLINED IN THE CONTROL PANEL SPECIFICATION NOTES.

REPLACE TBF FUSE WITH FAST ACTING FUSE RATED AT 250V, MAX 1 AMP BUSSMANN AGC–1 OR EQUAL

PILOT DEVICE LEGENDPLATES



PANEL NAMEPLATE



NOTE:
TEXT WILL REMAIN VERTICALLY CENTERED IF LESS THAN 3 LINES ARE USED.

DEVICE TAG



DATE	REVISION	NO.	BY	CK	APP

DESIGNED AJ
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DATE 01/13/26

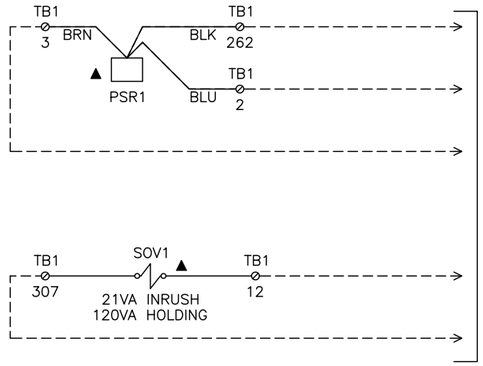
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Q–PRESS CONTROL PANEL

SANDPOINT, ID | SCALE: NONE

PROJECT NUMBER: 73013257 | DRAWING NO: HBR10366A16

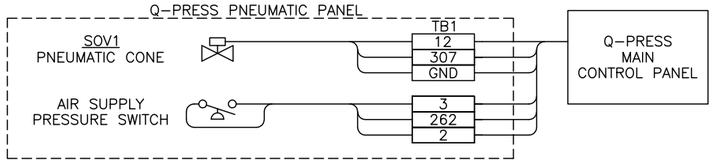
16 OF 16



AIR SUPPLY OK PRESURE SWITCH

PNEUMATIC CONE SOLENOID VALVE

FIELD WIRING DIAGRAM



DEVICE SETTINGS

PSR1 – SETTINGS

PARAMETER	DESCRIPTION	DEFAULT	FACTORY SETTING
P–	PRESSURE SETTING	50 PSI	75 PSI

SETPOINT CHANGE INSTRUCTIONS:

1. PRESS THE "S" KEY. THE DISPLAY SHOULD FLASH "P–".
2. USE THE UP AND DOWN ARROW KEYS TO ADJUST THE PRESSURE SETPOINT.
3. PRESS THE "S" KEY TO SAVE SETTING.

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Q–PRESS PNEUMATIC CONTROL PANEL

SANDPOINT, ID

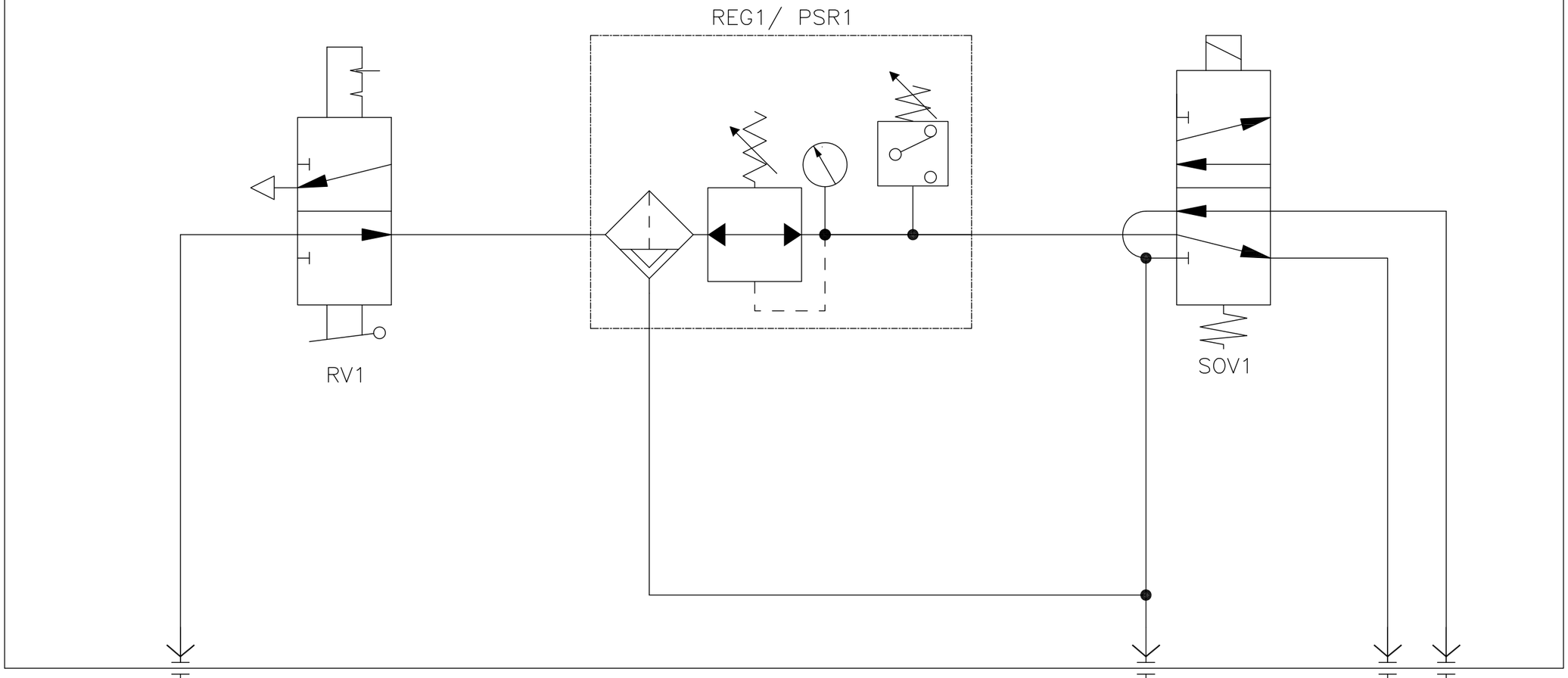
SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366B01

PNEUMATIC
CONTROL PANEL

NOTE: ALL AIR LINES WILL BE 3/8" BLUE POLYURETHANE TUBING.



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Q-PRESS PNEUMATIC
CONTROL PANEL

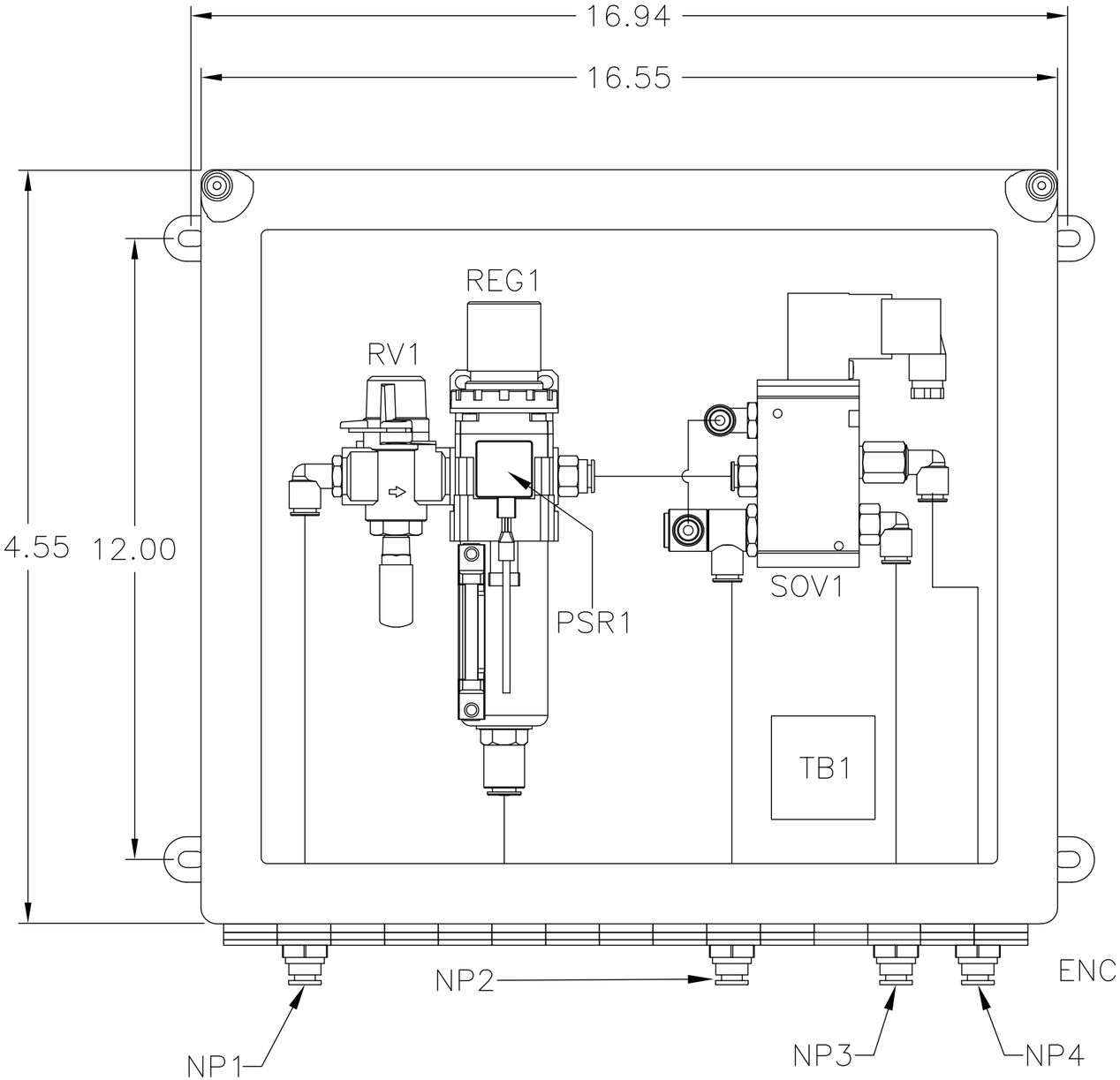
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SCALE: NONE

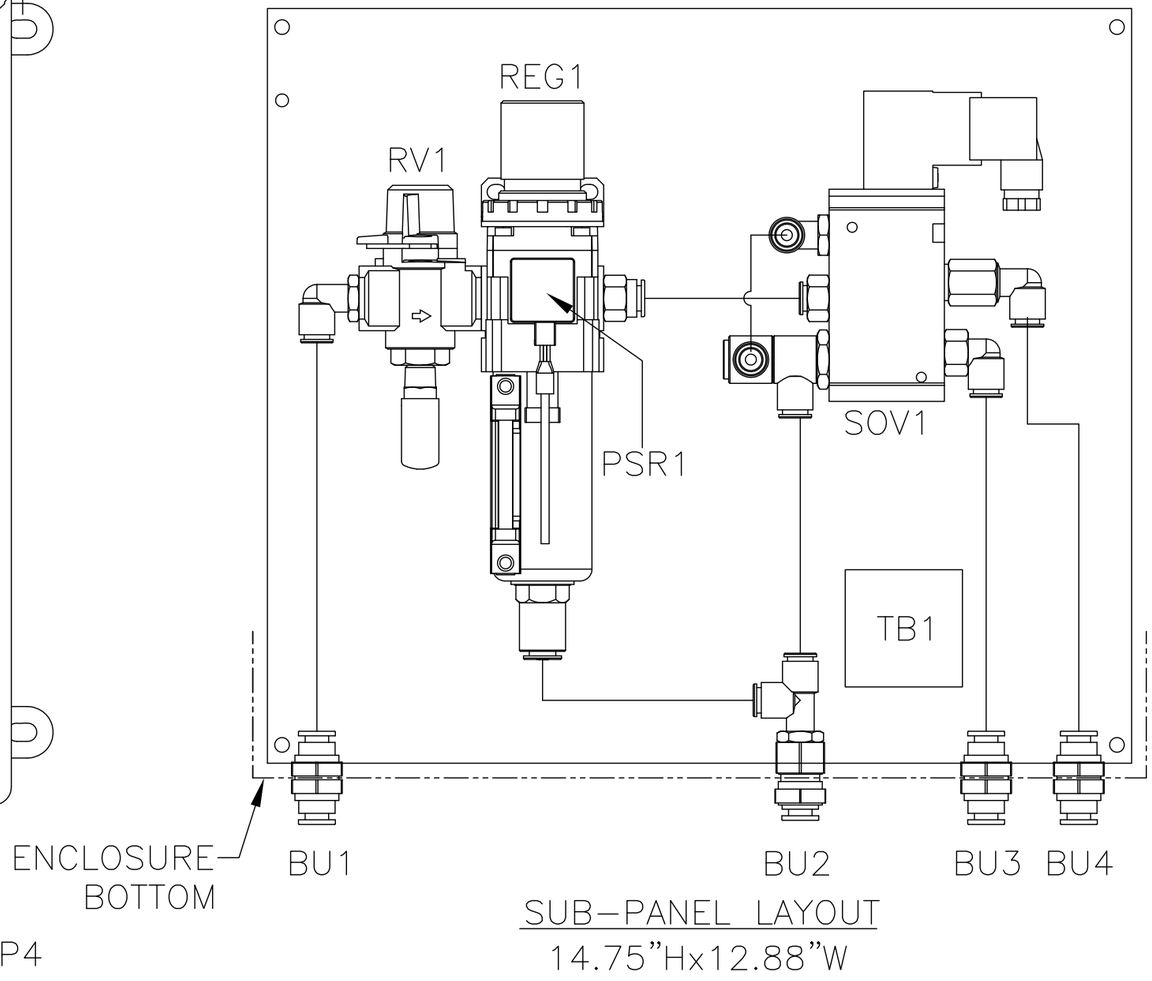
PROJECT NUMBER: 73013257

DRAWING NO: HBR10366B02

2 OF 3



ENCLOSURE LAYOUT
16"Hx14"Wx8"D
NEMA 4X FIBERGLASS W/WINDOW



SUB-PANEL LAYOUT
14.75"Hx12.88"W

LEGEND:
NP1 – AIR SUPPLY CONNECTION
NP2 – DRAIN CONNECTION
NP3 – CONTROL CONNECTION
NP4 – CONTROL CONNECTION

LBL1 – WARNING DAMAGE RESULTING FROM INSTALLATION OF TOP ENTRY CONDUIT WILL VOID WARRANTY
– USE PROPER FITTINGS, MEYERS TYPE 4 OR EQUAL
– PROTECT INTERIOR DEVICES FROM INSTALLATION DEBRIS
– CONDUIT MUST BE SEALED WATERTIGHT TO PREVENT WATER ENTRY

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Q-PRESS PNEUMATIC CONTROL PANEL

SANDPOINT, ID

SCALE: NONE

PROJECT NUMBER: 73013257

DRAWING NO: HBR10366B03

3 OF 3

Bill of Materials

D

ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Section: D	
Section Name: Bill of Materials	Date: 02-16-2026	Job Number: HBR10366	Page # 1/1
	By: AJ		

Item	Component	Description	Manufacturer Part Number	QTY	Device
Q-Press - Main Control Panel (Quantity: 2)					
1	00-000-000	Wire, Hardware, Wire labels, etc.	EleMech: Miscellaneous	2	
2	10-069-000	Wireway Duct Cover, 1.5"W, 6 Ft. Section, w/Panduit F Series	Panduit: C1.5WH6	6	
3	10-069-001	Wireway Duct Cover, 1"W, 6 Ft. Section, w/Panduit F Series	Panduit: C1WH6	6	
4	10-069-002	Wireway Duct Cover, 2"W, 6 Ft. Section, w/Panduit F Series	Panduit: C2WH6	9	
5	10-069-005	Wireway Duct, 1.5"Wx3"H, 6 Foot Section	Panduit: F1.5X3WH6	6	
6	10-069-007	Wireway Duct, 1"Wx3"H, 6 Foot Section	Panduit: F1X3WH6	6	
7	10-069-008	Wireway Duct, 2"Wx3"H, 6 Foot Section	Panduit: F2X3WH6	9	
8	25-000-A001	Legendplate Assembly, Yellow E-Stop, Standard Encl.	EleMech: 25-000-A001 Assembly	1	
9	25-000-A002	Legendplate Assembly, White, Black Text, Standard Encl.	EleMech: 25-000-A002 Assembly	8	
10	25-000-A019	Nameplate Assembly, White: Power Supply - 3/60/480VAC	EleMech: 25-000-A019 Assembly	1	
11	42-063-007	Terminal Block, Din Rail, 35MM Wide, 15 High, 2 Meters Long	Iboco: Omega 3 AF	2	
12	51-000-062	Wire, MTW Type, 600V, 105°C, CSA/UL1015, Tinned Copper	EleMech: 51-000-062	1	
13	52-000-003	Label, Underwriters Laboratories 698A, w/Decal Set	EleMech: 698A	1	
14	68-035-023	Air Cond, NEMA 4X, 800 BTU,115VAC,3.8 Amps,150WHTR,L2 Coated	Hoffman: T150116G173	1	AC1
15	56-097-005	Beacon, Steady/Stobe, LED, NEMA 4X, 24VDC, Red, 1/2"Male -NS	Federal: LP22LED-012-024R	1	AL1
16	18-000-002	Steel Barrier, 14Ga., 0.5"Wx10.0"x6.0"D, Standard	EleMech: 18-000-002	1	BAR1
17	23-005-058	Motor Starter Protector, 3PH, 600V, 19-25 Amp Range	Allen-Bradley: 140MT-F9E-C25	1	CB1
18	23-005-059	Motor Starter Protector, Line Terminal Adapter, w/140MT-F	Allen-Bradley: 140MT-F-TE	1	CB1
19	03-058-155	Circuit Breaker, 3 Pole, 480VAC, 15A, 10kA, UL489, Type D	Square D: M9F43315	1	CB2
20	03-058-126	Circuit Breaker, 1 Pole, 240VAC, 15A, 14kA, UL489, Type C	Square D: M9F42115	1	CB3
21	03-058-125	Circuit Breaker, 1 Pole, 240VAC, 10A, 14kA, UL489, Type C	Square D: M9F42110	2	CB4,5
22	03-058-123	Circuit Breaker, 1 Pole, 240VAC, 6A, 14kA, UL489, Type C	Square D: M9F42106	8	CB6-13
23	57-000-064	Cable, Ethernet, Cat. 6, RJ45M-RJ45M, 24AWG, Black	Cable Matters: 160001-BLK	2	CBL1,2
24	57-009-026	Cable, Comm., Ethernet, Cat. 6, 600V, Patch Cord, Black	Belden: E60500	1	CBL3
25	04-094-000	Current Monitor, Selectable, SPDT, 120/24V ,2-100A, w/Delay	Gavazzi: DIB01CM24100A	1	CM1
26	06-058-012	Control Relay, Bus Jumper, 2-Pole, w/Telemec. RXM Relay	Square D: RXZ S2	2	CR1-3
27	06-058-015	Control Relay, 3PDT,24VDC, 11Pin Spade, Indicator, Operator	Square D: RXM3AB2BD	3	CR1-3
28	38-058-003	Socket, 11 Pin Spade, Din, Screw Term., 3Tier, 250V w/3-Pole	Square D: RXZE2S111M	3	CR1-3
29	07-063-000	Distribution Block, End Cover, 4 Pole, 300V,10A, w/WK4E\U\VB	Wieland: 07.311.4053.1	2	DB

Item	Component	Description	Manufacturer Part Number	QTY	Device
30	07-063-001	Distribution Block, Jumper, 4 Pole, 300V,10A, w/WK4E\U\VB	Wieland: Z7.210.3427	6	DB
31	07-063-002	Distribution Block, Single Pole, 10A, 300V, WK4E\U\VB	Wieland: 57.404.6955.1	20	DB
32	09-001-A030	Disconnect Assembly, Non-Fused, 60 Amp, NEMA 4X, 12" Depth	ABB: OT60F3 Assembly	1	DS1
33	11-000-340	Enclosure Drip Shield, Stainless Steel, Per Inch	EleMech: 11-000-340	36	EN1
34	11-000-A042	Wind Kit, Alum/Hinge, Wing Knob w/out Frame, 12.75"H x 12"W	EleMech: 11-000-A042	1	EN1
35	11-035-143	Sub-Panel, Painted Steel, w/60"Hx36"W C. Hinge Encl	Hoffman: A-60P36	1	EN1
36	11-035-345	Corrosion Inhibitor, Emitter Type, Protects 10 Cubic Feet	Hoffman: A-HCI10E	2	EN1
37	11-035-487	Enclosure, Nema 4X, 316SS, 60"Hx36"Wx12"D, C. Hinge, 3-PT.	Hoffman: A-60H3612SS6LP3PT	1	EN1
38	15-011-000	Ground Lug, 14AWG - 4AWG	Blackburn: L70	2	GND
39	06-058-027	Control Relay Retension Clip, w/Telemec. RPM 1-Pole Relay	Square D: RPZR235	19	IR1-19
40	06-058-028	Control Relay, SPDT, 24VDC, 5Pin Spade, Operator, 15A	Square D: RPM12BD	19	IR1-19
41	06-058-040	Diode, 6-250VDC, w/ RXM Sockets, RPZF1/2 Sockets	Square D: RXM040W	19	IR1-19
42	38-058-009	Socket, 5 Pin Spade, Din Mount, Screw Term., w/ RPM 1-Pole	Square D: RPZF1	19	IR1-19
43	52-137-002	Label, Multiple Supply Sources, Warning, 2.5"Wx1.5"H, Yellow	Nameplate Tech: 52-137-002	1	LBL1
44	52-137-001	Label, High Voltage, Danger, 6.5"Wx3.5"H, White/Black/Red	Nameplate Tech: 52-137-001	1	LBL2
45	32-005-A005	Pilot light, NEMA 4X, Universal, LED, White	Allen-Bradley: 800H-QRH2W	1	LT1
46	32-005-A007	Pilot light, NEMA 4X, Universal, LED, Red	Allen-Bradley: 800H-QRH2R	1	LT2
47	32-005-A008	Pilot light, NEMA 4X, Universal, LED, Amber	Allen-Bradley: 800H-QRH2A	1	LT3
48	22-058-004	Aux. Contact, Top mounted, 2NO, w/Square D LC/T0 Series	Square D: LADN20	2	M1-F/R
49	22-058-A001	Contactor, 3PH, Reversing, NEMA 0, 1NO/1NC Aux., 120VAC Coil	Square D: T02BN13G7	1	M1-F/R
50	23-058-005	Motor Starter Protector, 3PH, 600V, 0.63-1.0 Amp Range, 508E	Square D: GV2P05	1	MSP1
51	23-058-011	Motor Starter Protector, Line Insulator, 508E	Square D: GV2GH7	1	MSP1
52	23-058-031	Motor Starter Protector, Aux., 1NO/1NC, S-Mnt, w/ GV2/3	Square D: GVAN11	1	MSP1
53	25-000-A010	Nameplate Assembly, White, Black Text, 1"Hx3"W	EleMech: 25-000-A010 Assembly	3	NP1,2,4
54	25-000-A058	Nameplate Assembly, Yellow: Intrinsically Safe Circ: PR5202	EleMech: 25-000-A058 Assembly	1	NP3
55	26-005-088	OIU, PVP 7 Standard, 7" Display, 24VDC, Touch, Ethernet	Allen Bradley: 2711P-T7C21D8S	1	OIU1
56	HBR-170-P022	Program, OIU, PVP 7 6/7", Standard w/cplgx	EleMech: HBR-170-P022	1	OIU1
57	29-005-117	Pushbutton, E-Stop, NEMA 4X, Oper+1NC, Twist Rel. Red Head	Allen-Bradley: 800H-TFRXT6D2	1	PB1
58	29-005-002	Pushbutton, NEMA 4X, Oper+1NO, Flush Head, Black	Allen-Bradley: 800H-AR2D1	1	PB3
59	30-183-001	Phase Failure, Voltage Monitoring Relay,200-240VAC, 2 SPDT	Telemecanique: RM22TR31	1	PFR1

Item	Component	Description	Manufacturer Part Number	QTY	Device
60	33-005-277	Compact 5069, Discrete Out., (16) 120AC/24DC Relay, 24VDC SA	Allen-Bradley: 5069-OW16	2	PLC1
61	33-005-278	Compact 5069, Analog Input, 4 Chnl., 24V SA Power	Allen-Bradley: 5069-IY4	1	PLC1
62	33-005-280	Compact 5069, Term Block, 18 Pin, Screw Clamp, w/ I/O	Allen-Bradley: 5069-RTB18-SCREW	6	PLC1
63	33-005-282	Compact 5069, Term. Block, 6 Pin/4 Pin, Screw Clamp, w/CPU	Allen-Bradley: 5069-RTB64-SCREW	1	PLC1
64	33-005-336	Compact 5069, CPU 0.6MB Mem, SD, 2-Ether, 8 Cards, 24VDC	Allen-Bradley: 5069-L306ER	1	PLC1
65	33-005-338	Compact 5069, Analog Output, 4 Chnl., 24V SA Power	Allen-Bradley: 5069-OF4	1	PLC1
66	33-005-347	Compact 5069, Discrete Input , (16) 24VDC Inputs, 24V SA	Allen-Bradley: 5069-IB16	2	PLC1
67	HBR-170-P008	Program, PLC, Compact Logix, Standard	EleMech: HBR-170-P008	1	PLC1
68	37-098-020	Power Supply, 120W, 85-264VAC IN, 24VDC OUT, UNO Series	Phoenix: 1110466	2	PS1,2
69	06-058-021	Control Relay, DPDT,120VAC, 8Pin Spade, Operator, 15A	Square D: RPM22F7	2	R1,2
70	38-058-008	Socket, 8 Pin Spade, Din Mount, Screw Term., w/ RPM 2-Pole	Square D: RPZF2	2	R1,2
71	14-543-001	Receptacle, Single, DIN Mount, 15A, w/Cover	Altech: DMRBU BLACKBOX	1	RECP1
72	13-000-A000	Spare Parts Box Assembly, Din Rail Mount	EleMech: 13-000-A000 Assembly	1	SP1
73	39-005-009	Selector Switch, NEMA 4X, 3 Pos. Maintained, 1NO-1NC	Allen-Bradley: 800H-JR2A	3	SS1,3,4
74	39-005-011	Selector Switch, Nema 4X, 3 Pos. Spring Fr. Right, 1NO-1NC	Allen-Bradley: 800H-JR5A	1	SS2
75	40-030-002	Surge Suppressor, 1 Pole, 120VAC, 200kA SCCR, DIN	Mersen: STP120P07	1	SUR1
76	33-098-028	Ethernet Switch, 5TX, 9-32VDC, RJ45, 5 Port, 10/100, Narrow	Phoenix: 1085039	1	SW1
77	41-018-A112	Transformer Assembly, 480/240-120VAC, 1.5KVA, 316SS	Cutler-Hammer: S20N11P16PS6 Assem	1	T1
78	42-063-001	Terminal Block, End Plate, Gray, w/WK4/U	Wieland: 07.311.0155.0	6	TB
79	42-063-003	Terminal Block, Single Pole Gray, 30A, 600V, 6MM Wide, WK4/U	Wieland: 57.504.0055.0	78	TB
80	42-063-015	Terminal Block, Jumper, w/WK4/U, 02 pole, Insulated	Wieland: Z7.281.1227	2	TB
81	42-063-000	Terminal Block, Labels, Custom Printed, w/WK4/U	Wieland: 04.242.6353-CUSTOM	184	TB,DB
82	42-063-004	Terminal Block, Ground, 30A, 600V, 6MM Wide, w/WK4/U	Wieland: 57.504.9055.0	11	TB,DB
83	42-063-009	Terminal Block, End Clamp, w/WKN10/U	Wieland: Z5.522.8553	17	TB,DB
84	42-063-008	Terminal Block, Labels, Blank, w/WK4/U-(600 tags per box)	Wieland: Z4.242.6353	30	TB1
85	13-012-034	Fuse, Glass, Fast Acting, 250VAC, 1A, 6.3mm	Bussman: AGC-1	5	TB3F
86	42-063-014	Terminal Block, End Plate for Knife Disc/Fused TB., WK	Wieland: 07.311.6155.0	5	TB3F
87	42-063-073	Terminal Block, Fuse Base, Single Pole, Gray, WK4 TKG	Wieland: 57.504.4055.0	5	TB3F
88	42-063-074	Terminal Block, Fuse Insert, 6.3mm Fuse,12-24V LED, WK4 TKG	Wieland: Z1.298.1753.0	5	TB3F
89	18-247-001	Transformer Isolated Barrier, Dual Channel, 120VAC/24VDC	PR Electronics: 5202B2	1	TIB1

Item	Component	Description	Manufacturer Part Number	QTY	Device
90	52-000-068	Label, PowerFlex 525, Video QR Code	EleMech: 52-000-068	1	VFD
91	HBR-170-P019	Program, VFD, PowerFlex 525, Standard	EleMech: HBR-170-P019	1	VFD
92	50-005-118	Variable Freq. Drive, Open, 5.0HP, 240VAC,3PH, Powerflex 525	Allen-Bradley: 25B-B017N104	1	VFD1
Q-Press Pressure Cone Pneumatic Panel (Standard) (Quantity: 2)					
93	51-000-062	Wire, MTW Type, 600V, 105°C, CSA/UL1015, Tinned Copper	EleMech: 51-000-062	1	
94	94-255-009	Tubing, 3/8"OD, Polyurethane, Blue, 100 Foot Roll	SMC USA: TIUB11BU-33	1	
95	94-255-008	Fitting, Bulkhead, Union, SS, w/ 3/8"OD Tube x 3/8"OD Tube	SMC USA: KQG2E11-00	3	BU1,3,4
96	94-255-042	Fitting, Bulkhead Union Connector 3/8"OD Tubex3/8"NPT 316SS	SMC USA: KQG2E11-N03	1	BU2
97	11-035-1077	Enclosure, Nema 4X, Fiberglass, Window, 16"Hx14"Wx8"D, Clamp	Hoffman: A-16148CHQRFGW	1	EN1
98	11-035-129	Sub-Panel, Painted Steel, w/16"Hx14"W Junction Box	Hoffman: A-16P14	1	EN1
99	94-255-005	Fitting, Male Connector, Straight, 3/8"OD Tube x 3/8"MNPT	SMC USA: KQ2H11-36AS	2	FIT
100	94-255-006	Fitting, Male Elbow, 3/8"OD Tube x 3/8"MNPT	SMC USA: KQ2L11-36AS	2	FIT
101	94-255-015	Fitting, Male Elbow, Extended, 3/8" OD Tube x 3/8" MNPT	SMC USA: KQ2W11-36AS	1	FIT
102	94-255-020	Fitting, Male Run Tee, 3/8"OD x 3/8" OD x 3/8" NPT	SMC USA: KQ2Y11-36AS	1	FIT
103	94-255-048	Fitting, Male Double Rotating Elbow, 3/8"OD Tube x 1/4"MNPT	SMC USA: KQ2VD11-35AS	1	FIT
104	94-255-049	Fitting, Male Elbow, 3/8"OD Tube x 1/4"MNPT	SMC USA: KQ2L11-35AS	1	FIT
105	94-255-004	Regulator, 0-120PSI, 3/8"NPT, w/ Filter and pressure switch	SMC USA: AW30-NO3BDE3-8Z	1	REG1
106	74-255-004	Solenoid Valve, Muffler, 1/4" NPT Port, 30 dB Reduction	SMC USA: AN20-NO2	1	RV1
107	94-255-016	Relief Valve, 3-Port, Locking Holes, 3/8"NPT	SMC USA: VHS30-N03-Z	1	RV1
108	94-255-017	Relief Valve, Spacer, w/ Bracket	SMC USA: Y300T	1	RV1
109	74-255-006	Solenoid Valve, 2 Pos, Single, (3) 3/8"/(2) 1/4" NPT, 120VAC	SMC USA: VFS3120-3DZ-03T	1	SOV1
110	94-215-004	Fitting, Tube Connector, Straight, 3/8" OD x 10mm OD	McMaster-Carr: 5779K259	2	SPARE
111	42-063-000	Terminal Block, Labels, Custom Printed, w/WK4/U	Wieland: 04.242.6353-CUSTOM	12	TB1
112	42-063-001	Terminal Block, End Plate, Gray, w/WK4/U	Wieland: 07.311.0155.0	1	TB1
113	42-063-003	Terminal Block, Single Pole Gray, 30A, 600V, 6MM Wide, WK4/U	Wieland: 57.504.0055.0	5	TB1
114	42-063-004	Terminal Block, Ground, 30A, 600V, 6MM Wide, w/WK4/U	Wieland: 57.504.9055.0	1	TB1
115	42-063-007	Terminal Block, Din Rail, 35MM Wide, 15 High, 2 Meters Long	Iboco: Omega 3 AF	1	TB1
116	42-063-009	Terminal Block, End Clamp, w/WKN10/U	Wieland: Z5.522.8553	2	TB1
Spare Parts / Ship Loose (Total Quantity Provided)					
117	61-000-012	Labor, Engineering, Submittal, Schematics, BOM	EleMech: 61-000-012	1	

Item	Component	Description	Manufacturer Part Number	QTY	Device
118	13-012-034	Fuse, Glass, Fast Acting, 250VAC, 1A, 6.3mm	Bussman: AGC-1	10	SPARE

SECTION 8
TECHNICAL SPECIFICATIONS

HUBER TECHNOLOGY INC.
1009 Airlie Parkway, Denver, NC 28037
Phone: 704.949.1010 – Fax: 704.949.1020
huber@hhusa.net – www.hubertechnology.com

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Datenblatt / datasheet **Main Motor**

Getriebebau NORD GmbH & Co.KG
Getriebebau-Nord-Str. 1
D - 22941 Bargteheide
www.nord.com

3 Phasen-Motor / 3 phase-motor

Motortyp : **100T2/4**
Motor type:

Elektrische Daten: / Electrical data:

Spannungsversorgung Voltage supply:	V	230	400	400
Ständerschaltung: Connection of stator :		Δ	Y	Δ
Frequenz (f): Frequency :	Hz	70		100
Drehzahl (n): Speed :	1/min	2100		3000
Nenndrehmoment (M_N): rated motor torque:	Nm	13,6		12,7
Nennleistung (P): Output :	kW	3,0		4,0
Induzierte Spannung (Ui): Inducted Voltage :	V	195	338	279
Nennstrom (I): Current :	A	9,39	5,40	8,90
Maximal Strom (I_{max}): Maximum current :	A	28,7	16,5	28,7
Maximales Drehmoment (M_{peak}): Peak torque:	Nm	42		42
Wirkungsgrad Efficiency	η (%)	91,4		92,1

Prüfdaten: / Tested data:

Schalldruckpegel (L_{PA}): Noise level:	dB(A)	51	(1500rpm)
Induktivität D-Achse (L_D): Inductance		22,6 U1-U2	mH
Induktivität Q-Achse (L_Q): Inductance		45,9 U1-U2	mH
Wicklungwiderstand bei 20°C (R): Resistance stator winding at 20°C:		1,33 U1-U2	Ω
Übertemperatur (T): (gemessen nach der Widerstandsmethode) Temperature rise: (at the stator winding resistance method)			K
Isolationswiderstand ($R_{Isol.}$): Insulation resistace :		> 100	Mega Ω
Stehspannungsprüfung: Winding test :		2352	V / 5 sek.
Schwingstärke: Class of vibration:		A	

Auftragsdaten: / Order data:

Auftrag Nr. : Order No.:	
Serial Nr. : Serial Nr. :	
Motor Nr. : Motor. No. :	
Kennlinien Nr: Diagram No:	

Allgemeindaten: / General data:

Drehrichtung: Direction of rotation :	beide cw, ccw			
Bauform : Design :				
Betriebsart: Duty:	S1			
Lagertyp: Type bearing:	IC 5			
Gehäusewerkstoff: Housing material:	Aluminium			
Wärmeklasse: Insulation class:	F			
Schutzart / IC Klasse: Type of protection / IC class:	IP 55	/	IC 4A1	
Service Faktor / Code letter: Service factor / Code letter:		/		
Kabeleinführung: Cable entry:	2xM25x1,5			
Gewicht: Weight:	18,0	kg		
Massenträgheitsmoment (J): (Motor incl. Optionen) Moment of inertia: (Motor with options)	0,00458		kgm²	
Maximale Aufstellungshöhe: Maximum altitude of site:	1000	m		
Zulässige Umgebungstemperatur: Maximum ambient temperature:	-15	bis to	40	°C

Vorschriften: / Classification authorities:

DIN EN 60034 Teil: 1,3,7

IE4

Motoroptionen: / Motor options:

* Auf Nennwert bezogene Größe (Einheitenlos)

Technische Änderungen Vorbehalten.
Technical data are subject to change.

Spraywash Gearmotor

SK01F-63S/6 CUS



Gearmotors

Description	Material
Product name	Helical geared motor
Motor Type	CUS
Motor speed	1.050 1/min
Ratio	111,60
Output speed	9,400 1/min
Service factor	1,00
Output Torque M2 (Nm)	91,30
Power (kW)	0,090
Voltage (V)	265/460
Frequency (Hz)	60
Mode of operation	S1
Type of enclosure	IP66
Insulation Class	F
Nominal current 1 (AMP)	0,80
Nominal current 2 (AMP)	0,46
Cosinus 1	0,62
Environmental temp. motor	40°C
Mounting pos. of the gearbox	M4
Tilted mounting position	M6-45-M1
second tilted mounting pos.	M4-60-M1
Type of housing	Flange B5
Shaft dimension	17X30
Part no. special output shaft	000000000050134940
Flange diameter (mm)	120
Breather	Spring-loaded breather
Type of motor connection	Star; High Voltage
Position of terminal box	2/I
Lubricant type	ISO VG 220 mineral oil
class oil	CLP 220
Colour	RAL 5015 Sky blue
Paint type	Standard paint
Painting instruction Old	Paint coat 3.2 standard
Extra work Old	Sealing
Nameplate/Terminalbox	GNP+MNP+TB Std (VA)
CE Logo	Yes
CCC Logo	No
Weight	approx. 13 KG /PC

Motor Data Sheet

3 phase motor	Motor type: **63S/6 CUS**

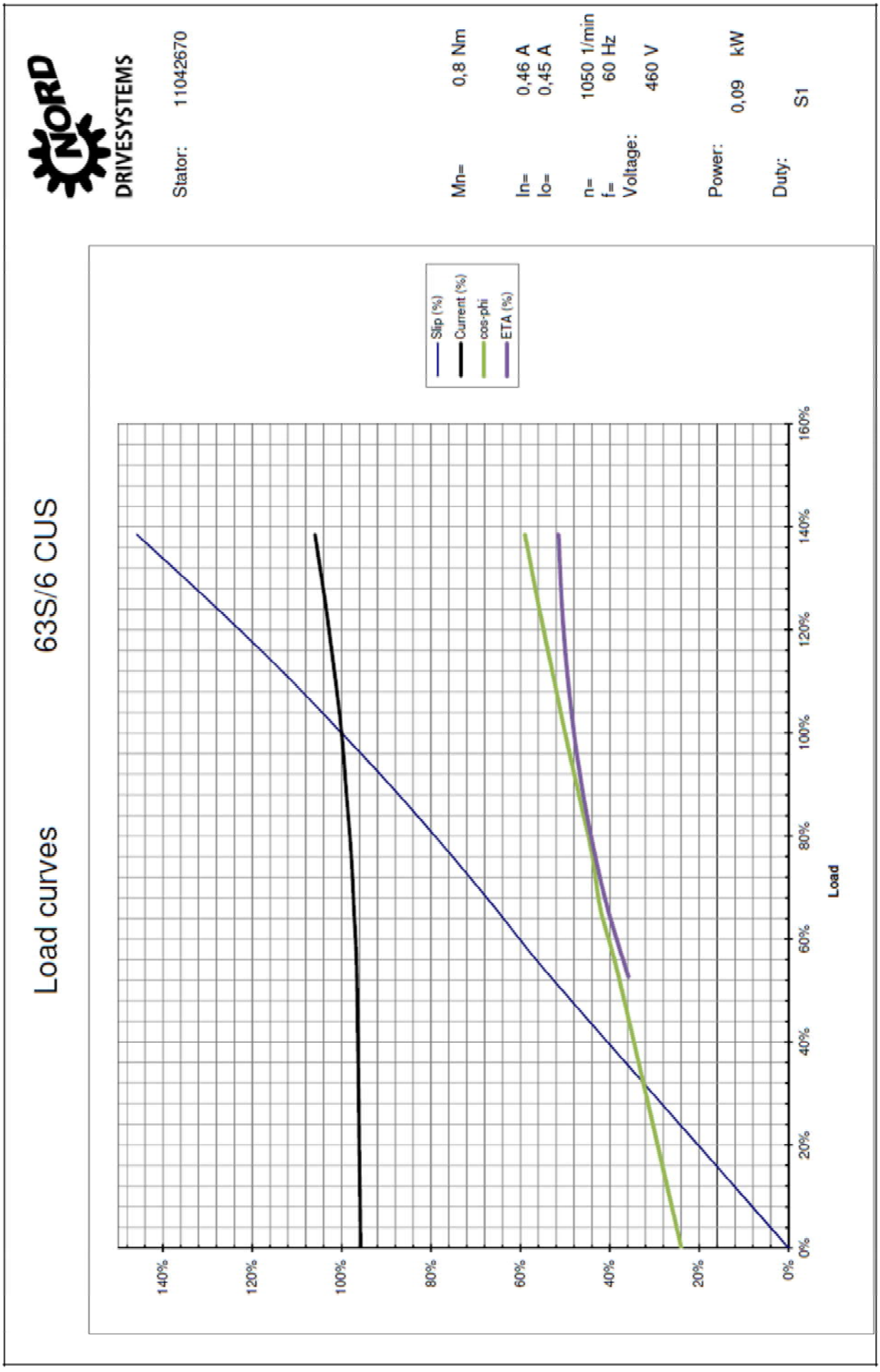
Electrical data:		
Frequency (f):	60	Hz
Output (P):	0,09	kW
Speed (n):	1050	1/min
Connection of stator:	D/Y	
Voltage (V):	265/460	V
Current (I):	0,80/0,46	A
Voltage range (U_{WB}):		V
Wide range current (I_{WB}):		A
Starting current/Current (I_A/I):	1,80	
Rated motor torque (M_N):	0,82	Nm
Starting motor torque (M_A):	2 (2,44)*	Nm
Minimum motor torque (Ms):	1,90 (2,32)*	Nm
Breakdown motor torque (M_K):	2 (2,44)*	Nm
cos phi:	0,62	Last
Eta(%):	39,90	100%
Eta(%):		75%
Eta(%):		50%
Service Faktor:	1,15	
Code letter:	F	

Tested data:		
Connection of stator:	D/Y	
Voltage (V):	265/460	V
No load current (I_0):	0,64/0,37	A
No load output (P_0):	0,094	kW
Noise level (L_{PA}):		dB(A)
Resistance stator winding at 20°C (R):	89 U1-U2	Ohm
Temperature rise (T):		K
(at the stator resistance method)		
Insulation resistance (R_{isol}):	100	Mega Ohm
Winding test:	2352	V/4 sek.
Class of vibration:		A

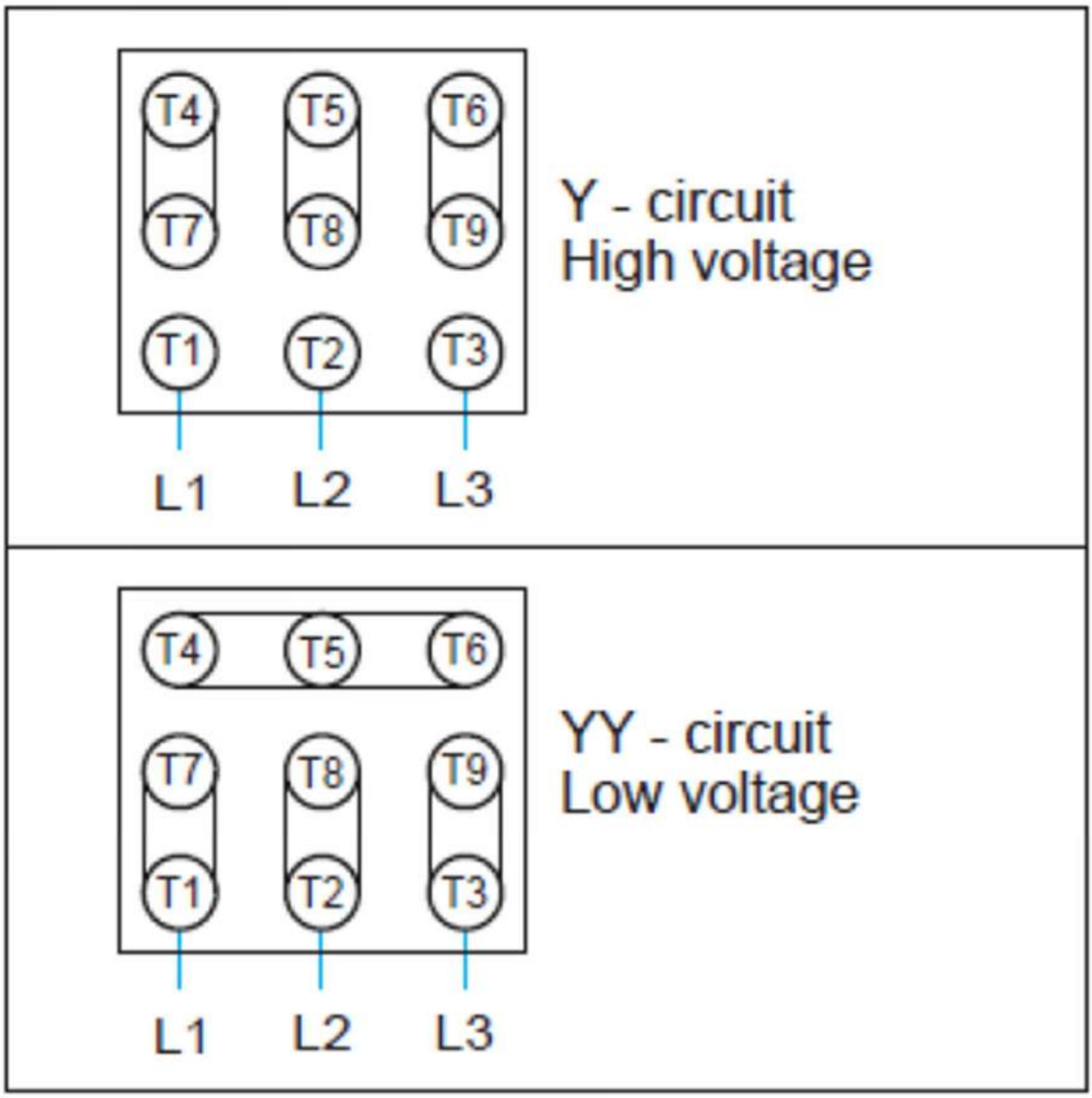
Order data:			
Order No.:	101588725-100		
Customer reference No.:			
Serial No.:			
Motor No.:			
Stator No.:	11042670		
General data:			
Direction of rotation:	CW/CCW		
Design:	Motoranb. WN Pos 958		
Duty:	S1		
Type bearing:			
Housing material:	Aluminium		
Insulation class:	F		
Type of protection:	IP 66		
Cable entry:	2 I		
Moment of inertia:	0,00028	kgm^2	
Maximum altitude of site:	1.000	m	
Ambient temperature:	-20°C	to	+40°C
Fan Type:	Standard IC 411		

Classification authorities:
NEMA (ELECTRICAL)

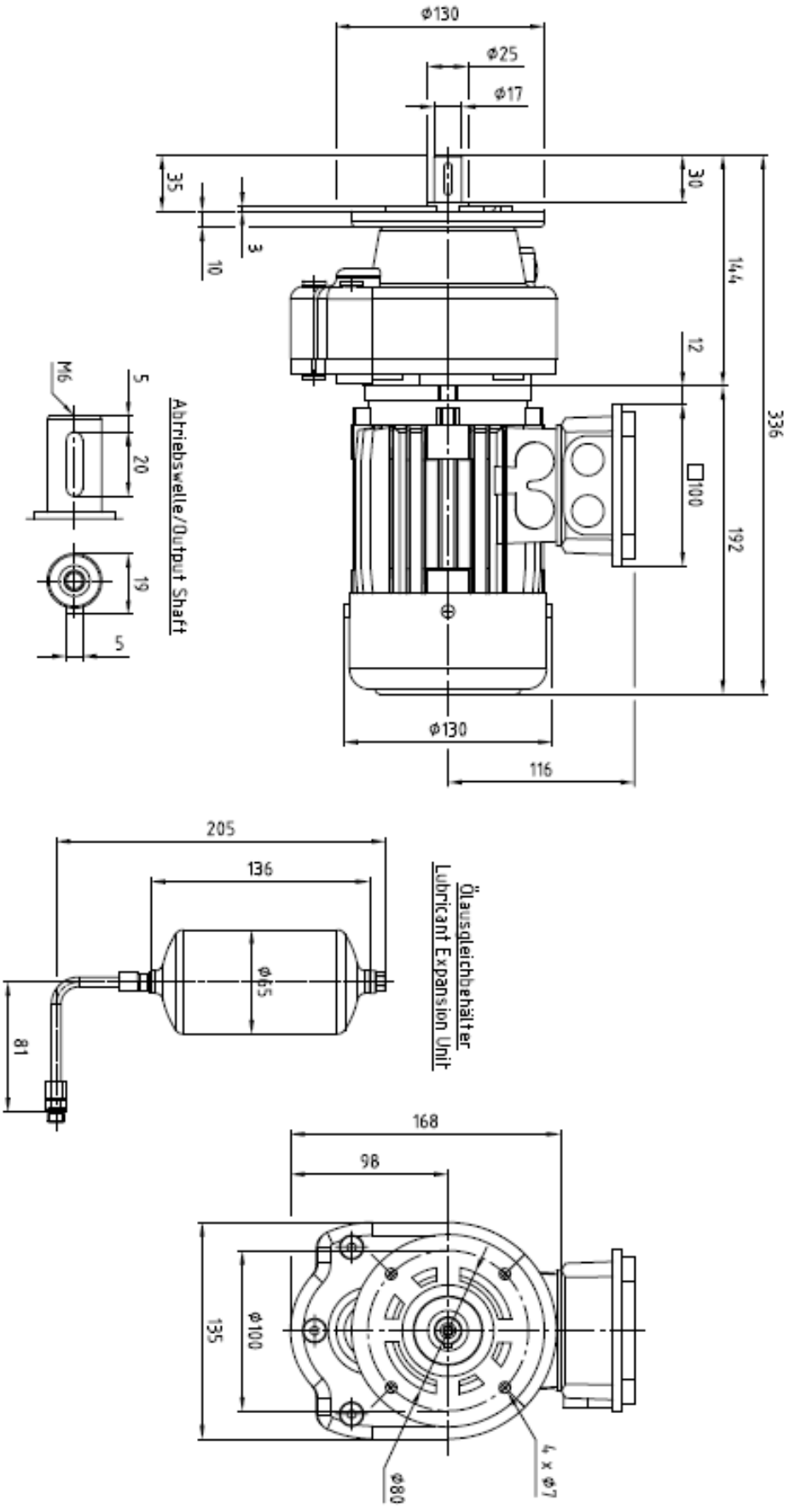
Motor Performance curve



Motor Connection Diagrams



Drawing


ø130
ø25
ø17
35
30
3
10
144
12
336
M6
5
20
Abtriebswelle/Output Shaft
19
5
□100
192
ø130
116
205
136
ø65
81
Ölausgleichbehälter
Lubricant Expansion Unit
168
98
135
ø100
ø80
4 x ø7

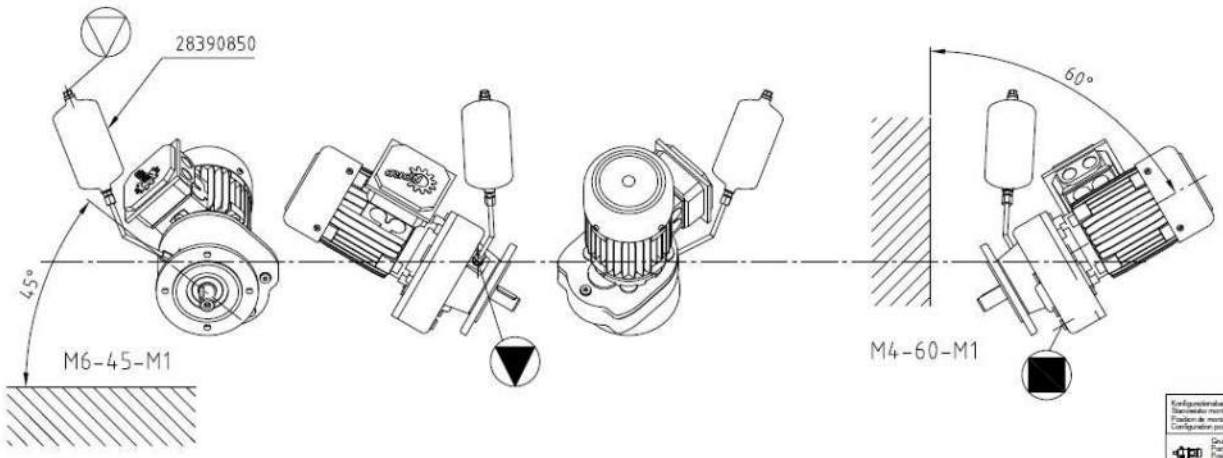
Lubricant table

This table shows comparable lubricants from various manufacturers. The manufacturer can be changed within a particular viscosity or lubricant type. Getriebebau NORD must be contacted in case of change of viscosity or lubricant type, as otherwise no warranty for the functionality of our gearboxes can be accepted.

Lubricant type	Details on type plate	DIN (ISO) / Ambient temperature	Castrol	FUCHS	KLÜBER LUBRICATION	Mobil	Shell
Mineral oil	CLP 680	ISO VG 680 0...40 °C	Alpha EP 680 Alpha SP 680 Optigear BM 680 Tribol 1100 / 680	Renolin CLP 680 Renolin CLP 680 Plus	Klüberoil GEM 1-680 N	Mobilgear 600 XP 680	Omala S2 G 680
	CLP 220	ISO VG 220 -10...40 °C	Alpha EP 220 Alpha SP 220 Optigear BM 220 Tribol 1100 / 220	Renolin CLP 220 Renolin CLP 220 Plus Renolin Gear 220 VCI	Klüberoil GEM 1-220 N	Mobilgear 600 XP 220	Omala S2 G 220

Lubrication quantity in L: tbd

Symbols for oil screw plugs in the mounting positions



Attention: The 0A has a 45 ° bend, insert as manufacturing note

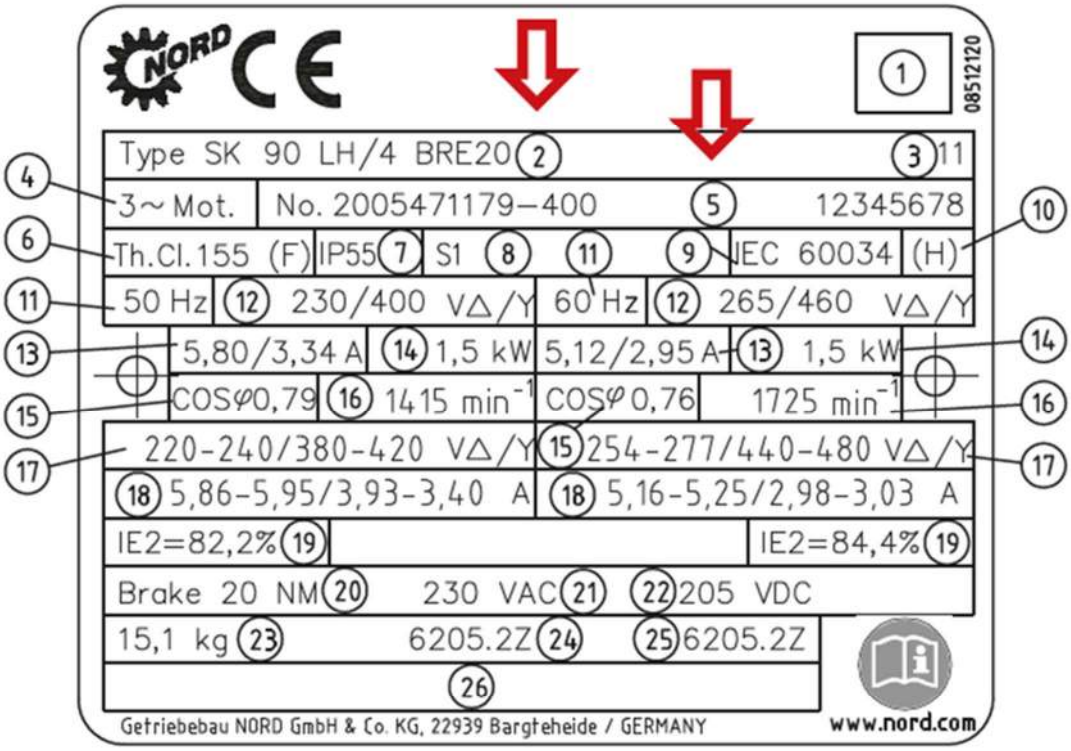
Entlüftung / Vent

Ölstand / Oil Level

Ölablass / Oil Drain

Explanation of the rating plate

Erläuterung des Typenschildes
Explanation of the rating plate
Explication de la plaque signalétique



DE

1 Matrix – Barcode
2 NORD - Motortyp
3 Herstellungsjahr
4 Phasenzahl
5 Fabrikationsnummer
6 Wärmeklasse
7 Schutzart
8 Betriebsart
9 Norm
10 Halbkeilwuchtung

11 Frequenz
12 Motorspannung
13 Nennstrom
14 Nennleistung
15 Leistungfaktor
16 Nenndrehzahl
17 Motorspannung - Weitbereich
18 Nennstrom - Weitbereich
19 Wirkungsgrad
20 Bremsmoment
21 Anschlußspannung Bremse
22 Bremsenspannung
23 Gewicht
24 Lagerung A-Seite
25 Lagerung B-Seite
26 Kundenzeile

EN

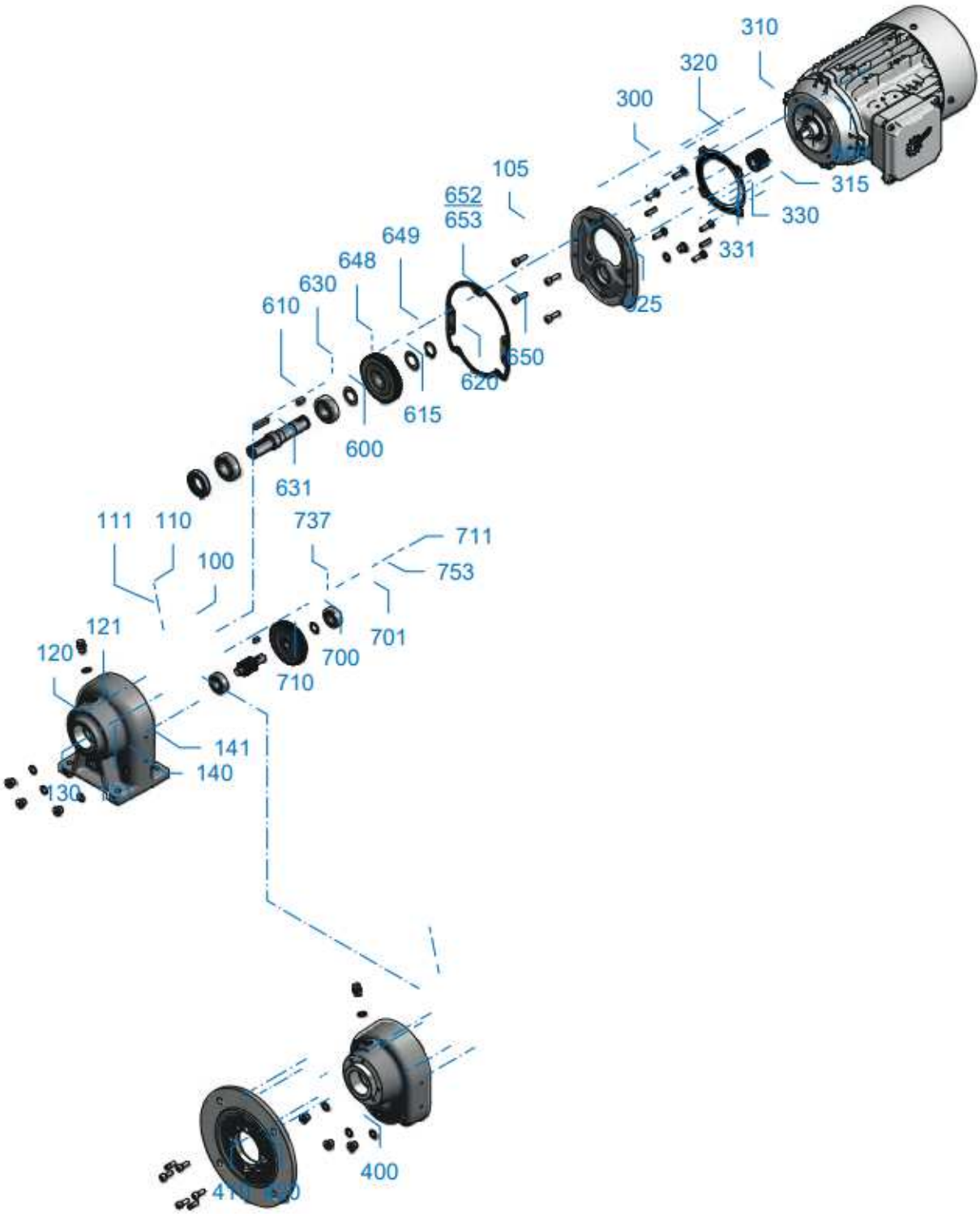
1 Matrix – Barcode
2 NORD - Motor type
3 Year of manufacture
4 Number of phases
5 Serial number
6 Heat class
7 Protection class
8 Operating mode
9 Standard
10 Half key balancing

11 Frequency
12 Motor voltage
13 Nominal current
14 Nominal power
15 Power factor
16 Nominal speed
17 Motor voltage - wide range
18 Nominal current - wide range
19 Efficiency
20 Braking torque
21 Brake connection voltage
22 Braking voltage
23 Weight
24 A side bearing
25 B side bearing
26 Customer line

FR

1 Code matriciel, à barres
2 Type de moteur NORD
3 Année de fabrication
4 Nombre de phases
5 Numéro de série
6 Classe thermique
7 Type de protection
8 Type de fonctionnement
9 Norme
10 Équilibrage dynamique avec une demi-clavette
11 Fréquence
12 Tension du moteur
13 Intensité nominale
14 Puissance nominale
15 Facteur de puissance
16 Vitesse nominale
17 Tension du moteur – plage étendue
18 Intensité nominale - plage étendue
19 Rendement
20 Couple de freinage
21 Tension de raccordement du frein
22 Tension de freinage
23 Poids
24 Palier côté A
25 Palier côté B
26 Ligne réservée au client

Part list


310
320
300
105
652
653
649
648
630
610
315
330
331
625
650
620
615
600
631
111
110
737
711
753
100
701
121
120
700
710
141
140
130
400

Part list

DE		EN		FR	
100	Gehäuse	100	Housing	100	Carter
105	Dichtung	105	Seal	105	Joints d'étanchéité
110	Schraube	110	Screw	110	Vis
111	Dichtung	111	Seal	111	Joints d'étanchéité
120	Schraube	120	Screw	120	Vis
121	Dichtung	121	Seal	121	Joints d'étanchéité
130	Schraube	130	Screw	130	Vis
131	Dichtung	131	Seal	131	Joints d'étanchéité
140	Schraube	140	Screw	140	Vis
141	Dichtung	141	Seal	141	Joints d'étanchéité
300	Getriebedeckel	300	Gear unit cover	300	Couvercle du réducteur
310	Dichtung	310	Seal	310	Joints d'étanchéité
315	Stift	315	Pin	315	Goupille
320	Schraube	320	Screw	320	Vis
325	Schraube	325	Screw	325	Vis
330	Schraube	330	Screw	330	Vis
331	Dichtung	331	Seal	331	Joints d'étanchéité
400	Flansch	400	Flange	400	Bride
410	Schraube	410	Screw	410	Vis
420	Stift	420	Pin	420	Goupille
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
610	Wälzlager	610	Roller bearing	610	Palier à roulement
615	Wälzlager	615	Roller bearing	615	Palier à roulement
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Parallel key	630	Clavette
631	Wellendiichtring	631	Shaft sealing ring	631	Bague d'étanchéité de l'arbre
648	Passfeder	648	Parallel key	648	Clavette
649	Passscheibe	649	Shim	649	Rondelle d'ajustage
650	Sicherungsring	650	Circlip	650	Circlip
652	Passscheibe	652	Shim	652	Rondelle d'ajustage
653	Passscheibe	653	Shim	653	Rondelle d'ajustage
700	Ritzelwelle	700	Pinion shaft	700	Arbre de pignon
701	Antriebsrad	701	Drive gear	701	Roue d'entrée
710	Wälzlager	710	Roller bearing	710	Palier à roulement
711	Wälzlager	711	Roller bearing	711	Palier à roulement
737	Passfeder	737	Parallel key	737	Clavette
753	Passscheibe	753	Shim	753	Rondelle d'ajustage
900	Antriebsritzel	900	Drive pinion	900	Pignon d'entrée

Certificate

CERTIFICATE OF COMPLIANCE

Certificate Number	20170217-E191510
Report Reference	E191510-19981208
Issue Date	2017-FEBRUARY-16
Issued to:	NORD MOTORIDUTTORI SRL VIA NEWTON 22 40017 S GIOVANNI PERSICETO BO ITALY
This is to certify that representative samples of	MOTORS SEE ADDENDUM PAGE.
	Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL 1004-1, CSA C22.2 No. 100-14 - Rotating Electrical Machines – General Requirements
Additional Information:	See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.

Bruce Mahrenholz, Director North American Certification Program

UL LLC

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Certificate

CERTIFICATE OF COMPLIANCE

Certificate Number	20170217-E191510
Report Reference	E191510-19981208
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This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Model CUS series three phase motors. 2 or 3 digit prefix numbers indicating frame size followed by 1 or 2 letter indicating stator size followed by "/" plus numbers indicating speed(s). Letters and numbers follow model designation to indicate options and nominal power. Frames 63 to 250.

Model HM & HMT series three phase motors. 2 or 3 digit prefix numbers indicating frame size followed by 1 or 2 letter indicating stator size followed by "/" plus numbers indicating speed(s). Letters and numbers follow model designation to indicate options and nominal power. Frames 80 to 100.

Bruce Mahrenholz, Director North American Certification Program

UL LLC

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APPENDIX A-J

See submittal package for Appendix A through Appendix J folders.

HUBER TECHNOLOGY INC.
1009 Airlie Parkway, Denver, NC 28037
Phone: 704.949.1010 – Fax: 704.949.1020
huber@hhusa.net – www.hubertechnology.com

HUBER TECHNOLOGY
WASTE WATER Solutions



HUBER
Screw Press Q-PRESS®

- Sludge dewatering with exceptional performance data
- Maximum operational reliability thanks to innovative control
- Optimized operating and disposal costs
- Robust, low-wear construction

More information, downloads and current news

www.huber-technology.com

Sludge dewatering

Sludge conditioned with flocculant is pumped via a flocculation section directly into the cylindrical filter basket of the HUBER Screw Press Q-PRESS®. A screw conveyor in the filter basket rotates at a very slow speed. The geometry of the auger continuously reduces the volume in the filter basket so that free water is pressed out of the sludge.

The auger pushes the increasingly thicker sludge towards an annular clearance past a pneumatically adjustable pressure cone at the discharge end.

A scraper on the screw shaft permanently cleans the filter basket from inside due to the rotation of the shaft. A stationary spray bar backwashes the filter basket of the HUBER Screw Press Q-PRESS® periodically and segment by segment from the outside. The dewatering process is not interrupted from size 620.2.

Parameters used for adjustment or control include not only the sludge feed and flocculant dosing and admixing, but also the screw shaft speed, the sludge feeding pressure, utilisation of the shaft drive and the pneumatic counterpressure of the discharge cone.

Innovation

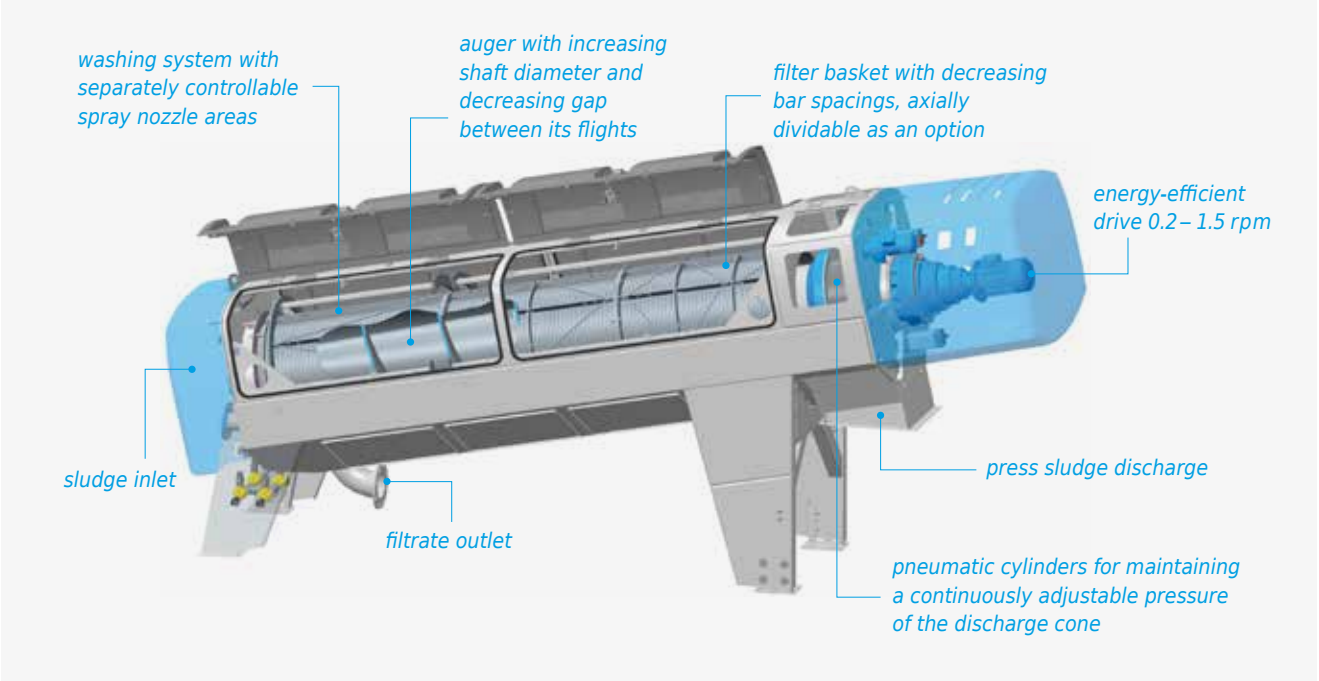
Energy efficiency:
The screw drives exceed the current energy efficiency standards of electric motors. Due to maximised electrical efficiency the HUBER Screw Press Q-PRESS® can therefore be operated with higher solids throughputs.

Dewatering results:
Specially developed scrapers on the screw shaft permanently and reliably clean the inner filter surface with every rotation of the screw. Free water can thus very easily run off. As a result, dewatering efficiency increases and flocculant consumption is reduced.

Due to the significantly enlarged open filter surface filter baskets with the same bar spacings are able to handle higher hydraulic loads without impairment of filtrate quality.

The outside of the filter is cleaned without interrupting the dewatering process. The predewatering and press zone can be washed independently of each other. Rewetting of press sludge through washing is reduced to a minimum especially in the press zone without neglecting the important washing in the predewatering zone.

Maintenance:
As an option, the three segments of the filter baskets are available as axially divided segments. Only the upper half of the basket needs to be removed for maintenance. The lower half of the filter basket can be removed from the screw shaft by means of a special mechanism but remains inside the filtrate chamber of the Q-PRESS® during maintenance. This saves a lot of time, reduces space requirements and the need for using lifting devices for maintenance.



Partial section of a HUBER Screw Press Q-PRESS®.

Advantages

High dewatering

- defined sludge volume reduction in the screw press
- continuously adjustable counterpressure at the discharge end
- filtrate discharge enhanced by gravity due to inclined installation
- unique scraper system for permanent cleaning of the inner filter surface
- significantly increased free filter surface
- continuous dewatering

Reliable operation with little downtime

- virtually no wear because of < 1 rpm screw rotation speed
- sturdy stainless steel design
- dividable filter baskets available as an option
- simplified filter dividing mechanism
- easy access through large inspection openings
- minimal space requirements for maintenance
- innovative self-monitoring control strategy
- proven in thousands of installations

Minimum operating costs

- outstanding energy efficiency
- specific power consumption < 6 kWh/t_{DR}
- little operator attention (< 20 min/day)
- high solids capture rate > 97 %

Low total investment costs

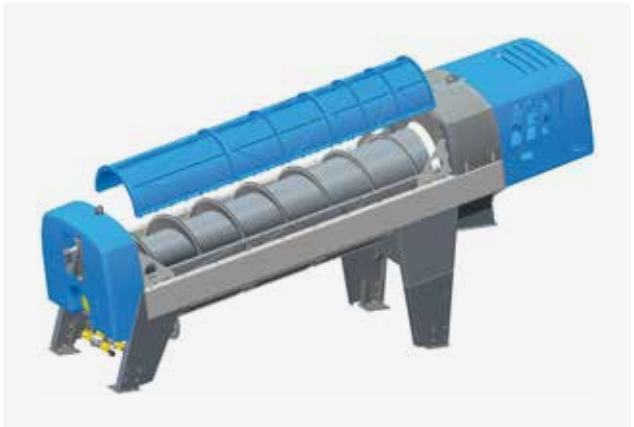
- compact design and small footprint
- easy connection of the screw conveyor
- optional tube flocculator
- integrated support legs
- vibration-free, virtually noiseless operation
- fully enclosed design
- optional process air extraction



Stationary mounted Q-PRESS® 440.2 for 3 m³/h.



Sturdy wedge wire basket made of stainless steel.



HUBER Screw Press Q-PRESS® inclined installation with optionally dividable screen baskets.



Digested sludge dewatering up to 30% DR.

Special applications of the Q-PRESS®

Dewatering of thin sludges

Due to pump feeding, large volumes of sludge water are removed already in the pre-dewatering zone. This permits cost-efficient dewatering of thin sludges with a solids concentration < 1%.

Advantages

- sludge dewatering without the need for prior thickening
- typical dewatering results of 18 – 25% DS
- sludge volume reduction up to > 97% in a single step
- saves investment and operation costs for preceding sludge thickening

Variable sludge characteristics

Dewatering performance is usually impaired and operator attention increased by frequently varying sludge quality.

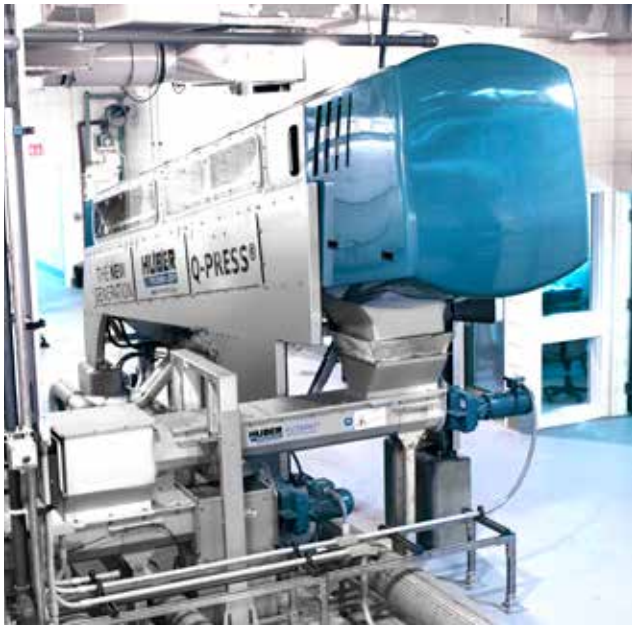
Our HUBER Screw Press Q-PRESS® automatically detects a change in sludge quality based on the filtration pressure and the drive load. An innovative control circuit adjusts the shaft speed accordingly, automatically ensuring maximum filtrate quality and dewatering results.

Advantages

- always optimum performance
- flexible with varying sludge qualities
- minimised operator attention
- reliable operation



Q-PRESS® 620.2 for surplus sludge dewatering.



HUBER Screw Press Q-PRESS® 800.2 for 20 m^3/h.

Unit sizes / performance

Size	Throughput* [kg_{DR}/h]	Drive [kW]	Weight [t]
280	15 – 90	0.55	0.7
440.2	30 – 180	1.5	1.5
620.2	60 – 350	2.3	2.7
800.2	90 – 540	3.1	3.5

** For optimal design and consideration of application-specific sludge properties, we offer laboratory and on-site tests with our mobile screw presses.*



The sizes of the HUBER Screw Press Q-PRESS®.

Huber Technology Inc.
1009 Airlie Parkway. Denver, NC 28037 USA
Phone: 704-949-1010 | info@hhusa.net
www.huber-technology.com

HST stud anchor

Features:	
	- high loading capacity
	- force- controlled expansion
	- suitable for tension zone
	- suitable for shock loading
	- fire prevention assessment
	- pre-assembled with nut and washer → time saving
	- cold formed
Material:	
~~**HST:**~~	~~- carbon steel, zinc plated to min. 5 µm~~
HST-R:	- stainless steel; A4; 1.4401; EN 10088
HST-HCR:	- stainless steel; 1.4529



~~HST~~ / HST-R / HST-HCR

CONC Concrete

Tension zone

Shock

Close edge distance/ spacing

A4 316 Corrosion resistance

HCR highMo High corrosion resistance

Fire resistance

Hilti Anchor programme

Basic loading data (for a single anchor): HST

All data on this page applies to

- concrete: as specified in the table
- no edge distance and spacing influence
- correct setting (See setting operations page 85)
- *steel* failure

For detailed design method, see pages 86 - 91.

CONC non-cracked concrete

Mean ultimate resistance, $R_{u,m}$ [kN]: concrete ≡ C20/25

Anchor size	M8	M10	M12	M16	M20	M24
Tensile $N_{Ru,m}$	16.6	22.3	35.2	48.7	76.0	86.1
Shear $V_{Ru,m}$	*23.0*	*26.5*	*44.2*	*72.2*	*119.1*	*125.0*

Characteristic resistance, R_k [kN]: concrete ≡ C20/25

Anchor size	M8	M10	M12	M16	M20	M24
Tensile N_{Rk}	9.0	16.0	20.0	35.0	50.0	60.0
Shear V_{Rk}	*13.0*	*20.0*	*30.0*	*50.0*	*55.0*	*94.0*

Following values according to the:

Concrete Capacity Method

Design resistance, R_d [kN]: concrete $f_{ck,cube}$ = 25 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
Tensile N_{Rd}	5.0	10.7	13.3	23.3	33.3	40.0
Shear V_{Rd}	10.4	16.0	24.0	40.0	41.4	62.7

Recommended load, L_{rec} [kN]: concrete $f_{ck,cube}$ = 25 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24
Tensile N_{Rec}	3.6	7.6	9.5	16.7	23.8	28.6
Shear V_{Rec}	7.4	11.4	17.1	28.6	29.6	44.8

cracked concrete

M8	M10	M12	M16	M20	M24
10.3	11.6	21.9	31.1	44.9	60.2
22.8	*24.4*	*47.5*	*67.6*	*107.4*	*116.4*

M8	M10	M12	M16	M20	M24
5.0	9.0	12.0	20.0	30.0	40.0
13.0	*20.0*	*30.0*	*50.0*	*55.0*	*94.0*

M8	M10	M12	M16	M20	M24
2.8	6.0	8.0	13.3	20.0	26.7
10.4	16.0	24.0	40.0	41.4	62.7

M8	M10	M12	M16	M20	M24
2.0	4.3	5.7	9.5	14.3	19.0
7.4	11.4	17.1	28.6	29.6	44.8

Basic loading data (for a single anchor): HST-R

All data on this section applies to

- concrete: as specified in the table
- no edge distance and spacing influence
- correct setting (See setting operations page 85)
- *steel* failure

For detailed design method, see pages 86 – 91.

CONC **non-cracked concrete**



cracked concrete

Mean ultimate resistance, $R_{u,m}$ [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16	M20	M24
Tensile $N_{Ru,m}$	18.1	26.7	35.1	49.8	77.4	79.1
Shear $V_{Ru,m}$	*22.8*	*31.9*	*50.3*	*84.0*	136.0	*151.4*

M8	M10	M12	M16	M20	M24
12.7	18.4	20.1	36.0	55.1	70.5
20.6	*31.9*	45.5	*84.0*	106.6	*151.4*

Characteristic resistance, R_k [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16	M20	M24
Tensile N_{Rk}	9.0	16.0	20.0	35.0	50.0	60.0
Shear V_{Rk}	*13.0*	*20.0*	*30.0*	*50.0*	*80.0*	*115.0*

M8	M10	M12	M16	M20	M24
5.0	9.0	12.0	25.0	30.0	40.0
13.0	*20.0*	*30.0*	*50.0*	*80.0*	*115.0*

Following values according to the:

Concrete Capacity Method

Design resistance, R_d [kN]: concrete $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20	M24
Tensile N_{Rd}	6.0	10.7	13.3	23.3	33.3	40.0
Shear V_{Rd}	10.4	16.0	24.0	38.5	55.6	79.9

M8	M10	M12	M16	M20	M24
3.3	6.0	8.0	16.7	20.0	26.7
10.4	16.0	24.0	38.5	55.6	79.9

Recommended load, L_{rec} [kN]: concrete $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20	M24
Tensile N_{Rec}	4.3	7.6	9.5	16.6	23.8	28.6
Shear V_{Rec}	7.4	11.4	17.1	27.5	39.7	57.1

M8	M10	M12	M16	M20	M24
2.4	4.3	5.7	11.9	14.2	19.0
7.4	11.4	17.1	27.5	39.7	57.1

Basic loading data (for a single anchor): HST-HCR

All data on this section applies to

- concrete: as specified in the table
- no edge distance and spacing influence
- correct setting (See setting operations page 85)
- *steel* failure

For detailed design method, see pages 86 - 91.

CONC **non-cracked concrete**



cracked concrete

Mean ultimate resistance, $R_{u,m}$ [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16
Tensile $N_{Ru,m}$	15.2	22.7	32.4	45.5
Shear $V_{Ru,m}$	*14.0*	*21.6*	*32.4*	*59.4*

M8	M10	M12	M16
13.8	16.2	21.5	32.4
14.0	*21.6*	*32.4*	*59.4*

Characteristic resistance, R_k [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16
Tensile N_{Rk}	9.0	16.0	20.0	35.0
Shear V_{Rk}	*13.0*	*20.0*	*30.0*	*55.0*

M8	M10	M12	M16
5.0	9.0	12.0	25.0
13.0	*20.0*	*30.0*	*55.0*

Following values according to the:

Concrete Capacity Method

Design resistance, R_d [kN]: concrete $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16
Tensile N_{Rd}	5.0	8.9	11.1	19.4
Shear V_{Rd}	10.4	16.0	24.0	44.0

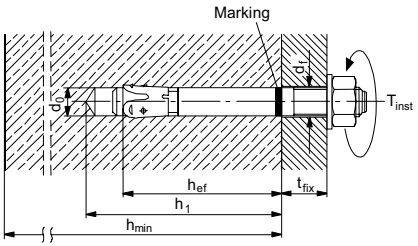
M8	M10	M12	M16
2.8	5.0	6.7	13.8
10.4	16.0	24.0	44.0

Recommended load, L_{rec} [kN]: concrete $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16
Tensile N_{Rec}	3.6	6.4	7.9	13.9
Shear V_{Rec}	7.4	11.4	17.1	31.4

M8	M10	M12	M16
2.0	3.6	4.8	9.9
7.4	11.4	17.1	31.4

Setting details



Setting Details \ Anchor size				M8	M10	M12	M16
d_o	[mm]	Nominal dia. of drill bit		8	10	12	16
T_{inst}	[Nm]	Rec. tightening torque	HST	20	45	60	110
			HST-R HST-HCR	20	40	60	110
SW	[mm]	Width across nut flats		13	17	19	24
d_f	[mm]	Clearance hole diameter		9	12	14	18
h_1	[mm]	Min. depth of drill hole		65	80	95	115
h_{ef}	[mm]	Effective embed. depth		47	60	70	82
t_{fix}	[mm]	Min. fasten.thickness		2	2	2	2
		Max. fasten.thickness		195	200	200	200
h_{min}	[mm]	Min. concrete thickness		100	120	140	160
Drill bit				TE-CX-8	TE-CX-10	TE-CX-12	TE-C-16 or TE-Y-

Setting Details \ Anchor size			M20	M24
d_o	[mm]	Nominal dia. of drill bit	20	24
T_{inst}	[Nm]	Rec.tightening torque	240	300
SW	[mm]	Width across nut flats	30	36
d_f	[mm]	Clearance hole diameter	22	26
h_1	[mm]	Min. depth of drill hole	140	170
h_{ef}	[mm]	Effective embed. depth	101	125
t_{fix}	[mm]	Min. fasten. thickness	2	2
		Max. fasten. thickness	305	330
h_{min}	[mm]	Min. concrete thickness	200	250
Drill bit			TE-C-S 20 TE-Y 20	TE-C-S 24 TE-Y 24

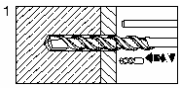
HST-HCR is available up to M16.

2

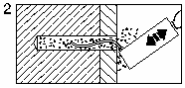
Installation equipment

Rotary hammer (TE1, TE 2, TE5, TE6, TE6A, TE15, TE15-C, TE18-M, TE 35, TE 55, TE 76), drill bit, blow-out pump, torque wrench, appropriate size hexagon drive socket for correct setting.

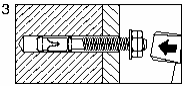
Setting operations



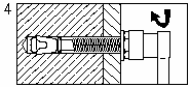
Drill hole with drill bit.



Blow out dust and fragments.



Install anchor.



Apply tightening torque.

Mechanical properties of anchor bolt

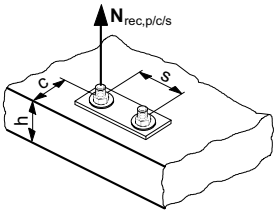
Anchor size				M8	M10	M12	M16	M20	M24
f_{uk}	[N/mm^2]	Nominal tensile strength	HST	800	800	800	680	550	530
			HST-R	700	700	700	650	700	700
			HST-HCR	700	700	700	700	-	-
f_{yk}	[N/mm^2]	min. Yield strength	HST	640	640	640	480	400	450
			HST-R	500	500	500	500	500	500
			HST-HCR	450	450	450	450	-	-
A_s	[mm^2]	Stressed cross-section in taper		24.2	41.3	57.4	105.7	167.4	240.5
A_s	[mm^2]	Stressed cross-section in thread		36.6	58	84.3	157	245	353
W_{el}	[mm^3]	Elastic moment of resistance		31.2	62.3	109	277	541	935
$M_{Rd,s}$	[Nm]	Design bending moment [1)]	HST	24.0	47.8	83.7	159.6	259.7	475.7
			HST-R	18.7	37.4	65.4	166.2	324.6	561
			HST-HCR	16.8	33.5	58.7	161.1	-	-

[1)] The design bending moment is calculated from $M_{Rd,s} = 1.2 \cdot W_{el} \cdot f_{uk} / \gamma_{Ms}$ where the partial safety factor γ_{Ms} varies with anchor type and size.

Detailed design method - Hilti CC

(The Hilti CC-Method is a simplified Version of ETAG Annex C)

TENSION



The tensile design resistance of a single anchor is the lower of,

$N_{Rd,p}$: concrete pull-out resistance

$N_{Rd,c}$: concrete cone resistance

$N_{Rd,s}$: steel resistance

$N_{Rd,p}$: Pull-out resistance



$$N_{Rd,p} = N^{0}_{Rd,p} \cdot f_B$$

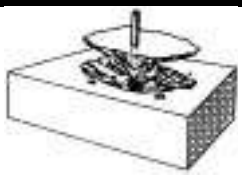
$N^0_{Rd,p}$: Design pull-out resistance

- Concrete compressive strength $f_{ck,cube(150)}$ = 25 N/mm^2

Anchor size			M8	M10	M12	M16	M20	M24
$N^0_{Rd,p}$ [1] [kN]	non-cracked concrete	HST	5.0	10.7	13.3	23.3	33.3	40.0
		HST-R	6.0	10.7	13.3	23.3	33.3	40.0
		HST-HCR	5.0	8.9	11.1	19.4	-	-
$N^0_{Rd,p}$ [1] [kN]	cracked concrete	HST	2.8	6.0	8.0	13.3	20.0	26.7
		HST-R	3.3	6.0	8.0	16.7	20.0	26.7
		HST-HCR	2.8	5.0	6.7	13.8	-	-

[1] The tensile design resistance is calculated from the tensile characteristic resistance $N^0_{Rk,p}$ by $N^0_{Rd,p} = N^0_{Rk,p}/\gamma_{Mp}$ where the partial safety factor γ_{Mp} varies with anchor type and size (as per relevant approval).

$N_{Rd,c}$: Concrete cone resistance



$$N_{Rd,c} = N^{0}_{Rd,c} \cdot f_B \cdot f_{AN} \cdot f_{RN}$$

$N^0_{Rd,c}$: Design concrete cone resistance

- Concrete compressive strength $f_{ck,cube(150)}$ = 25 N/mm^2

Anchor size			M8	M10	M12	M16	M20	M24
$N^0_{Rd,c}$ [1] [kN]	non-cracked concrete		9.0	15.6	19.7	24.9	34.1	47.0
$N^0_{Rd,c}$ [1] [kN]	cracked concrete		6.4	11.2	14.1	17.8	24.4	33.5
h_{ef}	[mm]	effective embedment depth	47	60	70	82	101	125

[1] The tensile design resistance is calculated from the tensile characteristic resistance $N^0_{Rk,c}$ by $N^0_{Rd,c} = N^0_{Rk,c}/\gamma_{Mc,N}$, where the partial safety factor $\gamma_{Mc,N}$ varies with anchor type and size (as per relevant approval).

f_B :Influence of concrete strength

Concrete strength designation (ENV 206)	Cylinder compressive strength $f_{ck,cyl}$ [N/mm²]	**Cube compressive strength $f_{ck,cube}$ [N/mm²]**	f_B
C20/25	20	**25**	**1.0**
C25/30	25	**30**	**1.1**
C30/37	30	**37**	**1.22**
C35/45	35	**45**	**1.34**
C40/50	40	**50**	**1.41**
C45/55	45	**55**	**1.48**
C50/60	50	**60**	**1.55**

Concrete cylinder: height 30cm, 15cm diameter	Concrete cube: side length 15cm
Concrete test specimen geometry	

$$f_B = \sqrt{\frac{f_{ck,cube}}{25}}$$

Limits:
$25\ N/mm^2 \le f_{ck,cube(150)} \le 60\ N/mm^2$

f_{AN} :Influence of anchor spacing

Anchor spacing	anchor size					
s [mm]	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
60	0.71		0.64			
70	0.75	0.69	0.67	0.64		
90	0.82	0.75	0.71	0.68		
110	0.89	0.81	0.76	0.72	0.68	
130	0.96	0.86	0.81	0.76	0.71	0.67
150		0.92	0.86	0.80	0.75	0.70
170		0.97	0.90	0.85	0.78	0.73
190			0.95	0.89	0.81	0.75
210			1.00	0.93	0.85	0.78
230				0.97	0.88	0.81
250				1.00	0.91	0.83
270					0.95	0.86
290					0.98	0.89
310					1.00	0.91
330						0.94
350						0.97
380						1.00

$$f_{AN} = 0.5 + \frac{s}{6 \cdot h_{ef}}$$

Limits:
$s_{min} \le s \le s_{cr,N}$
s_{min} varies with edge distance, see table “minimum spacing & minimum edge distance“, next page
$s_{cr,N} = 3 \cdot h_{ef}$

f_{RN} :Influence of edge distance

Edge distance	anchor size					
c [mm]	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
55	0.84	0.71	0.64			
60	0.89	0.75	0.68			
70	0.99	0.83	0.75	0.68		
80		0.92	0.82	0.74		
90		1.00	0.89	0.80		
100			0.96	0.86		
110				0.92		
120				0.98		
130						
140					0.94	
150					0.99	0.85
160						0.89
170						0.93
180						0.97

$$f_{RN} = 0.25 + 0.5 \cdot \frac{c}{h_{ef}}$$

Limits:
$c_{min} \le c \le c_{cr,N}$
c_{min} varies with spacing, see table “minimum spacing & minimum edge distance“, next page
$c_{cr,N} = 1.5 \cdot h_{ef}$

Note:
If more than 3 edges are smaller than $c_{cr,N}$ consult the Hilti Technical Advisory Service

HST			M8	M10	M12	M16	M20	M24
Minimum spacing	s_{min}	[mm]	60	55	60	70	100	125
	for c ≥	[mm]	50	80	85	110	225	255
Minimum edge distance	c_{min}	[mm]	50	55	55	85	140	170
	for s ≥	[mm]	60	115	145	150	270	295

HST-R			M8	M10	M12	M16	M20	M24
Minimum spacing	s_{min}	[mm]	60	55	60	70	100	125
	for c ≥	[mm]	60	70	80	110	195	205
Minimum edge distance	c_{min}	[mm]	60	50	55	70	140	150
	for s ≥	[mm]	60	115	145	160	210	235

HST-HCR			M8	M10	M12	M16
Minimum spacing	s_{min}	[mm]	60	55	60	70
	for c ≥	[mm]	60	70	80	110
Minimum edge distance	c_{min}	[mm]	60	55	55	70
	for s ≥	[mm]	60	115	145	160

Intermediatate values by interpolation.

$N_{Rd,s}$: Steel design tensile resistance

Anchor size		M8	M10	M12	M16	M20	M24
$N_{Rd,s}$ [1] [kN]	HST	12.8	21.3	28.7	50.0	46.9	90.1
	HST-R	11.3	18.7	26.7	44.2	63.0	90.2
	HST-HCR	12.9	21.5	30.5	56.3	-	-

[1] The design tensile resistance is calculated from the characteristic tensile resistance, $N_{Rk,s}$, using $N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$, where the partial safety factor γ_{Ms} varies with anchor type and size (as per relevant approval).



N_{Rd} : System design tensile resistance

N_{Rd} = lower of $N_{Rd,p}$, $N_{Rd,c}$ and $N_{Rd,s}$

Combined loading: Only if tensile load and shear load applied (See page 31 and section 4 “Examples”).

Detailed design method – Hilti CC

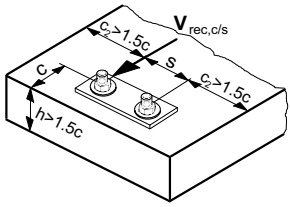
(The Hilti CC-Method is a simplified Version of ETAG Annex C)

SHEAR

The design shear resistance of a single anchor is the lower of,

$V_{Rd,c}$: concrete edge resistance

$V_{Rd,s}$: steel resistance

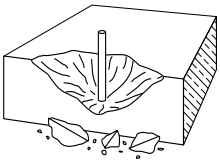


Note: If the conditions regarding h and c_2 are not met, consult your **Hilti technical advisory service.**

$V_{Rd,c}$: Concrete edge design resistance

The lowest concrete edge resistance must be calculated. All nearby edges must be checked, (not only the edge in the direction of shear). Shear direction is accounted for by the factor $f_{\beta,V}$.

$$V_{Rd,c} = V^{o}_{Rd,c} \cdot f_B \cdot f_{\beta,V} \cdot f_{AR,V}$$



$V^{0}_{Rd,c}$: Concrete edge design resistance

- Concrete compressive strength $f_{ck,cube(150)}$ = 25 N/mm²
- at a minimum edge distance c_{min}

HST		Anchor size	M8	M10	M12	M16	M20	M24
$V^{0}_{Rd,c}$ [1]	[kN]	non-cracked concrete	3.0	3.9	4.2	9.1	21.5	31.7
$V^{0}_{Rd,c}$ [1]	[kN]	cracked concrete	2.1	2.8	3.0	6.5	15.4	22.7
c_{min}	[mm]	min. edge distance	50	55	55	85	140	170
for s≥	[mm]	min. spacing distance	60	115	145	150	270	295

HST-R / HCR		Anchor size	M8	M10	M12	M16	M20	M24
$V^{0}_{Rd,c}$ [1]	[kN]	non-cracked concrete	3.9	3.4	4.2	6.8	21.5	26.3
$V^{0}_{Rd,c}$ [1]	[kN]	cracked concrete	2.8	2.4	3.0	4.9	15.4	18.8
c_{min}	[mm]	min. edge distance	60	50	55	70	140	150
for s≥	[mm]	min. spacing distance	60	115	145	160	210	235

HST-R / HCR		Anchor size	M8	M10	M12	M16
$V^{0}_{Rd,c}$ [1]	[kN]	non-cracked concrete	3.9	3.9	4.2	6.8
$V^{0}_{Rd,c}$ [1]	[kN]	cracked concrete	2.8	2.8	3.0	4.9
c_{min}	[mm]	min. edge distance	60	55	55	70
for s≥	[mm]	min. spacing distance	60	115	145	160

[1] The shear design resistance is calculated from the shear characteristic resistance $V^{o}_{Rk,c}$ by $V^{o}_{Rd,c} = V^{o}_{Rk,c}/\gamma_{Mc,V}$, where the partial safety factor $\gamma_{Mc,V}$ is equal to 1.5.

f_B : Influence of concrete strength

Concrete strength designation (ENV 206)	Cylinder compressive strength $f_{ck,cyl}$ [N/mm²]	**Cube compressive strength $f_{ck,cube}$ [N/mm²]**	f_B
C20/25	20	**25**	**1.0**
C25/30	25	**30**	**1.1**
C30/37	30	**37**	**1.22**
C35/45	35	**45**	**1.34**
C40/50	40	**50**	**1.41**
C45/55	45	**55**	**1.48**
C50/60	50	**60**	**1.55**

Concrete cylinder: height 30cm, 15cm diameter	Concrete cube: side length 15cm
Concrete test specimen geometry	

$$f_B = \sqrt{\frac{f_{ck,cube}}{25}}$$

Limits:
25 N/mm² ≤ $f_{ck,cube(150)}$ ≤ 60 N/mm²

$f_{\beta,V}$: Influence of shear load direction

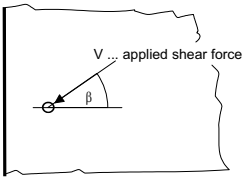
Angle β [°]	$f_{\beta,V}$
0 to 55	**1**
60	**1.1**
70	**1.2**
80	**1.5**
90 to 180	**2**

Formulae:

$f_{\beta,V} = 1$ for $0° \le \beta \le 55°$

$f_{\beta,V} = \frac{1}{\cos\beta + 0.5\sin\beta}$ for $55° < \beta \le 90°$

$f_{\beta,V} = 2$ for $90° < \beta \le 180°$



$f_{AR,V}$: Influence of spacing and edge distance

Formula for **single** anchor fastening influenced only by edge

$$f_{AR,V} = \frac{c}{c_{min}}\sqrt{\frac{c}{c_{min}}}$$

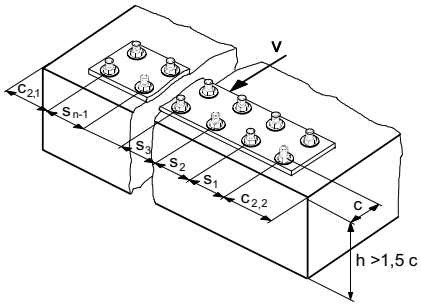
Formula for anchor **pair** valid for s < 3c

$$f_{AR,V} = \frac{3c + s}{6c_{min}}\sqrt{\frac{c}{c_{min}}}$$

results tabulated below

General formula for **n** anchors (edge plus n-1 spacing) only valid where s_1 to s_{n-1} are all < 3c and $c_2 > 1.5c$

$$f_{AR,V} = \frac{3c + s_1 + s_2 + \ldots + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$



Note: It is assumed that only the row of anchors closest to the free concrete edge carries the centric shear load

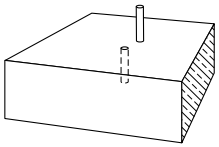
$f_{AR,V}$	c/c_{min} →	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
Single anchor with edge influence		1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72	6.27	6.83	7.41	8.00
s/c_{min} ↓	1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16	3.44	3.73	4.03	4.33
	1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31	3.60	3.89	4.19	4.50
	2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.13	2.38	2.63	2.90	3.18	3.46	3.75	4.05	4.35	4.67
	2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61	3.90	4.21	4.52	4.83
	3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76	4.06	4.36	4.68	5.00
	3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91	4.21	4.52	4.84	5.17
	4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05	4.36	4.68	5.00	5.33
	4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20	4.52	4.84	5.17	5.50
	5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35	4.67	5.00	5.33	5.67
	5.5						2.71	2.99	3.28	3.57	3.88	4.19	4.50	4.82	5.15	5.49	5.83
	6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65	4.98	5.31	5.65	6.00
	6.5							3.24	3.54	3.84	4.16	4.47	4.80	5.13	5.47	5.82	6.17
	7.0								3.67	3.98	4.29	4.62	4.95	5.29	5.63	5.98	6.33
	7.5									4.11	4.43	4.76	5.10	5.44	5.79	6.14	6.50
	8.0										4.57	4.91	5.25	5.59	5.95	6.30	6.67
	8.5											5.05	5.40	5.75	6.10	6.47	6.83
	9.0											5.20	5.55	5.90	6.26	6.63	7.00
	9.5												5.69	6.05	6.42	6.79	7.17
	10.0													6.21	6.58	6.95	7.33
	10.5														6.74	7.12	7.50
	11.0															7.28	7.67
	11.5																7.83
	12.0																8.00

These results are for a two-. Anchor fastening.

For fastening made with more than 2 anchors, use the general formulae for n anchors at the top of the page.

Anchor size		M8	M10	M12	M16	M20	M24
$V_{Rd,s}$ [kN]	HST	10.4	16.0	24.0	40.0	41.4	62.7
	HST-R	10.4	16.0	24.0	38.5	55.6	79.9
	HST-HCR	10.4	16.0	24.0	44.0	-	-

1) The design shear resistance is calculated from the characteristic shear resistance, $V_{Rk,s}$, using $V_{Rd,s} = V_{Rk,s} / \gamma_{Ms}$, where the partial safety factor γ_{Ms} varies with anchor type and size (as per relevant approval).



V_{Rd} : System design shear resistance

V_{Rd} = lower of $V_{Rd,c}$ and $V_{Rd,s}$

Combined loading: Only if tensile load and shear load applied (See page 31 and section 4 “Examples”).

California Air Tools #15020C Specifications

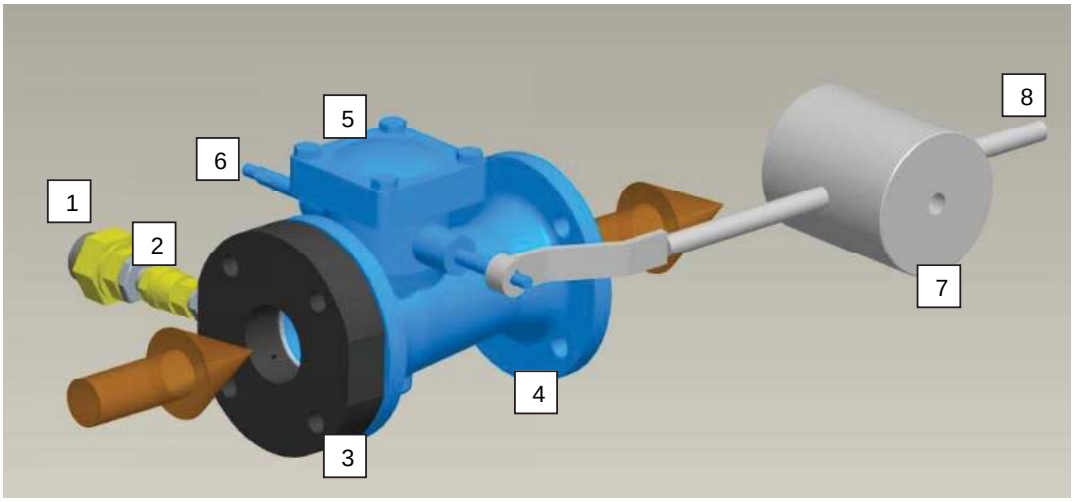
- **Zoro #:** G4124989
- **Mfr #:** 15020C

- **Tank Size**: 15 gal.
- **Voltage**: 120V
- **Max. Pressure**: 150 psi
- **HP**: 2
- **Tank Type**: Steel
- **Free Air CFM @ Max. Pressure**: 5.3 @ 90 psi
- **Includes**: (2) Air Filters, (2) Pressure Control Gauges, 1/4 in Quick Connector, Condor Pressure Switch, Easy Start Valve, Thermal Overload Protector, Wheel Kit
- **Overall Length**: 28 in
- **Compressor Type**: Ultra Quiet and Oil Free Air Compressor
- **Overall Height**: 31 in
- **Weight**: 90
- **Standards**: UL
- **Overall Width**: 17 in
- **Free Air CFM @ 90 PSI - Air Compressor**: 5.3
- **Cylinder Material**: Steel
- **Full Load Amps**: 14.0
- **Weight - Air Compressor**: 90 lb
- **Motor RPM**: 1,680 RPM
- **Motor Type**: Induction
- **(F)NPT Outlet**: 1/4 in
- **Lubrication Type - Air compressor**: Oil Free
- **Input Voltage - Air Compressor**: 110V AC
- **Max. Pressure - Air Compressor**: 150 psi
- **Item - Air Compressor**: Portable Air Compressor
- **Avg. Pump Life**: 3,000 hr
- **Item**: Ultra Quiet 2.0 HP 15G Air Compressor
- **Tank Size - Air Compressor**: 15 gal
- **HP - Air Compressor**: 2.0 hp
- **Tank Style - Air Compressor**: Horizontal
- **Features**: Two Pressure Control Gauges
- **Pump Life**: 3,000 hours
- **Connector Type**: One 1/4" Universal Quick Connectors
- **Width**: 28
- **Maximum PSI**: 125 PSI
- **CFM at 90 PSI**: 5.30 CFM
- **AMPS**: 15.0 Amps
- **Length**: 30
- **Time to fill the Tank**: 230 Seconds
- **Height**: 17
- **CFM at 40 PSI**: 6.40 CFM

- **Motor Speed**: 1680 RPMS
- **Country of Origin (subject to change)**: Multiple

Injection and mixing unit

Product specification



1 connection for polymer	5 cleaning opening
2 back valve	6 mixing valve shaft
3 injection ring	7 weight
4 mixing unit	8 lever

Design and function

The injection and mixing unit is a 2-part connection flange fitting. Via an injection ring the polymers are introduced into the sludge flow. Mixing of the sludge and polymers is achieved by means of a special mixing unit. A movable mixing valve inside reduces the pipeline cross section and generates a turbulent sludge flow.
The mixing valve is fitted on a projecting shaft with packing glands. The load on the mixing valve, and thus the mixing energy, is infinitely adjustable via a lever with displaceable weight.
Flock formation takes place in the following pressure pipeline running to the sludge treatment unit.
Both sludge and polymers must be forced through the injection and mixing unit by appropriate pumps.

Both the nominal width of the injection and mixing unit and the distance to the sludge treatment unit are very important for the formation of stable sludge flocks.
When selecting the pumps it is important to take into consideration that both the injection ring and mixing valve cause pressure losses, which are dependent on the material viscosity.

Transport and storage

The fittings require protection against external influences, such as damage or adverse weather conditions. The individual equipments components must be protected against shifting.

Installation

Preliminary work

Align inaccurate pipelines prior to starting any installation work. This will prevent stresses or breakage of the valve housing.
Check the ex works corrosion protection for transport damage and repair it if necessary.

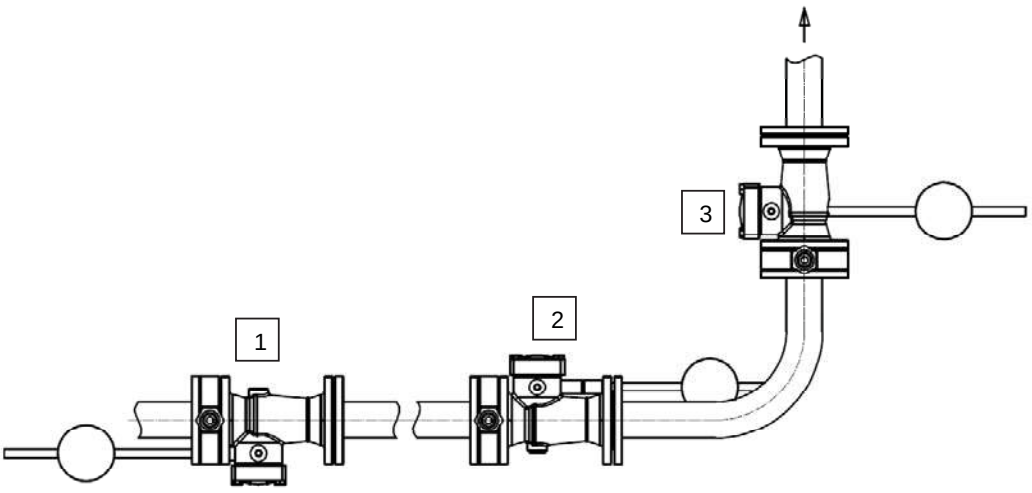
Installation position

The selected installation position should ensure that the fitting is at any time easily accessible and dismountable for inspection or repair.
Especially the pivoting area of the lever and the area around the cleaning opening of the mixing unit should be kept free.
If installed outdoors protect the fitting with a cover against extreme weather, such as snow or ice.

Installation options

The injection and mixing unit must be installed in a completely filled pressure pipeline.	**Note!**

Partially filled pipelines are inappropriate for a sufficient flock formation due to the undefined flow conditions and residence times.
The following three installation options are recommendable.



The sludge flows at first through the injection ring and then through the mixing unit. The metal cover ring of the injection ring points to the mixing unit. The mixing valve opens with the sludge flow. The weight-loaded lever closes the mixing valve against the sludge flow. The mixing valve shaft must be horizontal.	**Note!**

The installation position of the injection ring around the pipeline axis is selectable according to the flange bore hole pattern.
The lever with weight can be mounted on both sides of the shaft.

Start-up:

The mixing energy is adjustable by displacing (or removing) the weight.
The weight must be fixed reliably on the lever by means of the fixing screw.
After start-up the weight fixing screw on the lever should point downwards in order to prevent water retention inside the weight.

When varying the sludge throughput or switching on or off the pumps the lever with weight may insignificantly move up and down.	**Note!**
Mixing different types of polymers (emulsions and dispersions) may produce lumps inside the injection ring or screwed in back valve. Please refer to the polymer suppliers' recommendations.	**Note!**
Depending on the type of pre-treatment, the intensive mixing may lead to gasing within the mixing unit. In order to prevent gas retention inside the pipeline, a venting valve should be installed at the following high point of the sludge pipeline.	**Note**

Maintenance and repair:

The only maintenance required for the injection and mixing unit is regular visual inspection for leakage.
If required, the packing glands of the mixing unit can be re-adjusted, but be careful to maintain the movability of the mixing valve.

Cleaning:

The cause for a changing flock pattern on the sludge treatment unit may be dirt on the injection ring or mixing unit.

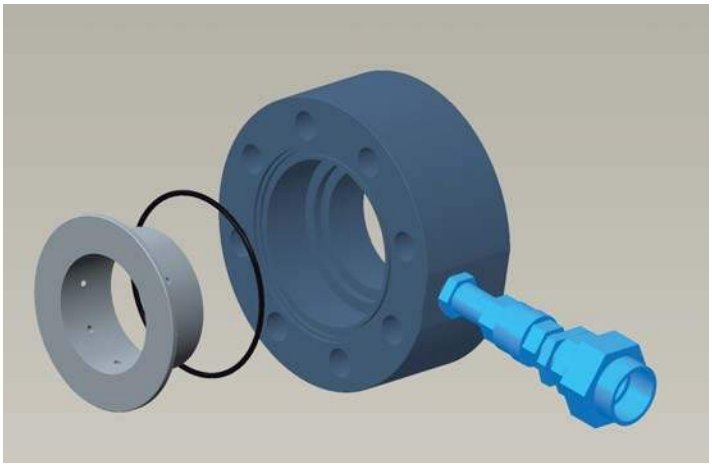
Always stop the sludge treatment process on the plant's mains isolator prior to starting with any cleaning work. Sludge or polymers may exit when opening plant components.	

Mixing valve:

- Open the cleaning openings of the mixing unit.
- Remove sediments from the mixing valve.
- Check the movability of the mixing valve.
- Close the cleaning openings.
- Repair the paint damage on the mixing unit.

Injection ring:

- Loosen the polymer feed line.
- Loosen the flange connection of the injection ring.
- Remove the injection ring from the pipeline.
- Remove the stub ring and O-ring from the injection ring.



- Check the channels in the injection ring for sedimentation.
- Clean the channels and back valve.

Polymers on an oil basis (emulsions) should not be washed off with water due to their agglutination tendency.	**Attention!**

- Insert new O-ring
- Remount the injection and mixing unit.

When mounted, the stub ring must point against mixing direction.	**Attention!**

Datenblatt / datasheet

Getriebebau NORD GmbH & Co.KG
Getriebebau-Nord-Str. 1
D - 22941 Bargteheide
www.nord.com

3 Phasen-Motor / 3 phase-motor

Motortyp : **100T2/4**
Motor type:

Elektrische Daten: / Electrical data:

Spannungsversorgung Voltage supply:	V	230	400	400
Ständerschaltung: Connection of stator :		Δ	Y	Δ
Frequenz (f): Frequency :	Hz	70		100
Drehzahl (n): Speed :	1/min	2100		3000
Nenndrehmoment (M_N): rated motor torque:	Nm	13,6		12,7
Nennleistung (P): Output :	kW	3,0		4,0
Induzierte Spannung (Ui): Inducted Voltage :	V	195	338	279
Nennstrom (I): Current :	A	9,39	5,40	8,90
Maximal Strom (I_{max}): Maximum current :	A	28,7	16,5	28,7
Maximales Drehmoment (M_{peak}): Peak torque:	Nm	42		42
Wirkungsgrad Efficiency	η (%)	91,4		92,1

Prüfdaten: / Tested data:

Schalldruckpegel (L_{PA}): Noise level:	dB(A)	51	(1500rpm)
Induktivität D-Achse (L_D): Inductance		22,6 U1-U2	mH
Induktivität Q-Achse (L_Q): Inductance		45,9 U1-U2	mH
Wicklungwiderstand bei 20°C (R): Resistance stator winding at 20°C:		1,33 U1-U2	Ω
Übertemperatur (T): (gemessen nach der Widerstandsmethode) Temperature rise: (at the stator winding resistance method)			K
Isolationswiderstand ($R_{Isol.}$): Insulation resistace :		> 100	Mega Ω
Stehspannungsprüfung: Winding test :		2352	V / 5 sek.
Schwingstärke: Class of vibration:		A	

Auftragsdaten: / Order data:

Auftrag Nr. : Order No.:	
Serial Nr. : Serial Nr. :	
Motor Nr. : Motor. No. :	
Kennlinien Nr: Diagram No:	

Allgemeindaten: / General data:

Drehrichtung: Direction of rotation :	beide cw, ccw			
Bauform : Design :				
Betriebsart: Duty:	S1			
Lagertyp: Type bearing:	IC 5			
Gehäusewerkstoff: Housing material:	Aluminium			
Wärmeklasse: Insulation class:	F			
Schutzart / IC Klasse: Type of protection / IC class:	IP 55	/	IC 4A1	
Service Faktor / Code letter: Service factor / Code letter:		/		
Kabeleinführung: Cable entry:	2xM25x1,5			
Gewicht: Weight:	18,0	kg		
Massenträgheitsmoment (J): (Motor incl. Optionen) Moment of inertia: (Motor with options)	0,00458		kgm²	
Maximale Aufstellungshöhe: Maximum altitude of site:	1000	m		
Zulässige Umgebungstemperatur: Maximum ambient temperature:	-15	bis to	40	°C

Vorschriften: / Classification authorities:

DIN EN 60034 Teil: 1,3,7

IE4

Motoroptionen: / Motor options:

* Auf Nennwert bezogene Größe (Einheitenlos)

Technische Änderungen Vorbehalten.
Technical data are subject to change.

swing check valve

RKF13-special



Base properties:	
base type:	RKF13
connection:	flange DIN2501
nominal pressure:	PN16
body material:	EN-JL1040-GG25 RAL5015
material inlying parts:	1.4021-SS
sealing material:	metallic
temperature medium:	0 up to +150°C

Description:

one-piece valve

exterior shaft

flange according to DIN2501

Options:

- ☐ rubber-Niro sealing
- ☐ brass – sealing brass

Product properties:

A high quality swing type check valve with lever and weight, designed for high demands for industrial use.

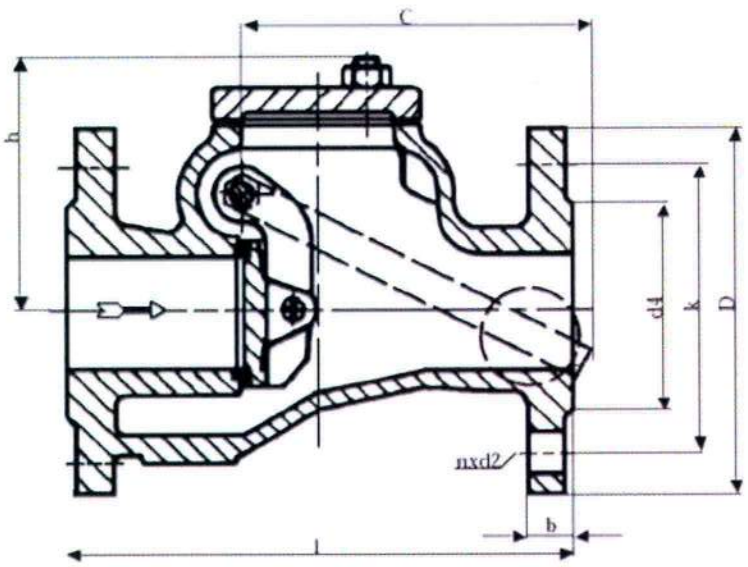
special design:

free of grease and oil

flange according to ANSI

custom sealings

Other special design on request.



The article is deliverable in default sizes (special sizes on demand):

Artikel-Nr	size	nominal size	one-side shaft	double-sided shaft	l	D	k	d4	h	n	d2	b	weight (kg)
110956	DN40	40mm	170		180	150	110	88	119	4	18	18	22,6
103212	DN50	50mm	180		200	165	125	102	120	4	18	20	24,8
103214	DN65	65mm		380	240	185	145	122	141	4	18	20	24,5
103213	DN80	80mm		400	260	200	160	138	168	8	18	22	33,2
103215	DN100	100mm		420	300	220	180	158	175	8	18	24	43,9
109537	DN125	125mm		450	350	250	210	188	199	8	18	26	59,2

Declarations:

material:

grey cast iron (***GG-25***), material-No.: ***EN-JL1040***, short name: EN-GJL-250, AISI: A48-40B

stainless steel (***V2A***), material-No.: ***1.4021***, short name: X20Cr13

Revision: 09/2009

Irrtum und Änderungen vorbehalten. © 2006 – MIT Moderne IndustrieTechnik GmbH.

Product Data Sheet
00813-0300-4750, Rev CB
May 2019

Rosemount® 8750W Magnetic Flowmeter System

for Utility, Water, and Wastewater Applications



- Best in class value with performance, reliability, and diagnostics suited for monitoring applications
- Reliable all welded coil housing and lightweight sensor design rated to IP68
- Available in 4–20mA with HART®, FOUNDATION™ Fieldbus, Modbus® RS-485, Process Diagnostics, and SMART™ Meter Verification to improve reliability and performance
- Available with drinking water certifications

ROSEMOUNT™

EMERSON™

Product Selection Guide

The Rosemount 8750W Magnetic Flowmetersensor is available in a flanged style and transmitter is available in remote and integral transmitter configurations to ensure compatibility with all utility, water, and wastewater applications.

Transmitter selection

Transmitter	General characteristics
Field mount 	■ Integral and remote configurations available ■ HART/Analog and Pulse outputs available ■ FOUNDATION™ Fieldbus and pulse output available ■ Modbus RS-485 and Pulse output available ■ Advanced Diagnostics available ■ LCD display (optional) — With optional optical switch local operator interface(1) ■ ~~Two discrete channels (optional)~~
~~Wall mount~~ 	■ ~~Wall mount configuration~~ ■ ~~HART/Analog and Pulse outputs available~~ ■ ~~Modbus RS-485 and Pulse output available~~ ■ ~~FOUNDATION™ Fieldbus and pulse output available~~ ■ ~~Advanced Diagnostics available~~ ■ ~~Local LCD display (optional)~~ — ~~With optional 15 button tactile key pad(1)~~ ■ ~~Two discrete channels (optional)~~

(1) HART or Modbus protocol only.

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Dimensional drawings 33

Sensor selection

Table 1: Sensor Selection

Sensor	General characteristics
Flanged 	■ Flanged process connections Welded coil housing ■ ½-in. (15 mm) to 48-in. (1200 mm) ■ Standard, reference, and bullet-nose electrodes available

Selecting materials

For guidance on selecting materials, refer to the *Rosemount™ Magnetic Flowmeter Material Selection Guide (00816-0100-3033)* , available at www.emerson.com/rosemount.

Magmeter Diagnostics

Rosemount diagnostics reduce cost & improve output by enabling new practices

Rosemount Magnetic Flowmeters provide device diagnostics that detect and warn of abnormal situations throughout the life of the meter - from installation to maintenance and meter verification. With Rosemount Magnetic Flowmeter diagnostics enabled, plant availability and throughput can be improved, and costs through simplified installation, maintenance and troubleshooting can be reduced.

Table 2: Magnetic flowmeter diagnostics

Diagnostic name	Diagnostic category	Product capability
Basic diagnostics		
Tunable Empty Pipe	Process	Standard
Electronics Temperature	Meter Health	Standard
Coil Fault	Meter Health	Standard
Transmitter Fault	Meter Health	Standard
Reverse Flow	Process	Standard
Coil current	Maintenance	Standard
Electrode saturation	Process/Maintenance	Standard
~~**Advanced diagnostics**~~		
~~High Process Noise~~	~~Process~~	~~Suite 1 (DA1)~~
~~Grounding and Wiring Fault~~	~~Installation~~	~~Suite 1 (DA1)~~
~~Coated Electrode Detection~~	~~Process~~	~~Suite 1 (DA1)~~
~~Commanded Smart Meter Verification~~	~~Meter Health~~	~~Suite 2 (DA2)~~
~~Continuous Smart Meter Verification~~	~~Meter Health~~	~~Suite 2 (DA2)~~

Table 2: Magnetic flowmeter diagnostics *(continued)*

Diagnostic name	Diagnostic category	Product capability
~~4-20 mA Loop Verification~~[1]	~~Installation~~	~~Suite 2 (DA2)~~

(1) Available with HART output only.

Options for accessing diagnostics

Rosemount Magmeter Diagnostics can be accessed through the Local Operator Interface (LOI), ProLink® III v3.1, a HART Field Communicator[1], and AMS® Suite: Intelligent Device Manager[1]. Contact your local Rosemount representative to activate diagnostics or for diagnostic availability on existing transmitters.

Access diagnostics through the LOI for quicker installation, maintenance, and meter verification

Rosemount Magnetic Flowmeter Diagnostics are available through the LOI to simplify maintenance.

Access diagnostics through ProLink III v. 3.0 (HART)/ProLink III v. 3.1 (HART, Modbus)

Simplify maintenance and troubleshooting practices by utilizing ProLink III v3.0/v3.1 to access diagnostics and troubleshooting information, log variable data, run SMART Meter Verification, and print verification reports.

Access diagnostics through AMS Intelligent Device Manager[1] for the ultimate value

The value of the diagnostics increases significantly when AMS Intelligent Device Manager is used. AMS Intelligent Device Manager provides a simplified screen flow and procedures for how to respond to the diagnostic messages.

Magnetic Flowmeter Sizing

Selecting the appropriate sensor size is an important step when considering a magnetic flowmeter. The physical properties of the process fluid, as well as the fluid velocity should be considered. It may be necessary to select a flow sensor that is larger or smaller than the adjacent piping to ensure the fluid velocity is in the recommended flow range for the application.

- Operation outside these guidelines may also give acceptable performance.

Table 3: Sizing guidelines

Application	Velocity range (ft/s)	Velocity range (m/s)
Normal Service	0–39	0–12
Preferred Service	2–20	0.6–6.1

Note
Operation outside these guidelines may also give acceptable performance.

To convert flow rate to velocity, use the appropriate factor listed in Table 4 and the following equation:

$$\text{Velocity} = \frac{\text{Flow Rate}}{\text{Factor}}$$

(1) Available with HART output only.

Example: English units	Example: SI units
Magmeter Size: 4 in. (factor from Table 4 = 39.679) Normal Flow Rate: 300 GPM $\text{Velocity} = \frac{300\ (\text{gpm})}{39.679}$ **Velocity = 7.56 ft/s**	Magmeter Size: 100 mm (factor from Table 4 = 492.78)Normal Flow Rate: 800 L/min $\text{Velocity} = \frac{800\ (\text{L/min})}{492.78}$ **Velocity = 1.62 m/s**

Table 4: Line size vs. conversion factor

Nominal line size—Inches (mm)	Gallons per minute factor	Liters per minute factor
½ (15)	0.947	11.762
1 (25)	2.694	33.455
1½ (40)	6.345	78.806
2 (50)	10.459	129.89
2 ½ (65)	14.923	185.33
3 (80)	23.042	286.17
4 (100)	39.679	492.78
5 (125)	62.356	774.42
6 (150)	90.048	1,118.3
8 (200)	155.93	1,936.5
10 (250)	245.78	3,052.4
12 (300)	352.51	4,378.0
14 (350)	421.70	5,237.3
16 (400)	550.80	6,840.6
18 (450)	697.19	8,658.6
20 (500)	866.51	10,761
24 (600)	1,253.2	15,564
30 (750)	2006.0	24,913
36 (900)	2,935.0	36,451
40 (1000)	3,652.1	45,357
42 (1050)	4,115.1	51,107
48 (1200)	5,407.6	67,159

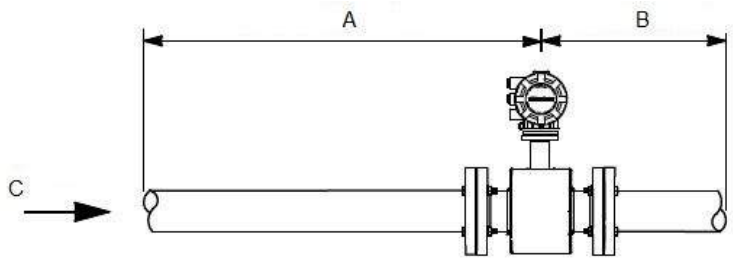
Table 5: Line size vs. velocity/rate

Nominal line size in inches (mm)	Minimum/maximum flow rate							
	Gallons per minute				Liters per minute			
	at 0.04 ft/s (low-flow cutoff)	at 1 ft/s (min range setting)	at 3 ft/s	at 39.37 ft/s (max range setting)	at 0.012 m/s (low-flow cutoff)	at 0.3 m/s (min range setting)	at 1 m/s	at 12 m/s (max range setting)
½ (15)	0.038	0.947	2.841	37.287	0.141	3.529	11.76	141.15
1 (25)	0.108	2.694	8.081	106.05	0.401	10.04	33.45	401.46
1½ (40)	0.254	6.345	19.04	249.82	0.946	23.64	78.81	945.67
2 (50)	0.418	10.459	31.38	411.77	1.559	38.97	129.89	1,558.7
2½ (65)	0.597	14.923	44.77	587.51	2.224	55.60	185.33	2,224.0
3 (80)	0.922	23.042	69.13	907.17	3.434	85.85	286.17	3,434.0
4 (100)	1.587	39.679	119.04	1,562.2	5.913	147.84	492.78	5,913.4
5 (125)	2.494	62.356	187.07	2,454.9	9.293	232.33	774.42	9,293.0
6 (150)	3.602	90.048	270.14	3,545.2	13.42	335.50	1,118.3	13,420
8 (200)	6.237	155.93	467.79	6,138.9	23.24	580.96	1,936.5	23,238
10 (250)	9.831	245.78	737.34	9,676.3	36.63	915.73	3,052.4	36,629
12 (300)	14.10	352.51	1,057.5	13,878	52.54	1,313.4	4,378.0	52,535
14 (350)	16.87	421.71	1,265.1	16,603	62.85	1,571.2	5,237.3	62,848
16 (400)	22.03	550.80	1,652.4	21,685	82.09	2,052.2	6,840.6	82,087
18 (450)	27.89	697.19	2,091.6	27,448	103.90	2,597.6	8,658.6	103,903
20 (500)	34.66	866.51	2,599.5	34,114	129.14	3,228.4	10,761	129,137
24 (600)	50.13	1,253.2	3,759.6	49,339	186.77	4,669.2	15,564	186,769
30 (750)	80.24	2,006.0	6,018.0	78,976	298.96	7,474.0	24,913	298,959
36 (900)	117.40	2,935.0	8,805.1	115,553	437.42	10,935	36,451	437,416
40 (1000)	146.09	3,652.1	10,956	143,785	544.29	13,607	45,357	544,286
42 (1050)	164.60	4,115.1	12,345	162,011	613.28	15,332	51,107	613,278
48 (1200)	216.30	5,407.6	16,223	212.898	805.91	20,148	67,159	805,908

Upstream and downstream piping

To ensure specified accuracy over widely varying process conditions, install the sensor with a minimum of five straight pipe diameters upstream and two pipe diameters downstream from the electrode plane.

Figure 1: Upstream and downstream straight pipe diameters



A. *Five pipe diameters (upstream)*
B. *Two pipe diameters (downstream)*
C. *Flow direction*

Installations with reduced upstream and downstream straight runs are possible. In reduced straight run installations, the meter may not meet accuracy specifications. Reported flow rates will still be highly repeatable.

Sensor grounding

A reliable ground path is required between the sensor and the process fluid. Optional grounding rings or process reference electrodes are available with the sensor to ensure proper grounding. See Table 5 and Table 6.

Ordering Information

Rosemount 8750W Magnetic Flowmeter Platform



The Rosemount 8750W Magnetic Flowmeter is available in a flanged sensor design. The sensors are fabricated from stainless and carbon steel and welded to provide a sealed coil housing that protects against moisture or other contaminants. Sizes range from 1/2-in. (15 mm) to 48-in. (1200 mm). The field mount transmitter has a die cast aluminum housing for excellent reliability. The wall mount transmitter features an easy to use operator interface. Both transmitter styles are available with advanced diagnostics to provide the best insight into the process and the meter's health.

Note
The starred (★) offerings represent the most common options, and should be selected for best delivery.

Model code structure

Example model code with one selection out of each category:
`8750W D M T 1 A 1 F P S A 010 C A1 Z5 DA2 AX M4 BD G5 B6 R15 V1 Q4 HR7 WG YF`

Table 6: Requirements - select one from each available choice

Example code	Category
8750W	Base model—Magnetic Flowmeter System (utility, water, and wastewater)
D	Sensor design revision—Revision "D"
M	Transmitter class (Table 8)
T	Transmitter mount (Table 9)
1	Transmitter power (Table 10)

Table 6: Requirements - select one from each available choice *(continued)*

Example code	Category
A	Transmitter outputs (Table 11)
1	Conduit entries (Table 12)
F	Sensor style (Table 13)
P	Lining material (Table 14)
S	Electrode material (Table 15)
A	Electrode type (Table 16)
010	Line size (Table 17)
C	Flange type and material (Table 18)
A1	Flange rating (Table 19)

Table 7: Options - select only as needed

Example code	Category
Z5	Hazardous area certifications (Table 20)
DA2	Advanced diagnostics (Table 21)
AX	Discrete input/output (Table 22)
M4	Display (Table 23)
BD	Certifications (Table 24)
G5	Grounding rings (Table 25)
B6	Miscellaneous (Table 26)
R15	Submergence protection (Table 27)
V1	Special paint (Table 28)
Q4	Quality certificates (Table 29)
HR7	Revision configuration (Table 30)
WG	Witness inspection (Table 31)
Yx	Quick Start Guide language (Table 32)

Requirements

Table 8: Rosemount 8750W transmitter class

Code	Description	
M	Revision 4 electronics	★
0	Spare sensor, no transmitter	

Table 9: Rosemount 8750W transmitter mount

Code	Description	
T	Integral field mount	★
R	Remote field mount	★

Table 9: Rosemount 8750W transmitter mount *(continued)*

Code	Description	
W	Remote wall mount	★

Table 10: Rosemount 8750W transmitter power

Code	Description	
1	AC Power Supply (90 -250VAC, 50/60Hz)	★
2	DC Power Supply (12 - 42VDC)	★
0	Spare sensor, no transmitter	

Table 11: Rosemount 8750W transmitter outputs

Code	Description	
A	4-20mA output with digital HART protocol & scalable pulse output	★
F	FOUNDATION™ Fieldbus & scalable pulse output	★
M	Modbus RS-485 electronics, scalable pulse	★
0	Spare sensor, no transmitter	

Table 12: Rosemount 8750W conduit entries

Code	Description	Integral mount quantity	Remote mount quantity	
1	½–14 NPT	2	4	★
2	M20–1.5 adapters	2	4	★
4(1)	½–14 NPT, additional entry	3	5	
5(1)	M20–1.5, additional entry	3	5	
0	Spare sensor, integral mount only, no transmitter	N/A	N/A	

(1) Not available with the wall mount transmitter.

Table 13: Rosemount 8750W sensor style

Code	Description	
F	Flanged	★
0	Spare transmitter, no sensor	

Table 14: Rosemount 8750W lining material

Code	Description	
T(1)	PTFE	★
P(2)	Polyurethane	★
N(3)	Neoprene	★
0	Spare transmitter, no sensor	

(1) Available in ½ - to 36-in. (15 mm to 900 mm) line sizes.
(2) Available in line sizes 1- to 36-in., 42-in., and 48-in. (25 mm to 900 mm, 1050 mm, and 1200 mm) line sizes.
(3) Available in line sizes 1- to 48-in. (25 mm to 1200 mm) line sizes.

Table 15: Rosemount 8750W electrode material

Code	Description	
S	316L stainless steel	★
H	Nickel alloy 276 (UNS N 10276)	★
0	Spare transmitter, no sensor	

Table 16: Rosemount 8750W electrode type

Code	Description	
A	2 Measurement electrodes – standard	★
B(1)	2 Measurement electrodes – bulletnose	★
E	2 Measurement electrodes plus 1 reference electrode – standard	★
F(1)	2 Measurment electrodes plus 1 reference electrode – bulletnose	★
0	Spare transmitter, no sensor	

(1) Not available in ½-in. (15mm).

Table 17: Rosemount 8750W line size

Code	Line size	Liner availability In this table, the starred (★) offerings represent available liner based on line size. Consult factory for additional Flange Type/Rating sensor availability		
		PTFE code T	Poly code P	Neoprene code N
005	½-in. (15 mm)	★		
010	1-in. (25 mm)	★	★	★
015	1½-in. (40 mm)	★	★	★
020	2-in. (50 mm)	★	★	★
025	2½-in. (65 mm)	★		★
030	3-in. (80 mm)	★	★	★
040	4-in. (100 mm)	★	★	★
050	5-in. (125 mm)	★		★
060	6-in. (150 mm)	★	★	★
080	8-in. (200 mm)	★	★	★
100	10-in. (250 mm)	★	★	★
120	12-in. (300 mm)	★	★	★
140	14-in. (350 mm)	★	★	★
160	16-in. (400 mm)	★	★	★
180	18-in. (450 mm)	★	★	★
200	20-in. (500 mm)	★	★	★
240	24-in. (600 mm)	★	★	★
300	30-in. (750 mm)	★	★	★

Table 17: Rosemount 8750W line size *(continued)*

Code	Line size	Liner availability In this table, the starred (★) offerings represent available liner based on line size. Consult factory for additional Flange Type/Rating sensor availability		
		PTFE code T	Poly code P	Neoprene code N
360	36-in. (900 mm)	★	★	★
400	40-in. (1000 mm)			★
420	42-in. (1050 mm)		★	★
480	48-in. (1200 mm)		★	★
000	Spare transmitter, no sensor			

Table 18: Rosemount 8750W flange type and material

Code	Description (see Table 33 for line size vs. flange type and rating)	
C	Slip-on,raised-face, carbon steel	★
S	Slip-on,raised-face, 304/304L SST	★
F	Slip-on, flat-face, carbon steel	
G	Slip-on,flat-face, 304/304L SST	
0	Spare transmitter, no sensor	

Table 19: Rosemount 8750W flange rating

Code	Description (see Table 33 for line size vs. flange type and rating)
A1	ASME B16.5, Class 150
A3	ASME B16.5, Class 300
AD	AWWA C207Class D; line size 30-in. and above; flat face flange only
AE	AWWA C207Class E; line size 30-in. and above; flat face flange only
DD	EN1092-1,PN10
DE	EN1092-1,PN16
DF	EN 1092-1, PN25
DH	EN 1092-1, PN40
GD	GB/T9119,PN10
GE	GB/T9119,PN16
GH	GB/T9119,PN40
JP	JISB2220, 10K
JR	JISB2220, 20K
KU	AS4087, PN16
KW	AS4087, PN21
KY	AS4087, PN35
TK	AS2129, Table D

Table 19: Rosemount 8750W flange rating *(continued)*

Code	Description (see Table 33 for line size vs. flange type and rating)
TL	AS2129, Table E
00	Spare transmitter, no sensor

Options

Note
These are not required, but they must be included in the model number if desired.

Table 20: Rosemount 8750W hazardous area certifications

Code	Description	
-[1]	Ordinary Locations - (no code required)	★
Z5	US Approvals, Class I Div 2, Non-Incendive and Dust for Non-Flammable Fluids	★
Z6	Canadian Approvals, Class I Div 2, Non-Incendive and Dust for Non-Flammable Fluids	★
ND	ATEX Dust	★
Z1	ATEX Non-Sparking and Dust for Non-Flammable Fluids	★
NF	IECEx Dust	★
Z7	IECEx Non-Sparking and Dust for Non-Flammable Fluids	★
Z2	INMETRO Non-Sparking and Dust for Non-Flammable Fluids	★
Z3	NEPSI Non-Sparking and Dust for Non-Flammable Fluids	★

(1) CSA (C/US) marked, CE marked, EAC marked and C-tick marked.

Table 21: Rosemount 8750W advanced diagnostics

Code	Description	
DA1	Process Diagnostics, High Process Noise Detection, Ground/Wiring Fault Detection, and Electrode Coating	★
DA2	Smart Meter Verification	★

Table 22: Rosemount 8750W discrete input/discrete output

Code	Description	
AX[1][2]	Two Discrete Channels (DI/DO 1, DO 2)	★

(1) Requires Conduit Entry code 4 or 5 when ordered with field mount transmitter.
(2) Not available with FOUNDATION Fieldbus (output code F).

Table 23: Rosemount 8750W display

Code	Description	
M4[1]	LCD with Local Operator Interface	★
M5	LCD display only	

(1) Not available with FOUNDATION Fieldbus (output code F).

Table 24: Rosemount 8750W certifications

Code	Description	
PD	European Pressure Equipment Directive Certification (PED)	★
CR	Canadian Registration Number (CRN) Certification	
BD	ASME B31.3 Process Piping Standard	
DW(1)	NSF DrinkingWater Certification	

(1) NSF drinking water certification is available with the PTFE liner in line sizes 0.5- to 36-in (15 mm to 900 mm) and the polyurethane liner in line sizes 4-to 36-in., 42-in., and 48-in. (80 mm to 900 mm, 1050 mm, and 1200 mm).

Table 25: Rosemount 8750W grounding rings

Code	Description	
G1	316L stainless steel (Qty 2)	★
G2	Nickel alloy C-276; UNS N 10276 (Qty 2)	
G5	316L stainless steel (Qty 1)	★
G6	Nickel alloy C-276; UNS N 10276 (Qty 1)	

Table 26: Rosemount 8750W miscellaneous

Code	Description
C1	Custom Configuration (completed CDS form required with order)
D1	High Accuracy Calibration (base ref accuracy 0.25% of rate)
B6	316 SST Mounting Bracket with U-bolt Kit for 2-in. Pipe Mount
P05(1)	5-point verification
P10(2)	10-point verification

(1) Available for ½ - to 24-in (15 mm to 600 mm) at velocities 1, 3, 5, 7, 10 ft/s; 30-in. (700 mm) at velocities 1, 3, 5, 7, 9.5 ft/s; 36-in. (900 mm) at velocities 1, 2, 3, 5,6.5 ft/s;40- to 48-in.(1000mm to 1200mm).
(2) Available for ½ - to 24-in. (15 mm to 600 mm) at velocities 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ft/s; 30- to 48-in. (700 mm to 1200 mm) not available.

Table 27: Rosemount 8750W submergence protection

Code	Description
R05	Potted junction box with 50 feet of combo cable/cable gland for use in conduit
R10	Potted junction box with 100 feet of combo cable/cable gland for use in conduit
R15	Potted junction box with 150 feet of combo cable/cable gland for use in conduit
R20	Potted junction box with 200 feet of combo cable/cable gland for use in conduit
R25	Potted junction box with 250 feet of combo cable/cable gland for use in conduit
R30	Potted junction box with 300 feet of combo cable/cable gland for use in conduit
S05	Potted junction box with 50 feet of submersible combo cable/cable gland
S10	Potted junction box with 100 feet of submersible combo cable/cable gland
S15	Potted junction box with 150 feet of submersible combo cable/cable gland
S20	Potted junction box with 200 feet of submersible combo cable/cable gland
S25	Potted junction box with 250 feet of submersible combo cable/cable gland

Table 27: Rosemount 8750W submergence protection *(continued)*

Code	Description
S30	Potted junction box with 300 feet of submersible combo cable/cable gland

Table 28: Rosemount 8750W special paint

Code	Description
V1	Coal tar paint (submersible/direct burial)

Table 29: Rosemount 8750W quality certificates

Code	Description
Q4	Calibration certificate per ISO 10474 3.1B/EN 10204 3.1
Q8	Material traceability per ISO 10474 3.1B/EN 10204 3.1

Table 30: Rosemount 8750W revision configuration

Code	Description
HR7	HART Revision 7

Table 31: Rosemount 8750W witness inspection

Code	Description
WG	Witness Inspection

Table 32: Rosemount 8750W Quick Start Guide language

Code	Description	
YF	French	★
YG	German	★
YI	Italian	★
YM	Chinese (Mandarin)	★
YP	Portuguese (Brazil)	★
YR	Russian	★
YS	Spanish	★

Table 33: Slip on flange options by line size

	Flange code and rating																	
	A1	A3	AD	AE	DD	DE	DF	DH	GD	GE	GH	JP	JR	KU	KW	KY	TK	TL
Size code	ASME Class 150	ASME Class 300	AWWA Class D	AWWA Class E	EN PN10	EN PN16	EN PN25	EN PN40	GB/T PN 10	GB/T PN 16	GB/T PN 40	JIS 10K	JIS 20K	AS4087 PN16	AS4087 PN21	AS4087 PN35	AS2129 Table D	AS2129 Table E
005	★	★						★			★	★	★				★	★
010	★	★						★			★	★	★				★	★

Product Specifications

Basic specifications

The tables below outline some of the basic performance, physical, and functional specifications.

~~Table 34: Wall mount transmitter Specifications~~

	Style	Wall mount
	Base accuracy(1)	0.5% Standard 0.25% High Accuracy Option
	Mounting	Remote
	Power supply	Global AC or DC
	User interface	LCD display with 15 button tactile keypad (optional) LCD display only (optional) No display (standard)
	Communication protocol	HART with 4–20mA FOUNDATION™ fieldbus Modbus RS-485
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Transmitter specifications
	Ordering information	Ordering Information

(1) For complete accuracy specifications, please refer to Transmitter functional specifications.

Table 35: Field mount transmitter specifications

	Style	Field mount
	Base accuracy(1)	0.5% Standard 0.25% High Accuracy Option
	Mounting	Integral or Remote
	Power supply	Global AC or DC
	User interface	LCD display with 4 Optical Switch LOI (optional) LCD display only (optional) No display (standard)
	Communication protocol	HART FOUNDATION™ fieldbus Modbus RS-485
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Transmitter specifications
	Ordering information	Ordering Information

(1) For complete accuracy specifications, please refer to Transmitter functional specifications.

Table 36: Sensor specifications

	Style	Flanged
	Base accuracy(1)	0.5% Standard 0.25% High Accuracy Option
	Line sizes	½-in. to 48-in. (15 mm to 1200 mm)
	Design features	Standard Process Design
	Detailed specifications	Sensor specifications
	Ordering information	Ordering Information

(1) For complete accuracy specifications, refer to the sensor detailed specifications.

Table 37: Lining Material Selection

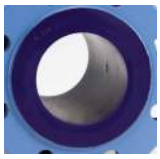
Liner material	General characteristics
PTFE 	Process temperature: 0 to +248 °F (-18 to +120 °C)
Polyurethane 	Process temperature: 0 to +140 °F (-18 to +60 °C)
	~~Typically applied in clean water~~
Neoprene 	Typically applied in water with chemicals, and sea water
	Process temperature: 0 to 176 °F (-18 to 80 °C)

Table 38: Electrode Material

Electrode material	General characteristics
316L Stainless Steel	Good corrosion resistance
	Good abrasion resistance
Nickel Alloy 276 (UNS N10276)	Better corrosion resistance
	High strength

Table 39: Electrode Type

Electrode type	General characteristics
Standard Measurement	Lowest cost
	Good for most applications
Measurement + Reference Electrode	Low cost grounding option especially for large line sizes

Table 39: Electrode Type *(continued)*

Electrode type	General characteristics
(Also see Table 40 and Table 41 for grounding options and installation)	Minimum conductivity of 100 microSiemens/cm
	Not recommended for electrolytic or galvanic corrosion applications
Bulletnose	Extended head protrudes into the flow stream for self-cleaning
	Best option for coating processes

Table 40: Process Reference Options

Grounding options	General characteristics
No Grounding Options (grounding straps)	Acceptable for conductive unlined pipe
	Grounding straps provided at no cost
Reference Electrode	Same material as measurement electrodes
	Sufficient grounding option when process fluid conductivity is greater than 100 microSiemens/cm
	Not recommended in electrolysis applications, galvanic corrosion applications, applications where the electrodes may coat, or non-conductive pipe.
Grounding Rings	Low conductivity process fluids
	Cathodic or electrolysis applications that may have stray currents in or around the process
	Variety of materials for process fluid compatibility

Table 41: Process Reference Installation

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	Acceptable	Not required	Not required	Not required
Conductive lined pipe	Not acceptable	Acceptable	Acceptable	Acceptable
Non-conductive pipe	Not acceptable	Acceptable	Not recommended	Acceptable

Transmitter specifications

Transmitter functional specifications

Transmitter coil drive current

500mA

Flow rate range

Capable of processing signals from fluids with velocities between 0.04 and 39 ft/s (0.01 to 12 m/s) for both forward and reverse flow in all sensor sizes. Full scale continuously adjustable between –39 and 39 ft/s (–12 to 12 m/s).

Conductivity limits

Process liquid must have a conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Power supply

- 90 - 250VAC @ 50/60Hz

- 12 - 42VDC

Line power fuses

- 90 - 250VAC systems:
  - 2 amp quick acting
  - Bussman AGC2 or equivalent
- 12 - 42VDC systems
  - 3 amp quick acting
  - Bussman AGC3 or equivalent

Power consumption

- 90 - 250VAC: 40VA maximum
- 12 - 42VDC: 15W maximum

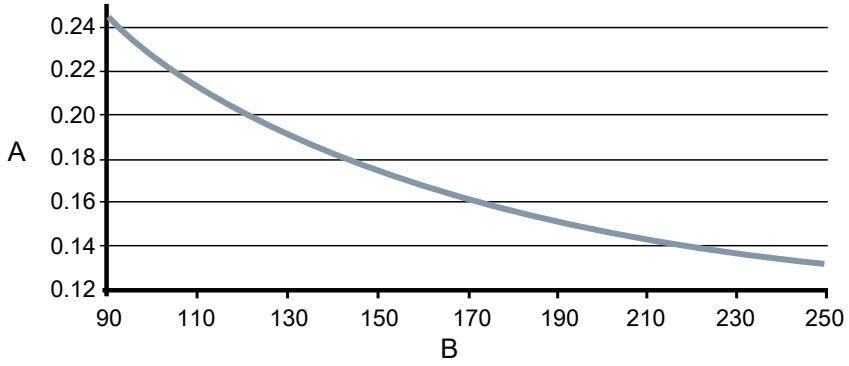
Switch-on current

- At 250VAC: Maximum 35.7A (< 5ms)
- At 42VDC: Maximum 42A (< 5ms)

AC power supply requirements

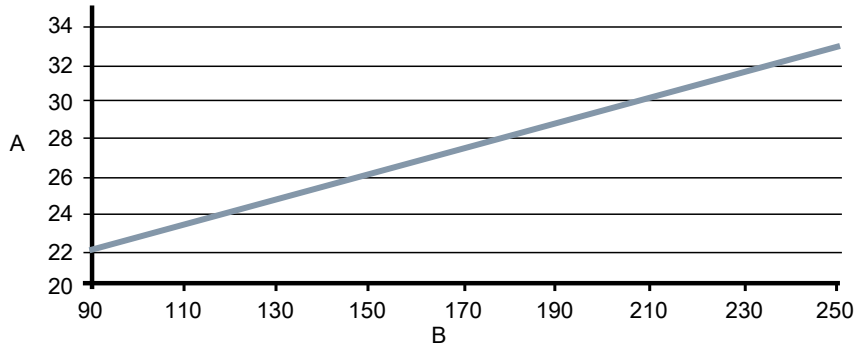
Units powered by 90 - 250VAC have the following power requirements. Peak inrush is 35.7A at 250VAC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: Inrush (Amps) = Supply (Volts) / 7.0

Figure 2: AC current requirements



A. Supply current (amps)
B. Power supply (VAC)

Figure 3: Apparent power

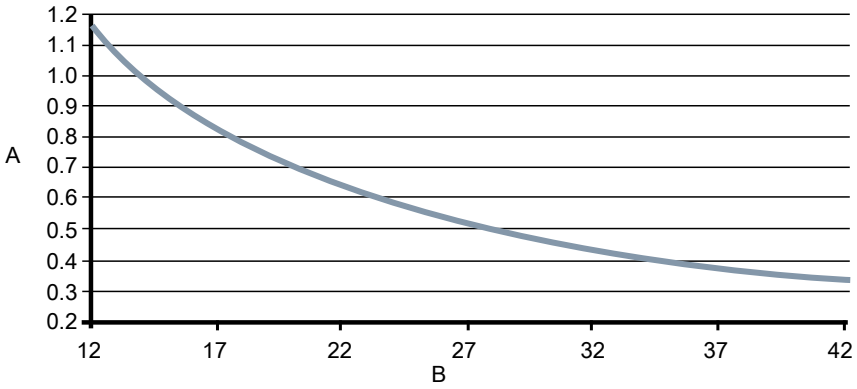


A. Apparent power (VA)
B. Power supply (VAC)

DC power supply requirements

Units powered by 12VDC power supply may draw up to 1.2A of current steady state. Peak inrush is 42A at 42VDC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: Inrush (Amps) = Supply (Volts) / 1.0

Figure 4: DC current requirements



A. Supply current (amps)
B. Power supply (VDC)

Ambient temperature limits

- Operating:
  - –58 to 140 °F (–50 to 60 °C) without LOI/Display
  - –4 to 140 °F (–20 to 60 °C) with LOI/Display
  - The LOI/Display will not be visible at temperatures below -20°C
- Storage:
  - –58 to 185 °F (–50 to 85 °C) without LOI/Display
  - –22 to 176 °F (–30 to 80 °C) with LOI/Display

Humidity limits

0–95% RH to 140 °F (60 °C)

Altitude

2000 meters maximum

Enclosure rating

Type 4X, IEC 60529, IP66 (transmitter)

Transient protection rating

Built in transient protection that conforms to:

- IEC 61000-4-4 for burst currents
- IEC 61000-4-5 for surge currents
- IEC 611185-2.2000, Class 3 up to 2kV and up to 2kA protection

Turn-on time

- 5 minutes to rated accuracy from power up
- 5 seconds from power interruption

Start-up time

50ms from zero flow

Low flow cut-off

Adjustable between 0.01 and 38.37 ft/s (0.003 and 11.7 m/s). Below selected value, output is driven to the zero flow rate signal level.

Overrange capability

Signal output will remain linear until 110% of upper range value or 44 ft/s (13 m/s). The signal output will remain constant above these values. Out of range message displayed on LOI/Display and the Field Communicator.

Damping

Adjustable between 0 and 256 seconds

Advanced diagnostics capabilities

Basic

- Self test
- Transmitter faults
- Analog output test
- Pulse output test
- Tunable empty pipe
- Reverse flow
- Coil circuit fault
- Electronics temperature

~~Process diagnostics (DA1)~~

- ~~Ground/wiring fault~~
- ~~High process noise~~
- ~~Electrode coating diagnostic~~

~~Smart Meter Verification (DA2)~~

- ~~Smart Meter Verification (continuous or on-demand)~~

- ~~4-20mA loop verification~~[2]

Output signals

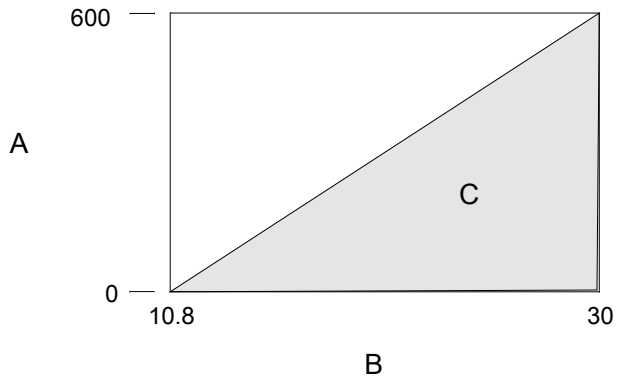
Analog output adjustment [3]

4–20mA, switch-selectable as internally or externally powered.

Analog loop load limitations

- Internally powered 24VDC max, 500 ohms max loop resistance
- Externally powered 10.8 - 30VDC max.
- Loop resistance is determined by the voltage level of the external power supply at the transmitter terminals:

Figure 5: Analog loop load limitations



A. Load (ohms)
B. Power supply (volts)
C. Operating region

- $R_{max} = 31.25 (V_{ps} – 10.8)$
- V_{ps} = power supply voltage (volts)
- Rmax = maximum loop resistance (ohms)

The analog output is automatically scaled to provide 4mA at lower range value and 20mA at upper range value. Full scale continuously adjustable between -39 and 39 ft/s (-12 to 12 m/sec), 1 ft/s (0.3 m/s) minimum span.

HART Communications is a digital flow signal. The digital signal is superimposed on the 4–20mA signal and is available for the control system interface. A minimum of 250 ohms loop resistance is required for HART communications.

Analog alarm mode

High or low alarm signal is user-selectable via the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values. High or low alarm signal is user-selectable via the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values.

Low	3.75 mA	Requires CDS (C1)
High	22.50 mA	Factory default
NAMUR Low	3.5 mA	Requires CDS (C1)

(2) Available with HART output only.
(3) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

	Totalizer	Non-volatile totalizer for net, gross, forward and reverse totals.
Discrete Output	The DO function block processes a discrete setpoint and saves it to a specified channel to produce an output signal. The block supports mode control, output tracking, and simulation.	

Modbus RS-485 output

Transmitters with a Modbus output provide an RS-485 signal to a Modbus host system; data rates can be configured from 1200 baud to 115.2 kilobaud.

Scalable pulse frequency adjustment

- 0-10,000Hz, switch-selectable as internally or externally powered (4)
- Pulse value can be set to equal desired volume in selected engineering units
- Pulse width adjustable from 0.1 to 650 ms
- Internally powered: Outputs up to 12VDC(5)
- Externally powered: Input 5 - 28VDC

Output testing

Analog output test (5)	Transmitter may be commanded to supply a specified current between 3.5 and 23mA.
Pulse output test	Transmitter may be commanded to supply a specified frequency between 1 and 10,000Hz.(4)

~~Optional discrete output function (AX option)~~

~~Externally powered at 5 - 28VDC, 240mA max, solid state switch closure to indicate either:~~

~~Reverse flow~~	~~Activates switch closure output when reverse flow is detected.~~
~~Zero flow~~	~~Activates switch closure output when flow goes to 0 ft/s or below low flow cutoff.~~
~~Empty pipe~~	~~Activates switch closure output when an empty pipe condition is detected.~~
~~Transmitter faults~~	~~Activates switch closure output when a transmitter fault is detected.~~
~~Flow limit 1, flow limit 2~~	~~Activates switch closure output when the transmitter measures a flow rate that meets the conditions established for this alert. There are two independent flow limit alerts that can be configured as discrete outputs.~~
~~Totalizer limit~~	~~Activates switch closure output when the transmitter measures a total flow that meets the conditions established for this alert.~~
~~Diagnostic status~~	~~Activates switch closure output when the transmitter detects a condition that meets the configured criteria of this output.~~

~~Optional discrete input function (AX option)~~

~~Externally powered at 5 - 28VDC, 1.4 - 20mA to activate switch closure to indicate either:~~

~~Reset Totalizer A (or B or C)~~	~~Resets Totalizer A (or B or C) value to zero.~~
~~Reset All Totals~~	~~Resets all totalizer values to zero.~~
~~Positive Zero Return (PZR)~~	~~Forces outputs of the transmitter to zero flow.~~

Security lockout

Security lockout switch on the electronics board can be set to deactivate all LOI and HART-based communicator functions to protect configuration variables from unwanted or accidental change.

(4) For transmitters with intrinsically safe outputs (option code B), frequency range is limited to 0-5000Hz.
(5) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

LOI lockout

The display can be manually locked to prevent unintentional configuration changes. The display lock can be activated through a HART communication device, or by holding the UP arrow for 3 seconds and then following the on-screen instructions. When the display lock is activated, a lock symbol will appear in the lower right hand corner of the display. To deactivate the display lock, hold the UP arrow for 3 seconds and follow the on-screen instructions.

Display auto lock can be configured from the LOI with the following settings: OFF, 1 Minute, or 10 Minutes

Sensor compensation

Rosemount sensors are calibrated in a flow lab at the factory and are assigned a calibration number. The calibration number must be entered into the transmitter, enabling interchangeability of sensors without calculations or a compromise in standard accuracy.

Transmitters and other manufacturers' sensors can be calibrated at known process conditions or at the Rosemount NIST-Traceable Flow Facility. Transmitters calibrated on site require a two-step procedure to match a known flow rate. This procedure can be found in the operations manual.

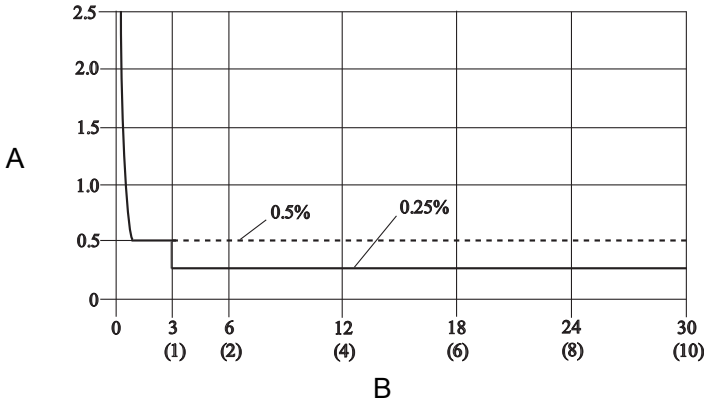
Performance specifications

System specifications are given using the frequency output and with the unit at reference conditions.

Accuracy

Includes the combined effects of linearity, hysteresis, and repeatability.

- Standard system accuracy:
  - ±0.5% of rate from 1 to 39 ft/s (0.3 to 12 m/s)
  - ±0.005 ft/s (0.0015 m/s) from the low flow cutoff to 1 ft/s (0.3 m/s)
- Optional high accuracy:(6)
  - ±0.25% of rate ±1.0 mm/sec from 3 to 39 ft/s (1 to 12 m/s)



A. Percentage of rate
B. Velocity in ft/s (m/s)

Analog output effects

Analog output has the same accuracy as frequency output plus an additional ±4 μ A at room temperature.

Repeatability	±0.1% of reading
Response time (analog output)	20 ms max response time to step change in input
Stability	±0.1% of rate over six months
Ambient temperature effect	±0.25% change over operating temperature range

(6) For sensor sizes greater than 12 in. (300 mm) the high accuracy is ±0.25% of rate from 3 to 39 ft/sec (1 to 12 m/sec).

Wall mount transmitter physical specifications

Materials of construction

Standard housing	Low copper aluminum Type 4X and IEC 60529 IP66
Paint	Polyurethane coat (1.8 to 2.2 mils thick)
Optional housing	Not available
Cover gaskets	Silicone

Electrical connections

Conduit entries	½ inch NPT or M20
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Vibration rating

2G per IEC 61298

Dimensions

See Dimensional drawings.

Weight

Wall mount transmitter	Aluminum	Approximately 9 lbs. (4 kg)

Add 1 pound (0.5 kg) for LOI/Display.

Field mount transmitter physical specifications

Materials of construction

Standard housing	Low copper aluminum Type 4X and IEC 60529 IP66
Paint	Polyurethane coat (1.8 to 2.2 mils thick)
Optional housing	316/316L unpainted, option code SH Type 4X and IEC 60529 IP66
Cover gasket	Aluminum housing: Buna-N

Ingress protection

Consult Emerson for installations requiring IP67/IP68/IP69K.

Electrical connections

Conduit entries	Available in 1/2 inch NPT or M20. See ordering table footnotes for details
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Vibration rating

Integral mount	2G per IEC 61298
Remote mount	5G per IEC 61298

Dimensions

See Dimensional drawings.

Weight

Field mount transmitter only	Aluminum	Approximately 7 lbs. (3.2 kg)
	316 stainless steel	Approximately 23 lbs. (10.5 kg)

Add 1 pound (0.5 kg) for LOI/Display.

Sensor specifications



Functional specifications

Service

Conductive liquids and slurries

Line sizes

½ –in. to 48-in. (15 mm to 1200 mm)

Sensor coil resistance

7 - 16 Ω

Interchangeability

System accuracy is maintained regardless of line size or optional features. Each sensor nameplate has a sixteen-digit calibration number that can be entered into a transmitter during configuration.

Upper range limit

39.37 ft/s (12 m/s)

Ambient temperature limits

- –20 to 140 °F (–29 to 60 °C) standard design

Pressure limits

See Process temperature limits.

Vacuum limits

PTFE lining	Full vacuum to +248 °F (+120 °C) through 4-in. (100 mm) line sizes. Consult Technical Support for vacuum applications with line sizes of 6 inches (150 mm) or larger
All other standard sensor lining materials	Full vacuum to maximum material temperature limits for all available line sizes.

~~Submergence protection IP68~~

~~The remote mount sensor is rated IP68 for submergence to a depth of 33 ft (10 m) for a period of 48 hours. IP68 rating requires that the transmitter must be remote mount. Installer must use IP68 approved cable glands, conduit connections, and/or conduit plugs.~~

~~For more details on proper installation techniques for IP68, reference Rosemount Technical Note 00840-0100-4750 available on www.emerson.com.~~

Conductivity limits

Process liquid must have a minimum conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Process temperature limits

PTFE lining	0 to +248 °F (–18 to +120 °C)
Polyurethane lining	0 to +140 °F (–18 to +60 °C)
Neoprene lining	0 to +176 °F (–18 to +80 °C)

Table 43: Temperature vs. Pressure Limits for ASME B16.5 class flanges (1)

Sensor temperature vs. pressure limits for ASME B16.5 class flanges (½ -in. to 24-in. Line Sizes)(2)					
Flange material	**Flange rating**	**Pressure**			
		@ -20 to 100 °F (-29 to 38 °C)	**@ 200 °F (93 °C)**	**@ 300 °F (149 °C)**	**@ 350 °F (177 °C)**
Carbon Steel	Class 150	285 psi	260 psi	230 psi	215 psi
	Class 300	740 psi	675 psi	655 psi	645 psi
304 Stainless Steel	Class 150	275 psi	235 psi	205 psi	190 psi
	Class 300	720 psi	600 psi	530 psi	500 psi

(1) Liner temperature limits must also be considered.
(2) 30-in. and 36-in. AWWA C207 Class D rated to 150 psi at atmospheric temperature.

Table 44: Temperature vs. Pressure Limits for AS2129 Table D and E flanges (1)

Sensor temperature vs. pressure limits for AS2129 Table D and E flanges (4-in. to 24-in. line sizes)					
Flange Material	**Flange Rating**	**Pressure**			
		@ -29 to 50 °C (-20 to 122 °F)	**@ 100 °C (212 °F)**	**@ 150 °C (302 °F)**	**@ 200 °C (392 °F)**
Carbon Steel	D	101.6 psi	101.6 psi	101.6 psi	94.3 psi
	E	203.1 psi	203.1 psi	203.1 psi	188.6 psi

(1) Liner temperature limits must also be considered.

Dimensions

See Dimensional drawings.

Weight

See Table 48 through Table 55.

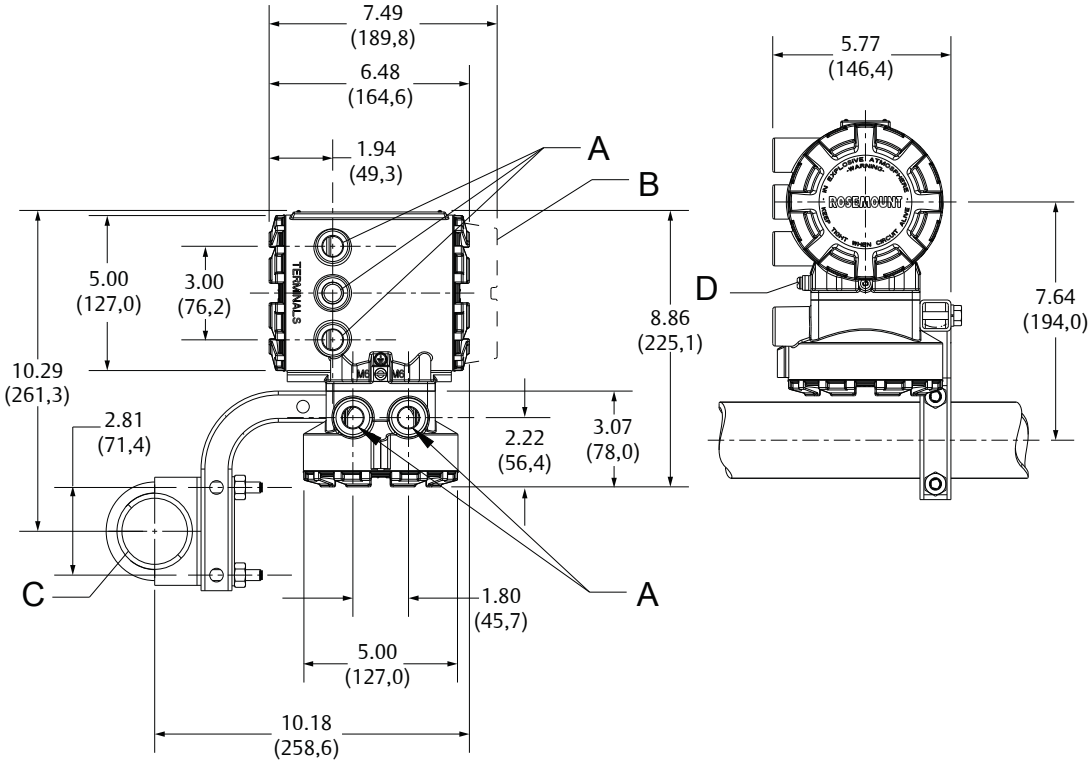
Product Certifications

For detailed approval certification information and installation drawings, please see the appropriate document listed below:

- Document number 00825-MA00-0004: *Rosemount 8750W Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0005: *Rosemount 8750W Approval Document – Class Division*
- Document number 00825-MA00-0006: *Rosemount 8750W Approval Document – North America Zone*

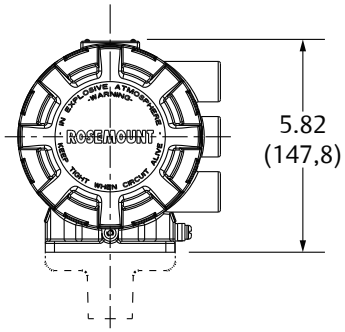
Dimensional drawings

~~Figure 6: Remote field mount transmitter~~

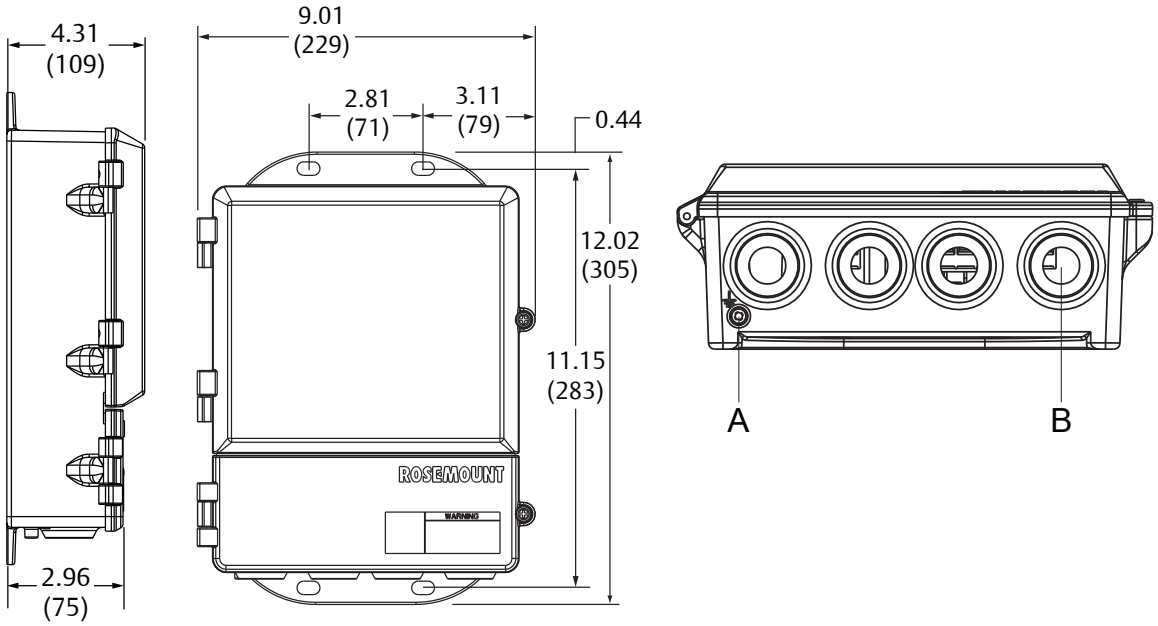


A. ½-in.–14 NPT or M20 conduit entry
B. LOI cover
C. 2-in. pipe bracket
D. Ground lug

Figure 7: Integral field mount transmitter



~~Figure 8: Wall mount transmitter with standard cover~~

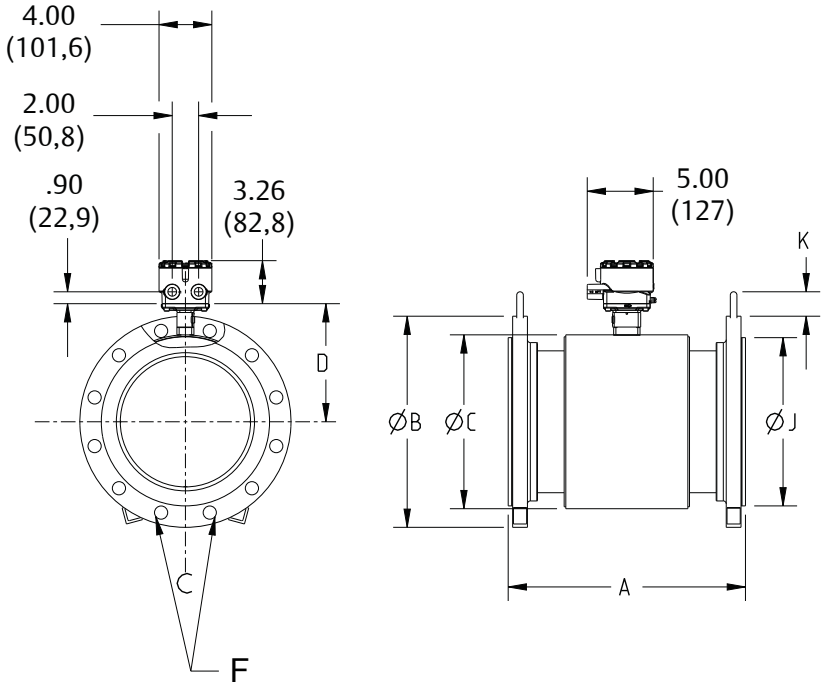


A. Ground lug
B. ½-in.–14 NPT conduit connection (four places)

Table 48: Raised face flanged sensor ½ - to 2½ -in. (15 mm to 65 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly					
2.5-in. (65 mm) JIS B2220 - 10K, SO/RF	7.82 (199)	7.76 (197)	N/A	6.89 (175)	6.31 (160)	5.37 (136)	4.57 (116)	25 (11)
2.5-in. (65 mm) JIS B2220 - 20K, SO/RF	7.82 (199)	7.76 (197)	N/A	6.89 (175)	6.31 (160)	5.37 (136)	4.57 (116)	26 (12)
2.5-in. (65 mm) AS 4087 PN16, SO/RF	7.82 (199)	7.76 (197)	N/A	6.50 (165)	6.31 (160)	5.37 (136)	4.06 (103)	18 (8)
2.5-in. (65 mm) AS 4087 PN21, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	24 (11)
2.5-in. (65 mm) AS 4087 PN35, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	27 (12)
2.5-in. (65 mm) GB/T9119 PN40, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	31 (14)

Figure 11: Raised face flanged sensor 3-in to 48-in. (75 mm to 1200 mm)



- F – Flange bolts to straddle center line

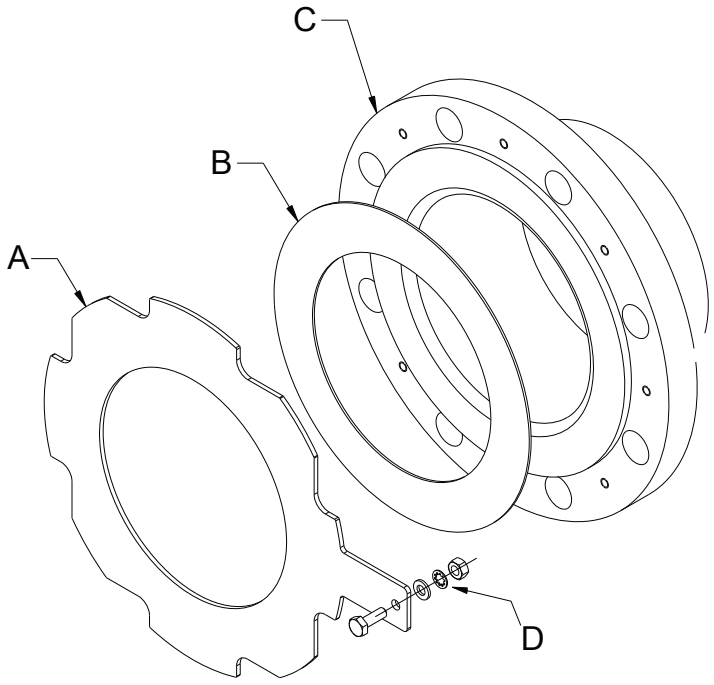
Table 49: Raised face flanged Sensor 3- to 6-in. (75 mm to 150 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
3-in. (80 mm) ASME - 150, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.50 (191)	7.21 (183)	5.82 (148)	5.00 (127)	1.70 (43)	34 (15)
3-in. (80 mm) ASME - 300, SO/RF	8.63 (219)	8.51 (216)	8.63 (219)	8.25 (210)	7.21 (183)	5.82 (148)	5.00 (127)	1.70 (43)	43 (19)
3-in. (80 mm) EN 1092-1 - PN40, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.87 (200)	7.21 (183)	5.82 (148)	5.43 (138)	1.70 (43)	38 (17)
3-in. (80 mm) AS 2129 table D, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.80 (122)	1.70 (43)	24 (11)
3-in. (80 mm) AS 2129 table E, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.80 (122)	1.70 (43)	25 (11)
3-in. (80 mm) JIS - 10K, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.96 (126)	1.70 (43)	28 (13)
3-in. (80 mm) JIS - 20K, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.87 (200)	7.21 (183)	5.82 (148)	5.20 (132)	1.70 (43)	34 (16)
3-in. (80 mm) AS 4087 PN16, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.80 (122)	1.70 (43)	20 (9)
3-in. (80 mm) AS 4087 PN21, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	8.07 (205)	7.21 (183)	5.82 (148)	5.55 (141)	1.70 (43)	56 (25)
3-in. (80 mm) AS 4087 PN35, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	8.07 (205)	7.21 (183)	5.82 (148)	5.55 (141)	1.70 (43)	109 (49)
3-in. (80 mm) GB/T9119 PN40, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.87 (200)	7.21 (183)	5.82 (148)	5.43 (138)	1.70 (43)	37 (17)
4-in. (100 mm) ASME - 150, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.00 (229)	7.91 (201)	6.17 (157)	6.19 (157)	1.70 (43)	45 (20)
4-in. (100 mm) ASME - 300, SO/RF	10.88 (276)	10.73 (273)	10.88 (276)	10.00 (254)	7.91 (201)	6.17 (157)	6.19 (157)	1.70 (43)	65 (29)
4-in. (100 mm) EN 1092-1 - PN16, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.66 (220)	7.91 (201)	6.17 (157)	6.22 (159)	1.70 (43)	41 (19)
4-in. (100 mm) EN 1092-1 - PN40, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.25 (235)	7.91 (201)	6.17 (157)	6.38 (162)	1.70 (43)	49 (22)
4-in. (100 mm) AS 2129 table D, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.46 (215)	7.91 (201)	6.17 (157)	6.06 (154)	1.70 (43)	31 (14)
4-in. (100 mm) AS 2129 table E, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.46 (215)	7.91 (201)	6.17 (157)	6.06 (154)	1.70 (43)	33 (15)
4-in. (100 mm) JIS - 10K, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.27 (210)	7.91 (201)	6.17 (157)	5.95 (151)	1.70 (43)	35 (16)
4-in. (100 mm) JIS - 20K, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.86 (225)	7.91 (201)	6.17 (157)	6.30 (160)	1.70 (43)	44 (20)
4-in. (100 mm) AS 4087 PN16, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.46 (215)	7.91 (201)	6.17 (157)	6.06 (154)	1.70 (43)	28 (13)

Table 54: Flat face sensor 30- to 48-in. (750 mm to 1200 mm) dimensions *(continued)*

Size, description	Length			Dim B	Dim C	Dim D	Liner Ø on face			Dim K	Flow tube wgt (lbs./kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly				Dim J PTFE	Dim J Neoprene	Dim J Poly		
48-in. (1200 mm) AWWA CLASS D, SO/FF	N/A	47.2 (1199)	N/A	59.50 (1511)	55.27 (1404)	29.86 (758)	N/A	59.50 (1511)	N/A	3.38 (86)	1892 (848)

Figure 13: Flanged sensor ½- to 48-in. (15 mm to 1200 mm) grounding ring



A. Grounding ring
B. Customer supplied gasket
C. Flow tube
D. Grounding strap hardware

Table 55: Flanged sensor ½- to 48-in. (15 mm to 1200 mm) grounding ring dimensions

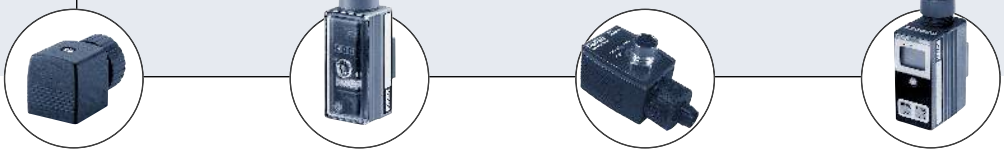
	Single grounding ring thickness		Double grounding ring thickness	
	Min	Max	Min	Max
0.5-in. (15 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
1-in. (25 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
1.5-in. (40 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
2-in. (50 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
2.5-in. (65 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
3-in. (80 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
4-in. (100 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
5-in. (125 mm)	0.059 (1,5)	0.12 (3)	0.12 (3)	0.24 (6,1)

2/2-way Solenoid Valve with servo diaphragm



- Pivoted armature pilot drive with emergency manual operation
- Media separated
- Circuit function can be modified
- Adjustable switching times (waterhammer-free)
- Threaded port or flange connections
- Approvals:

Type 5282 can be combined with...



Type 2508
Cable plug

Type 1078
Timer unit

Type 2511
ASI cable plug

Type 8600
Dosing control

The Type 5282 is a pilot-controlled normally closed solenoid valve with a servo-diaphragm, media separated, for universal use with liquid and gaseous media corresponding to the material resistance. As standard, the 3-way pivoted armature pilot drive has an emergency manual operation. The closing and opening times are continuously adjustable.

Power consumption		
Inrush	Hold	
AC [VA]	AC [VA/W]	DC [W]
24	14/8	8

A differential pressure of 7 PSI (0.5 bar) is required to open the full orifice. The response times can be changed by turning the restrictor screws (in the body cover).

Technical data	
Orifice	1/2" - 2" (DN 13 - 65 mm)
Body material	
Threaded port	Brass, stainless steel 1.4581
Flange	Stainless steel 1.4541
Seal material	NBR, FKM, EPDM (on request)
Media	
NBR	Neutral media, such as compressed air, water, hydraulic oil
EPDM	Oil and fat-free media, incl. alkalis, hot water
FKM	Hot air, oxygen, per-solutions, hot oil
Media temperature	
NBR	14°F to 194°F (-10°C to +90°C)
EPDM	-22°F to 194°F (-30°C to +90°C)
FKM	32°F to 194°F (0°C to +90°C)
Ambient temperature	Max. 131°F (+55°C)
Voltage tolerance	±10%
Duty cycle	100% continuous rating
Electrical connection	Tag connector acc. DIN 43650 Form A for cable plug Type 2508
Protection class	IP 65 with cable plug
Installation	As required, preferably with actuator upright

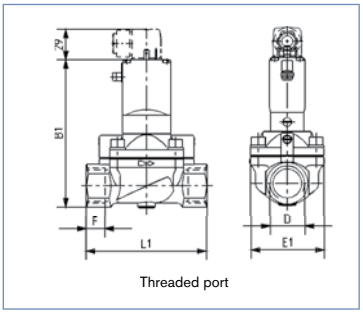
Class 1, Div. 1

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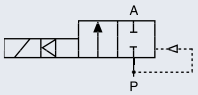
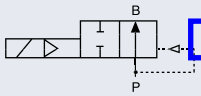
Solenoid valve dimensions

Dimensions [mm]								
Threaded port						Flange port		
DN	D	B1	E1	F	L1	B2	G	L2
13	NPT 1/2	123.0	40	14	65	–	–	–
20	NPT 3/4	131.0	60	16	100	–	–	–
25	NPT 1	141.0	70	18	115	184.5	120	160
32	NPT 1 1/4	147.0	85	20	126	192.0	140	180
40	NPT 1 1/2	156.0	85	22	126	201.0	150	200
50	NPT 2	177.5	115	24	164	225.0	165	230
65	NPT 2 1/2	185.0	115	27	180	–	–	–



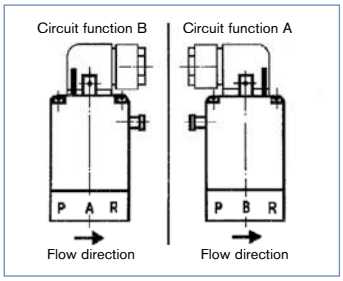
Threaded port

Ordering chart for valves (other versions on request) UL recognized / CSA/ CE
Manual override, supplied without cable plug, different seal materials on request

Circuit function	Orifice [mm]	Port connection [NPT]	Cv value water [GPM]	Nominal pressure [psi]	Voltage/ frequency [V/Hz]	Item no. Seal material NBR Seal Brass Body	Item no. Seal material FKM Seal Stainless Steel Body
A 2/2-way valve, NC 	13.0 (Brass) 20.0 (Stainless steel)	NPT 1/2	4.7	2.8 - 145	024/DC	456 890	456 914
					024/50-60	456 891	456 915
					120/50-60	456 892	456 916
					240/50-60	456 893	456 917
or	20.0	NPT 3/4	5.8	2.8 - 145	024/DC	456 894	456 918
					024/50-60	456 895	456 919
B 2/2-way valve, NO					120/50-60	456 896	456 920
					240/50-60	456 897	456 921
	25.0	NPT 1	11.7	2.8 - 145	024/DC	456 898	456 922
					024/50-60	456 899	456 923
					120/50-60	456 900	456 924
					240/50-60	456 901	456 925
	32.0	NPT 1 1/4	23.5	2.8 - 145	024/DC	456 902	456 926
					024/50-60	456 903	456 927
					120/50-60	456 904	456 928
					240/50-60	456 905	456 929
	40.0	NPT 1 1/2	23.5	2.8 - 145	024/DC	456 906	456 930
					024/50-60	456 907	456 931
					120/50-60	456 908	56 932
					240/50-60	456 909	456 933
	50.0	NPT 2	47.0	2.8 - 145	024/DC	456 910	456 934
					024/50-60	456 911	456 935
					120/50-60	456 912	456 936
					240/50-60	456 913	456 937

Delivered as circuit function A
Change to the circuit function B by turning the pilot drive through 180°

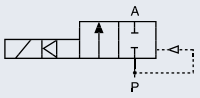
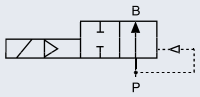
Mounting instructions:
Arrangement of the pilot control



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Solenoid valve ordering chart

Ordering chart for valves (other versions on request) UL listed / FM class / Division 2 / CSA / CE
Manual override, supplied with cable plug type 2509, different seal materials on request

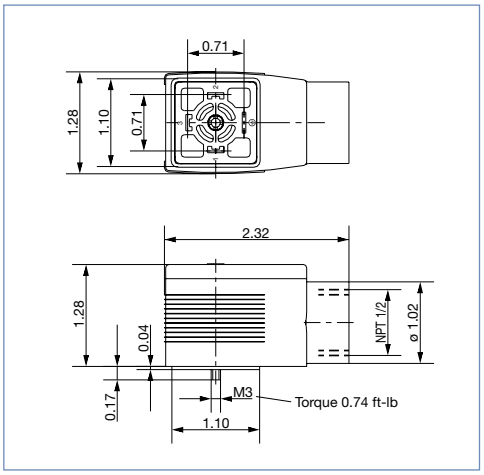
Circuit function	Orifice [mm]	Port connection [NPT]	Cv value water [GPM]	Pressure range [psi]	Voltage/ frequency [V/Hz]	Item no. Threaded port NBR Brass	Item no. Threaded port FKM Stainless Steel
A 2/2-way valve NC 	13.0 (Brass) 20.0 (Stainless steel)	NPT 1/2	4.7	2.8 - 145	024/DC	457 870	457 894
					024/50-60	457 871	457 895
					120/50-60	457 872	457 896
					240/50-60	457 873	457 897
or	20.0	NPT 3/4	5.8	2.8 - 145	024/DC	457 874	457 898
					024/50-60	457 875	457 899
B 2/2-way valve NO 					120/50-60	457 876	457 900
					240/50-60	457 877	457 901
	25.0	NPT 1	11.7	2.8 - 145	024/DC	457 878	457 902
					024/50-60	457 879	457 903
					120/50-60	457 880	457 904
					240/50-60	457 881	457 905
	32.0	NPT 1 1/4	23.5	2.8 - 145	024/DC	457 882	457 906
					024/50-60	457 883	457 907
					120/50-60	457 884	457 908
					240/50-60	457 885	457 909
	40.0	NPT 1 1/2	23.5	2.8 - 145	024/DC	457 886	457 910
					024/50-60	457 887	457 911
					120/50-60	457 888	457 912
					240/50-60	457 889	457 913
	50.0	NPT 2	47.0	2.8 - 145	024/DC	457 890	457 914
					024/50-60	457 891	457 915
					120/50-60	457 892	457 916
					240/50-60	457 893	457 917

Delivered as circuit function A

Change to circuit function B by turning the pilot drive through 180°.

NOTE: All UL listed valves include type 2509 1/2“ conduit cable plug

Type 2509 Dimensions [mm]

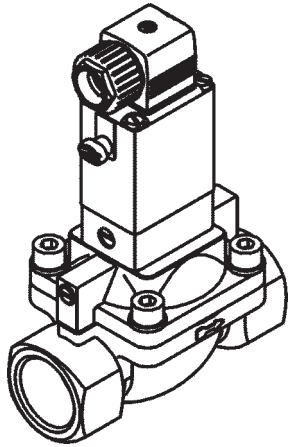


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Oper ating instructions

Type 5282

2/2-way solenoid valve with servo-membrane



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Sicherheit (D)

Bestimmungsgemäße Verwendung

Bitte beachten Sie die Hinweise dieser Betriebsanleitung sowie die Einsatzbedingungen und zulässigen Daten gemäß Datenblatt Typ 5282, damit das Gerät einwandfrei funktioniert und lange einsatzfähig bleibt. Bei Nichtbeachtung dieser Hinweise sowie bei unzulässigen Eingriffen in das Gerät entfällt jegliche Haftung unsererseits, ebenso erlischt die Garantie auf Geräte- u. Zubehörteile! Das Gerät dient ausschließlich als 2/2-Wege-Magnetventil für die lt. Datenblatt zulässigen Medien. Eine andere oder darüber hinausgehende Benutzung gilt als ***nicht bestimmungsgemäß***. Für hieraus resultierende Schäden haftet Bürkert nicht. Das Risiko trägt allein der Anwender.

ACHTUNG!

- **Halten Sie sich bei Einsatzplanung und Betrieb des Gerätes an die einschlägigen allgemein anerkannten sicherheitstechnischen Regeln.**
- **Treffen Sie geeignete Maßnahmen, um unbeabsichtigtes Betätigen oder unzulässige Beeinträchtigungen auszuschließen.**
- **Beachten Sie, daß in Systemen, die unter Druck stehen, Leitungen und Ventile nicht gelöst werden dürfen. Schalten Sie vor Eingriffen in das System in jedem Fall die Spannung ab!**
- **Achten Sie auf den einwandfreien Sitz der Dichtung beim Verschrauben der Spule mit der Gerätesteckdose.**
- **Verstellen Sie auf keinen Fall die mit roter Farbe gesicherten Schrauben!**
- **Bei Ausführungen mit Explosionsschutz sind zusätzlich die Angaben der Konformitätsbescheinigung PTB Nr. Ex-89.C.1041 zu beachten .**

Warnung!

- **Verletzungsgefahr! Bei Dauerbetrieb kann die Spule sehr heiß werden.**

Safety (GB)

Proper Usage

To ensure the proper function of the device and promote long service lift, you must comply with the information in these Operating Instructions and the application conditions and specifications provided in the Type 5282 Data Sheet. Usage of the device in a manner that is contrary to these Operating Instructions or the application conditions and specifications provided in the Type 5282 Data Sheet is improper and will void your warranty. This device serves exclusively as a 2/2-way solenoid valve for the media stated to be permissible on the data sheet. Any other use is considered improper use. ***Bürkert will not be responsible for any improper use of the device.***

ATTENTION!

- **Be sure to observe generally accepted safety rules when planning, installing and using this device. For example, take suitable measures to prevent unintentional operations of the device.**
- **Do not impair the operation of the device.**
- **Do not attemp to detach or unscrew any lines or valves in the system that are under pressure, and always be sure to switch off the voltage supply before working on the system.**
- **When attaching the coil to the plug socket, be sure the seal is properly seated.**
- **Never adjust the screws which are sealed with red paint, for any reason!**
- **For explosion-proof models, data from the conformity certificate PTB No. Ex-89.C.1041 must also be complied with!**

WARNING!

- **Do not touch the coil during use as it becomes very hot.**

Sécurité (F)

Utilisation conforme aux prescriptions

Afin que l'appareil puisse fonctionner parfaitement et pendant longtemps, veuillez observer les instructions contenues dans cette notice d'utilisation ainsi que les conditions d'utilisation et les données admissibles mentionnées dans la fiche technique du type 5282. En cas d'inobservation de ces instructions et d'interventions non autorisées dans l'appareil, nous déclinons toute responsabilité et la garantie couvrant l'appareil et les accessoires s'éteint! L'appareil sert uniquement d'électrovanne 2/2 voies pour les fluides admis selon la fiche technique. Une autre utilisation ou une utilisation excédant ce contexte sera considérée comme ***non conforme aux prescriptions***. Pour les dommages qui en résulteraient, le fabricant/fournisseur décline toute responsabilité. L'utilisateur seul en assume le risque.

ATTENTION!

- **Pour la planification de l'utilisation et l'exploitation de l'appareil, veuillez vous en tenir aux règles applicables et généralement reconnues en matière de technique de sécurité.**
- **Prenez les mesures nécessaires pour exclure tout actionnement involontaire ou des altérations inadmissibles.**
- **Notez qu'il n'est pas permis de desserrer des conduites ou des vannes se trouvant sous pression dans des systèmes! Avant d'intervenir dans le système, coupez l'alimentation électrique dans tous les cas!**
- **Veillez à ce que le joint repose parfaitement lorsque vous visserez la bobine avec le connecteur.**
- **Ne dérégler en aucun cas les vis assurées avec de la peinture rouge!**
- **Dans les exécutions antidéflagrantes, les indications de l'attestation de conformité PTB N° Ex-89.C.1041 doivent observées en plus.**

AVERTISSEMENT!

- **Risque de blessure! En cas de fonctionnement permanent, la bobine peut devenir très chaude.**

Seguridad (E)

Utilización con arreglo a las disposiciones

Se ruega observar las indicaciones contenidas en este Manual de instrucciones así como las condiciones de uso y datos admisibles con arreglo a la hoja de servicio Tipo 5282, de modo que el aparato funcione impecablemente y permanezca durante largo tiempo apto para el empleo. La inobservancia de estas indicaciones así como las intervenciones inadmisibles en el aparato suponen la declinación por nuestra parte de toda clase de responsabilidad, además de la extinción de la garantía de los aparatos y de las piezas de los accesorios. El aparato sirve exclusivamente como válvula magnética de 2/2 pasos para los medios autorizados según la hoja de datos. Cualquier otra utilización que vaya más e*lla* ***no será conforme a las disposiciones*** al fabricante / suministrador no es responsable de los daños que de ello pudieran resul-tar. El riesgo corresponde únicamente al usuario.

ATENCIÓN!

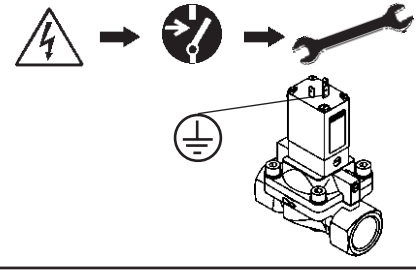
- **Para la planificación y operación del aparato ate-nerse a las correspondientes reglas generales y re-conocidas de la técnica de seguridad.**
- **Tomar las medidas apropiadas para excluir accionamientos no intencionados o perjuicios inadmisibles; prestar atención a que en el caso de sistemas que se encuentren bajo presión no deben desconec-tarse conducciones y válvulas.**
- **Antes de proceder a intervenciones en el sistema desconectar siempre la tensión.**
- **Prestar atención al asiento impecable de la empaquetadura al atornillar la válvula con la caja de enchufe para aparatos eléctricos.**
- **En ningún caso desajustar los tornillos asegurados con color rojo!**
- **En las ejecuciones con protección debe tenerse adicionalmente en cuenta los datos de la declaración de conformidad PTB n° Ex-89.C.1041.**

¡AVISO!

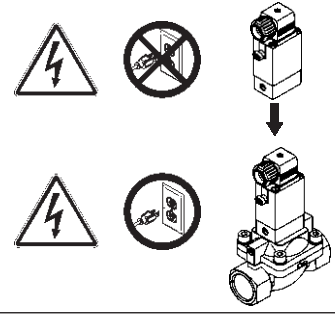
- **¡Peligro de lesiones! En estado de operación continua la bobina puede ponerse muy caliente.**

Safety (D) (GB) (F) (E)

① Voltage-free assembly



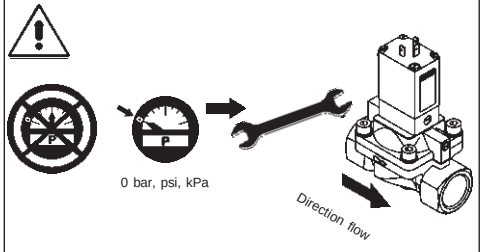
② Electrical connection



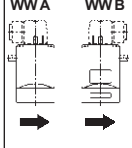
D GB F E

Safety

③ Fluid connection



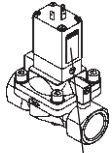
④ Conversion from Function A to Function B



After carrying out to conversion to circuit function B, re-label the unit.

D GB

Technical Data



Temperature



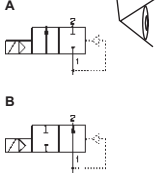
Messing/brass

Sealing material	Temp. Medium
NBR	0 .. +80 °C
EPDM	-30 .. +90 °C
FPM	-10 .. + 50 °C

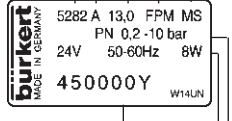
Nominal size

Circuit function

Type



Example



Id. No.

Voltage (±10 %) - Frequenc y - Power

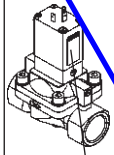
Nominal pressure

We reserve the right to make technical changes without notice

Technische Daten

F E

Caractéristiques techniques / Datos técnicos



Température d' ambiante
Temperatura de ambiente



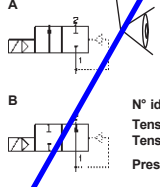
Boîtier/Caja
Laiton/Latón
Acier fin/Acero inoxidable

Matériau d'étanchéité / Material de estanqueidad	Temp. Fluide/Medio
NBR	0 .. +80 °C
EPDM	-30 .. +90 °C
FPM	-10 .. + 50 °C

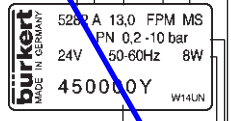
Dimension nominale
Anchura nominal

Fonctionnement
Funcionamiento

Type/Tipo



Exemple/
Ejemplo



N° id. / N° de pedido

Tension (±10%) - fréquence - puissance
Tensión (±10 %) - frecuencia - potencia

Pression nominale/Presión nominal

Sous reserve de modification techniques.
Nos reservamos el derecho de llevar a cabo modificaciones tècnicas sin previo aviso.

Branch Offices

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Fax (0 79 40) 10-204

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Dresden	Ph: (0 35 92) 36 30 - 0
Frankfurt	Ph: (0 61 03) 94 14 - 0
Hannover	Ph: (05 11) 9 02 76 - 0
München	Ph: (0 89) 82 92 28 - 0
Stuttgart	Ph: (07 11) 4 51 10 - 0

BÜRKERT INTERNATIONAL

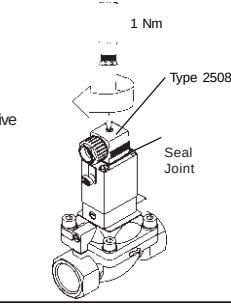
A	Ph.	(01) 894 13 33	Fax	(01) 894 13 00
AUS	Ph.	(02) 96 74 61 66	Fax	(02) 96 74 61 67
B	Ph.	(03) 325 89 00	Fax	(03) 325 61 61
CDN	Ph.	(0905) 847 55 66	Fax	(0905) 847 90 06
CH	Ph.	(041) 785 66 66	Fax	(041) 785 66 33
CN	Ph.	(0512) 808 19 16	Fax	(0512) 824 51 06
CZ	Ph.	(0641) 22 61 80	Fax	(0641) 22 61 81
DK	Ph.	(044) 50 75 00	Fax	(044) 50 75 75
E	Ph.	(093) 371 08 58	Fax	(093) 371 77 44
F	Ph.	(01) 48 10 31 10	Fax	(01) 48 91 90 93
GB	Ph.	(01453) 73 13 53	Fax	(01453) 73 13 43
HKG	Ph.	(02) 24 80 12 02	Fax	(02) 24 18 19 45
I	Ph.	(02) 95 90 71	Fax	(02) 95 90 72 51
IRE	Ph.	(021) 86 13 36	Fax	(021) 86 13 37
J	Ph.	(03) 53 05 36 10	Fax	(03) 53 05 36 11
KOR	Ph.	(02) 34 62 55 92	Fax	(02) 34 62 55 94
MAL	Ph.	(04) 657 64 49	Fax	(04) 657 21 06
N	Ph.	(063) 84 44 10	Fax	(063) 84 44 55
NL	Ph.	(0346) 58 10 10	Fax	(0346) 56 37 17
NZ	Ph.	(09) 570 25 39	Fax	(09) 570 25 73
PL	Ph.	(022) 827 29 00	Fax	(022) 6 27 47 20
RC	Ph.	(02) 27 58 31 99	Fax	(02) 27 58 24 99
S	Ph.	(040) 664 51 00	Fax	(040) 664 51 01
SA	Ph.	(011) 397 29 00	Fax	(011) 397 44 28
SF	Ph.	(09) 54 97 06 00	Fax	(09) 503 12 75
SIN	Ph.	383 26 12	Fax	383 26 11
TR	Ph.	(0232) 459 53 95	Fax	(0232) 459 76 94
USA	Ph.	(0949) 223 31 00	Fax	(0949) 223 31 98

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info@de.buerkert.com

Betriebsanleitung-Nr. 803 322 - ind 06/may00 05/00/10'M

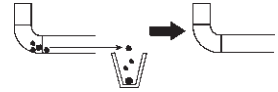
Assembly

① Instrument socket

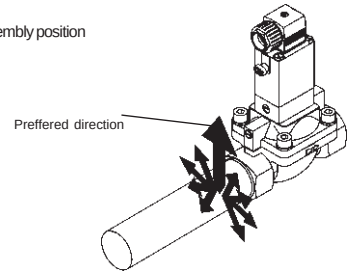


Always connect the protective

② Cleaning the piperuns



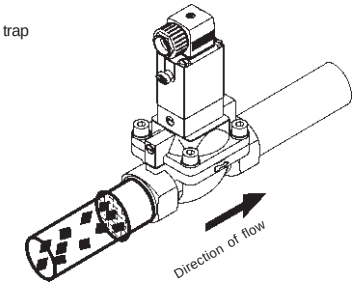
③ Any assembly position



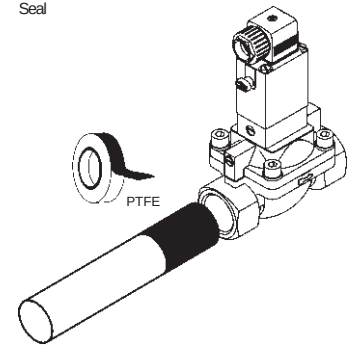
D GB F E

Assembly

④ Dirt trap

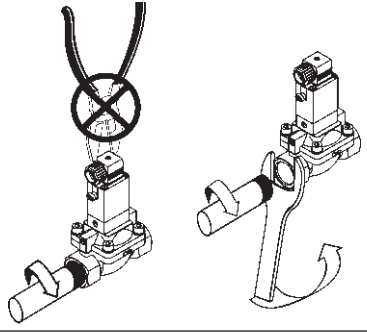


⑤ Seal

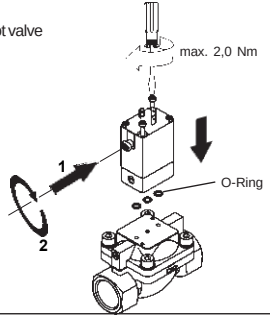


Assembly

⑥ Screwing in the pipe connections



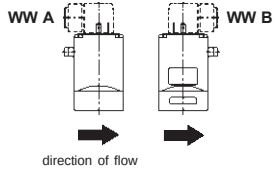
⑦ Assembly of pilot valve



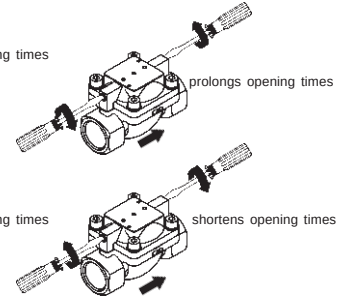
D GB F E

Assembly

⑧ Configuration of the pilot control



⑧ Opening and closing times



Do not move screws that are locked with red paint!

D GB F E

Troubleshooting

Check the voltage!

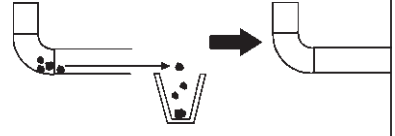


Check the pressure!



bar, psi, kPa

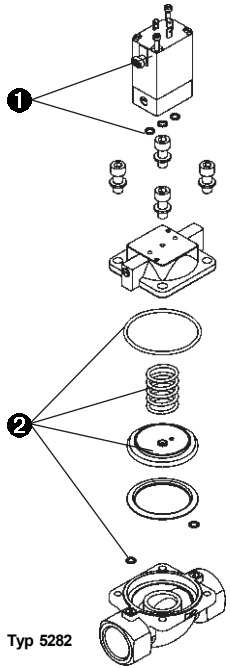
Check the piperun!



Spare parts

❶ D GB Set of pilot controls

❷ D GB Set of Wearing Parts



Spare parts

❶ Set of pilot controls

Sealing material	Voltage	Order no. \ \	\ \ \
NBR	24 V/DC	138 109 A	138 117 R
NBR	24 V/56 Hz	138 112 L	138 114 N
NBR	110 V/56 Hz	138 111 K	138 115 P
NBR	230 V/56 Hz	138 110 W	138 116 Q
FPM	24 V/DC	138 120 Y	138 129 V
FPM	24 V/56 Hz	138 122 N	138 124 Q
FPM	110 V/56 Hz	138 123 P	138 126 J
FPM	230 V/56 Hz	138 118 S	138 125 R
EPDM	24 V/DC	138 100 D	138 106 X
EPDM	24 V/56 Hz	138 095 P	138 104 V
EPDM	110 V/56 Hz	138 096 Q	138 103 U
EPDM	230 V/56 Hz	138 097 R	138 101 S

❶ Set of pilot controls

NBR	24 V/DC	138 109 A	-
NBR	24 V/56 Hz	138 112 L	-
NBR	100 V/56 Hz	138 108 H	-
NBR	110 V/56 Hz	138 111 K	-
NBR	200 V/56 Hz	138 107 T	-
NBR	230 V/56 Hz	138 110 W	-
FPM	24 V/DC	-	138 129 V
FPM	24 V/56 Hz	-	138 124 Q
FPM	100 V/56 Hz	-	138 128 U
FPM	110 V/56 Hz	-	138 126 J
FPM	200 V/56 Hz	-	138 127 K
FPM	230 V/56 Hz	-	138 125 R

❷ Set ofWearing Parts

\ DN \	\ Sealing material	Order no.	
13	NBR	624 031 M	-
13	FPM	624 032 N	-
13	EPDM	624 033 P	-
20	NBR	624 034 Q	624 037 K
20	FPM	624 035 R	624 038 U
20	EPDM	624 036 J	624 039 V
25	NBR	624 040 A	624 043 Z
25	FPM	624 041 X	624 044 S
25	EPDM	624 042 Y	624 045 T
32, 40	NBR	624 046 U	624 049 F
32, 40	FPM	624 047 V	624 050 C
32, 40	EPDM	624 048 E	624 051 Z
50, 65	NBR	624 052 S	624 055 V
50, 65	FPM	624 053 T	624 056 W
50, 65	EPDM	624 054 U	624 057 X

SPRAY BAR PROXIMITY SENSOR

(2x) NAMUR NG5003

APPENDIX INFORMATION

efector100

ifm electronic

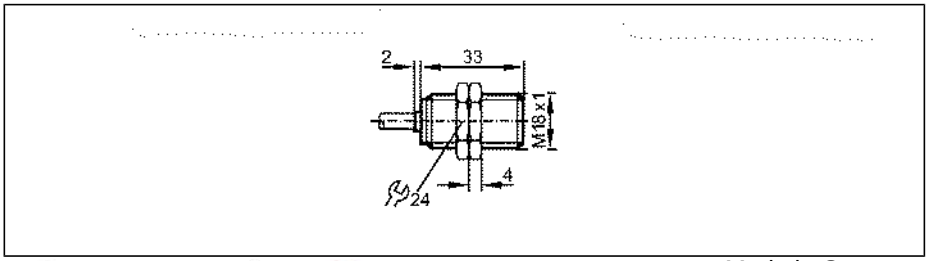
Inductive sensors
NAMUR EN 60947-5-6 ⟨Ex⟩

NG5003

IG-2008-N/1D/2G
Inductive sensor
Plastic thread M18 x 1
Cable

ATEX approval
Group II, category 1D
Group II, category 1G/2G

Sensing range 8mm [nf]
non-flush mountable



Made in Germany

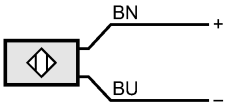
Electrical design Output		Connection to certified intrinsically safe circuits with the max. values U = 15 V / I = 50 mA / P = 120 mW normally closed
Nominal voltage	[V]	8.2 DC (1kΩ)
Supply voltage	[V]	7.5...30 DC when used outside the hazardous area
Current rating	[mA]	< 30 when used outside the hazardous area
Current consumption	[mA]	< 1 *)
Internal capacitance	[nF]	< 155
Internal inductance	[µH]	< 50
Real sensing range (Sr)	[mm]	8 ± 10 %
Switch-point drift	[% of Sr]	-10...10
Hysteresis	[% of Sr]	1...15
Switching frequency	[Hz]	300
Correction factors		mild steel = 1 / stainless steel approx. 0.7 / brass approx. 0.5 / Al approx. 0.4 / Cu approx. 0.3
Ambient temperature	[°C]	-20...80
Protection		IP 67, II
Shock / vibration resistance		30g (11 ms) / 10-55 Hz (1 mm)
EMC		EN 60947-5-6
Approval		PTB 01 ATEX 2191 BVS 04 ATEX E153 TIIS TC16108
Marking of the unit		⟨Ex⟩II 1D Ex iaD 20 T 90°C Ta: -20...70°C ⟨Ex⟩II 1D Ex iaD 20 T 100°C Ta: -20...80°C ⟨Ex⟩II 1G Ex ia IIB T6 Ta: -20...55°C ⟨Ex⟩II 1G Ex ia IIB T5 Ta: -20...65°C ⟨Ex⟩II 2G Ex ia IIC T6 Ta: -20...70°C ⟨Ex⟩II 2G Ex ia IIC T5 Ta: -20...80°C
Housing materials		PBT
Connection		PVC cable / 2 m; 2 x 0.5 mm²
Weight	[kg]	0.148
Remarks		*) damped; (> 2.1 mA undamped)
Accessories (included)		2 lock nuts

NG5003

Wiring

Core colors

BN	brown
BU	blue



SPRAY BAR NOZZLES

LECHLER SERIES 632

APPENDIX INFORMATION



Flat fan nozzles

Belt cleaning
Coating
Steam cleaning
Degreasing
High pressure cleaning
Gravel washing
Cooling
Surface treatment
Phosphating
Rain curtains
Foam control
Foam spraying
Lubrication
Filter cleaning
Spray cleaning
Washing processes
and many others...

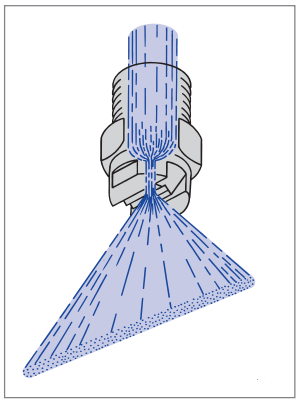
Flat fan nozzles

Lechler flat fan nozzles stand for uniform liquid distribution and jet pressures. Particularly powerful jets are generated with spray angles up to 60°. Nozzles with small flow rates are especially suited for humidifying and spraying in general. The flow geometry of the nozzle allows to produce accurate, compact jets, available with different liquid distribution patterns.

Basically, Lechler flat fan nozzles are designed for parabolic liquid distribution. Unaffected by transient pressures, they are suited for universal application. Their performance data are exactly defined. Operational values, such as flow rates, spray width, jet thickness and liquid distribution are readily available for a great variety of feed pressures. There are also special-design nozzles with rectangular or trapezoidal distribution of liquid.

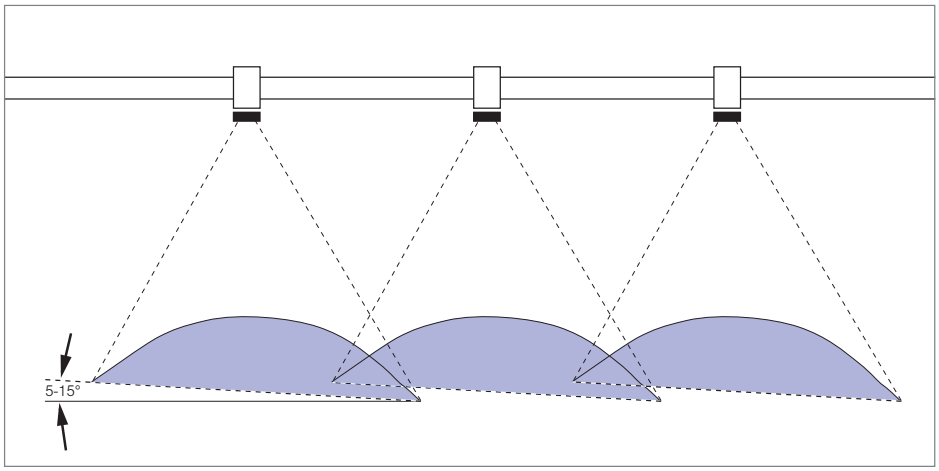
Simple and cost-saving fixing attachments, as for instance dove-tail guides and eyelet clamps, considerably facilitate assembling and aligning of the nozzles.

For all cleaning operations, in steelmaking and in many other fields of surface treatment, in short, wherever powerful, uniform water jets are required, Lechler flat fan nozzles constitute a decisive basis for achieving reliable process results.

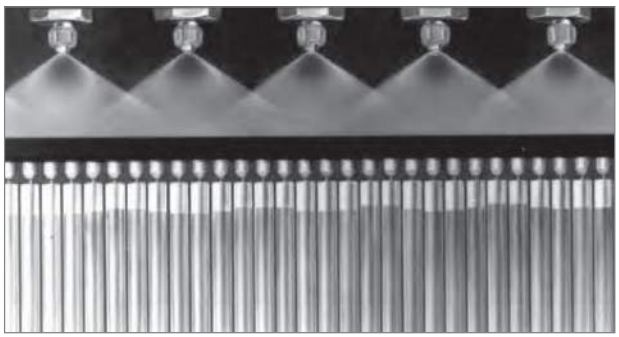


The **tongue-type nozzle** design represents a special kind of flat fan nozzle. With this nozzle type, the flat fan spray pattern is produced by a solid stream, impinging upon and deflecting from an outside deflector plate. As a result, a powerful, sharply delimited flat jet is shaped.
The deflector plate has the form of a tongue, which determines the spray angle formation. Due to large free cross-sections, tongue-type nozzles are particularly clog-proof.

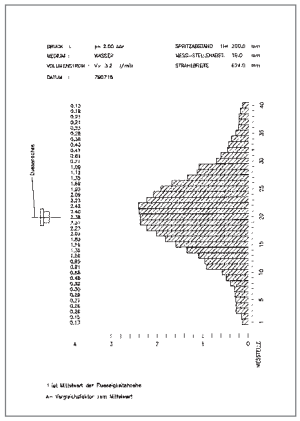




Arrangement of nozzles



Total liquid distribution



Liquid distribution
single nozzle

Flat fan nozzles

Series 632

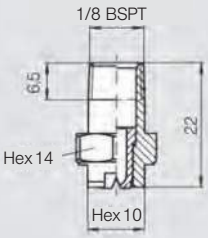


Standard design with conical, self-sealing thread connection. Stable spray angle. Uniform, parabolical distribution of liquid. Spray pipes equiped with these nozzles show an extremely uniform total distribution of liquid.

Applications:
Spray cleaning, surface treatment, filter cleaning, belt cleaning, lubricating, coating.



PVDF



Weight brass: 17 g

Conversion formula for the above series: $\dot{V}_2 = \dot{V}_1 * \sqrt{\frac{p_2}{p_1}}$

Flat fan nozzles

Series 632



Spray angle	Ordering no. Type	Material-no. 16 1.4305/303 SS	17 1.4571/316 SS	30 Brass	5E PVDF	Code 1/8 BSPT	1/4 BSPT	A Ø [mm]	E Ø [mm]	V̇ [l/min] p [bar] 0,5	1,0	2,0	[US gal./min] at 40 psi	3,0	5,0	10,0	Spray width B at p = 2 bar H= 250 mm	H= 500 mm
60°	632. 304	○	○	○	○	CA	CC	0,70	0,40	0,16*	0,23*	0,32	0,10	0,39	0,51	0,72	215	425
	632. 334	○	○	○	○	CA	CC	0,90	0,50	0,22*	0,32*	0,45	0,14	0,55	0,71	1,01	220	440
	632. 364	○	○	○	○	CA	CC	1,00	0,60	0,31*	0,44*	0,63	0,20	0,77	1,00	1,40	230	460
	632. 404	○	○	○	○	CA	CC	1,20	0,80	0,50*	0,71	1,00	0,31	1,23	1,58	2,24	245	485
	632. 444	○	○	○	○	CA	CC	1,35	0,90	0,62*	0,88	1,25	0,39	1,53	1,98	2,80	255	495
	632. 484	○	○	○	○	CA	CC	1,50	1,00	0,80*	1,13	1,60	0,50	1,96	2,53	3,58	260	510
	632. 514	○	○	○	○	CA	CC	1,65	1,10	0,95*	1,34	1,90	0,59	2,33	3,00	4,25	270	520
	632. 564	○	○	○	○	CA	CC	2,00	1,30	1,25	1,77	2,50	0,78	3,06	3,95	5,59	280	535
	632. 604	○	○	○	○	CA	CC	2,20	1,50	1,58	2,23	3,15	0,98	3,86	4,98	7,04	290	550
	632. 644	○	○	○	-	-	CC	2,50	1,60	2,00	2,83	4,00	1,24	4,90	6,33	8,94	295	565
	632. 674	○	○	○	-	-	CC	2,70	1,80	2,38	3,36	4,75	1,47	5,82	7,51	10,62	300	575
	632. 724	○	○	○	-	-	CC	3,00	2,10	3,15	4,46	6,30	1,95	7,72	9,96	14,09	305	590
	632. 764	○	○	○	-	-	CC	3,50	2,30	4,00	5,66	8,00	2,48	9,80	12,65	17,89	310	595
	632. 804	○	-	○	-	-	CC	4,00	2,60	5,00	7,07	10,00	3,10	12,25	15,81	22,36	310	595
	632. 844	○	-	○	-	-	CC	4,50	3,00	6,25	8,84	12,50	3,88	15,31	19,76	27,95	310	590
	632. 884	○	-	○	-	-	CC	5,00	3,40	8,00	11,31	16,00	4,96	19,60	25,30	35,78	300	570
	632. 944	-	-	○	-	-	CC	5,70	4,40	11,20	15,84	22,40	6,95	27,43	35,42	50,09	300	570
75°	632. 145	○	-	○	-	CA	CC	0,16	0,30	-	0,04*	0,05	0,02	0,06	0,08	0,11	280	550
	632. 165	○	-	○	-	CA	CC	0,20	0,34	-	0,05*	0,07	0,02	0,08	0,10	0,15	290	560
	632. 185	○	-	○	-	CA	CC	0,35	0,20	-	0,06*	0,08*	0,02	0,10	0,13	0,18	300	575
	632. 215	○	-	○	-	CA	CC	0,40	0,20	-	0,08*	0,11	0,03	0,14	0,18	0,25	300	580
	632. 245	○	-	○	-	CA	CC	0,50	0,30	-	0,12*	0,16*	0,05	0,20	0,26	0,36	310	585
	632. 275	○	-	○	-	CA	CC	0,60	0,30	0,11*	0,16*	0,22	0,07	0,27	0,35	0,49	310	590
90°	632. 216	○	-	○	-	CA	CC	0,40	0,20	-	0,08*	0,11*	0,03	0,14	0,18	0,25	370	700
	632. 276	○	-	○	-	CA	CC	0,60	0,30	0,11*	0,16*	0,22	0,07	0,27	0,35	0,49	375	720
	632. 306	○	○	○	○	CA	CC	0,70	0,40	0,16*	0,23*	0,32	0,10	0,39	0,51	0,72	380	740
	632. 336	○	○	○	○	CA	CC	0,90	0,50	0,22*	0,32*	0,45	0,14	0,55	0,71	1,01	415	800
	632. 366	○	○	○	○	CA	CC	1,00	0,50	0,31*	0,44*	0,63	0,20	0,77	1,00	1,41	420	810
	632. 406	○	○	○	○	CA	CC	1,20	0,70	0,50*	0,71	1,00	0,31	1,23	1,58	2,24	430	820
	632. 446	○	○	○	○	CA	CC	1,35	0,80	0,62*	0,88	1,25	0,39	1,53	1,98	2,80	435	830
	632. 486	○	○	○	○	CA	CC	1,50	0,80	0,80*	1,13	1,60	0,50	1,96	2,53	3,58	440	835
	632. 516	○	○	○	○	CA	CC	1,65	0,90	0,95*	1,34	1,90	0,59	2,33	3,00	4,25	440	840
	632. 566	○	○	○	○	CA	CC	2,00	1,10	1,25	1,77	2,50	0,78	3,06	3,95	5,59	445	850
	632. 606	○	○	○	○	CA	CC	2,20	1,20	1,58	2,23	3,15	0,98	3,86	4,98	7,04	450	860
	632. 646	○	○	○	-	-	CC	2,50	1,30	2,00	2,83	4,00	1,24	4,90	6,33	8,94	455	865
	632. 676	○	○	○	-	-	CC	2,70	1,40	2,38	3,36	4,75	1,47	5,82	7,51	10,62	465	875
	632. 726	○	○	○	-	-	CC	3,00	1,70	3,15	4,46	6,30	1,95	7,72	9,96	14,09	470	885
	632. 766	○	○	○	-	-	CC	3,50	1,90	4,00	5,66	8,00	2,48	9,80	12,65	17,89	475	890
	632. 806	○	-	○	-	-	CC	4,00	2,40	5,00	7,07	10,00	3,10	12,25	15,81	22,36	480	900
	632. 886	○	-	○	-	-	CC	5,00	3,10	8,00	11,31	16,00	4,96	19,60	25,30	35,78	480	910

A = Equivalent bore diameter · E = narrowest free cross section
*Differing spray pattern
Subject to technical modifications.

Continued on next page.

Example for ordering:	Type	+	Material no.	+	Code	=	Ordering no.
	632. 304.	+	16	+	CA	=	632. 304. 16. CA

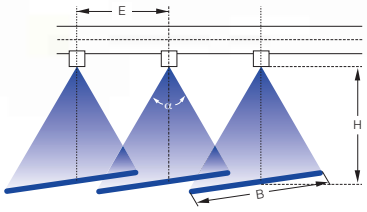
The folded page at the end of the catalogue will give you a survey on the various assembly possibilities.
For complete assembly accessories, please refer to „Accessories“.

Conversion formula for the above series: $\dot{V}_2 = \dot{V}_1 * \sqrt{\frac{p_2}{p_1}}$

Examples for nozzle arrangement.

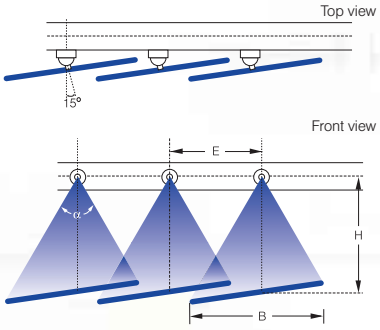
Arrangement of flat fan nozzles with parabolic liquid distribution

Lechler flat fan nozzles provide a consistent, uniform coverage over the impact area. For this purpose, the spray widths B ought to overlap each other by 1/3 to 1/4. To avoid interferences of the sprays, the nozzle orifices must be offset 5°-15° to the pipe axis.



Alignment of tongue-type Nozzles

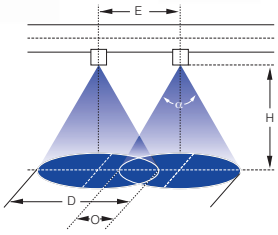
Lechler tongue-type nozzles have a rectangular liquid distribution. In order to achieve an even surface coverage the nozzles need to be aligned in such a way that spray widths B overlap by 50%. Therefore the nozzles should be inclined in an angle of 15° to the vertical of the horizontal axis of the tube (either with a weld base at an angle or a Lechler ball joint nozzle mount) in order to prevent a disturbance of the spray.



Arrangement of full cone and hollow cone nozzles

For full cone and hollow cone nozzles, the distance E should be sized so that the spray cones overlap by about 1/3 to 1/4.

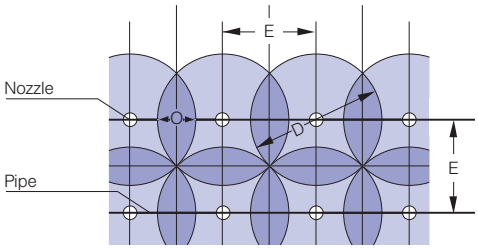
O = Overlap of spray angles
D = Spray diameter
E = Nozzle distance
H = Installation distance of nozzles
α = Spray angle



Working aids

Square or offset arrangement of full cone or hollow cone nozzles

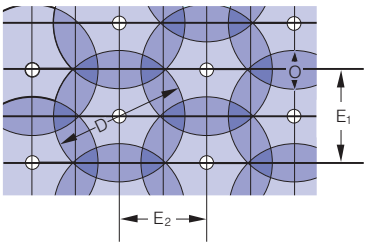
Square arrangement



Nozzle distance: $E = \frac{D}{\sqrt{2}}$

Overlap: $O = D - E$

Offset arrangement



Nozzle distance: $E_1 = \frac{D}{2} \times \sqrt{3}$

Nozzle distance: $E_2 = \frac{3}{4} D$

Overlap: $O = D - E_1$

APPENDIX INFORMATION

SK01F-63S/6 CUS



Gearmotors

Description	Material
Product name	Helical geared motor
Motor Type	CUS
Motor speed	1.050 1/min
Ratio	111,60
Output speed	9,400 1/min
Service factor	1,00
Output Torque M2 (Nm)	91,30
Power (kW)	0,090
Voltage (V)	265/460
Frequency (Hz)	60
Mode of operation	S1
Type of enclosure	IP66
Insulation Class	F
Nominal current 1 (AMP)	0,80
Nominal current 2 (AMP)	0,46
Cosinus 1	0,62
Environmental temp. motor	40°C
Mounting pos. of the gearbox	M4
Tilted mounting position	M6-45-M1
second tilted mounting pos.	M4-60-M1
Type of housing	Flange B5
Shaft dimension	17X30
Part no. special output shaft	000000000050134940
Flange diameter (mm)	120
Breather	Spring-loaded breather
Type of motor connection	Star; High Voltage
Position of terminal box	2/I
Lubricant type	ISO VG 220 mineral oil
class oil	CLP 220
Colour	RAL 5015 Sky blue
Paint type	Standard paint
Painting instruction Old	Paint coat 3.2 standard
Extra work Old	Sealing
Nameplate/Terminalbox	GNP+MNP+TB Std (VA)
CE Logo	Yes
CCC Logo	No
Weight	approx. 13 KG /PC

Motor Data Sheet

3 phase motor	Motor type: **63S/6 CUS**

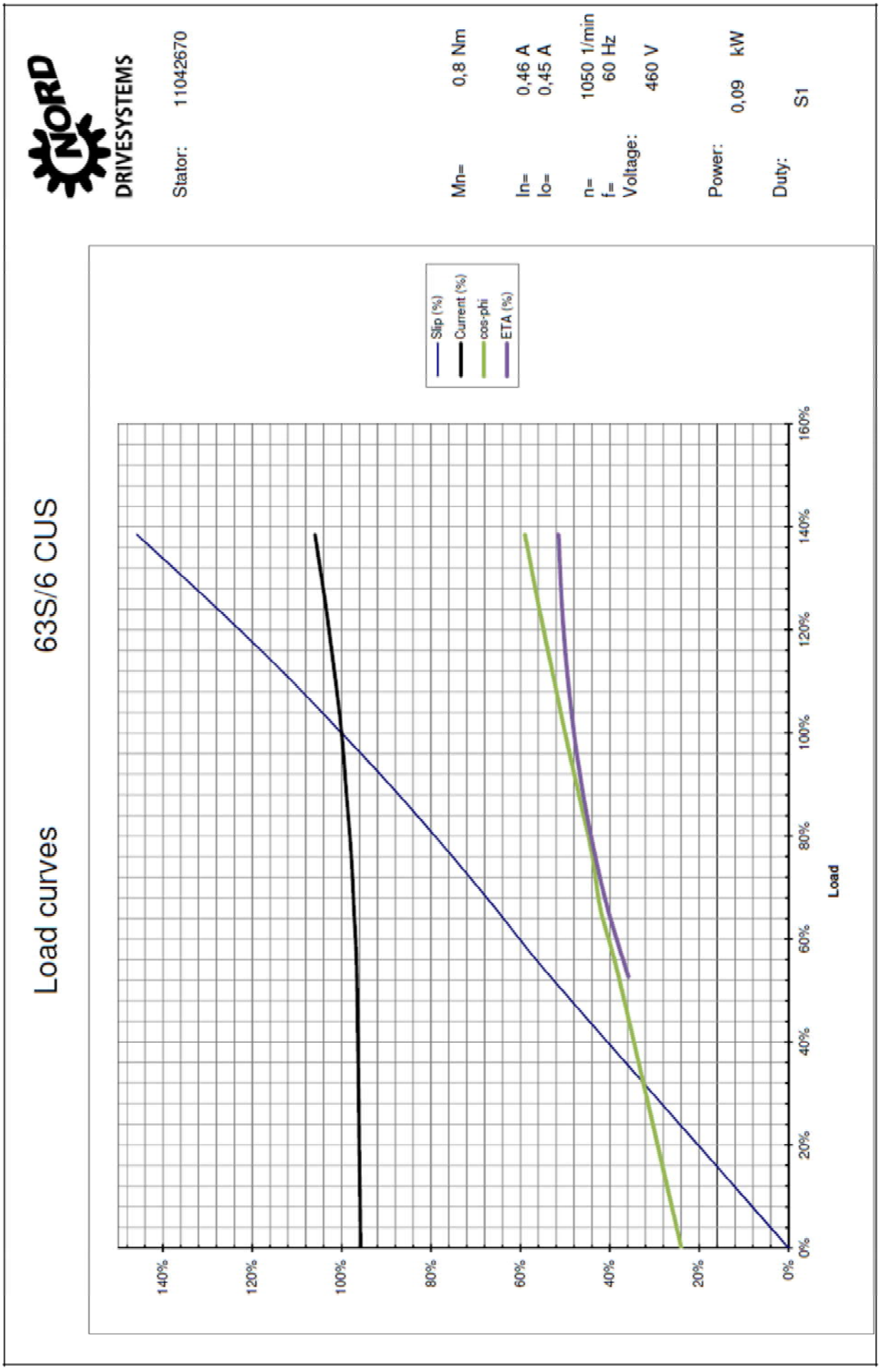
Electrical data:		
Frequency (f):	60	Hz
Output (P):	0,09	kW
Speed (n):	1050	1/min
Connection of stator:	D/Y	
Voltage (V):	265/460	V
Current (I):	0,80/0,46	A
Voltage range (U_{WB}):		V
Wide range current (I_{WB}):		A
Starting current/Current (I_A/I):	1,80	
Rated motor torque (M_N):	0,82	Nm
Starting motor torque (M_A):	2 (2,44)*	Nm
Minimum motor torque (Ms):	1,90 (2,32)*	Nm
Breakdown motor torque (M_K):	2 (2,44)*	Nm
cos phi:	0,62	Last
Eta(%):	39,90	100%
Eta(%):		75%
Eta(%):		50%
Service Faktor:	1,15	
Code letter:	F	

Tested data:		
Connection of stator:	D/Y	
Voltage (V):	265/460	V
No load current (I_0):	0,64/0,37	A
No load output (P_0):	0,094	kW
Noise level (L_{PA}):		dB(A)
Resistance stator winding at 20°C (R):	89 U1-U2	Ohm
Temperature rise (T):		K
(at the stator resistance method)		
Insulation resistance (R_{isol}):	100	Mega Ohm
Winding test:	2352	V/4 sek.
Class of vibration:		A

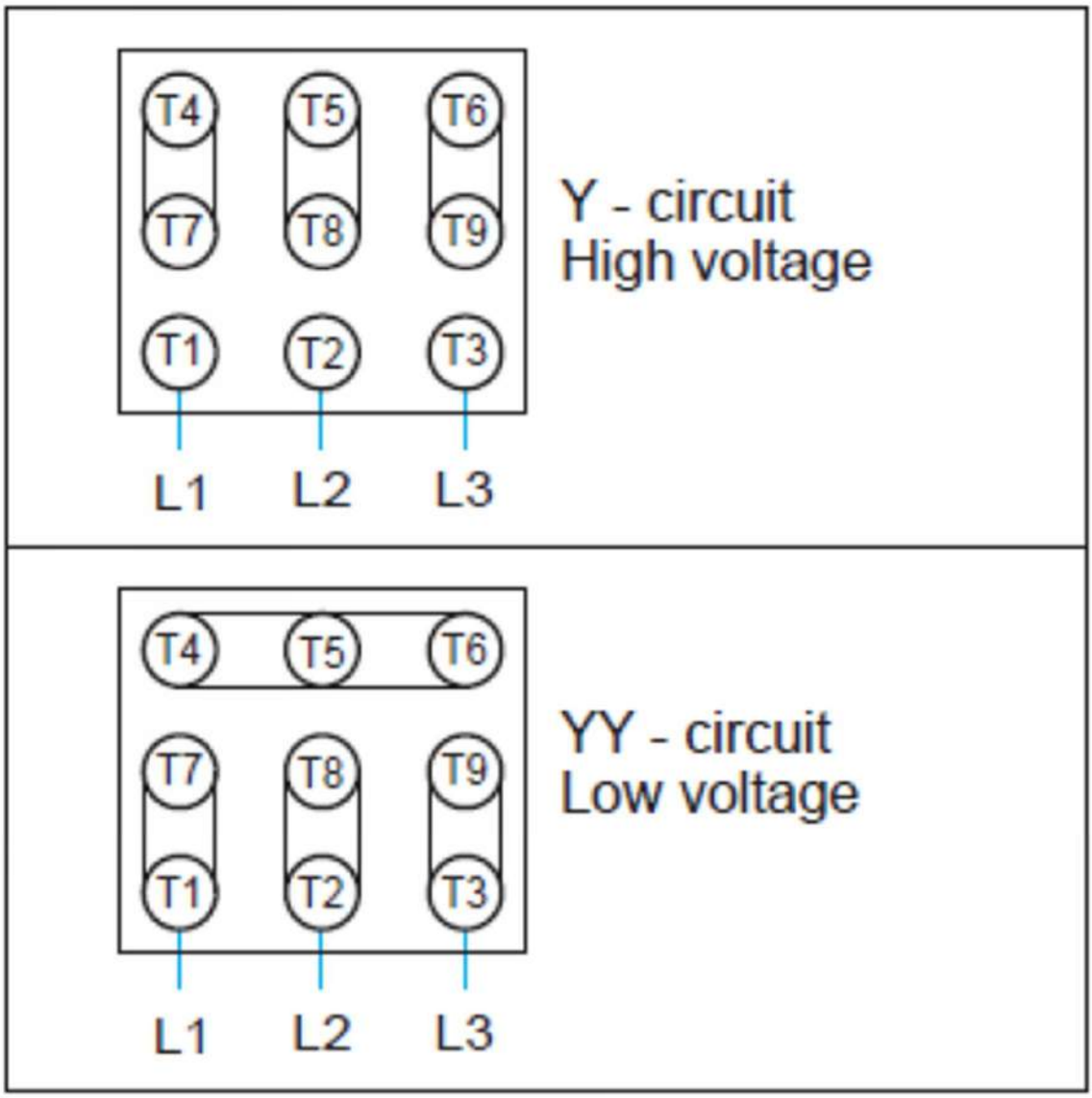
Order data:			
Order No.:	101588725-100		
Customer reference No.:			
Serial No.:			
Motor No.:			
Stator No.:	11042670		
General data:			
Direction of rotation:	CW/CCW		
Design:	Motoranb. WN Pos 958		
Duty:	S1		
Type bearing:			
Housing material:	Aluminium		
Insulation class:	F		
Type of protection:	IP 66		
Cable entry:	2 I		
Moment of inertia:	0,00028	kgm^2	
Maximum altitude of site:	1.000	m	
Ambient temperature:	-20°C	to	+40°C
Fan Type:	Standard IC 411		

Classification authorities:
NEMA (ELECTRICAL)

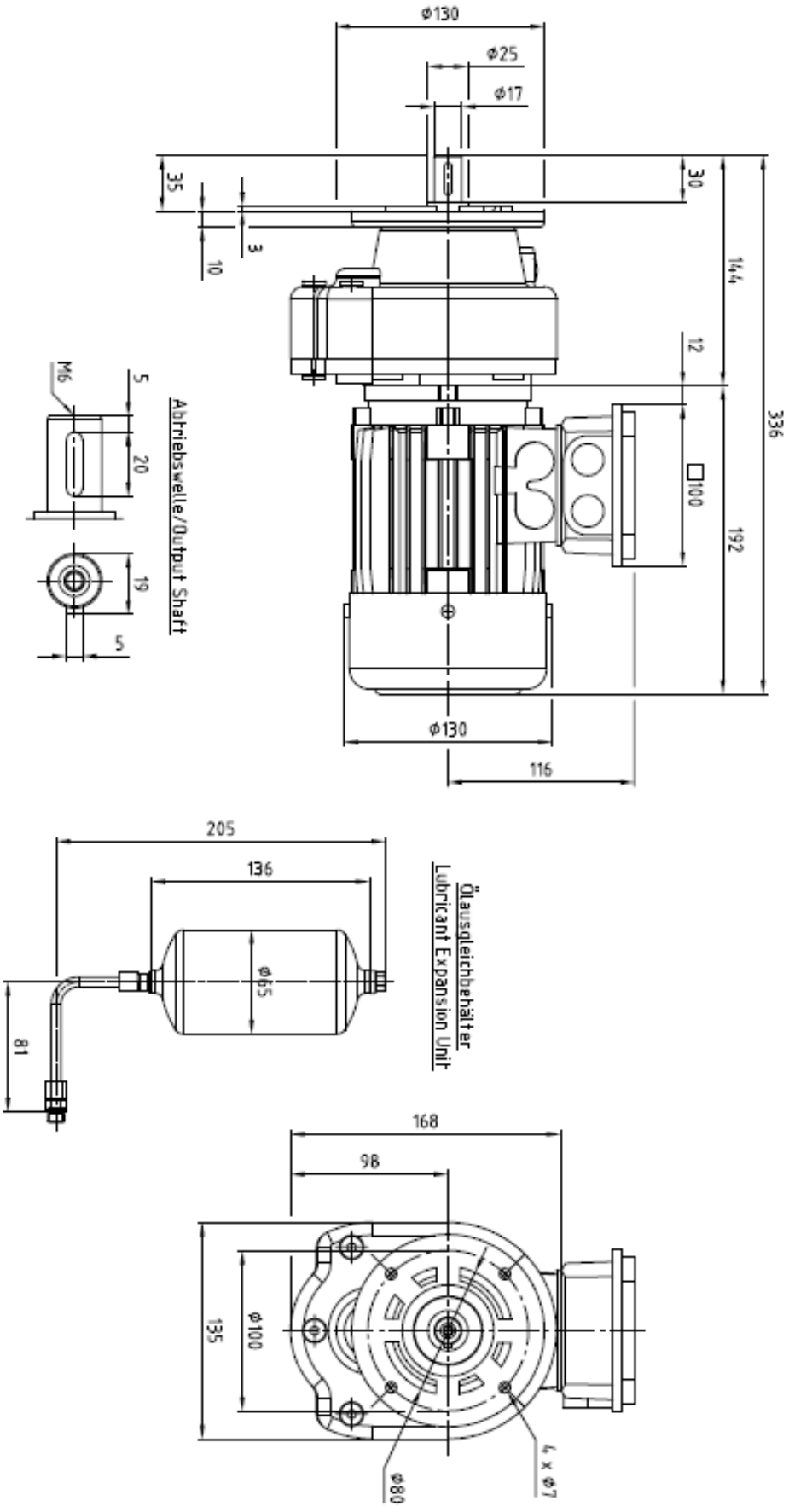
Motor Performance curve



Motor Connection Diagrams



Drawing


ø130
ø25
ø17
35
30
3
10
144
12
336
M6
5
20
Abtriebswelle/Output Shaft
19
5
□100
192
ø130
116
205
136
ø65
81
Ölausgleichbehälter
Lubricant Expansion Unit
168
98
135
ø100
ø80
4 x ø7

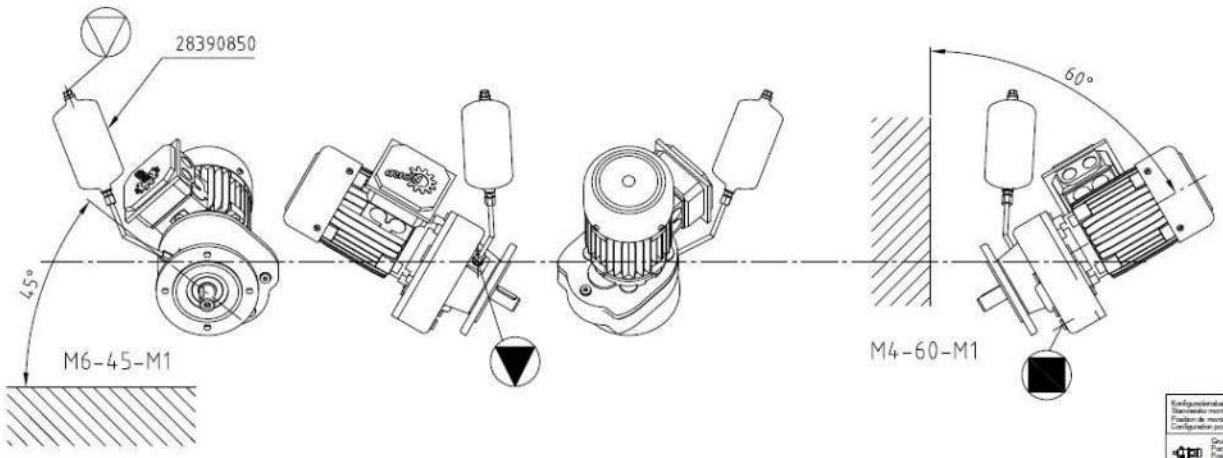
Lubricant table

This table shows comparable lubricants from various manufacturers. The manufacturer can be changed within a particular viscosity or lubricant type. Getriebebau NORD must be contacted in case of change of viscosity or lubricant type, as otherwise no warranty for the functionality of our gearboxes can be accepted.

Lubricant type	Details on type plate	DIN (ISO) / Ambient temperature	Castrol	FUCHS	KLÜBER LUBRICATION	Mobil	Shell
Mineral oil	CLP 680	ISO VG 680 0...40 °C	Alpha EP 680 Alpha SP 680 Optigear BM 680 Tribol 1100 / 680	Renolin CLP 680 Renolin CLP 680 Plus	Klüberoil GEM 1-680 N	Mobilgear 600 XP 680	Omala S2 G 680
	CLP 220	ISO VG 220 -10...40 °C	Alpha EP 220 Alpha SP 220 Optigear BM 220 Tribol 1100 / 220	Renolin CLP 220 Renolin CLP 220 Plus Renolin Gear 220 VCI	Klüberoil GEM 1-220 N	Mobilgear 600 XP 220	Omala S2 G 220

Lubrication quantity in L: tbd

Symbols for oil screw plugs in the mounting positions



Attention: The 0A has a 45 ° bend, insert as manufacturing note

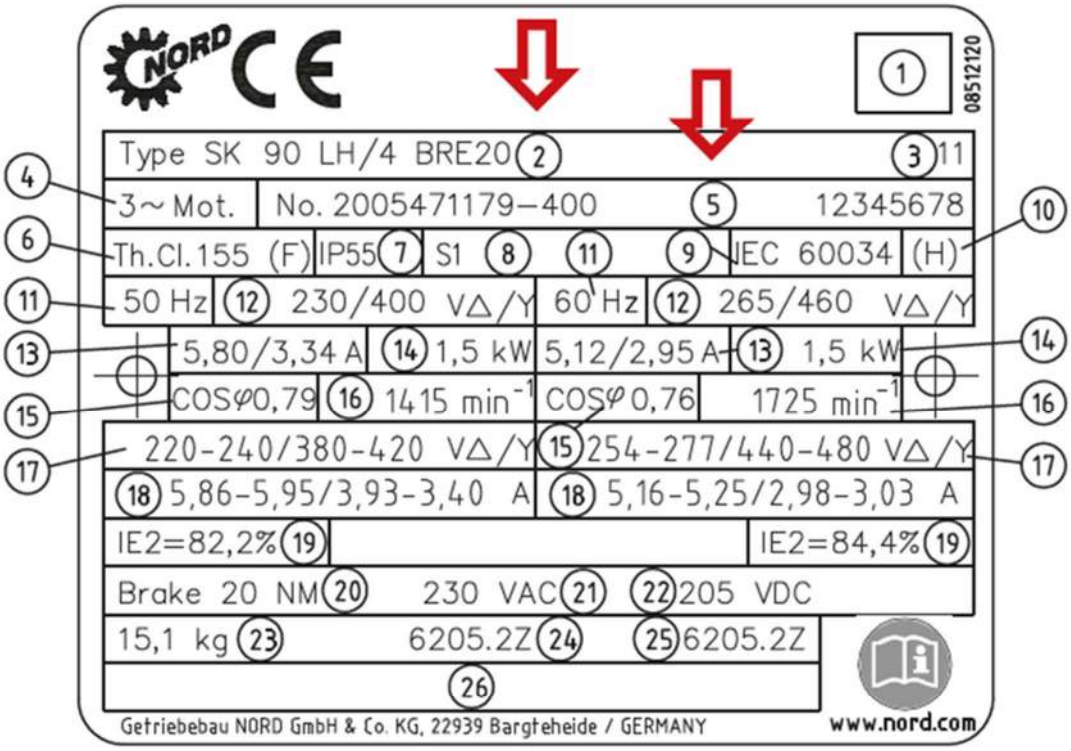
Entlüftung / Vent

Ölstand / Oil Level

Ölablass / Oil Drain

Explanation of the rating plate

Erläuterung des Typenschildes
Explanation of the rating plate
Explication de la plaque signalétique



DE

1 Matrix – Barcode
2 NORD - Motortyp
3 Herstellungsjahr
4 Phasenzahl
5 Fabrikationsnummer
6 Wärmeklasse
7 Schutzart
8 Betriebsart
9 Norm
10 Halbkeilwuchtung

11 Frequenz
12 Motorspannung
13 Nennstrom
14 Nennleistung
15 Leistungfaktor
16 Nenndrehzahl
17 Motorspannung - Weitbereich
18 Nennstrom - Weitbereich
19 Wirkungsgrad
20 Bremsmoment
21 Anschlußspannung Bremse
22 Bremsenspannung
23 Gewicht
24 Lagerung A-Seite
25 Lagerung B-Seite
26 Kundenzeile

EN

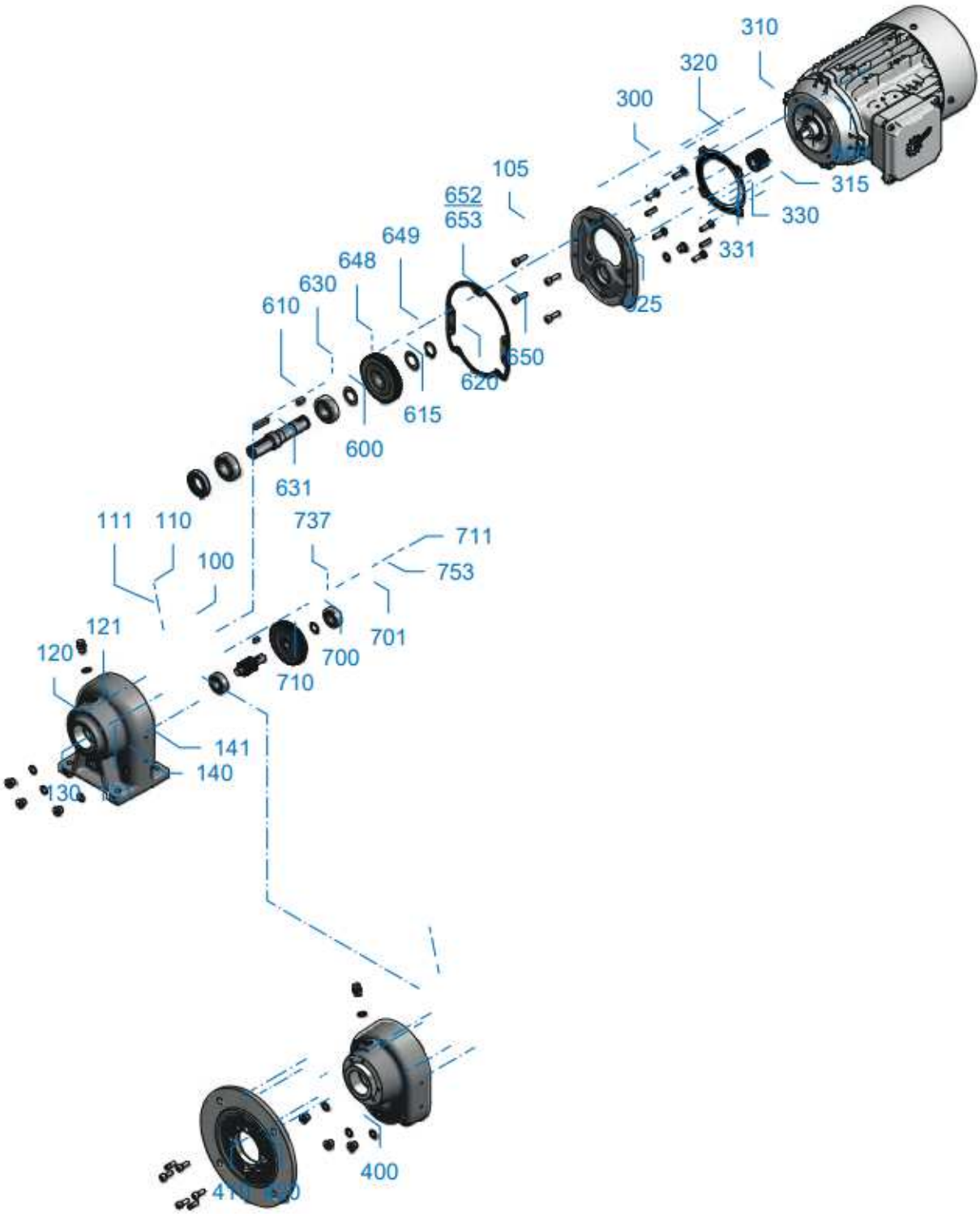
1 Matrix – Barcode
2 NORD - Motor type
3 Year of manufacture
4 Number of phases
5 Serial number
6 Heat class
7 Protection class
8 Operating mode
9 Standard
10 Half key balancing

11 Frequency
12 Motor voltage
13 Nominal current
14 Nominal power
15 Power factor
16 Nominal speed
17 Motor voltage - wide range
18 Nominal current - wide range
19 Efficiency
20 Braking torque
21 Brake connection voltage
22 Braking voltage
23 Weight
24 A side bearing
25 B side bearing
26 Customer line

FR

1 Code matriciel, à barres
2 Type de moteur NORD
3 Année de fabrication
4 Nombre de phases
5 Numéro de série
6 Classe thermique
7 Type de protection
8 Type de fonctionnement
9 Norme
10 Équilibrage dynamique avec une demi-clavette
11 Fréquence
12 Tension du moteur
13 Intensité nominale
14 Puissance nominale
15 Facteur de puissance
16 Vitesse nominale
17 Tension du moteur – plage étendue
18 Intensité nominale - plage étendue
19 Rendement
20 Couple de freinage
21 Tension de raccordement du frein
22 Tension de freinage
23 Poids
24 Palier côté A
25 Palier côté B
26 Ligne réservée au client

Part list


310
320
300
105
652
653
649
648
630
610
315
330
331
625
650
620
615
600
631
111
110
737
711
753
100
701
121
120
700
710
141
140
130
400

Part list

DE		EN		FR	
100	Gehäuse	100	Housing	100	Carter
105	Dichtung	105	Seal	105	Joints d'étanchéité
110	Schraube	110	Screw	110	Vis
111	Dichtung	111	Seal	111	Joints d'étanchéité
120	Schraube	120	Screw	120	Vis
121	Dichtung	121	Seal	121	Joints d'étanchéité
130	Schraube	130	Screw	130	Vis
131	Dichtung	131	Seal	131	Joints d'étanchéité
140	Schraube	140	Screw	140	Vis
141	Dichtung	141	Seal	141	Joints d'étanchéité
300	Getriebedeckel	300	Gear unit cover	300	Couvercle du réducteur
310	Dichtung	310	Seal	310	Joints d'étanchéité
315	Stift	315	Pin	315	Goupille
320	Schraube	320	Screw	320	Vis
325	Schraube	325	Screw	325	Vis
330	Schraube	330	Screw	330	Vis
331	Dichtung	331	Seal	331	Joints d'étanchéité
400	Flansch	400	Flange	400	Bride
410	Schraube	410	Screw	410	Vis
420	Stift	420	Pin	420	Goupille
600	Abtriebswelle	600	Output shaft	600	Arbre de sortie
610	Wälzlager	610	Roller bearing	610	Palier à roulement
615	Wälzlager	615	Roller bearing	615	Palier à roulement
620	Abtriebsrad	620	Output gear	620	Roue de sortie
630	Passfeder	630	Parallel key	630	Clavette
631	Wellendiichtring	631	Shaft sealing ring	631	Bague d'étanchéité de l'arbre
648	Passfeder	648	Parallel key	648	Clavette
649	Passscheibe	649	Shim	649	Rondelle d'ajustage
650	Sicherungsring	650	Circlip	650	Circlip
652	Passscheibe	652	Shim	652	Rondelle d'ajustage
653	Passscheibe	653	Shim	653	Rondelle d'ajustage
700	Ritzelwelle	700	Pinion shaft	700	Arbre de pignon
701	Antriebsrad	701	Drive gear	701	Roue d'entrée
710	Wälzlager	710	Roller bearing	710	Palier à roulement
711	Wälzlager	711	Roller bearing	711	Palier à roulement
737	Passfeder	737	Parallel key	737	Clavette
753	Passscheibe	753	Shim	753	Rondelle d'ajustage
900	Antriebsritzel	900	Drive pinion	900	Pignon d'entrée

Certificate

CERTIFICATE OF COMPLIANCE

Certificate Number	20170217-E191510
Report Reference	E191510-19981208
Issue Date	2017-FEBRUARY-16
Issued to:	NORD MOTORIDUTTORI SRL VIA NEWTON 22 40017 S GIOVANNI PERSICETO BO ITALY
This is to certify that representative samples of	MOTORS SEE ADDENDUM PAGE.
	Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL 1004-1, CSA C22.2 No. 100-14 - Rotating Electrical Machines – General Requirements
Additional Information:	See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.

Bruce Mahrenholz, Director North American Certification Program

UL LLC

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Certificate

CERTIFICATE OF COMPLIANCE

Certificate Number	20170217-E191510
Report Reference	E191510-19981208
Issue Date	2017-FEBRUARY-16

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Model CUS series three phase motors. 2 or 3 digit prefix numbers indicating frame size followed by 1 or 2 letter indicating stator size followed by "/" plus numbers indicating speed(s). Letters and numbers follow model designation to indicate options and nominal power. Frames 63 to 250.

Model HM & HMT series three phase motors. 2 or 3 digit prefix numbers indicating frame size followed by 1 or 2 letter indicating stator size followed by "/" plus numbers indicating speed(s). Letters and numbers follow model designation to indicate options and nominal power. Frames 80 to 100.

Bruce Mahrenholz, Director North American Certification Program

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Tel. +1 018883146673

SERVICE

There are 3 North Service Centers in Central America. The right contact person can be found on our website www.nord.com you will also find your contact person for North and South America there.

Specification sheet

VEGABAR 28

Two-wire 4 … 20 mA

Pressure sensor with ceramic measuring cell



Application area

The VEGABAR 28 is a universally applicable pressure sensor with switching function and ceramic measuring cell. It is used for measuring gases, vapours and liquids. Even with high requirements for robustness and hygiene, the device records the measured values with high accuracy.

The optional universal connection for hygiene adapters reduces the installation effort and stockkeeping.

Your benefit

- High plant availability through maximum overload and vacuum resistance of the ceramic measuring cell
- Coloured 360° status indication
- Convenient wireless setup and diagnostics with smartphone via Bluetooth
- Easy integration into control systems due to a variety of connection technologies

Function

The heart of the pressure transmitter is the pressure measuring cell transforming the pressure into an electrical signal. This pressure-dependent signal is convereted by the integrated electronics into a standardized output signal.

Sensor element with VEGABAR 28 is the ceramic CERTEC® measuring cell with excellent long-term stability and high overload resistance.

Technical data

Measuring ranges	-1 … +60 bar/-100 … +6000 kPa (-14.5 … +870 psig)
Smallest measuring range	+0.1 bar/+10 kPa (+1.45 psig)
Deviation	< 0.3 %
Output signal	4 … 20 mA
Process fitting	Thread from G¼, ¼ NPT, hygienic fittings from DN 25
Process temperature	-40 … +130 °C (-40 … +266 °F)
SIP process temperature	+150 °C (+302 °F) with brief vapour stratification
Ambient, storage and transport temperature	-40 … +70 °C (-40 … +140 °F)
Bluetooth standard	Bluetooth 5.0 (downward compatible to Bluetooth 4.0 LE)
Effective range Bluetooth typ.	25 m (82 ft)
Operating voltage	12 … 35 V DC
Protection rating	up to IP66/IP68 (0.5 bar) or IP66/IP67/IP69 acc. to EN 60529/IEC 529, up to Type 6P NEMA/UL 50E

Materials

The wetted parts of the device are made of 316L, PVDF, duplex steel or sapphire-ceramic®. The process seal is made of FKM, EPDM or FFKM, depending on the process fitting.

A complete overview of the available materials and seals can be found on our homepage under "*Products*" and "*Configure & Order*".

Housing versions

The housing is equipped with plug connector according to ISO 4400, M12 x 1 or direct cable outlet.

It is available with protection ratings up to IP68 (0.5 bar)/IP69.

Electronics versions

In addition to the two-wire electronics 4 … 20 mA, three-wire electronics with IO link as well as 4 … 20 mA (active) and transistor outputs are also possible.

Depending on the electronics, the connection is made via ISO 4400, M12 x 1 plug or direct cable outlet.

Approvals

Worldwide approvals are available for VEGA instruments, e.g. for use in hazardous areas, on ships or in hygienic applications.

The technical data in the respective safety instructions are valid for approved instruments (e.g. with Ex approval). In some cases, these data can differ from the data listed herein.

You can find detailed information on the existing approvals with the appropriate product on our homepage.

Adjustment

The Bluetooth version of the device enables wireless connection to smartphones/tablets (iOS/Android) or Windows PCs.



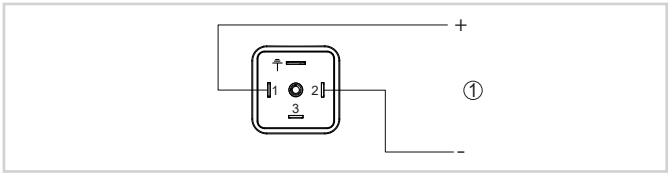
Wireless connection to standard operating devices

Operation is via a free app from the "*Apple App Store*", the "*Google Play Store*" or the "*Baidu Store*". Alternatively, adjustment can also be carried out via PACTware/DTM and a Windows PC.



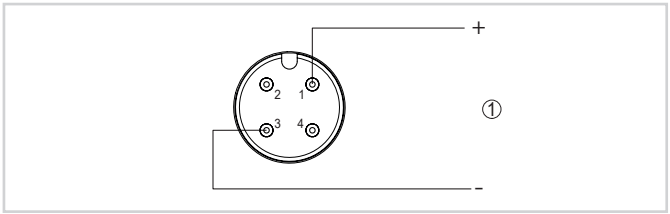
Adjustment via PACTware or app

Electrical connection



Wiring plan - two-wire 4 … 20 mA - plug according to ISO 4400

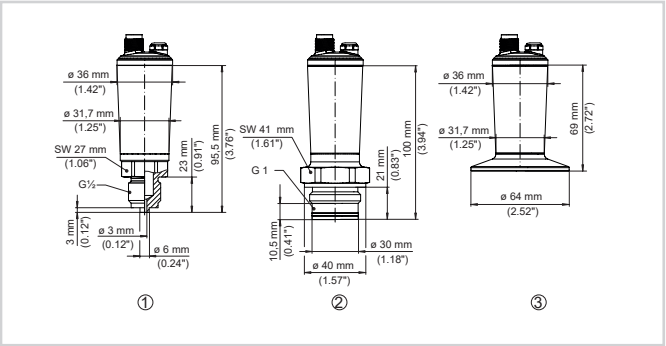
1 *Voltage supply and signal output*



Wiring plan - two-wire 4 … 20 mA - M12 x 1 plug

1 *Voltage supply and signal output*

Dimensions



Dimensions VEGABAR 28

1 *Thread G½ (EN 837), manometer connection*
2 *Thread G1 (ISO 228-1)*
3 *Clamp 2" PN 40, ø 64 mm (DIN 32676, ISO 2852)*

Information

You can find further information on the VEGA product line on our homepage.

In the download section on our homepage you'll find operating instructions, product information, brochures, approval documents, instrument drawings and much, much more.

Software accessories such as the current device software and the appropriate operating software are also available there.

Instrument selection

On our homepage under "*Products*" you can select the suitable measuring principle and instrument for your application.

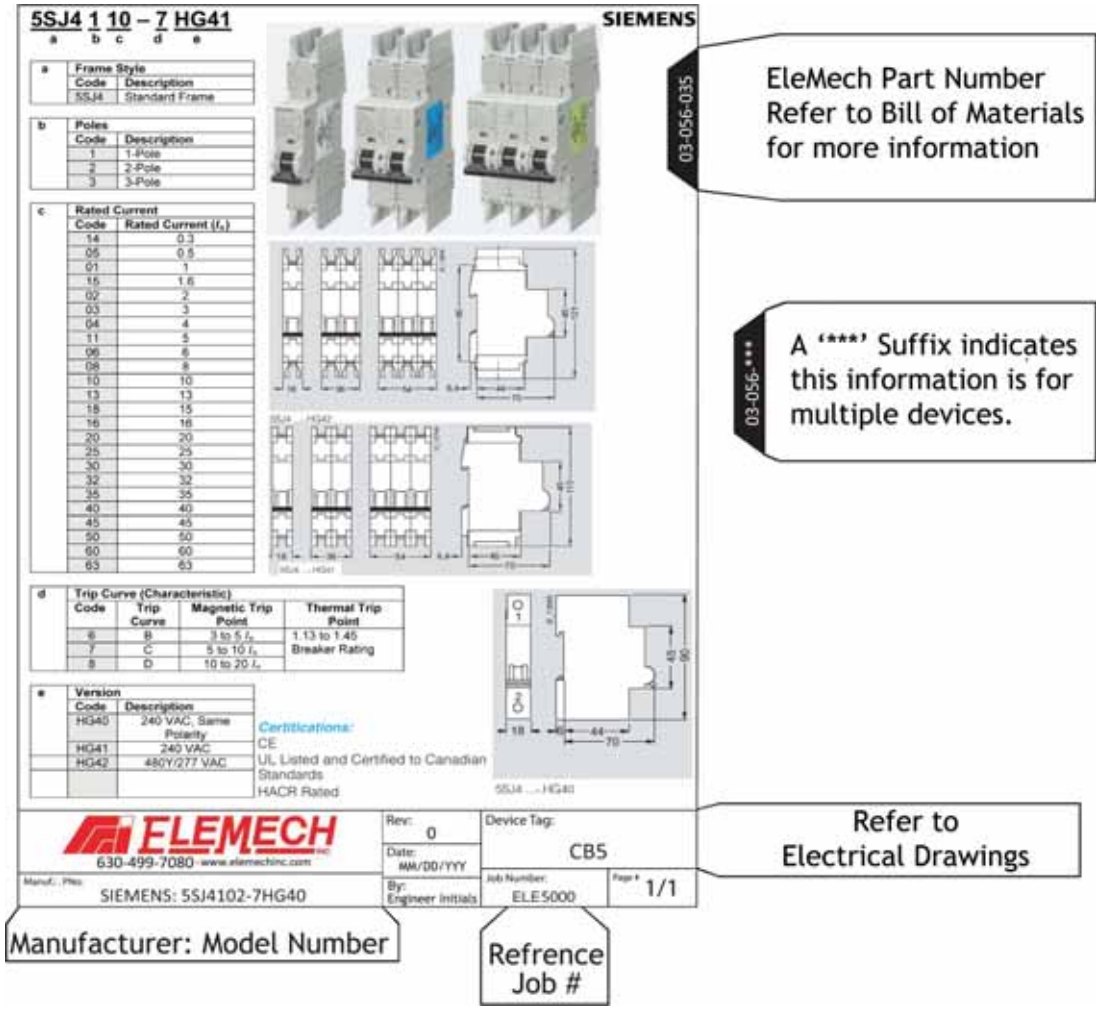
There you will also find detailed information on the available device versions.

Contact

You can find your personal contact person at VEGA on our homepage under " *Contact*".

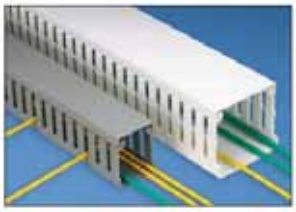
Catalog Cuts

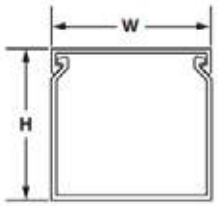
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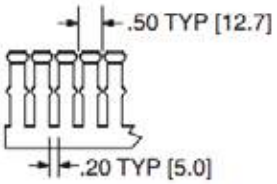


Panduct® Type F Narrow Slot Wiring Duct

- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

Part Numbering System for Panduct® Wiring Duct

G | 2 | X | 2 | LG | — | 6 | -A

Type
G = Wide Slot
F = Narrow Slot
FL = Flexible Duct
FS = Solid Wall
H = Hinged Cover Wide Slot
HN = Hinged Cover, Narrow Slot
HS = Hinged Cover, Solid Wall
D = Round Hole
NNC = Halogen Free, Metric
NE = Halogen Free
MC = Narrow Slot, Metric
TNC = Low Smoke, Halogen Free

Nominal Width
In. or mm

Nominal Height
In. or mm

Color
LG = Light Gray
WH = White
BL = Black
IB = Intrinsic Blue
IG = International Gray

Length
6 ft. or 2m

Options
-A = Adhesive backed
NM = No mounting holes
= Leave blank for no options

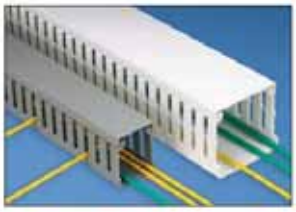
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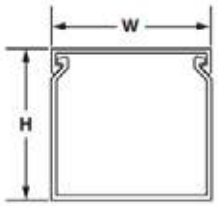
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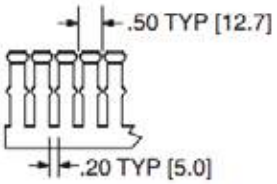
Rev: 0	Device Tag:		
Date: 02-16-2026			
Manuf.: . PNo: Panduit: C1.5WH6	By: AJ	Job Number: HBR10366	Page # 1/1

Panduct® Type F Narrow Slot Wiring Duct

- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

Part Numbering System for Panduct® Wiring Duct

G	2	X	2	LG	—	6	-A
Type	Nominal Width		Nominal Height	Color		Length	Options

Type
G = Wide Slot
F = Narrow Slot
FL = Flexible Duct
FS = Solid Wall
H = Hinged Cover Wide Slot
HN = Hinged Cover, Narrow Slot
HS = Hinged Cover, Solid Wall
D = Round Hole
NNC = Halogen Free, Metric
NE = Halogen Free
MC = Narrow Slot, Metric
TNC = Low Smoke, Halogen Free

Nominal Width
In. or mm

Nominal Height
In. or mm

Color
LG = Light Gray
WH = White
BL = Black
IB = Intrinsic Blue
IG = International Gray

Length
6 ft. or 2m

Options
-A = Adhesive backed
NM = No mounting holes
= Leave blank for no options

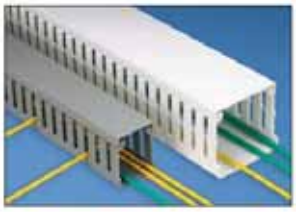
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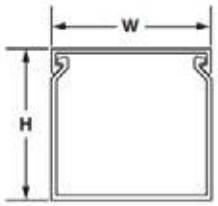
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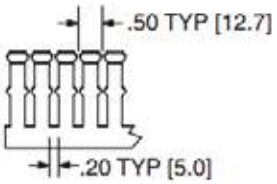
Rev:	Device Tag:
0	
Date: 02-16-2026	
By: AJ	Job Number: HBR10366
Manuf.: . PNo: Panduit: C1WH6	Page # 1/1

Panduct® Type F Narrow Slot Wiring Duct

- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

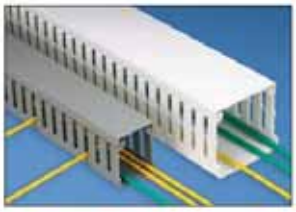
Part Numbering System for Panduct® Wiring Duct

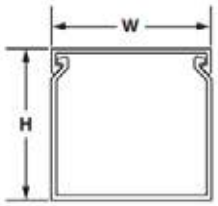
G	2	X	2	LG	—	6	-A
Type	Nominal Width		Nominal Height	Color		Length	Options
G = Wide Slot F = Narrow Slot FL = Flexible Duct FS = Solid Wall H = Hinged Cover Wide Slot HN = Hinged Cover, Narrow Slot HS = Hinged Cover, Solid Wall D = Round Hole NNC = Halogen Free, Metric NE = Halogen Free MC = Narrow Slot, Metric TNC = Low Smoke, Halogen Free	In. or mm		In. or mm	LG = Light Gray WH = White BL = Black IB = Intrinsic Blue IG = International Gray		6 ft. or 2m	-A = Adhesive backed NM = No mounting holes = Leave blank for no options

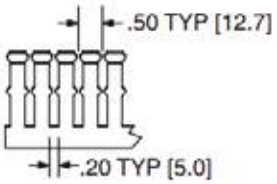
10-069-002

Panduct® Type F Narrow Slot Wiring Duct

- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

Part Numbering System for Panduct® Wiring Duct

G — 2 X 2 — LG — 6 -A

Type
G = Wide Slot
F = Narrow Slot
FL = Flexible Duct
FS = Solid Wall
H = Hinged Cover Wide Slot
HN = Hinged Cover, Narrow Slot
HS = Hinged Cover, Solid Wall
D = Round Hole
NNC = Halogen Free, Metric
NE = Halogen Free
MC = Narrow Slot, Metric
TNC = Low Smoke, Halogen Free

Nominal Width
In. or mm

Nominal Height
In. or mm

Color
LG = Light Gray
WH = White
BL = Black
IB = Intrinsic Blue
IG = International Gray

Length
6 ft. or 2m

Options
-A = Adhesive backed
NM = No mounting holes
= Leave blank for no options

10-069-005

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Rev: 0
Date: 02-16-2026
By: AJ

Device Tag:

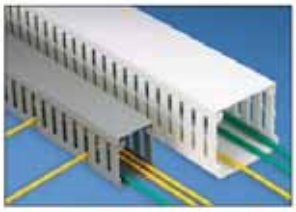
Job Number: HBR10366

Page # 1/1

Manuf.: . PNo:
Panduit: F1.5X3WH6

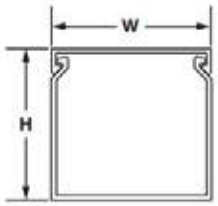
Panduct® Type F Narrow Slot Wiring Duct

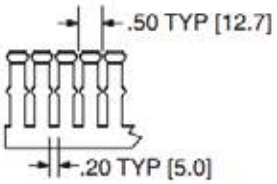
- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet



10-069-007

Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120





Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

Part Numbering System for Panduct® Wiring Duct

G	2	X	2	LG	—	6	-A
Type	Nominal Width		Nominal Height	Color		Length	Options

Type
G = Wide Slot
F = Narrow Slot
FL = Flexible Duct
FS = Solid Wall
H = Hinged Cover Wide Slot
HN = Hinged Cover, Narrow Slot
HS = Hinged Cover, Solid Wall
D = Round Hole
NNC = Halogen Free, Metric
NE = Halogen Free
MC = Narrow Slot, Metric
TNC = Low Smoke, Halogen Free

Nominal Width
In. or mm

Nominal Height
In. or mm

Color
LG = Light Gray
WH = White
BL = Black
IB = Intrinsic Blue
IG = International Gray

Length
6 ft. or 2m

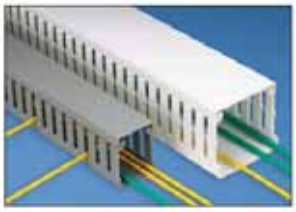
Options
-A = Adhesive backed
NM = No mounting holes
= Leave blank for no options

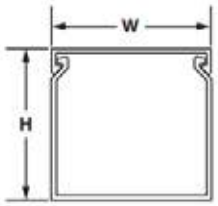
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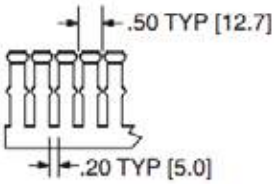
Rev:	Device Tag:
0	
Date: 02-16-2026	
By: AJ	Job Number: HBR10366
Manuf.: . PNo: Panduit: F1X3WH6	Page # 1/1

Panduct® Type F Narrow Slot Wiring Duct

- Narrow slot/finger design provides more slots to fit the spacing of high-density terminal blocks and other hardware
- Material: Lead-free PVC
- UL recognized continuous use temperature: 122°F (50°C)
- UL 94 flammability rating of V-0
- Conforms with NFPA 79-2007 section 13.3.1 requirement for flame retardant material
- Provided with mounting holes
- Base and cover length is 6 feet







Base Part Number	Duct Size (W x H)* In.	Duct Size (W x H)* mm	Slot Width In.	Slot Width mm	Cover Part Number	Std. Pkg. Qty.	Base Ctn. Qty.	Cover Ctn. Qty.
F.5X.5LG6	0.69 x 0.60	17.5 x 15.2	0.20	5.0	C.5LG6	6	120	120
F.5X1LG6	0.69 x 1.06	17.5 x 26.9	0.20	5.0	C.5LG6	6	120	120
F.75X.75LG6	0.93 x 0.82	23.6 x 20.9	0.20	5.0	C.75LG6	6	120	120
F.75X1.5LG6	0.93 x 1.57	23.6 x 39.9	0.20	5.0	C.75LG6	6	120	120
F1X1LG6	1.26 x 1.13	32.0 x 28.7	0.20	5.0	C1LG6	6	120	120
F1X1.5LG6	1.26 x 1.62	32.0 x 41.1	0.20	5.0	C1LG6	6	120	120
F1X2LG6	1.26 x 2.12	32.0 x 53.8	0.20	5.0	C1LG6	6	120	120
F1X3LG6	1.26 x 3.12	32.0 x 79.2	0.20	5.0	C1LG6	6	120	120
F1X4LG6	1.26 x 4.10	32.0 x 104.1	0.20	5.0	C1LG6	6	60	120
F1.5X1LG6	1.75 x 1.12	44.5 x 28.4	0.20	5.0	C1.5LG6	6	120	120
F1.5X1.5LG6	1.75 x 1.62	44.5 x 41.1	0.20	5.0	C1.5LG6	6	120	120
F1.5X2LG6	1.75 x 2.12	44.5 x 53.8	0.20	5.0	C1.5LG6	6	120	120
F1.5X3LG6	1.75 x 3.12	44.5 x 79.2	0.20	5.0	C1.5LG6	6	120	120
F1.5X4LG6	1.75 x 4.10	44.5 x 104.1	0.20	5.0	C1.5LG6	6	60	120
F2X1LG6	2.25 x 1.12	57.2 x 28.4	0.20	5.0	C2LG6	6	120	120
F2X1.5LG6	2.25 x 1.62	57.2 x 41.1	0.20	5.0	C2LG6	6	120	120
F2X2LG6	2.25 x 2.12	57.2 x 53.8	0.20	5.0	C2LG6	6	120	120
F2X3LG6	2.25 x 3.12	57.2 x 79.2	0.20	5.0	C2LG6	6	60	120
F2X4LG6	2.25 x 4.10	57.2 x 104.1	0.20	5.0	C2LG6	6	60	120
F2X5LG6	2.25 x 5.10	57.2 x 129.5	0.20	5.0	C2LG6	6	60	120
F2.5X3LG6	2.75 x 3.12	69.9 x 79.2	0.20	5.0	C2.5LG6	6	120	120
F3X1LG6	3.25 x 1.12	82.6 x 28.4	0.20	5.0	C3LG6	6	120	120
F3X2LG6	3.25 x 2.12	82.6 x 53.8	0.20	5.0	C3LG6	6	120	120
F3X3LG6	3.25 x 3.12	82.6 x 79.2	0.20	5.0	C3LG6	6	60	120
F3X4LG6	3.25 x 4.10	82.6 x 104.1	0.20	5.0	C3LG6	6	60	120
F3X5LG6	3.25 x 5.10	82.6 x 129.5	0.20	5.0	C3LG6	6	60	120
F4X2LG6	4.25 x 2.12	108.0 x 53.8	0.20	5.0	C4LG6	6	60	120
F4X3LG6	4.25 x 3.12	108.0 x 79.2	0.20	5.0	C4LG6	6	60	120
F4X4LG6	4.25 x 4.10	108.0 x 104.1	0.20	5.0	C4LG6	6	60	120
F4X5LG6	4.25 x 5.10	108.0 x 129.5	0.20	5.0	C4LG6	6	60	120
F6X4LG6	6.25 x 4.15	158.8 x 105.4	0.20	5.0	C6LG6	6	60	120

Part number shown for LG (Light Gray). For other color availability see color selection guide, page C1.48.
Base and cover sold separately.
*"H" dimension includes duct and cover.

Part Numbering System for Panduct® Wiring Duct

G	2	X	2	LG	—	6	-A
Type	Nominal Width		Nominal Height	Color		Length	Options
G = Wide Slot F = Narrow Slot FL = Flexible Duct FS = Solid Wall H = Hinged Cover Wide Slot HN = Hinged Cover, Narrow Slot HS = Hinged Cover, Solid Wall D = Round Hole NNC = Halogen Free, Metric NE = Halogen Free MC = Narrow Slot, Metric TNC = Low Smoke, Halogen Free	In. or mm		In. or mm	LG = Light Gray WH = White BL = Black IB = Intrinsic Blue IG = International Gray		6 ft. or 2m	-A = Adhesive backed NM = No mounting holes = Leave blank for no options

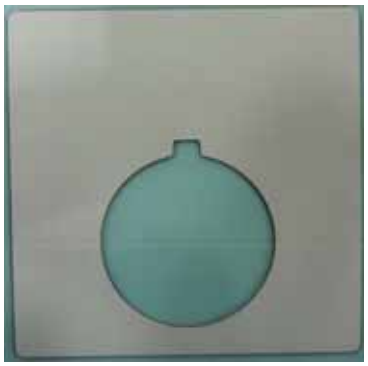
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Rev:	Device Tag:
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Date: 02-16-2026	
By: AJ	Job Number: HBR10366
Manuf.: . PNo: Panduit: F2X3WH6	Page # 1/1







Part Number	Description
25-000-A000	Legendplate Assembly, Black, White Text, Standard Encl.
25-000-A001	Legendplate Assembly, Yellow E-Stop, Standard Encl.
25-000-A002	Legendplate Assembly, White, Black Text, Standard Encl.

Panduit Raised Panel Label

25-000-A002

PRODUCT SPECIFICATIONS:

Description:	Material is RoHS compliant (European Union directive 2002/95/EC). GMH3-W consists of a polyester film laminated to a microcellular foam backed high tack adhesive.
Print Methods:	This material is recommended for thermal transfer printing.
Standard Colors:	White
Thickness:	28.0 +/- 1.0 mil (ASTM D3652)
Recommended Ribbons:	RMR4BL-A, RMR4BL, RMER4BL
Service Temperature Range:	-40°F to 212°F (-40°C to 100°C)
Minimum Application Temperature:	50°F (10°C)
Storage Conditions:	Store at 70°F (21°C) and 50% Relative Humidity.

Base Part Number	White	Width A	Height B	Print-On Area Height C	Vertical Repeat D	Horizontal Repeat E	Hole Diameter F
C240X240*	APT-30	2.40" (61.0mm)	2.40" (61.0mm)	.90" (22.8mm)	2.53" (64.1mm)	N/A	1.18" (30.0mm)





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Rev: 0	Device Tag:		
Date: 02-16-2026			
Manuf.: . PNo: EleMech: 25-000-A002 Assembly	By: AJ	Job Number: HBR10366	Page # 1/1

3/60/400 POWER SUPPLY

25-000-A019

Part Number	Cross Reference	Description
25-000-A014	EleMech: 25-000-A014 Assembly	Nameplate Assembly, White: Power Supply - 1/60/120VAC
25-000-A014	EleMech: 25-000-A014 Assembly	Nameplate Assembly, White: Power Supply - 1/60/120VAC
25-000-A015	EleMech: 25-000-A015 Assembly	Nameplate Assembly, White: Power Supply - 1/60/208VAC
25-000-A015	EleMech: 25-000-A015 Assembly	Nameplate Assembly, White: Power Supply - 1/60/208VAC
25-000-A016	EleMech: 25-000-A016 Assembly	Nameplate Assembly, White: Power Supply - 1/60/240VAC
25-000-A016	EleMech: 25-000-A016 Assembly	Nameplate Assembly, White: Power Supply - 1/60/240VAC
25-000-A017	EleMech: 25-000-A017 Assembly	Nameplate Assembly, White: Power Supply - 3/60/208VAC
25-000-A017	EleMech: 25-000-A017 Assembly	Nameplate Assembly, White: Power Supply - 3/60/208VAC
25-000-A018	EleMech: 25-000-A018 Assembly	Nameplate Assembly, White: Power Supply - 3/60/240VAC
25-000-A018	EleMech: 25-000-A018 Assembly	Nameplate Assembly, White: Power Supply - 3/60/240VAC
25-000-A019	EleMech: 25-000-A019 Assembly	Nameplate Assembly, White: Power Supply - 3/60/480VAC
25-000-A019	EleMech: 25-000-A019 Assembly	Nameplate Assembly, White: Power Supply - 3/60/480VAC
25-000-A026	EleMech: 25-000-A026 Assembly	Nameplate Assembly, White: Power Supply - 3/60/575VAC
25-000-A030	EleMech: 25-000-A030 Assembly	Nameplate Assembly, White: Power Supply - 3/60/200VAC
25-000-A031	EleMech: 25-000-A031 Assembly	Nameplate Assembly, White: Power Supply - 3/60/600VAC
25-000-A032	EleMech: 25-000-A032 Assembly	Nameplate Assembly, White: Power Supply - 3/60/440VAC
25-000-A036	EleMech: 25-000-A036 Assembly	Nameplate Assembly, White: Power Supply - 3/50/380VAC
25-000-A042	EleMech: 25-000-A019 Assembly	Nameplate Assembly, Black: Power Supply - 3/60/480VAC
25-000-A043	EleMech: 25-000-A036 Assembly	Nameplate Assembly, White: Power Supply - 3/50/415VAC
25-000-A044	EleMech: 25-000-A044 Assembly	Nameplate Assembly, White: Power Supply - 3/60/220VAC
25-000-A045	EleMech: 25-000-A045 Assembly	Nameplate Assembly, White: Power Supply - 1/60/220VAC
25-000-A046	EleMech: 25-000-A046 Assembly	Nameplate Assembly, White: Power Supply - 3/60/230VAC
25-000-A049	EleMech: 25-000-A049 Assembly	Nameplate Assembly, White: Power Supply - 3/50/400VAC
25-000-A051	EleMech: 25-000-A051 Assembly	Nameplate Assembly, White: Power Supply - 3/60/460VAC
25-000-A051	EleMech: 25-000-A051 Assembly	Nameplate Assembly, White: Power Supply - 3/60/460VAC
25-000-A057	EleMech: 25-000-A057 Assembly	Nameplate Assembly, White: Power Supply - 1/50/220VAC

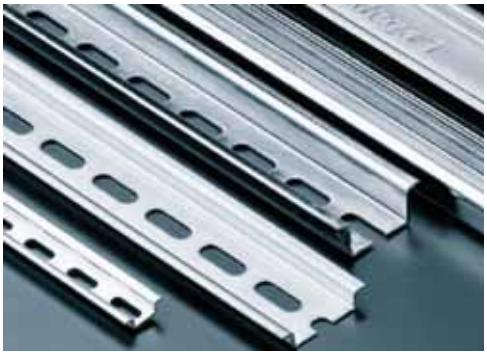
DIN RAILS

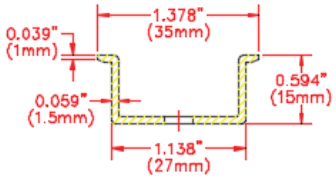
IBOCO Integrated Panel Management

42-063-007

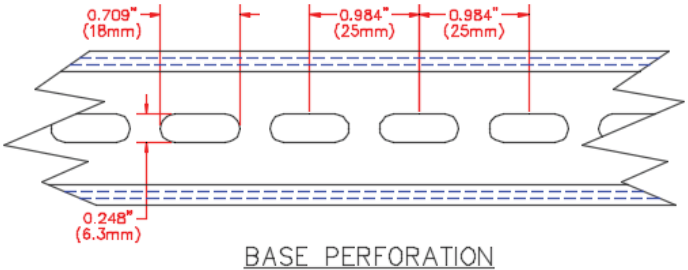
Catalog Number	Lengths per Pack
G1	12
G1F	12
G1F1	24
OMEGA 2F	20
OMEGA 2F1	40*
OMEGA 3	20
OMEGA 3F	20
OMEGA 3F1	40*
OMEGA 3FD	20
OMEGA 3A	10
OMEGA 3AF	10
OMEGA 3AF1	20*
OMEGA 3AFD	10
OMEGA 3B	10
OMEGA 3B1	10*
OMEGA 75	2

Treated with galvanic zinc plating and passivation (gal Zn 8c according to Din 50960)
Minimum thickness 6 microns
Standard length: 2 meters (6'6¾")

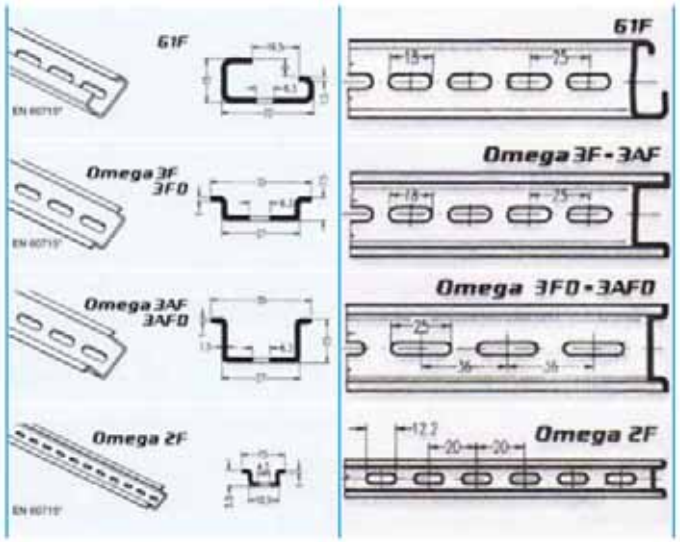


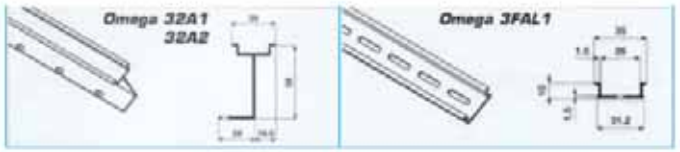


FRONT SECTION



BASE PERFORATION





ELEMECH INC.
630-499-7080 · www.elemechinc.com

Manuf.: . PNo: Iboco: Omega 3 AF	Rev: 0	Device Tag:	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

Wire – MTW Type

51-000-062

CONDUCTORS:
- 22 AWG - 8AWG Stranded Tinned Copper per ASTM B-33
- 22 AWG - 10 AWG Solid Tinned Copper per ASTM M-33

INSULATION:
- Color-Coded Polyvinyl Chloride (PVC)

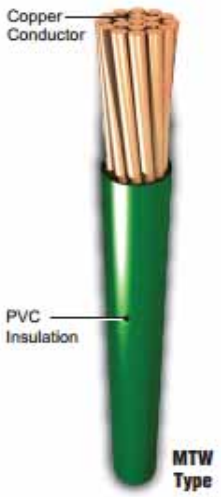
TEMPERATURE RANGE/ VOLTAGE RATING:
- UL 1011/1015/1028/BC-5W2: 105°C/600V
- UL MTW: 90°C/600V
- CSA AWM I A/B & TEW: 105°C/600V

FLAME COMPLIANCES:
- UL VW-1
- CSA FT-1

INDUSTRY APPROVALS:
- UL Standard 758 - Styles 1011/1015/1028/1032/1230/1231/1335/1344
- UL Standard 1063 - MTW
- UL Standard 1426 - BC-5W2: 16 AWG - 8 AWG
- CSA AWM I A/B & TEW
- UL THHW
- UL CT Tray Rated
- SAE J378

STANDARD COLORS:
- Black, Orange, Blue, Violet, White, Yellow, Brown, Green/Yellow, Red, Green, Gray

OPTIONS:
- Stripes available upon request (minimums may apply)
- Other copper constructions available upon request (minimums may apply)



Catalog Number	Description
F22027	22 AWG (7/.0096) TC AWM 1015
F20037	20 AWG (10/30) TC AWM 1015
F18054	18 AWG (16/30) TC AWM 1015
F16032	16 AWG (26/30) TC AWM 1015
F14037	14 AWG (41/30) TC AWM 1015
F12024	12 AWG (65/30) TC AWM 1015
F10012	10 AWG (105/30) TC AWM 1015
F08010	8 AWG (7X19/29) TC AWM 1028

TEW/MTW Wire (Tinned Copper) Applications:

› This tinned copper hook up wire may be used for wiring of machine tools, appliances, and control cabinets.

UL LISTED

ELEMECH INC.
630-499-7080 · www.elemechinc.com

Rev: 0	Device Tag:		
Date: 02-16-2026			
Manuf.: . PNo: EleMech: 51-000-062	By: AJ	Job Number: HBR10366	Page # 1/1



52-000-003

Part Number	Cross Reference	Description
52-000-003	EleMech: 698A	Label, Underwriters Laboratories 698A, w/Decal Set

T-SERIES COMPACT OUTDOOR WITH ADVANCED CORROSION PROTECTION

nVent | HOFFMAN

68-035-023

INDUSTRY STANDARDS

UL/cUL Listed; Type 12, 3R, 4; 4X optional; File No. SA6453
UR/cUR Recognized

UR/cUR Recognized on select models, reference performance data tables.
CE
EAC
Telcordia GR-487 capable

FEATURES

- Stock models equipped with head pressure control for low-ambient operation, compressor heater, coated condenser coil, malfunction switch, thermostat and heater package
- R134A earth-friendly refrigerant
- Models for 115, 230 and 460 VAC power input
- UL Listed to save customers time and money with agency approvals (some models UL recognized)
- Outdoor model operating temperature range from -40 F/-40 C to 131 F/55 C
- Exterior and fully recessed mounting options on many models
- Compact footprint to minimize real estate and maximize capacity
- Reliable mechanical thermostat on enclosure side of the unit
- Dual condenser-side air movers for performance redundancy
- Two levels of corrosion protecton:
  - Level 1 - Protective coatings on all exposed copper tubing and solder joints, condenser coil and thermostat.
  - Level 2 - All protective coatings in Level 1 plus a coated evaporator coil. Foam wrap added over protective coatings on thermostat.



OPTIONS

- Outdoor Package
- Harsh Environment Package*
- Stainless Steel Package*
- Heater Package

COOLING PERFORMANCE	
Nominal:	
BTU/Hr.	**800/800**
Watts	**235/235**
At 131 F/131 F (55 C/55 C):	
BTU/Hr. (50/60 Hz)	819
W (50/60 Hz)	240
At 95 F/95 F (35 C/35 C):	
BTU/Hr. (50 /60 Hz)	948
W (50/60 Hz)	278
Refrigerant	R-134A
Refrigerant Charge (ounces/grams)	4/113
Operating Temperature Range:	
Maximum (°F/°C)	131/55
Minimum (°F/°C)	-40/-40
Airflow at 0 Static Pressure:	
Internal loop 50 Hz (CFM / m^3/hr.)	25/42
External loop 50 Hz (CFM / m^3/hr.)	48/82
Internal loop 60 Hz (CFM / m^3/hr.)	30/51
External loop 60 Hz (CFM / m^3/hr.)	53/90
Max. Heater W (Outdoor Models)	150
ELECTRICAL DATA	
Rated Voltage	**100/115**
Frequency (Hz)	50/60
Operating Range	+/- 10%
Max. Power Consumption (W at 50/60 Hz)	360/403
Max. Nominal Current (A at 50/60 Hz)	3.6/3.5
Starting Current (A)	8.0/9.2

ELEMECH INC.
630-499-7080 · www.elemechinc.com

Rev: 0
Date: 02-16-2026
By: AJ

Device Tag: AC1

Manuf.: . PNo: Hoffman: T150116G173

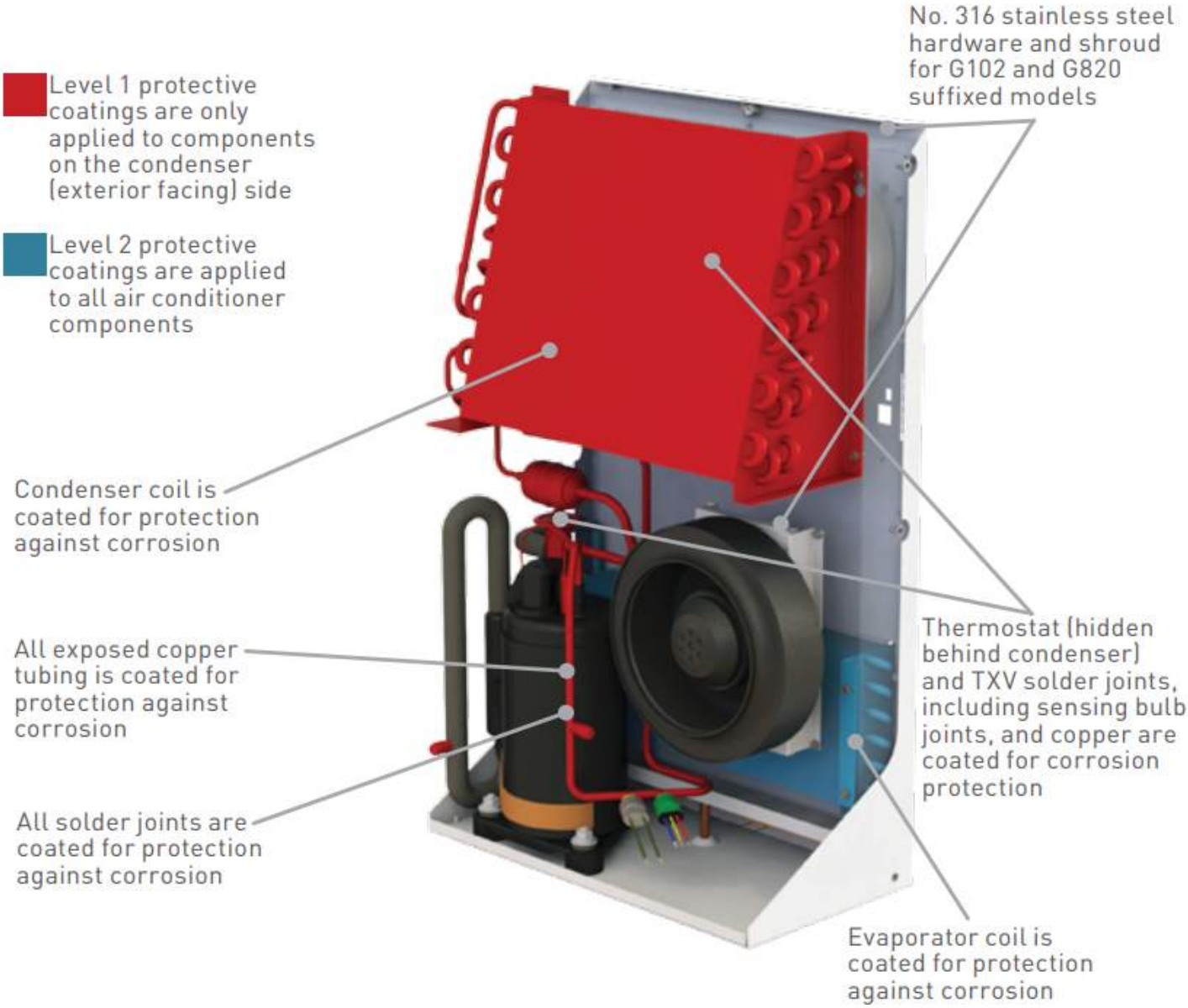
Job Number: HBR10366

T-SERIES COMPACT OUTDOOR
WITH ADVANCED CORROSION PROTECTION

Outdoor Model/SST/Corrosion/4X/Heater

68-035-023

- Two levels of corrosion protecton:
  - Level 1 - Protective coatings on all exposed copper tubing and solder joints, condenser coil and thermostat.
  - Level 2 - All protective coatings in Level 1 plus a coated evaporator coil. Foam wrap added over protective coatings on thermostat.



FEDERAL SIGNAL

56-097-005



Model LP22LED

StreamLine® Low Profile LED Light

Perfect size meets superior performance.

A B C G R

c UL us CE

Model LP22LED is a unique, multi-pattern LED light ideal for a variety of industrial applications requiring low profile signaling. The unit can be flush mounted or mounted on a 1/2" NPT pipe with the integrated pipe mount. The enclosure consists of a polycarbonate dome in five colors (Amber, Blue, Clear, Green and Red) and is rated Type 4X.

The LP22LED has four flash patterns (steady light, single flash, double flash and triple flash) selectable via dip-switch.

FEATURES

- Available in 12-24V AC/DC and 90-240VAC
- 1/2" NPT or flush mount
- Four flash patterns
- Five lamp/lens colors: Amber, Blue, Clear, Green and Red
- IP65, NEMA Type 4X enclosure
- Low profile — only 2.71" tall x 2.99" diameter (69mm x 76mm)
- UL and cUL Listed and CE Compliant

MODEL	VOLTAGE	FLASH RATE/MINUTE			
		STEADY	SINGLE FLASH	DOUBLE FLASH	TRIPLE FLASH
LP22LED-012-024*	12-24VAC/DC	N/A	120 (+/-10)	90 (+/-10)	140 (+/-10)
LP22LED-090-240*	90-240VAC	N/A	120 (+/-10)	90 (+/-10)	140 (+/-10)

* Indicates color: (A) Amber, (B) Blue, (C) Clear, (G) Green or (R) Red

SPECIFICATIONS

Lamp Life:		100,000 Hours
Light Source:		LED Array
Operating Temperature Range:	-22°F to 122°F	-30°C to 50°C
Net Weight:	5.29 oz.	0.15 kg
Height — above surface:	2.71"	69 mm
Diameter:	2.99"	76 mm

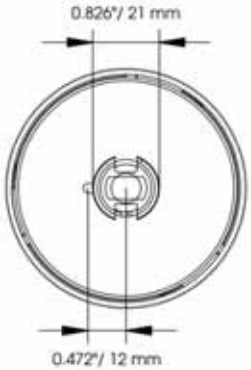
HOW TO ORDER

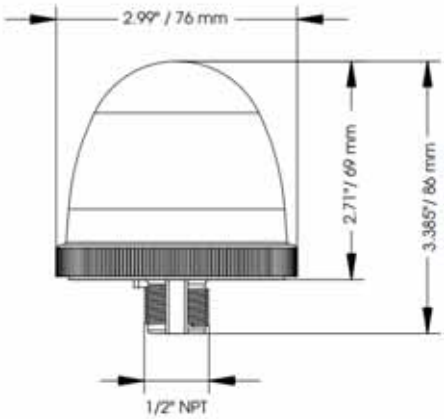
LP22LED - **012-024** **A**

MODEL

VOLTAGE
012-024 12-24VAC/DC
090-240 90-240VAC

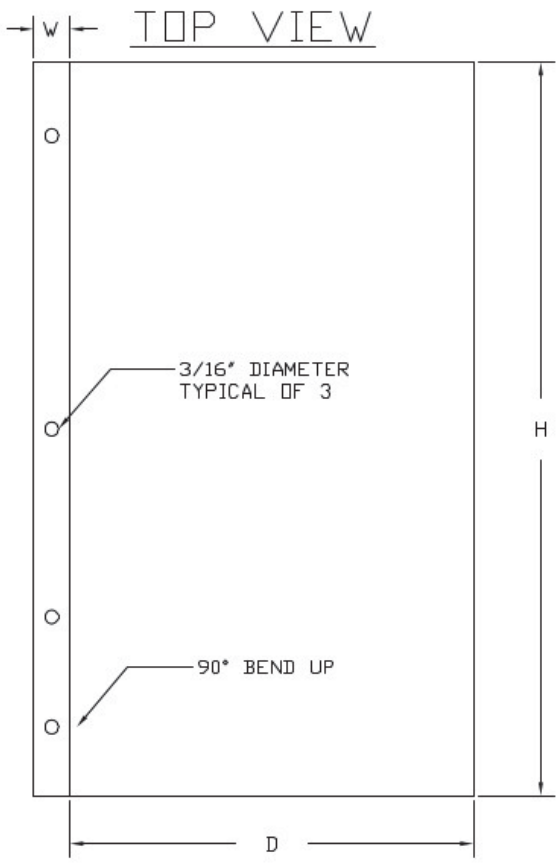
COLOR
A Amber
B Blue
C Clear
G Green
R Red





ELEMECH INC.
630-499-7080 · www.elemechinc.com

Manuf.: . PNo: Federal: LP22LED-012-024R	Rev: 0	Device Tag: AL1	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1



FORMED VIEW

Manufacture: EleMech Inc.

Material: 14 Gauge Steel

Part Number	Description
18-000-000	Steel Barrier, 14 Ga., White Finish, 0.5"Wx5.5H"x7.0"D
18-000-002	Steel Barrier, 14Ga., White Finish, 0.5"Wx10.0"x6.0"D
18-000-003	Steel Barrier, 14Ga., White Finish, 0.5"Wx6.0"x3.0"D
18-000-004	Steel Barrier, 14Ga., White Finish, 0.5"Wx7.0"x7.0"D
18-000-005	Steel Barrier, 14Ga., White Finish, 0.5"Wx11.0"x6.0"D
18-000-006	Steel Barrier, 14Ga., White Finish, 1.0"Wx7.0"x6.0"D
18-000-007	Steel Barrier, 14 Ga., White Finish, 0.5"Wx15.0"x6.0"D
18-000-008	Steel Barrier, 14 Ga., White Finish, 0.5"Wx23.5"x6.5"D

140MT Motor Protection Circuit Breakers

Allen-Bradley
by ROCKWELL AUTOMATION

23-005-058

Certifications

- ATEX
- CB Scheme
- CCC
- CE Marked
- cULus Listed
- EAC
- IECEx
- Morocco
- UKCA

Standards Compliance

- IEC/EN 60947-2, IEC/EN 60947-4-1
- UL 60947-4-1
- CSA C22.2, No. 60947-4-1
- EN45545-1, -2

Standards Compliance

- IEC/EN 60947-2, IEC/EN 60947-4-1
- UL 60947-4-1
- CSA C22.2, No. 60947-4-1
- EN45545-1, -2



F-Frame Devices

140MT	-	F	9	E	-	C10
a		b	c	d		e

a	
Bulletin Number	
Code	Description
140MT	140MT Motor Protection Circuit Breaker

b	
Current Rating/ Frame Size	
Code	Description
F	45 A, Frame F

c	
Interrupting Rating/ Breaking Capacity	
Code	Description
9	High break

d	
Function	
Code	Description
E	Adjustable Thermal/Fixed Magnetic (15 x I_n) MPCB
N	Fixed Magnetic (15 x I_n) MCP
T	Adjustable Thermal/Fixed Magnetic (19...22 x I_n) MPCB

e	
Current Range	
Code	Description
C	10 (example: C16 = 16 A)

Rated Operational Current (I_e) [A]	Motor Current Adjustment Range [A]	Nominal Magnetic Trip Current [A]	Max Short-circuit Current [kA]		Max. 3-phase Hp Ratings(1)				Max. kW, 3-Phase – AC-3(1)				Cat. No.
			400V (I_{cu})	480V (group motor)	200V	230V	460V	575V	230V	400/415V	500V	690V	
F-Frame, Adjustable Thermal/Fixed Magnetic (15 x I_n)													
12	9...12	180	100	65	3	3	7.5	10	3	5.5	5.5	7.5	140MT-F9E-C12
16	12...16	240	100	65	3	5	10	10	4	7.5	10	11	140MT-F9E-C16
20	15...20	300	100	65	5	5	10	15	5.5	7.5	11	15	140MT-F9E-C20
25	19...25	375	100	65	5	7.5	15	20	5.5	11	15	22	140MT-F9E-C25
32	24...32	480	65	65	7.5	10	20	30	7.5	15	18.5	30	140MT-F9E-C32
38	30...38	570	65	65	10	10	25	30	11	18.5	22	30	140MT-F9E-C38
45	36...45	675	65	65	10	15	30	40	11	22	30	37	140MT-F9E-C45

(1) Hp/kW ratings shown are for reference. The final selection of the MPCB/MPSD depends on the actual motor full load current.
(2) Suitable for continuous operation at 90% current rating at 480V only if used in a minimum enclosure size of 250 x 175 x 150 mm (10 x 7 x 6 in).

Multi 9

Schneider Electric

03-058-155

UL 489 / CSA C22.2 No 5 / IEC/EN 60947-2 / GB 14048-2

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

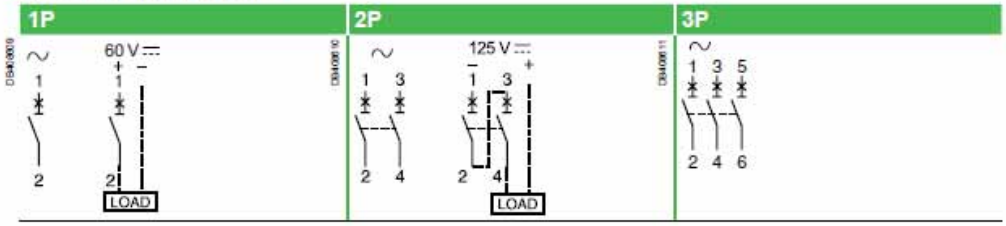
- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries.



Number of 18 mm (0.71 in.) poles	Rating (A) 25°C/77°F	Breaking capacity (kA rms) AIR UL 489 / CSA C22.2 No 5				Icu IEC 60947-2			
	Voltage (Ue)	277 V ~	240 V ~	120 V ~	60 V ⎓	440 V ~	415 V ~	240 V ~	60 V ⎓
1P	0.5 to 35	10	14	14	10	-	3	10	20
	40 to 63	-	10	10	10	-	3	10	20
	Voltage (Ue)	480Y/277 V ~		240 V ~	125 V ⎓	440 V ~	415 V ~	240 V ~	125 V ⎓
2P	1 to 25	10		14	10	6	10	20	-
	30 to 35	10		14	-	6	10	20	-
3P	1 to 35	10		14	-	6	10	20	-
2P/3P	40 to 63	-		10	-	6	10	20	-



Electrical diagrams



Catalogue numbers

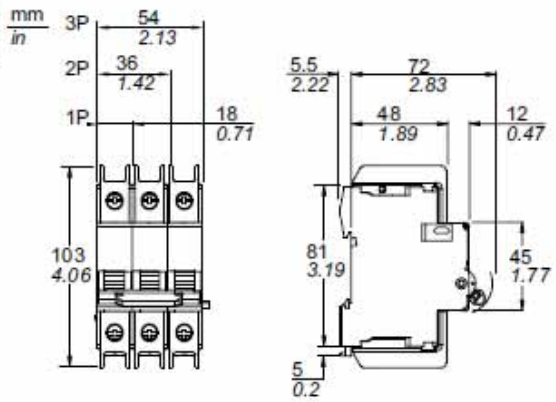
Tunnel terminal connection

Type	UL489 and CSA voltages	1P				2P			3P		
Auxiliaries		Remote indication and tripping, see page 43									
Rating (In)		Curve Z	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules
C60BP											
0.5	480Y/277 V and 240 V	M9F44170	M9F42170	M9F43170	2	-	-	4	-	-	6
1		M9F44101	M9F42101	M9F43101		M9F42201	M9F43201		M9F42301	M9F43301	
2		M9F44102	M9F42102	M9F43102		M9F42202	M9F43202		M9F42302	M9F43302	
3		M9F44103	M9F42103	M9F43103		M9F42203	M9F43203		M9F42303	M9F43303	
4		M9F44104	M9F42104	M9F43104		M9F42204	M9F43204		M9F42304	M9F43304	
5		M9F44105	M9F42105	M9F43105		M9F42205	M9F43205		M9F42305	M9F43305	
6		M9F44106	M9F42106	M9F43106		M9F42206	M9F43206		M9F42306	M9F43306	
8		M9F44108	M9F42108	M9F43108		M9F42208	M9F43208		M9F42308	M9F43308	
10		M9F44110	M9F42110	M9F43110		M9F42210	M9F43210		M9F42310	M9F43310	
15		M9F44115	M9F42115	M9F43115		M9F42215	M9F43215		M9F42315	M9F43315	
20		M9F44120	M9F42120	M9F43120		M9F42220	M9F43220		M9F42320	M9F43320	
25		M9F44125	M9F42125	M9F43125		M9F42225	M9F43225		M9F42325	M9F43325	
30		M9F44130	M9F42130	M9F43130		M9F42230	M9F43230		M9F42330	M9F43330	
35		M9F44135	M9F42135	M9F43135		M9F42235	M9F43235		M9F42335	M9F43335	
40	240 V only	M9F44140	M9F42140	M9F43140	2	M9F42240	M9F43240	4	M9F42340	M9F43340	6
45		M9F44145	M9F42145	M9F43145		M9F42245	M9F43245		M9F42345	M9F43345	
50		M9F44150	M9F42150	M9F43150		M9F42250	M9F43250		M9F42350	M9F43350	
63		M9F44163	M9F42163	M9F43163		M9F42263	M9F43263		M9F42363	M9F43363	

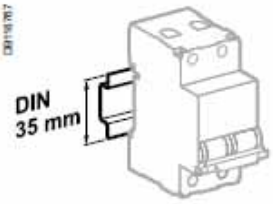
Weight (g / oz)

Circuit-breaker	
Type	C60BP
1P	130 g / 4.58 oz
2P	260 g / 9.17 oz
3P	390 g / 13.76 oz

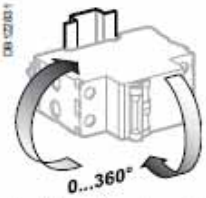
Dimensions (mm / inches)



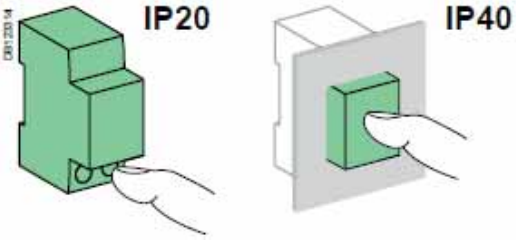
C60BPTunnel terminal



Clip on DIN rail 35 mm.



Indifferent position of installation.



Technical data

Main characteristics			
Insulation voltage (Ui)			500 V
Service breaking capacity (Ics)		In alternating current	75 % of Icu
		In direct current	100 % of Icu
Pollution degree			3
Rated impulse withstand voltage (Uimp)			6 kV
Thermal tripping	Reference temperature		25°C / 77°F
Magnetic tripping	Z curve	In alternating current	3 In ± 20 %
		In direct current	4.2 In ± 20 %
	C curve	In alternating current	8.5 In ± 20 %
		In direct current	12 In ± 20 %
	D curve (=K curve)	In alternating current	12 In ± 20 %
		In direct current	17 In ± 20 %

Additional characteristics		
Degree of protection (IEC 60529)	Device only	IP20
	Device in modular enclosure	IP40 Insulation class II
Endurance (O-C)	Electrical	10,000 cycles
	Mechanical	20,000 cycles
Operating temperature		-30°C to +70°C / -22°F to 158°F
Storage temperature		-40°C to +80°C / -40°F to 176°F
Tropicalization (IEC 60068-1)		Treatment 2 (relative humidity 95 % at 55°C / 131°F)
Dissipated power		See page 68

Multi 9

Schneider Electric

03-058-126

UL 489 / CSA C22.2 No 5 / IEC/EN 60947-2 / GB 14048-2

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

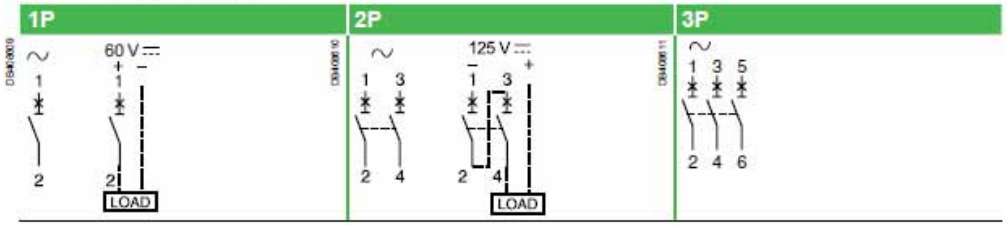
- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries.



Number of 18 mm (0.71 in.) poles	Rating (A) 25°C/77°F	Breaking capacity (kA rms) AIR UL 489 / CSA C22.2 No 5				Icu IEC 60947-2			
	Voltage (Ue)	277 V ~	240 V ~	120 V ~	60 V ⎓	440 V ~	415 V ~	240 V ~	60 V ⎓
1P	0.5 to 35	10	14	14	10	-	3	10	20
	40 to 63	-	10	10	10	-	3	10	20
	Voltage (Ue)	480Y/277 V ~		240 V ~	125 V ⎓	440 V ~	415 V ~	240 V ~	125 V ⎓
2P	1 to 25	10		14	10	6	10	20	-
	30 to 35	10		14	-	6	10	20	-
3P	1 to 35	10		14	-	6	10	20	-
2P/3P	40 to 63	-		10	-	6	10	20	-



Electrical diagrams



Catalogue numbers

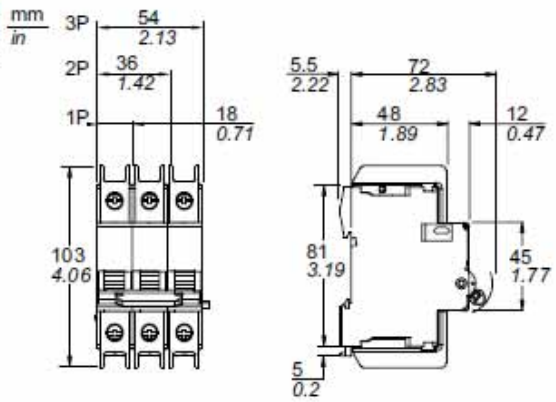
Tunnel terminal connection

Type	UL489 and CSA voltages	1P				2P			3P		
Auxiliaries		Remote indication and tripping, see page 43									
Rating (In)		Curve Z	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules
C60BP											
0.5	480Y/277 V and 240 V	M9F44170	M9F42170	M9F43170	2	-	-	4	-	-	6
1		M9F44101	M9F42101	M9F43101		M9F42201	M9F43201		M9F42301	M9F43301	
2		M9F44102	M9F42102	M9F43102		M9F42202	M9F43202		M9F42302	M9F43302	
3		M9F44103	M9F42103	M9F43103		M9F42203	M9F43203		M9F42303	M9F43303	
4		M9F44104	M9F42104	M9F43104		M9F42204	M9F43204		M9F42304	M9F43304	
5		M9F44105	M9F42105	M9F43105		M9F42205	M9F43205		M9F42305	M9F43305	
6		M9F44106	M9F42106	M9F43106		M9F42206	M9F43206		M9F42306	M9F43306	
8		M9F44108	M9F42108	M9F43108		M9F42208	M9F43208		M9F42308	M9F43308	
10		M9F44110	M9F42110	M9F43110		M9F42210	M9F43210		M9F42310	M9F43310	
15		M9F44115	M9F42115	M9F43115		M9F42215	M9F43215		M9F42315	M9F43315	
20		M9F44120	M9F42120	M9F43120		M9F42220	M9F43220		M9F42320	M9F43320	
25		M9F44125	M9F42125	M9F43125		M9F42225	M9F43225		M9F42325	M9F43325	
30		M9F44130	M9F42130	M9F43130		M9F42230	M9F43230		M9F42330	M9F43330	
35		M9F44135	M9F42135	M9F43135		M9F42235	M9F43235		M9F42335	M9F43335	
40	240 V only	M9F44140	M9F42140	M9F43140	2	M9F42240	M9F43240	4	M9F42340	M9F43340	6
45		M9F44145	M9F42145	M9F43145		M9F42245	M9F43245		M9F42345	M9F43345	
50		M9F44150	M9F42150	M9F43150		M9F42250	M9F43250		M9F42350	M9F43350	
63		M9F44163	M9F42163	M9F43163		M9F42263	M9F43263		M9F42363	M9F43363	

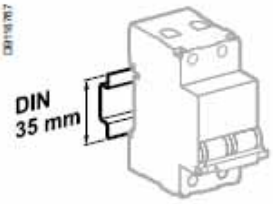
Weight (g / oz)

Circuit-breaker	
Type	C60BP
1P	130 g / 4.58 oz
2P	260 g / 9.17 oz
3P	390 g / 13.76 oz

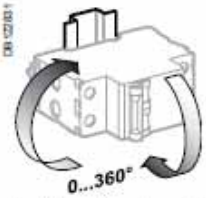
Dimensions (mm / inches)



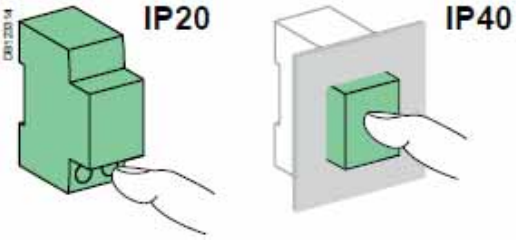
C60BPTunnel terminal



Clip on DIN rail 35 mm.



Indifferent position of installation.



Technical data

Main characteristics			
Insulation voltage (Ui)			500 V
Service breaking capacity (Ics)		In alternating current	75 % of Icu
		In direct current	100 % of Icu
Pollution degree			3
Rated impulse withstand voltage (Uimp)			6 kV
Thermal tripping	Reference temperature		25°C / 77°F
Magnetic tripping	Z curve	In alternating current	3 In ± 20 %
		In direct current	4.2 In ± 20 %
	C curve	In alternating current	8.5 In ± 20 %
		In direct current	12 In ± 20 %
	D curve (=K curve)	In alternating current	12 In ± 20 %
		In direct current	17 In ± 20 %

Additional characteristics		
Degree of protection (IEC 60529)	Device only	IP20
	Device in modular enclosure	IP40 Insulation class II
Endurance (O-C)	Electrical	10,000 cycles
	Mechanical	20,000 cycles
Operating temperature		-30°C to +70°C / -22°F to 158°F
Storage temperature		-40°C to +80°C / -40°F to 176°F
Tropicalization (IEC 60068-1)		Treatment 2 (relative humidity 95 % at 55°C / 131°F)
Dissipated power		See page 68

Multi 9

Schneider Electric

03-058-125

UL 489 / CSA C22.2 No 5 / IEC/EN 60947-2 / GB 14048-2

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

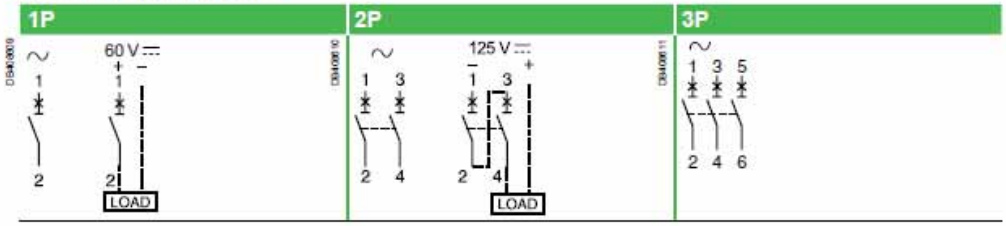
- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries.



Number of 18 mm (0.71 in.) poles	Rating (A) 25°C/77°F	Breaking capacity (kA rms) AIR UL 489 / CSA C22.2 No 5				Icu IEC 60947-2			
	Voltage (Ue)	277 V ~	240 V ~	120 V ~	60 V ⎓	440 V ~	415 V ~	240 V ~	60 V ⎓
1P	0.5 to 35	10	14	14	10	-	3	10	20
	40 to 63	-	10	10	10	-	3	10	20
	Voltage (Ue)	480Y/277 V ~		240 V ~	125 V ⎓	440 V ~	415 V ~	240 V ~	125 V ⎓
2P	1 to 25	10		14	10	6	10	20	-
	30 to 35	10		14	-	6	10	20	-
3P	1 to 35	10		14	-	6	10	20	-
2P/3P	40 to 63	-		10	-	6	10	20	-



Electrical diagrams



Catalogue numbers

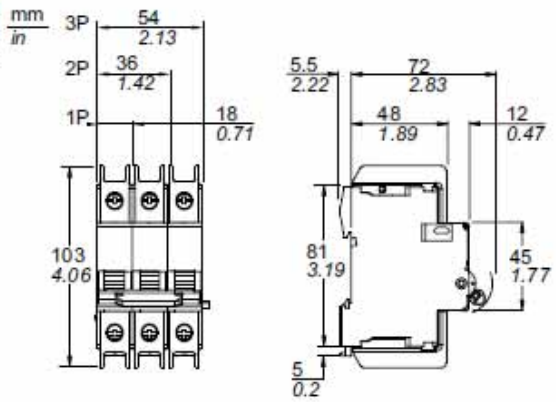
Tunnel terminal connection

Type	UL489 and CSA voltages	1P				2P			3P		
Auxiliaries		Remote indication and tripping, see page 43									
Rating (In)		Curve Z	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules
C60BP											
0.5	480Y/277 V and 240 V	M9F44170	M9F42170	M9F43170	2	-	-	4	-	-	6
1		M9F44101	M9F42101	M9F43101		M9F42201	M9F43201		M9F42301	M9F43301	
2		M9F44102	M9F42102	M9F43102		M9F42202	M9F43202		M9F42302	M9F43302	
3		M9F44103	M9F42103	M9F43103		M9F42203	M9F43203		M9F42303	M9F43303	
4		M9F44104	M9F42104	M9F43104		M9F42204	M9F43204		M9F42304	M9F43304	
5		M9F44105	M9F42105	M9F43105		M9F42205	M9F43205		M9F42305	M9F43305	
6		M9F44106	M9F42106	M9F43106		M9F42206	M9F43206		M9F42306	M9F43306	
8		M9F44108	M9F42108	M9F43108		M9F42208	M9F43208		M9F42308	M9F43308	
10		M9F44110	M9F42110	M9F43110		M9F42210	M9F43210		M9F42310	M9F43310	
15		M9F44115	M9F42115	M9F43115		M9F42215	M9F43215		M9F42315	M9F43315	
20		M9F44120	M9F42120	M9F43120		M9F42220	M9F43220		M9F42320	M9F43320	
25		M9F44125	M9F42125	M9F43125		M9F42225	M9F43225		M9F42325	M9F43325	
30		M9F44130	M9F42130	M9F43130		M9F42230	M9F43230		M9F42330	M9F43330	
35		M9F44135	M9F42135	M9F43135		M9F42235	M9F43235		M9F42335	M9F43335	
40	240 V only	M9F44140	M9F42140	M9F43140	2	M9F42240	M9F43240	4	M9F42340	M9F43340	6
45		M9F44145	M9F42145	M9F43145		M9F42245	M9F43245		M9F42345	M9F43345	
50		M9F44150	M9F42150	M9F43150		M9F42250	M9F43250		M9F42350	M9F43350	
63		M9F44163	M9F42163	M9F43163		M9F42263	M9F43263		M9F42363	M9F43363	

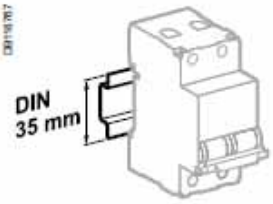
Weight (g / oz)

Circuit-breaker	
Type	C60BP
1P	130 g / 4.58 oz
2P	260 g / 9.17 oz
3P	390 g / 13.76 oz

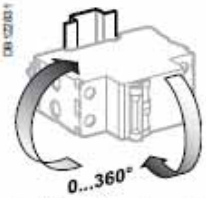
Dimensions (mm / inches)



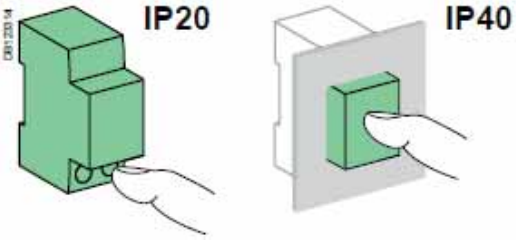
C60BPTunnel terminal



Clip on DIN rail 35 mm.



Indifferent position of installation.



Technical data

Main characteristics			
Insulation voltage (Ui)			500 V
Service breaking capacity (Ics)		In alternating current	75 % of Icu
		In direct current	100 % of Icu
Pollution degree			3
Rated impulse withstand voltage (Uimp)			6 kV
Thermal tripping	Reference temperature		25°C / 77°F
Magnetic tripping	Z curve	In alternating current	3 In ± 20 %
		In direct current	4.2 In ± 20 %
	C curve	In alternating current	8.5 In ± 20 %
		In direct current	12 In ± 20 %
	D curve (=K curve)	In alternating current	12 In ± 20 %
		In direct current	17 In ± 20 %

Additional characteristics		
Degree of protection (IEC 60529)	Device only	IP20
	Device in modular enclosure	IP40 Insulation class II
Endurance (O-C)	Electrical	10,000 cycles
	Mechanical	20,000 cycles
Operating temperature		-30°C to +70°C / -22°F to 158°F
Storage temperature		-40°C to +80°C / -40°F to 176°F
Tropicalization (IEC 60068-1)		Treatment 2 (relative humidity 95 % at 55°C / 131°F)
Dissipated power		See page 68

Multi 9

Schneider Electric

03-058-123

UL 489 / CSA C22.2 No 5 / IEC/EN 60947-2 / GB 14048-2

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

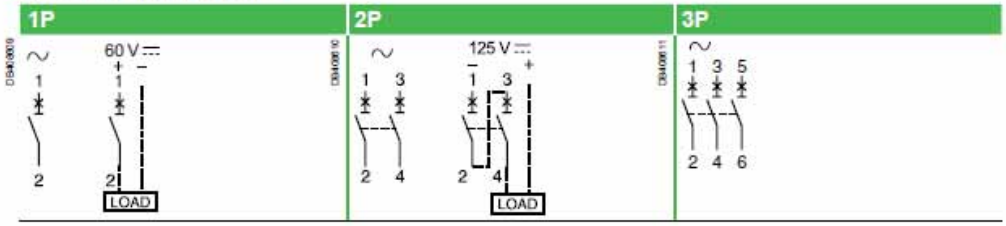
- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries.



Number of 18 mm (0.71 in.) poles	Rating (A) 25°C/77°F	Breaking capacity (kA rms) AIR UL 489 / CSA C22.2 No 5				Icu IEC 60947-2			
	Voltage (Ue)	277 V ~	240 V ~	120 V ~	60 V ⎓	440 V ~	415 V ~	240 V ~	60 V ⎓
1P	0.5 to 35	10	14	14	10	-	3	10	20
	40 to 63	-	10	10	10	-	3	10	20
	Voltage (Ue)	480Y/277 V ~		240 V ~	125 V ⎓	440 V ~	415 V ~	240 V ~	125 V ⎓
2P	1 to 25	10		14	10	6	10	20	-
	30 to 35	10		14	-	6	10	20	-
3P	1 to 35	10		14	-	6	10	20	-
2P/3P	40 to 63	-		10	-	6	10	20	-



Electrical diagrams



Catalogue numbers

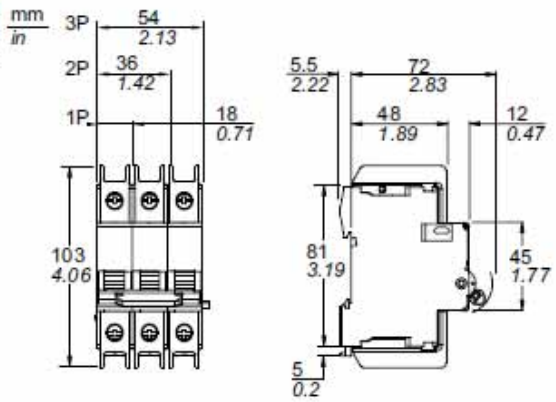
Tunnel terminal connection

Type	UL489 and CSA voltages	1P				2P			3P		
Auxiliaries		Remote indication and tripping, see page 43									
Rating (In)		Curve Z	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules	Curve C	Curve D (=K)	Width in 9 mm modules
C60BP											
0.5	480Y/277 V and 240 V	M9F44170	M9F42170	M9F43170	2	-	-	4	-	-	6
1		M9F44101	M9F42101	M9F43101		M9F42201	M9F43201		M9F42301	M9F43301	
2		M9F44102	M9F42102	M9F43102		M9F42202	M9F43202		M9F42302	M9F43302	
3		M9F44103	M9F42103	M9F43103		M9F42203	M9F43203		M9F42303	M9F43303	
4		M9F44104	M9F42104	M9F43104		M9F42204	M9F43204		M9F42304	M9F43304	
5		M9F44105	M9F42105	M9F43105		M9F42205	M9F43205		M9F42305	M9F43305	
6		M9F44106	M9F42106	M9F43106		M9F42206	M9F43206		M9F42306	M9F43306	
8		M9F44108	M9F42108	M9F43108		M9F42208	M9F43208		M9F42308	M9F43308	
10		M9F44110	M9F42110	M9F43110		M9F42210	M9F43210		M9F42310	M9F43310	
15		M9F44115	M9F42115	M9F43115		M9F42215	M9F43215		M9F42315	M9F43315	
20		M9F44120	M9F42120	M9F43120		M9F42220	M9F43220		M9F42320	M9F43320	
25		M9F44125	M9F42125	M9F43125		M9F42225	M9F43225		M9F42325	M9F43325	
30		M9F44130	M9F42130	M9F43130		M9F42230	M9F43230		M9F42330	M9F43330	
35		M9F44135	M9F42135	M9F43135		M9F42235	M9F43235		M9F42335	M9F43335	
40	240 V only	M9F44140	M9F42140	M9F43140	2	M9F42240	M9F43240	4	M9F42340	M9F43340	6
45		M9F44145	M9F42145	M9F43145		M9F42245	M9F43245		M9F42345	M9F43345	
50		M9F44150	M9F42150	M9F43150		M9F42250	M9F43250		M9F42350	M9F43350	
63		M9F44163	M9F42163	M9F43163		M9F42263	M9F43263		M9F42363	M9F43363	

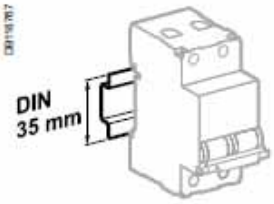
Weight (g / oz)

Circuit-breaker	
Type	C60BP
1P	130 g / 4.58 oz
2P	260 g / 9.17 oz
3P	390 g / 13.76 oz

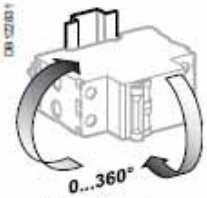
Dimensions (mm / inches)



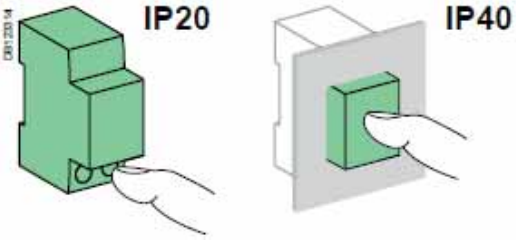
C60BPTunnel terminal



Clip on DIN rail 35 mm.



Indifferent position of installation.



Technical data

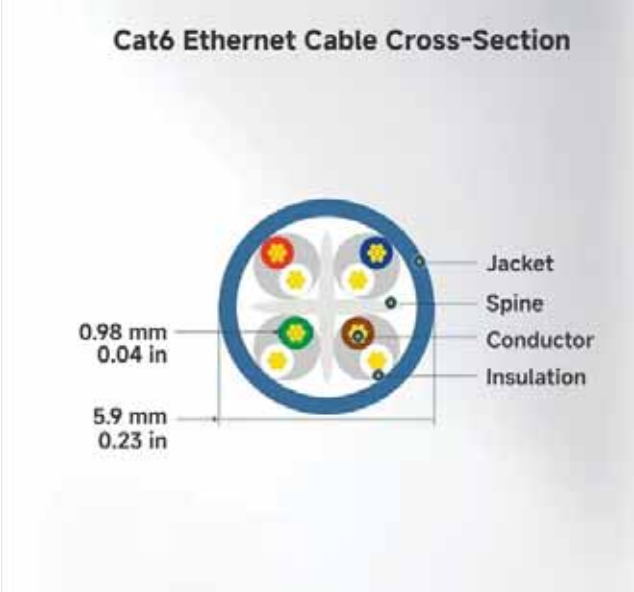
Main characteristics			
Insulation voltage (Ui)			500 V
Service breaking capacity (Ics)		In alternating current	75 % of Icu
		In direct current	100 % of Icu
Pollution degree			3
Rated impulse withstand voltage (Uimp)			6 kV
Thermal tripping	Reference temperature		25°C / 77°F
Magnetic tripping	Z curve	In alternating current	3 In ± 20 %
		In direct current	4.2 In ± 20 %
	C curve	In alternating current	8.5 In ± 20 %
		In direct current	12 In ± 20 %
	D curve (=K curve)	In alternating current	12 In ± 20 %
		In direct current	17 In ± 20 %

Additional characteristics		
Degree of protection (IEC 60529)	Device only	IP20
	Device in modular enclosure	IP40 Insulation class II
Endurance (O-C)	Electrical	10,000 cycles
	Mechanical	20,000 cycles
Operating temperature		-30°C to +70°C / -22°F to 158°F
Storage temperature		-40°C to +80°C / -40°F to 176°F
Tropicalization (IEC 60068-1)		Treatment 2 (relative humidity 95 % at 55°C / 131°F)
Dissipated power		See page 68

Cable Matters

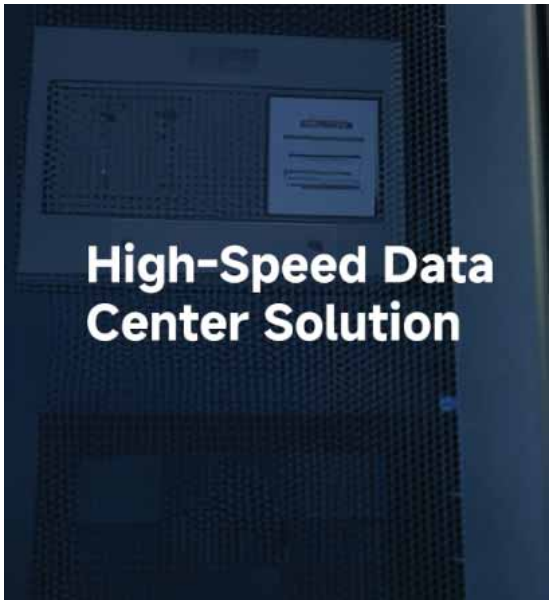
CAT 6
10Gbps Snagless Ethernet Cable

57-000-064









Features

- High-Performance Connectivity: This Cat 6 ethernet cable is designed for superior performance, with a 24 AWG copper wire core. It provides universal connectivity as an ethernet cord for LAN network components such as PCs, servers, printers, routers, and more, ensuring reliable and fast network connections
- Advanced Cat6 Technology: Experience Cat6 performance with higher bandwidth at a Cat5e price. This network cable is future-proof, ready for 10-Gigabit Ethernet and backwards compatible with any existing Cat 5 cable network. It meets or exceeds Category 6 performance according to the TIA/EIA 568-C.2 standard

DataTuff Industrial Ethernet Cord Sets (RJ45). Cat 5e 4-Pair, 24 AWG – Heavy Duty Oil- & Sunlight-Resistant Black Jackets

IP67 interface complies with the EtherNet/IP specification (IEC 61076-3-106 Variant 1)

BELDEN

57-009-026

- **Cord Sets (RJ45)**
  Cat 6 or Cat 5e UTP or FTP with solid 24 AWG conductors and industrial-grade sunlight/oil resistant jackets. Suitable for use in IP67 or IP20 installations.

IP20 Cord Set



Shielded with Solid Conductors (ref: Belden Bonded-Pair Cable 7929A)
Cable Rating NEC: CMR, CMX-Outdoor CEC: CMR FT4. MSHA

Belden Part No.	IP Rating	Length meters (Ft.)	Tethered Cap	Package Quantity
E504001 010S1	IP67	1 m (3.3 ft.)	Yes	1
E504002 010S1	IP67	2 m (6.6 ft.)	Yes	1
E504003 010S1	IP67	3 m (9.8 ft.)	Yes	1
E504005 010S1	IP67	5 m (16.4 ft.)	Yes	1
E504025 010S1	IP67	25 m (82 ft.)	Yes	1
E505001 010S1	IP20	1 m (3.3 ft.)	–	1
E505002 010S1	IP20	2 m (6.6 ft.)	–	1
E505003 010S1	IP20	3 m (9.8 ft.)	–	1
E505005 010S1	IP20	5 m (16.4 ft.)	–	1

General Description:

2 meter (6.6 ft.), Shielded with solid conductors (ref: Belden Bonded-Pair Cable 7958A). Cable Rating NEC: CMR, CMX-Outdoor. CEC: CMR FT4. MSHA. 600V AWM Rated.

Item #	Putup	Ship Weight	Color	Notes	Item Desc
E605002 010S1	1 EA	0.226 LB	BLACK		CORDSET IP20 C6A FTP SO 2M BK

General Description:

2 meter (6.6 ft.), Shielded with solid conductors (ref: Belden Bonded-Pair Cable 7953A). Cable Rating NEC: CMR. CEC: CMR FT4. 600V AWM Rated.

Applicable Specifications and Agency Compliance (Overall)

Applicable Standards & Environmental Programs

EU Directive 2002/95/EC (RoHS):	Yes
EU RoHS Compliance Date (mm/dd/yyyy):	01/01/2006
MII Order #39 (China RoHS):	EUP 50

Notes (Overall)

Notes: For additional information about this product, visit our web site at http://www.belden.com

Cable

Description:	4 pair, 23 AWG bare copper, Polyolefin Insulation, Bonded pairs, Overall Beldfoil® Shield, Industrial Grade PVC, Oil Res, Sun Res, CMR, FT4. 600V AWM Rated.
Part Number:	7953A
Shielding:	Aluminum Foil-Polyester Tape
Electrical Performance:	Category 6A
Maximum Operating Voltage:	300 V RMS (600 V AWM Rated)
Applicable Standards:	ANSI/TIA-568-C.2, ISO/IEC 11801, EtherNet/IP(tm) Specification, UL 1666 Riser

Monitoring Relays
1-Phase True RMS AC Over or Under Current
Type DIB01 100A

04-094-000

Ordering Key

DIB 01 C M24 100A

- Housing
- Function
- Type
- Item number
- Output
- Power supply
- Measuring range



Input Specifications

Input (current level)		
DIB01 100A	Built-in current transformer	
Measuring ranges		
Selectable by DIP-switch		**Max current**
2 to 20 A AC		120 A
5 to 50 A AC		120 A
10 to 100 A AC		120 A
Max. current for 30 s	250 A	
Max. current for 1 s	2000 A	

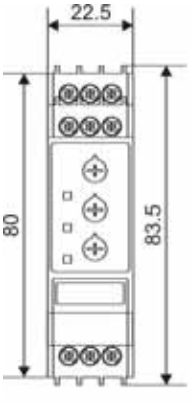
Contact input	
DIB01	Terminals A1, Y1
Disabled	Open
Enabled	< 10 kΩ
Latch disable	> 500 ms

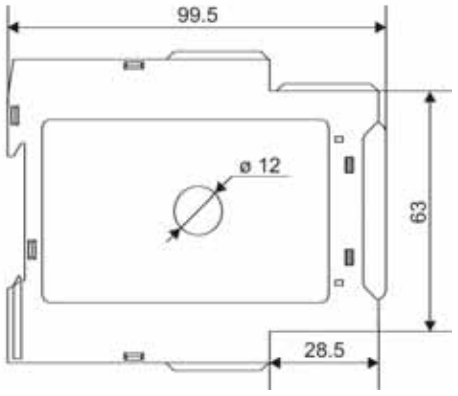
Supply Specifications

Power supply	Overvoltage cat. III (IEC 60664, IEC 60038)
Rated operational voltage through terminals: A1, A2	24 VDC - 15% +10% 24 to 240 VAC ± 15% 45 to 65 Hz
Dielectric voltage	
Supply to input	4 kV
Supply to output	4 kV
Input to output	4 kV
Rated operational power	
DC	1 W
AC	1 W / 35 VA

Output Specifications

Output		SPDT relay
Rated insulation voltage		250 VAC
Contact ratings ($AgSnO_2$)		μ
Resistive loads	AC 1	8 A @ 250 VAC
	DC 12	5 A @ 24 VDC
Small inductive loads	AC 15	2.5 A @ 250 VAC
	DC 13	2.5 A @ 24 VDC
Mechanical life		≥ 30 x 10^6 operations
Electrical life		≥ 10^5 operations (at 8 A, 250 V, cos φ = 1)
Operating frequency		≤ 7200 operations/h
Dielectric strength		
Dielectric voltage		≥ 2 kVAC (rms)
Rated impulse withstand volt.		4 kV (1.2/50 μs)





Approvals UL, CSA

ELEMECH INC.
630-499-7080 · www.elemechinc.com

Rev: 0	Device Tag: CM1		
Date: 02-16-2026			
Manuf.: . PNo: Gavazzi: DIB01CM24100A	By: AJ	Job Number: HBR10366	Page # 1/1

RXZS2

bus jumper for Zelio Relay RXZ sockets with separate contacts



06-058-012

Main

Commercial Status	Commercialised
Range of product	Zelio Relay
Accessory / separate part type	Jumper
Accessory / separate part designation	Bus jumper
Sale per indivisible quantity	10

Complementary

Product compatibility	Socket RXZ
Accessory / separate part destination	All RXZ sockets with separate contacts
[Ith] conventional free air thermal current	5 A
Product weight	0.005 kg

Ordering and shipping details

Category	21128 - ZELIO ICE CUBE RELAY ACCESSORIES
Discount Schedule	CP2
GTIN	00785901924098
Nbr. of units in pkg.	10
Package weight(Lbs)	0.01
Stock Code	Stock - Normally stocked in distribution facility
Returnability	Y
Country of origin	CN

Zelio® Plug-in Relays
RXM

Telemecanique

06-058-015


RXM●AB2F7

RXM Miniature Relays (page 4)

2 pole relays; 12 A, 1/2 hp (IEC rating = 12 A)
3 pole relays; 10 A, 1/3 hp (IEC rating = 10 A)
4 pole relays; 8 A, 1/3 hp (IEC rating = 6 A)
4 pole relays; 3 A (low level), 1/16 hp (IEC rating = 3 A)

- Mechanical "relay status" indicator on all relays
- Pilot light option available
- Manual operator optional for all relays
- Built-in marking area

Insulation characteristics

Rated insulation voltage (Ui)		250 V (IEC), 300 V (UL, CSA)
Rated impulse withstand voltage (Uimp)		3.6 kV (1.2/50 µs)
Dielectric strength (rms voltage)	Between coil and contact	2,500 Vac
	Between poles	2,500 Vac
	Between contacts	1,500 Vac

Contact characteristics

Relay type			**RXM2AB●●●**	**RXM3AB●●●**	**RXM4AB●●●**
Number and type of contacts (see page 12)			DPDT	3PDT	4PDT
Contact materials			AgNi		
Conventional thermal current (Ith)	For ambient temperature ≤ 131 °F (55 °C)		12 A	10 A	6 A
Rated operational current	Conforming to IEC in utilization category AC-1	N.O.	12 A	10 A	6 A
		N.C.	6 A	5 A	3 A
	Conforming to UL Resistive @277 Vac, hp @120 Vac		12 A, 1/2 hp	10 A, 1/3 hp	8 A, 1/3 hp
Maximum operating rate In operating cycles/hour	No load		18,000		
	Under load		1,200		
Switching voltage	Maximum		250 Vac/Vdc		
Switching capacity	Minimum		10 mA on 17 V		
	Maximum		3,000 VA	2,500 VA	1,500 VA
Utilization coefficient			20%		
Mechanical durability in millions of operating cycles			10		
Electrical durability in millions of operating cycles	Resistive load		0.1		

Coil characteristics

Average consumption		AC	1.2 VA
		DC	0.9 W
Drop-out voltage threshold		AC	> 0.15 Uc
		DC	> 0.1 Uc
Operating time (response time)	Between coil energization and making of the N.O. contact	AC	20 ms
		DC	20 ms
	Between coil de-energization and making of the N.C. contact	AC	20 ms
		DC	20 ms

Coil voltage Uc			**12 V**	**24 V**	**48 V**	**110 V**	**120 V**	**125 V**	**220 V**	**230 V**	**240 V**
Relay coil voltage codes			**JD**	**BD**	**ED**	**FD**	**—**	**GD**	**MD**	**—**	**—**
DC	Average resistance at 68 °F (20 °C) ± 10%		160 Ω	650 Ω	2,600 Ω	11,000 Ω	—	11,000 Ω	14,000 Ω	—	—
	Operating voltage limits	Min.	9.6 V	19.2 V	38.4 V	88 V	—	100 V	176 V	—	—
		Max.	13.2 V	26.4 V	52.8 V	121 V	—	138 V	242 V	—	—
Relay coil voltage codes			**—**	**B7**	**E7**	**—**	**F7**	**—**	**M7**	**P7**	**U7**
AC	Average resistance at 68 °F (20 °C) ± 15%		—	180 Ω	770 Ω	—	4,430 Ω	—	15,000 Ω	15,000 Ω	15,500 Ω
	Operating voltage limits	Min.	—	19.2 V	38.4 V	—	96 V	—	176 V	184 V	192 V
		Max.	—	26.4 V	52.8 V	—	132 V	—	242 V	253 V	264 V

Environment

Dielectric strength	2000 V AC (between poles) 2000 V AC (between coil and contact) 1300 V AC (between contacts)
Product certifications	CSA GOST Lloyds UL
Standards	EN/IEC 61810-1 UL 508 CSA C22.2 No 14

Telemecanique

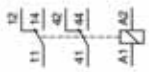
06-058-015

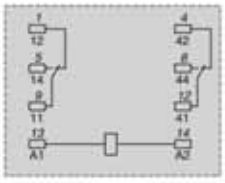
Miniature relays with lockable test button, without LED

Coil Voltage	Number and type of contacts - Thermal current (Ith)								
	DPDT - 12 A			3PDT - 10 A			4PDT - 6 A		
	Catalog Number	Weight		Catalog Number	Weight		Catalog Number	Weight	
		lb.	kg		lb.	kg		lb.	kg
12 Vdc	RXM2AB1JD	0.082	0.037	RXM3AB1JD	0.084	0.038	RXM4AB1JD	0.080	0.036
24 Vdc	RXM2AB1BD	0.082	0.037	RXM3AB1BD	0.084	0.038	RXM4AB1BD	0.080	0.036
48 Vdc	RXM2AB1ED	0.082	0.037	RXM3AB1ED	0.084	0.038	RXM4AB1ED	0.080	0.036
110 Vdc	RXM2AB1FD	0.082	0.037	RXM3AB1FD	0.084	0.038	RXM4AB1FD	0.080	0.036
220 Vdc	—	—	—	—	—	—	RXM4AB1MD	0.080	0.036
24 Vac	RXM2AB1B7	0.082	0.037	RXM3AB1B7	0.084	0.038	RXM4AB1B7	0.080	0.036
48 Vac	RXM2AB1E7	0.082	0.037	RXM3AB1E7	0.084	0.038	RXM4AB1E7	0.080	0.036
120 Vac	RXM2AB1F7	0.082	0.037	RXM3AB1F7	0.084	0.038	RXM4AB1F7	0.080	0.036
230 Vac	RXM2AB1P7	0.082	0.037	RXM3AB1P7	0.084	0.038	RXM4AB1P7	0.080	0.036
240 Vac	—	—	—	—	—	—	RXM4AB1U7	0.080	0.036
Miniature relays with lockable test button, with LED									
12 Vdc	RXM2AB2JD	0.082	0.037	RXM3AB2JD	0.084	0.038	RXM4AB2JD	0.080	0.036
24 Vdc	RXM2AB2BD	0.082	0.037	RXM3AB2BD	0.084	0.038	RXM4AB2BD	0.080	0.036
48 Vdc	RXM2AB2ED	0.082	0.037	RXM3AB2ED	0.084	0.038	RXM4AB2ED	0.080	0.036
110 Vdc	RXM2AB2FD	0.082	0.037	RXM3AB2FD	0.084	0.038	RXM4AB2FD	0.080	0.036
125 Vdc	—	—	—	—	—	—	RXM4AB2GD	0.080	0.036
24 Vac	RXM2AB2B7	0.082	0.037	RXM3AB2B7	0.084	0.038	RXM4AB2B7	0.080	0.036
48 Vac	RXM2AB2E7	0.082	0.037	RXM3AB2E7	0.084	0.038	RXM4AB2E7	0.080	0.036
120 Vac	RXM2AB2F7	0.082	0.037	RXM3AB2F7	0.084	0.038	RXM4AB2F7	0.080	0.036
230 Vac	RXM2AB2P7	0.082	0.037	RXM3AB2P7	0.084	0.038	RXM4AB2P7	0.080	0.036

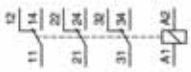
Miniature relays

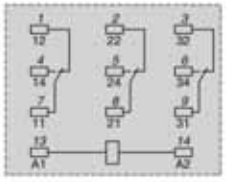
RXM2●●●●●



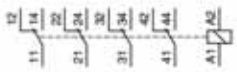


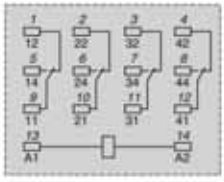
RXM3●●●●●



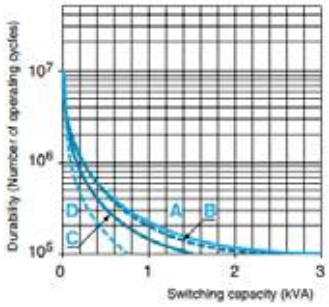


RXM4●●●●●



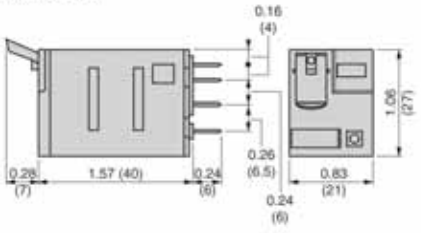


Resistive load AC



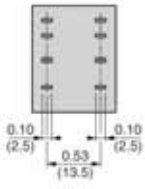
RXM ●●●●●●

Common view

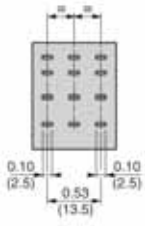


RXM 2

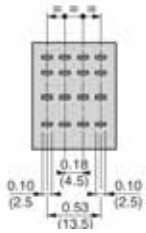
Pin side view



RXM 3



RXM 4



ELEMECH INC.
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Rev: 0	Device Tag: CR1-3		
Date: 02-16-2026			
Manuf.: . PNo: Square D: RXM3AB2BD	By: AJ	Job Number: HBR10366	Page # 2/2

Sockets

Telemecanique

38-058-003

RXZE2S108M

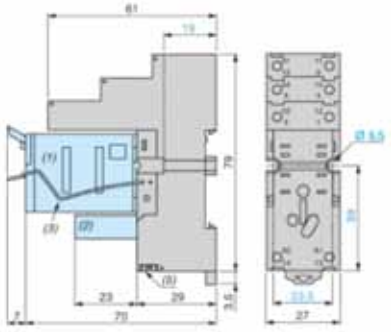


Complementary

[Ith] conventional free air thermal current	12 A 5 A with bus jumper
[Ue] rated operational voltage	< 250 V
Tightening torque	<= 1 N.m (M3 screw(s))
Fixing mode	By screw mounting on panel Clip-on mounting on 35 mm symmetrical DIN rail
Marking	CE
Width	27 mm
Product weight	0.058 kg 0.07 kg

Environment

Standards	IEC 61984
Product certifications	CSA UL
Ambient air temperature for storage	-40...85 °C
Ambient air temperature for operation	-40...55 °C
IP degree of protection	IP20 conforming to EN/IEC 60529
Dielectric strength	2500 V
RoHS EUR status	Compliant
RoHS EUR conformity date	0801



1 Relay
2 Protection Module
3 Carriage Stirrup
5 2 Links connection

Approvals for Sockets:

RXZE2S111M



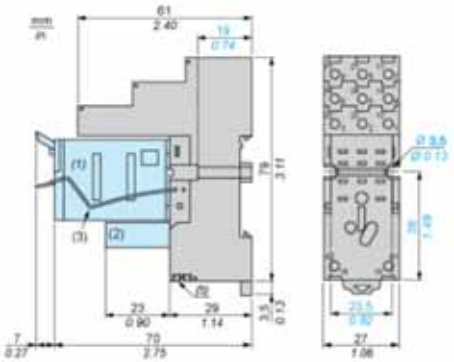
Complementary

[Ith] conventional free air thermal current	10 A 5 A with bus jumper
[Ue] rated operational voltage	< 250 V
Tightening torque	<= 1 N.m (M3 screw(s))
Fixing mode	By screw mounting on panel Clip-on mounting on 35 mm symmetrical DIN rail
Marking	CE
Width	27 mm
Product weight	0.066 kg

Environment

Standards	IEC 61984
Product certifications	CSA UL
Ambient air temperature for storage	-40...85 °C
Ambient air temperature for operation	-40...55 °C
IP degree of protection	IP20 conforming to EN/IEC 60529
Dielectric strength	2500 V
RoHS EUR status	Compliant
RoHS EUR conformity date	0801

Dimensions



(1) Relays
(2) Protection module
(3) Maintaining clamp
(4) 2 elongated holes Ø 3.5 mm x 6.5 mm / Ø 0.13 in. x 0.25 in.
(5) 2 bus jumpers

Approvals for Sockets:

RXZE2S114M

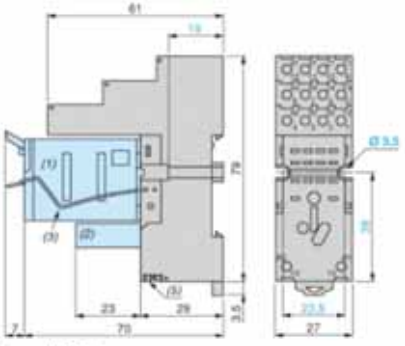


Complementary

[Ith] conventional free air thermal current	10 A 5 A with bus jumper
[Ue] rated operational voltage	< 250 V
Tightening torque	<= 1 N.m (M3 screw(s))
Fixing mode	By screw mounting on panel Clip-on mounting on 35 mm symmetrical DIN rail
Marking	CE
Width	27 mm
Product weight	0.058 kg 0.07 kg

Environment

Standards	IEC 61984
Product certifications	CSA UL
Ambient air temperature for storage	-40...85 °C
Ambient air temperature for operation	-40...55 °C
IP degree of protection	IP20 conforming to EN/IEC 60529
Dielectric strength	2500 V
RoHS EUR status	Compliant
RoHS EUR conformity date	0801



1 Relay
2 Protection Module
3 Carriage Stirrup
5 2 Links connection

Approvals for Sockets:

wieland

07-063-000

General Data

Part No: 07.311.4053.1
Description: End Cover – Black
Type of end plate – Yes
Snap in - Yes
Inflammability Class of insulation material acc. With UL94 – V0



ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Device Tag: DB	
Manuf.: . PNo: Wieland: 07.311.4053.1	Date: 02-16-2026	Job Number: HBR10366	Page # 1/1
	By: AJ		

Cross connectors, (jumper bars) uninsulated

wieland

07-063-001

Type	Part no.	Std. pack
WKM 4/15	**6 mm spacing Screw: M 3**	
2pole 9215 - 2	Z7.210.3227.0	50
3pole 9215 - 3	Z7.210.3327.0	50
4pole 9215 - 4	Z7.210.3427.0	50
5pole 9215 - 5	Z7.210.3527.0	50
6pole 9215 - 6	Z7.210.3627.0	50
70pole 9215 M-70	Z7.210.3027.0	10



General

Colour	Other
Type	Cross connector
Modular spacing	6 mm
Number of bridged clamps	4
Mounting method	Screwable
Insulated	No

Accessories

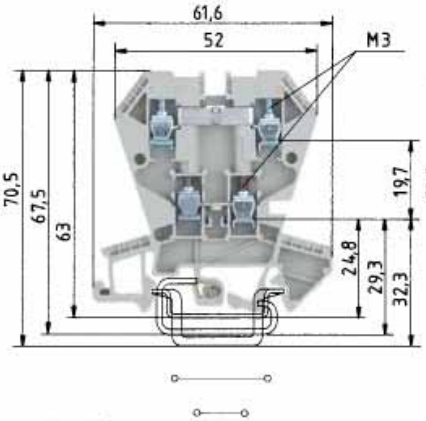
Type	Cross connector
Mounting method	Screwable
Insulated	No
Colour	Other
Number of bridged clamps	4
Modular spacing	6 mm

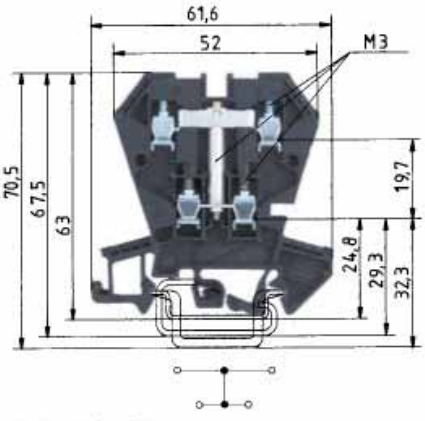
wieland

07-063-002

Multi-tier blocks with screw connection

selos





		WK 4 E/U				WK 4 E/U /VB			
0344 Ex II 2GD IM2		fine-stranded	solid	V	A	fine-stranded	solid	V	A
Ex e I/II		0.5-4mm²	0.5-4mm²	400V/6kV/3[3]	32	0.5-4mm²	0.5-4mm²	400V/6kV/3	32
EN 60947-7-1:2002									
EN 60947-7-2:2002									
UL ratings	Field/factory wiring	No. 22-10 AWG		300V	20	No. 22-10 AWG		300V	20
CSA ratings		No. 20-12 AWG		300V	10	No. 20-12 AWG		300V	10
KEMA 02 ATEX 2114 U[1]	EN 60079-0/EN 60079-7	0.5-4mm²	0.5-4mm²	275V	24/24[2]	0.5-4mm²	0.5-4mm²	275V	24
Width	Wire strip length	6mm			9mm	6mm			9mm
Approvals									

		Type	Part No.	Std. Pack	Type	Part No.	Std. Pack
Multi-tier block	gray	WK 4 E/U	57.404.7055.0	100			
Multi-tier block, vert. connected	black				WK 4 E/U/VB SCHWARZ	57.404.6955.1	100
Multi-tier ground block	green/yellow						
Function block	red						
Function block	orange						
Accessories							
1. Mounting rail TS 35, DIN rail 7.5 mm high	L = 2 m	35 x 27 x 7,5 EN 60715	98.300.0000.0	1	35 x 27 x 7,5 EN 60715	98.300.0000.0	1
Mounting rail TS 35, DIN rail, 15 mm high	L = 2 m	35 x 24 x 15 EN 60715	98.360.0000.0	1	35 x 24 x 15 EN 60715	98.360.0000.0	1
Mounting rail TS 32, G rail*	L = 2 m	9006 EN 60715 G-32	98.190.0000.0	1	9006 EN 60715 G-32	98.190.0000.0	1
2. End clamp with U-foot*	10mm wide	WE 1/U	Z5.523.5753.0	100	WE 1/U	Z5.523.5753.0	100
End clamp TS 35, with screw	8mm wide	9708/2 S 35	Z5.522.8553.0	100	9708/2 S 35	Z5.522.8553.0	100
End clamp TS 35, without screw	8mm wide	9708	Z5.522.7053.0	100	WEF 1/35	Z5.523.9353.0	100
3. End plate	gray	AP 4 E	07.311.4055.0	10	AP 4 E	07.311.4055.0	10
	blue						
4. Partition	gray	TW 4 E	07.311.5055.0	10	TW 4 E	07.311.5055.0	10
	blue						
5. Cross connector with screws	2 pole	9215-2	Z7.210.3227.0	50	9215-2	07.210.3227.0	1
for top tier	3 pole	9215-3	Z7.210.3327.0	50	9215-3	07.210.3327.0	1
	up to 6 pole	9215-6	Z7.210.3627.0	50	9215-6	07.210.3627.0	1
Jumper comb for lower tier block	2 pole	IVBS WK 4 E-2	Z7.256.4227.0	10	IVBS WK 4 E-2	Z7.256.4227.0	10
insulated, angled	up to 6 pole	IVBS WK 4 E-6	Z7.256.4627.0	10	IVBS WK 4 E-6	Z7.256.4627.0	10
Jumper comb for lower tier block	2 pole	IVB WK 4 E-2	Z7.255.2227.0	10	IVB WK 4 E-2	Z7.255.2227.0	10
insulated, straight	up to 6 pole	IVB WK 4 E-6	Z7.255.2627.0	10	IVB WK 4 E-6	Z7.255.2627.0	10
6. Partition plate with marking facility							
7. Single cover with marking facility		AD VB 4/15 GELB	04.326.2953.8	10	AD VB 4/15 GELB	04.326.2953.8	10
8. Cover with warning symbol over 4 blocks							

For more accessories see pages 60-77
For marking systems see pages 70-75

[1] Please note the mounting instructions on the cover page.
[2] With end plates 500 V/6 kV/3
[3] Ratings to adjacent feed-through blocks of the same series and size
[4] For the current carrying capability of the mounting rail see AT catalog section **facts** & DATA.
[5] With/without jumper
* Do not use in Ex environments.

ELEMECH INC.
630-499-7080 · www.elemechinc.com

Rev: 0
Date: 02-16-2026
By: AJ
Device Tag: DB
Manuf.: . PNo: Wieland: 57.404.6955.1
Job Number: HBR10366
Page # 1/1

Front operated non-fusible disconnect switches, base and DIN-rail mounting, UL/CSA

Number of poles	Ampere rating	Horsepower rating 3-phase 240 V AC	480 V AC	600 V AC	Type
	A	HP	HP	HP	
3	20	5	10	10	OT16F3
4	20	5	10	10	OT16F4N2
3	30	7.5	15	20	OT25F3
4	30	7.5	15	20	OT25F4N2
3	40	10	20	25	OT40F3
4	40	10	20	25	OT40F4N2
3	60	15	30	30	OT63F3
4	60	15	30	30	OT63F4N2
3	80	20	40	40	OT80F3
4	80	20	40	40	OT80F4N2
3	30	10	20	30	OT30F3
4	30	10	20	30	OT30F4N2
3	60	20	40	40	OT60F3
4	60	20	40	40	OT60F4N2
3	100	30	50	50	OT100F3
4	100	30	50	50	OT100F4N2



09-001-A030



OHB65J6



OXP6X_

Approvals:
- OT16,25,40,63,80: UL 508. CSA 22-2 No.14
- OT30,60,100: UL 98. CSA 22-2 No.4
- IEC 60947-3

Technical data according to UL/CSA, AC ratings

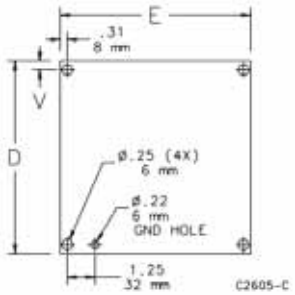
Switch type			OT16F	OT25F	OT40F	OT63F	OT80F	OT30F	OT60F
		Approval	$_cUL_{US}$ Listed	$_cUL_{US}$ Listed	$_cUL_{US}$ Listed	$_cUL_{US}$ Listed	$_cUL_{US}$ Listed	$_cUL_{US}$ Listed	$_cUL_{US}$ Listed
			E63822	E63822	E63822	E63822	E63822	E101914	E101914
		Compliance	UL508	UL508	UL508	UL508	UL508	UL98	UL98
			CSA C22.2 No.14	CSA C22.2 No.14	CSA C22.2 No.14	CSA C22.2 No.14	CSA C22.2 No.14	CSA C22.2 No.4	CSA C22.2 No.4
General purpose amp rating	pf= 0.7...0.8	-40° to 40 °C	20 A	30 A	40 A	60 A	80 A	30 A	60 A
Max. operating voltage			600 V	600 V	600 V	600 V	600 V	600 V	600 V
Max. horsepower rating / motor FLA current	pf= 0.4...0.5	240 V	5 HP/15.2 A	7.5 HP/22.0 A	10 HP/28.0 A	15 HP/42.0 A	20 HP/54.0 A	10 HP/28.0 A	20 HP/54.0 A
	Three phase	480 V	10 HP/14.0 A	15 HP/21.0 A	20 HP/27.0 A	30 HP/40.0 A	40 HP/52.0 A	20 HP/27.0 A	40 HP/52.0 A
		600 V	10 HP/11.0 A	20 HP/22.0 A	25 HP/27.0 A	30 HP/32.0 A	40 HP/41.0 A	30 HP/32.0 A	40 HP/41.0 A
	Single phase	120 V	1 HP/16.0 A	1.5 HP/20.0 A	2 HP/24.0 A	2 HP/24.0 A	2 HP/24.0 A	2 HP/24.0 A	3 HP/34.0 A
		240 V	2 HP/12.0 A	3 HP/17.0 A	5 HP/28.0 A	7.5 HP/40.0 A	10 HP/50.0 A	5 HP/28.0 A	7.5 HP/40.0 A
		480 V	5 HP/14.0 A	7.5 HP/21.0 A	10 HP/26.0 A	15 HP/34.0 A	20 HP/44.0 A	–	–
		600 V	7.5 HP/16.0 A	10 HP/20.0 A	15 HP/27.0 A	15 HP/27.0 A	20 HP/38.5 A	–	–
Short circuit rating with fuse	Maximum fuse size		30 A 60 A	30 A 60 A	30 A 60 A	100 A 150 A	100 A 150 A	60 A	60 A
	Fuse type	J	10 kA 10 kA	10 kA 10 kA	10 kA 10 kA	100 kA –	100 kA –	200 kA	200 kA
	Fuse type	T	10 kA 10 kA	10 kA 10 kA	10 kA 10 kA	100 kA –	100 kA –	200 kA	200 kA

SUB-PANELS FOR ENCLOSURES

nVent HOFFMAN

11-035-143

SUB-PANEL CATALOG NUMBER	SUB-PANEL DIMENSIONS (IN.)
A-DPESS	D x E





NOTE:

1. 6 indicates 316 Stainless Steel.
2. AL indicates Aluminum
3. G indicates Conductive Steel

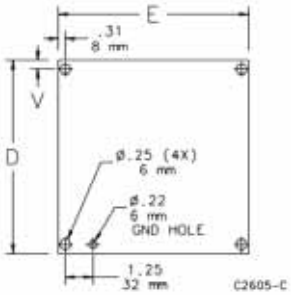
Catalog Number	Material	Panel Size D x E (in.)	Panel Size D x E (mm)	Panel Gauge or Thickness	Edge Flanges	T (in.)	T (mm)	Number of Holes
A12P24	Painted steel	9.00 x 21.00	229 x 533	12 ga.	0	–	–	4
A12P24G	Conductive steel	9.00 x 21.00	229 x 533	12 ga.	0	–	–	4
A16P12	Painted steel	13.00 x 9.00	330 x 229	12 ga.	0	–	–	4
A16P12G	Conductive steel	13.00 x 9.00	330 x 229	12 ga.	0	–	–	4
A16P12SS6	Stainless Steel	13.00 x 9.00	330 x 229	12 ga.	0	–	–	4
A16P12AL	Aluminum	13.00 x 9.00	330 x 229	0.10 in./3 mm	0	–	–	4
A16P16	Painted steel	13.00 x 13.00	330 x 330	12 ga.	0	–	–	4
A16P16G	Conductive steel	13.00 x 13.00	330 x 330	12 ga.	0	–	–	4
A16P16SS6	Stainless Steel	13.00 x 13.00	330 x 330	12 ga.	0	–	–	4
A16P16AL	Aluminum	13.00 x 13.00	330 x 330	0.10 in./3 mm	0	–	–	4
A18P18	Painted steel	15.00 x 15.00	381 x 381	12 ga.	0	–	–	4
A18P18G	Conductive steel	15.00 x 15.00	381 x 381	12 ga.	0	–	–	4
A20P12	Painted steel	17.00 x 9.00	432 x 229	12 ga.	0	–	–	4
A20P12G	Conductive steel	17.00 x 9.00	432 x 229	12 ga.	0	–	–	4
A20P16	Painted steel	17.00 x 13.00	432 x 330	12 ga.	0	–	–	4
A20P16G	Conductive steel	17.00 x 13.00	432 x 330	12 ga.	0	–	–	4
A20P16SS6	Stainless Steel	17.00 x 13.00	432 x 330	12 ga.	0	–	–	4
A20P16AL	Aluminum	17.00 x 13.00	432 x 330	0.10 in./3 mm	0	–	–	4
A20P20	Painted steel	17.00 x 17.00	432 x 432	12 ga.	0	–	–	4
A20P20G	Conductive steel	17.00 x 17.00	432 x 432	12 ga.	0	–	–	4
A20P20SS6	Stainless steel	17.00 x 17.00	432 x 432	12 ga.	0	–	–	4
A20P20AL	Aluminum	17.00 x 17.00	432 x 432	0.10 in./3 mm	0	–	–	4
A24P16	Painted steel	21.00 x 13.00	533 x 330	12 ga.	0	–	–	4
A24P16G	Conductive steel	21.00 x 13.00	533 x 330	12 ga.	0	–	–	4
A24P16SS6	Stainless Steel	21.00 x 13.00	533 x 330	12 ga.	0	–	–	4
A24P20	Painted steel	21.00 x 17.00	533 x 432	12 ga.	2	0.75	19	4
A24P20G	Conductive steel	21.00 x 17.00	533 x 432	12 ga.	2	0.75	19	4
A24P20SS6	Stainless Steel	21.00 x 17.00	533 x 432	12 ga.	2	0.75	19	4
A24P20AL	Aluminum	21.00 x 17.00	533 x 432	0.10 in./3 mm	4	0.75	19	4
A24P24	Painted steel	21.00 x 21.00	533 x 533	12 ga.	2	0.75	19	4
A24P24G	Conductive steel	21.00 x 21.00	533 x 533	12 ga.	2	0.75	19	4
A24P24SS6	Stainless Steel	21.00 x 21.00	533 x 533	12 ga.	2	0.75	19	4
A24P24AL	Aluminum	21.00 x 21.00	533 x 533	0.10 in./3 mm	2	0.75	19	4
A30P16	Painted steel	27.00 x 13.00	686 x 330	12 ga.	2	0.75	19	4
A30P16G	Conductive steel	33.00 x 27.00	838 x 686	12 ga.	2	0.75	19	4
A30P20	Painted steel	27.00 x 17.00	686 x 432	12 ga.	2	0.75	19	4
A30P20G	Conductive steel	27.00 x 17.00	686 x 432	12 ga.	2	0.75	19	4
A30P20SS6	Stainless Steel	27.00 x 17.00	686 x 432	12 ga.	2	0.75	19	4
A30P24	Painted steel	27.00 x 21.00	686 x 533	12 ga.	2	0.75	19	4
A30P24G	Conductive steel	27.00 x 21.00	686 x 533	12 ga.	2	0.75	19	4
A30P24SS6	Stainless Steel	27.00 x 21.00	686 x 533	12 ga.	2	0.75	19	4
A30P24AL	Aluminum	27.00 x 21.00	686 x 533	0.10 in./3 mm	2	0.75	19	4
A30P30	Painted steel	27.00 x 27.00	686 x 686	12 ga.	4	0.75	19	4
A30P30G	Conductive steel	27.00 x 27.00	686 x 686	12 ga.	4	0.75	19	4
A30P30SS6	Stainless Steel	27.00 x 27.00	686 x 686	12 ga.	4	0.75	19	4
A36P16	Painted steel	33.00 X 13.00	838 X 330	12 ga.	2	0.75	19	4
A36P16G	Conductive steel	33.00 x 13.00	838 x 330	12 ga.	2	0.75	19	4
A36P24	Painted steel	33.00 x 21.00	838 x 533	12 ga.	2	0.75	19	6
A36P24G	Conductive steel	33.00 x 21.00	838 x 533	12 ga.	2	0.75	19	6
A36P24SS6	Stainless Steel	33.00 x 21.00	838 x 533	12 ga.	2	0.75	19	6
A36P24AL	Aluminum	33.00 x 21.00	838 x 533	0.10 in./3 mm	2	0.75	19	6
A36P30	Painted steel	33.00 x 27.00	838 x 686	12 ga.	4	0.75	19	6
A36P30G	Conductive steel	33.00 x 27.00	838 x 686	12 ga.	4	0.75	19	6
A36P30SS6	Stainless Steel	33.00 x 27.00	838 x 686	12 ga.	4	0.75	19	6
A36P30AL	Aluminum	33.00 x 27.00	838 x 686	0.10 in./3 mm	4	0.75	19	6
A36P36	Painted steel	33.00 x 33.00	838 x 838	12 ga.	4	0.75	19	8
A36P36G	Conductive steel	33.00 x 33.00	838 x 838	12 ga.	4	0.75	19	8
A36P36SS6	Stainless Steel	33.00 x 33.00	838 x 838	12 ga.	4	0.75	19	8
A40P24	Painted steel	37.00 x 21.00	940 x 533	12 ga.	4	0.75	19	6
A40P24G	Conductive steel	37.00 x 21.00	940 x 533	12 ga.	4	0.75	19	6
A40P30	Painted steel	37.00 x 29.00	940 x 737	12 ga.	4	0.75	19	4
A40P30G	Conductive steel	37.00 x 29.00	940 x 737	12 ga.	4	0.75	19	4
A42P24	Painted steel	39.00 x 21.00	991 x 533	12 ga.	2	0.75	19	6
A42P24G	Conductive steel	39.00 x 21.00	991 x 533	12 ga.	2	0.75	19	6
A42P30	Painted steel	39.00 x 27.00	991 x 686	12 ga.	4	0.75	19	6

SUB-PANELS FOR ENCLOSURES

nVent HOFFMAN

11-035-143

SUB-PANEL CATALOG NUMBER	SUB-PANEL DIMENSIONS (IN.)
A-DPESS	D x E





NOTE:

1. 6 indicates 316 Stainless Steel.
2. AL indicates Aluminum
3. G indicates Conductive Steel

Catalog Number	Material	Panel Size D x E (in.)	Panel Size D x E (mm)	Panel Gauge or Thickness	Edge Flanges	T (in.)	T (mm)	Number of Holes
A42P30G	Conductive steel	39.00 x 27.00	991 x 686	12 ga.	4	0.75	19	6
A42P30SS6	Stainless Steel	39.00 x 27.00	991 x 686	12 ga.	4	0.75	19	6
A42P36	Painted steel	39.00 x 33.00	991 x 838	12 ga.	4	0.75	19	8
A42P36G	Conductive steel	39.00 x 33.00	991 x 838	12 ga.	4	0.75	19	8
A42P36SS6	Stainless Steel	39.00 x 33.00	991 x 838	12 ga.	4	0.75	19	8
A42P42	Painted steel	39.00 x 39.00	991 x 991	12 ga.	4	0.75	19	8
A42P42G	Conductive steel	39.00 x 39.00	991 x 991	12 ga.	4	0.75	19	8
A48P24	Painted steel	45.00 x 21.00	1143 x 533	12 ga.	2	0.75	19	6
A48P24G	Conductive steel	45.00 x 21.00	1143 x 533	12 ga.	2	0.75	19	6
A48P30	Painted steel	45.00 x 27.00	1143 x 686	12 ga.	4	0.75	19	6
A48P30G	Conductive steel	45.00 x 27.00	1143 x 686	12 ga.	4	0.75	19	6
A48P36	Painted steel	45.00 x 33.00	1143 x 838	12 ga.	4	0.75	19	8
A48P36G	Conductive steel	45.00 x 33.00	1143 x 838	12 ga.	4	0.75	19	8
A48P36SS6	Stainless Steel	45.00 x 33.00	1143 x 838	12 ga.	4	0.75	19	8
A48P36AL	Aluminum	45.00 x 33.00	1143 x 838	0.10 in./3 mm	4	0.75	19	8
A48P42	Painted steel	45.00 x 39.00	1143 x 991	12 ga.	4	0.75	19	8
A48P42G	Conductive steel	45.00 x 39.00	1143 x 991	12 ga.	4	0.75	19	8
A48P48	Painted steel	44.00 x 44.00	1118 x 1118	11 ga.	4	0.84	21	10
A48P48G	Conductive steel	44.00 x 44.00	1118 x 1118	11 ga.	4	0.84	21	10
A54P42	Painted steel	50.00 x 38.00	1270 x 965	11 ga.	4	0.84	21	10
A54P42G	Conductive steel	50.00 x 38.00	1270 x 965	11 ga.	4	0.84	21	10
A60P24	Painted steel	57.00 x 21.00	1448 x 533	12 ga.	4	0.75	19	6
A60P24G	Conductive steel	57.00 x 21.00	1448 x 533	12 ga.	4	0.75	19	6
A60P30	Painted steel	57.00 x 27.00	1448 x 686	12 ga.	4	0.75	19	6
A60P30G	Conductive steel	57.00 x 27.00	1448 x 686	12 ga.	4	0.75	19	6
A60P36	Painted steel	57.00 x 33.00	1448 x 838	12 ga.	4	0.75	19	8
A60P36G	Conductive steel	57.00 x 33.00	1448 x 838	12 ga.	4	0.75	19	8
A60P36SS6	Stainless Steel	57.00 x 33.00	1448 x 838	12 ga.	4	0.75	19	8
A60P36AL	Aluminum	57.00 x 33.00	1448 x 838	0.10 in./3 mm	4	0.75	19	8
A60BFP42	Painted steel	56.00 x 38.00	1422 x 965	11 ga.	4	0.84	21	10
A60BFP42G	Conductive steel	56.00 x 38.00	1422 x 965	11 ga.	4	0.84	21	10
A60P48	Painted steel	56.00 x 44.00	1422 x 1118	11 ga.	4	0.84	21	10
A60P48G	Conductive steel	56.00 x 44.00	1422 x 1118	11 ga.	4	0.84	21	10
A60P60	Painted steel	56.00 x 56.00	1422 x 1422	11 ga.	4	0.84	21	10
A60P60G	Conductive steel	56.00 x 56.00	1422 x 1422	11 ga.	4	0.84	21	10
A72P36	Painted steel	69.00 x 33.00	1753 x 838	12 ga.	4	0.75	19	8
A72P36G	Conductive steel	69.00 x 33.00	1753 x 838	12 ga.	4	0.75	19	8
A72P60	Painted steel	68.00 x 56.00	1727 x 1422	11 ga.	4	0.84	21	10
A72P60G	Conductive steel	68.00 x 56.00	1727 x 1422	11 ga.	4	0.84	21	10
A72P72	Painted steel	68.00 x 68.00	1727 x 1727	11 ga.	4	0.84	21	10
A72P72G	Conductive steel	68.00 x 68.00	1727 x 1727	11 ga.	4	0.84	21	10

Industrial Corrosion Inhibitors

PENTAIR

11-035-345

AHCI ___ ___

Cubic Feet Protected

Code	Application Method
DV	Foam Device
E	Emmiter
R	Tape Roll
S	Spray



Catalog Number	Enclosure Volume Protected
AHCI1DV	1 cu. ft. (28.32 liters)
AHCI5E	5 cu. ft. (141.6 liters)
AHCI10E	10 cu. ft. (283.2 liters)
AHCI60R	60 cu. ft. per roll (1699 liters)
AHCI240R	240 cu. ft. per roll (6797 liters)
AHCI238S	Corrosion Inhibitor Spray

AHCI1DV

Foam device protects one cubic foot (28 liters) of enclosure volume for approximately one year.Size: .25 x 1.25 x 3.00 in. (6 x 32 x 76mm). Package quantity 50.

AHCI60R

Tape protects sixty cubic feet of enclosure volume per roll. Use approximately 2.50" (6.3cm) of tape per cubic foot (28 liters) of enclosure volume to be protected. Each roll of tape is packaged individually in a resealable bag.Size: .25" x .75" x 12.00' (6mm x 19mm x 3.6m). Package quantity 3.

AHCI240R

Tape protects 240 cubic feet of enclosure volume per roll. Use approximately 1.00" (2.5cm) of tape per cubic foot (28 liters) of enclosure volume to be protected. Each roll of tape is packaged individually in a resealable bag.Size: .25" x 2.00" x 20.00' (6mm x 51mm x 6.1m). Package quantity 1.

AHCI5E

Emitter protects five cubic feet (142 liters) of enclosure volume for approximately one year. Emitters contain additional red metal (non-ferrous) inhibitors.Size: 2.50" (diameter) x 1.50" (high) (63mm x 38mm). Package quantity 25.

AHCI10E

Emitter protects ten cubic feet (283 liters) of enclosure volume for approximately one year. Emitters contain additional red metal (non-ferrous) inhibitors.Size: 2.50" (diameter) x 2.00" (high) (63mm x 51mm). Package quantity 12.

AHCI238S

Spray is a non-conductive, nonflammable, vapor phase film and is non-toxic. It has essentially neutral pH value. Application provides instant protection against corrosion. Spray is water soluble and can be easily flushed away with water if desired. This product should be kept from freezing, and has a shelf life of 2+ years in normal warehouse conditions. Package quantity 6.

Life Expectancy And Usage

The normal useful life-span of Hoffman corrosion inhibitors is in excess of one year. However, inhibitor life expectancy is shortened by approximately 25% when exposed to temperatures above 104° F (40°C). This product is not recommended for use where temperature exceeds 199°F. Ventilated enclosures or enclosures not sealed properly, as well as frequent door openings, also shorten the product life. Additional inhibitors should be used if these conditions exist. Since Hoffman corrosion inhibitors are vapor-phase protective, all surfaces to be protected should be accessible to the vapors. The maximum distance the vapors can travel is approximately 1.50 feet (.46 meters). Protection of long narrow enclosures can be achieved with tape or multiple inhibitors.

CONTINUOUS HINGE WITH 3-POINT LATCH TYPE 4X WALL-MOUNT ENCLOSURES

PENTAIR

11-035-487

ENCLOSURE CATALOG NUMBER	ENCLOSURE DIMENSIONS (IN.)	SUB-PANEL CATALOG NUMBER
A-AHCBSS6LP3PT-W/MOD	A x B x C	A APB

NOTE:

1. 3PT INDICATES 3-POINT LATCH
2. MOD INDICATES PAINTED WHITE (CUSTOM)
3. "W" INDICATES PAINTED WHITE (CUSTOM)



APPLICATION

These enclosures feature Hoffman's exclusive POWERGLIDE™ Handle with 3-point latching, ideal for indoor or outdoor applications that require corrosion protection, convenient access, and padlocking security.

SPECIFICATIONS

- 14 gauge Type 304 or 316L stainless steel bodies and doors
- Seams continuously welded and ground smooth
- Seamless foam-in-place gasket
- Rolled lip around three sides of door
- Internal 3-point latch and Type 316L stainless steel padlocking POWERGLIDE Handle
- Remove door by pulling stainless steel continuous hinge pin
- Data pocket is high-impact thermoplastic
- Collar studs provided for mounting optional panels
- Exterior hardware on Type 316L stainless steel enclosures matches enclosure material
- Bonding provision on door; grounding stud on body

INDUSTRY STANDARDS

UL 508A Listed; Type 3R, 4, 4X, 12; File No. E61997
cUL Listed per CSA C22.2 No 94; Type 3R, 4, 4X, 12; File No. E61997

NEMA/EEMAC Type 3R, 4, 4X, 12, 13
IEC 60529, IP66
Meets NEMA Type 3RX requirements

FINISH

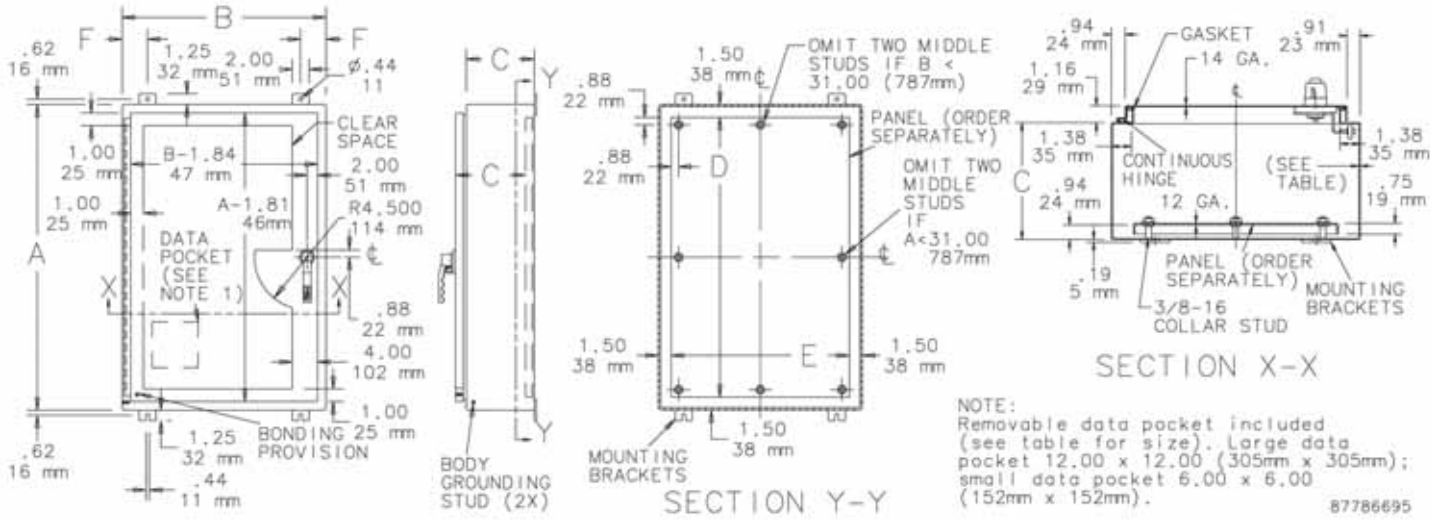
Door, sides, top and bottom have smooth #4 brushed finish. Handle is electropolished.

ACCESSORIES

See also Accessories.
Panels for Type 3R, 4, 4X, 12 and 13 Enclosures
Steel and Stainless Steel Window Kits
H2OMIT™ Vent Drains, Type 4X
H2OMIT™ Thermoelectric Dehumidifier

MODIFICATION AND CUSTOMIZATION

Hoffman excels at modifying and customizing products to your specifications. Contact your local Hoffman sales office or distributor for complete information.



NOTE:
Removable data pocket included (see table for size). Large data pocket 12.00 x 12.00 (305mm x 305mm); small data pocket 6.00 x 6.00 (152mm x 152mm).

87786695

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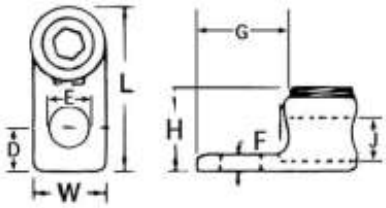
Rev:	Device Tag:
0	EN1
Date: 02-16-2026	
By: AJ	Job Number: HBR10366
Manuf.: . PNo: Hoffman: A-60H3612SS6LP3PT	Page # 1/1

15-011-000



Copper Connectors
T&B Catalog Number: L70
UPC Number: 78378613002
Status: Active
Description:

Type L - Copper Single Conductor, One-Hole Mount for Conductor Range 14 Sol.-4 Str.



Features

	Cold forged from pure electrolytic copper with 99 percent conductivity.

General

Style	Type L - Copper Single Conductor, One-Hole Mount
Material	Copper
Wire Range	14 Sol.-4 Str.

Dimension Information

Length (inches)	1 1/8
Width (inches)	17/32
Height (inches)	35/64
D (inches)	9/32
E (inches)	9/32
F (inches)	3/32
G (inches)	21/32
J (inches)	9/32

Packaging

T&B Inner Pack	100
Package in Units	1000
T&B Sold in UOM	Each
T&B Weight Per UOM	3.32 lbs. per 100

Notes

	Available with screwdriver slot head screws only.
	UL 486A tested.

Certifications

RoHS Compliance	Yes

Certifications

File Nbr:
E9809

For further technical assistance, please contact us...

Thomas & Betts - USA
8155 T&B Blvd.
Memphis, TN 38125
www.tnb.com

T&B Technical Support
MS 3B-50
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Memphis, TN 38125

Hours: 7AM - 6PM CDT
Monday-Friday
Phone: (888) 862-3289
Fax: (901) 252-1321
Email:techsupport@tnb.com

Zelio® Plug-In Relays
RPM power relays

Telemecanique

06-058-027



RPZF2 + relay RPM22F7



RUW24●●●



RPZ1DA



RPZ3FA

Sockets

Contact terminal arrangement	Connection	Relay type	Sold in lots of	Catalog number	Weight kg
Mixed	Screw clamp terminals	RPM1●●●	10	RPZF1	0.042
		RPM2●●●	10	RPZF2	0.054
		RPM3●●●	10	RPZF3	0.072
		RPM4●●●	10	RPZF4	0.094

Protection modules

Description	Voltage	Socket type	Sold in lots of	Catalog number	Weight
	V				kg
Diode	⎓ 6...250	RPZF1RPZ F2	20	RXM040W	0.003
		RPZF3 RPZF4	10	RUW240BD	0.004
RC circuit	∿ 24...60	RPZF1RPZ F2	20	RXM041BN7	0.010
	∿ 110...240	RPZF1RPZ F2	20	RXM041FU7	0.010
		RPZF3 RPZF4	10	RUW241P7	0.004
Varistor	∿/⎓ 6...24	RPZF1RPZ F2	20	RXM021RB	0.030
	∿/⎓ 24...60	RPZF1RPZ F2	20	RXM021BN	0.030
	∿/⎓ 110...240	RPZF1RPZ F2	20	RXM021FP	0.030
	∿/⎓ 24	RPZF3 RPZF4	10	RUW242B7	0.004
	∿/⎓ 240	RPZF3 RPZF4	10	RUW242P7	0.004

Timer module *(1)*

Description	Voltage	Socket type	Catalog number	Weight
	V			kg
Multifunction	∿/⎓ 24... 240	RPZF3 RPZF4	RUW101MW	0.020

Accessories

Description	For use with	Sold in lots of	Catalog number	Weight kg
Metal hold-down clip (for single-pole relays)	RPZF1	20	RPZR235	0.001
Mounting adapters for DIN rail *(2)*	RPM1●●●	20	RPZ1DA	0.004
	RPM2●●●	20	RXZE2DA	0.004
	RPM3●●●	20	RPZ3DA	0.004
	RPM4●●●	20	RPZ4DA	0.006
Mounting adapters with fixing lugs for panel	RPM1●●●	20	RPZ1FA	0.002
	RPM2●●●	20	RXZE2FA	0.002
	RPM3●●●	20	RPZ3FA	0.003
	RPM4●●●	20	RPZ4FA	0.004
Clip-in ID tags (sheet of 108 ID tags)	All relays	10	RXZL520	0.080

(1) See timer module description (selection of functions and time delays) on page 41
(2) Test button becomes inaccessible.

Zelio® Plug-In Relays

RPM power relays



Telemecanique

06-058-028

General characteristics

Conforming to standards			IEC/EN 61810-1 (iss. 2), UL 508, CSA C22-2 n° 14
Product certifications			cULus File E164862 CCN NLDX, NLDX7; cURus File E164862 CCN NLDX2, NLDX8; CSA; CE; RoHS compliant
Ambient air temperature around the device	Storage	°C (F)	- 40... + 85 (-40... +185)
	Operation	°C (F)	- 40... + 55 (-40... +131)
Vibration resistance conforming to IEC/EN 60068-2-6	In operation		3 gn (10...150 Hz/± 1 mm / 5g/5 cycles)
	Not operating		5 gn (10...150 Hz/± 1 mm / 5g/5 cycles)
Degree of protection	Conforming to IEC/EN 60529		IP 40
Shock resistance conforming to IEC/EN 60068-2-27	Opening		15 gn
	Closing		15 gn
Protection category			RT I
Mounting position			Any

Insulation characteristics

Rated insulation voltage (Ui)	Conforming to IEC/EN 60947	V	250 (IEC), 300 (UL, CSA)
Rated impulse withstand voltage (Uimp)		kV	4 (1.2/50 µs)
Dielectric strength (rms voltage)	Between coil and contact	∼ V	1550
	Between poles	∼ V	1550
	Between contacts	∼ V	1500

Contact characteristics

Relay type				RPM1●●●	RPM2●●●	RPM3●●●	RPM4●●●
Number and type of contacts				1 C/O	2 C/O	3 C/O	4 C/O
Contact materials				AgNi			
Conventional thermal current (Ith)	For ambient temperature ≤ 55 °C		A	15			
Rated operational current in utilization categories AC-1 and DC-1	Conforming to IEC	NO	A	15			
		NC	A	7.5			
	Conforming to UL		A	15			
Switching current	Minimum		mA	10			
Switching voltage	Maximum		V	∼/⎓ 250 (IEC)			
	Minimum		V	17			
Nominal load (resistive)			A	15 / 250 ∼ V			
			A	15 / 28 ⎓ V			
Switching capacity	Maximum	∼	VA	3750			
		⎓	W	420			
	Minimum		mW	170			
Maximum operating rate In operating cycles/hour	No-load			18 000			
	Under load			1200			
Utilization coefficient				20 %			
Mechanical durability	In millions of operating cycles			10			
Electrical durability In millions of operating cycles	Resistive load			0.1		0.06	
	Inductive load			See curves below			

Electrical durability of contacts
Resistive load ∼

Reduction coefficient for inductive load ∼ (depending on power factor cos φ)

Maximum switching capacity on resistive load ⎓

Telemecanique

06-058-028

Power relays without LED (sold in lots of 10)

Control circuit voltge	Number and type of contacts - Thermal current (Ith)							
	1 C/O - 15 A		2 C/O - 15 A		3 C/O - 15 A		4 C/O - 15 A	
	Catalog number	Weight	Catalog number	Weight	Catalog number	Weight	Catalog number	Weight
V		kg		kg		kg		kg
⎓ 12	RPM11JD	0.026	RPM21JD	0.036	RPM31JD	0.054	RPM41JD	0.071
⎓ 24	RPM11BD	0.026	RPM21BD	0.036	RPM31BD	0.054	RPM41BD	0.071
⎓ 48	RPM11ED	0.026	RPM21ED	0.036	RPM31ED	0.054	RPM41ED	0.071
⎓ 110	RPM11FD	0.026	RPM21FD	0.036	RPM31FD	0.054	RPM41FD	0.071
~ 24	RPM11B7	0.026	RPM21B7	0.036	RPM31B7	0.054	RPM41B7	0.071
~ 48	RPM11E7	0.026	RPM21E7	0.036	RPM31E7	0.054	RPM41E7	0.071
~ 120	RPM11F7	0.026	RPM21F7	0.036	RPM31F7	0.054	RPM41F7	0.071
~ 230	RPM11P7	0.026	RPM21P7	0.036	RPM31P7	0.054	RPM41P7	0.071

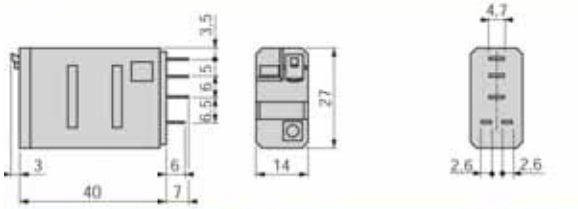
Power relays with LED (sold in lots of 10)

⎓ 12	RPM12JD	0.026	RPM22JD	0.036	RPM32JD	0.054	RPM42JD	0.071
⎓ 24	RPM12BD	0.026	RPM22BD	0.036	RPM32BD	0.054	RPM42BD	0.071
⎓ 48	RPM12ED	0.026	RPM22ED	0.036	RPM32ED	0.054	RPM42ED	0.071
⎓ 110	RPM12FD	0.026	RPM22FD	0.036	RPM32FD	0.054	RPM42FD	0.071
~ 24	RPM12B7	0.026	RPM22B7	0.036	RPM32B7	0.054	RPM42B7	0.071
~ 48	RPM12E7	0.026	RPM22E7	0.036	RPM32E7	0.054	RPM42E7	0.071
~ 120	RPM12F7	0.026	RPM22F7	0.036	RPM32F7	0.054	RPM42F7	0.071
~ 230	RPM12P7	0.026	RPM22P7	0.036	RPM32P7	0.054	RPM42P7	0.071

Dimensions (mm):

Power relays

RPM 1

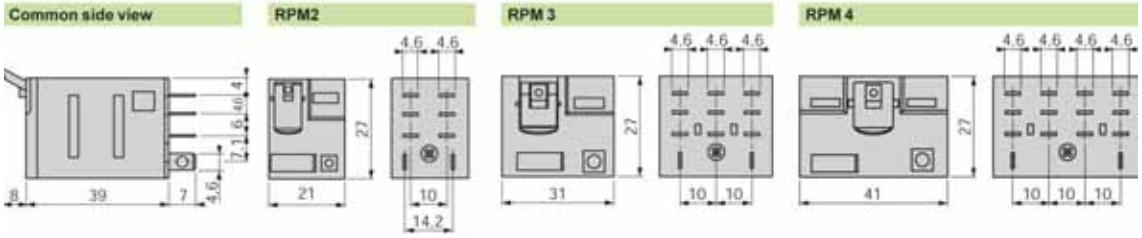


Common side view

RPM2

RPM 3

RPM 4



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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: IR1-19

Job Number: HBR10366

Page # 2/2

Manuf.: . PNo: Square D: RPM12BD

RXM040W

Telemecanique

diode - 6..250 V DC - for RPZ/RXZ sockets

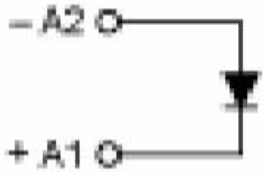
06-058-040



Main

Range of product	Zelio Relay
Accessory / separate part category	Protection accessories
Accessory / separate part type	Protection module
Accessory / separate part designation	Diode
Product compatibility	Socket RPZ (1 C/O) Socket RPZ (2 C/O) Socket RXZ (2 C/O) Socket RXZ (3 C/O) Socket RXZ (4 C/O)
Accessory / separate part destination	Zelio Relay RXM Zelio Relay RPM
[Uc] control circuit voltage	6...250 V DC
Sale per indivisible quantity	20

Wiring Diagram



ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Device Tag: IR1-19	
	Date: 02-16-2026		
Manuf.: . PNo: Square D: RXM040W	By: AJ	Job Number: HBR10366	Page # 1/2

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06-058-040

Power relays without LED (sold in lots of 10)

Control circuit voltge	Number and type of contacts - Thermal current (Ith)							
	1 C/O - 15 A		2 C/O - 15 A		3 C/O - 15 A		4 C/O - 15 A	
	Catalog number	Weight	Catalog number	Weight	Catalog number	Weight	Catalog number	Weight
V		kg		kg		kg		kg
⎓ 12	RPM11JD	0.026	RPM21JD	0.036	RPM31JD	0.054	RPM41JD	0.071
⎓ 24	RPM11BD	0.026	RPM21BD	0.036	RPM31BD	0.054	RPM41BD	0.071
⎓ 48	RPM11ED	0.026	RPM21ED	0.036	RPM31ED	0.054	RPM41ED	0.071
⎓ 110	RPM11FD	0.026	RPM21FD	0.036	RPM31FD	0.054	RPM41FD	0.071
~ 24	RPM11B7	0.026	RPM21B7	0.036	RPM31B7	0.054	RPM41B7	0.071
~ 48	RPM11E7	0.026	RPM21E7	0.036	RPM31E7	0.054	RPM41E7	0.071
~ 120	RPM11F7	0.026	RPM21F7	0.036	RPM31F7	0.054	RPM41F7	0.071
~ 230	RPM11P7	0.026	RPM21P7	0.036	RPM31P7	0.054	RPM41P7	0.071

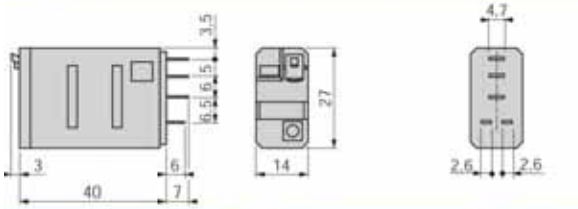
Power relays with LED (sold in lots of 10)

⎓ 12	RPM12JD	0.026	RPM22JD	0.036	RPM32JD	0.054	RPM42JD	0.071
⎓ 24	RPM12BD	0.026	RPM22BD	0.036	RPM32BD	0.054	RPM42BD	0.071
⎓ 48	RPM12ED	0.026	RPM22ED	0.036	RPM32ED	0.054	RPM42ED	0.071
⎓ 110	RPM12FD	0.026	RPM22FD	0.036	RPM32FD	0.054	RPM42FD	0.071
~ 24	RPM12B7	0.026	RPM22B7	0.036	RPM32B7	0.054	RPM42B7	0.071
~ 48	RPM12E7	0.026	RPM22E7	0.036	RPM32E7	0.054	RPM42E7	0.071
~ 120	RPM12F7	0.026	RPM22F7	0.036	RPM32F7	0.054	RPM42F7	0.071
~ 230	RPM12P7	0.026	RPM22P7	0.036	RPM32P7	0.054	RPM42P7	0.071

Dimensions (mm):

Power relays

RPM 1



Common side view

RPM2

RPM 3

RPM 4



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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: IR1-19

Job Number: HBR10366

Page # 2/2

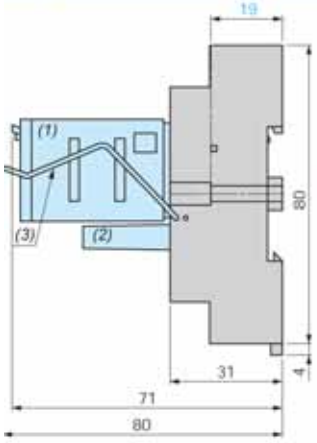
Manuf.: . PNo: Square D: RXM040W

Sockets

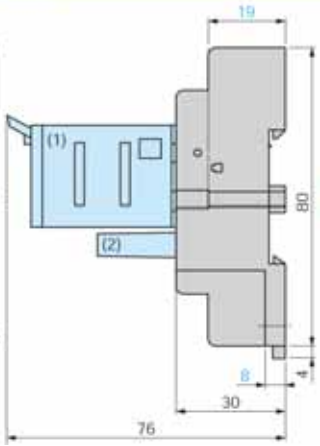
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38-058-009

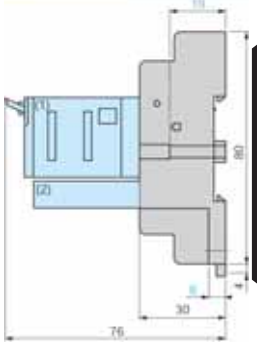
RPZF1



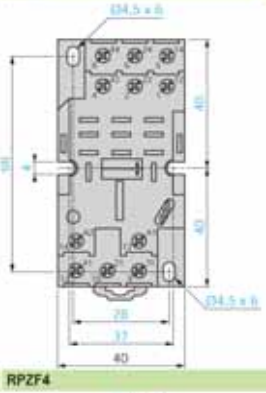
RPZF2



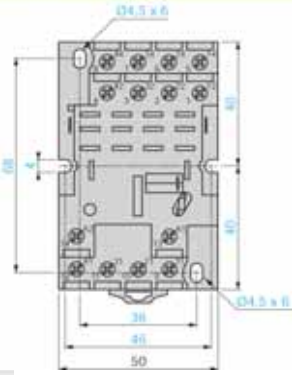
Common side view



RPZF3



RPZF4



Socket characteristics

Socket type			RPZF1	RPZF2	RPZF3	RPZF4
Relay types used			RPM1●●●	RPM2●●●	RPM3●●●	RPM4●●●
Protection module types used			RXM02●●● RXM04●●●	RXM02●●● RXM04●●●	RUW24●●●	RUW24●●●
Contact terminal arrangement			Mixed			
Wire connection method			Screw clamp terminals			
Product certifications			cURus File E172326 CCN SWIV2, SWIV8; CSA; CE; RoHS compliant			
Conforming to standards			IEC 61984, CE			

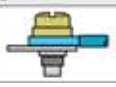
Electrical characteristics

Conventional thermal current (Ith)		A	16	
Maximum operating voltage		V	250 (IEC)	

Insulation characteristics

Between adjacent output contacts		Vrms	2500	
Between input and output contacts		Vrms	2500	
Between contacts and DIN rail		Vrms	2500	

General characteristics

Ambient air temperature around the device	Operation		°C	- 40…+ 55	
	Storage		°C	- 40…+ 85	
Degree of protection	Conforming to IEC/EN 60529			IP 20	
Connection	Solid wire without cable end	1 conductor		0.5…1.5 mm² - AWG 20…AWG 16	0.5…2.5 mm² - AWG 20…AWG 14
		2 conductors		0.5…1.5 mm² - AWG 20…AWG 16	0.5…2.5 mm² - AWG 20…AWG 14
	Flexible wire with cable end	1 conductor		0.25…1 mm² - AWG 22…AWG 17	0.25…1.5 mm² - AWG 22…AWG 16
		2 conductors		0.25…1 mm² - AWG 22…AWG 17	0.25…1.5 mm² - AWG 22…AWG 16
Maximum tightening torque / Screw size			Nm	1 / M3 screw	1 / M3.5 screw
Mounting				35 mm DIN rail / panel mount	
Mounting on DIN rail				By red plastic clip	
Terminal referencing				IEC, NEMA	
Compatibility with the metal hold-down clip				Yes	No
Timer module compatibility				No	Yes
Protection module				RXM040W, RXM041●●, RXM021●●	RUW24●●
Clip-in ID tags				No	
Wire connection method	Screw clamp terminals				

Sockets

Contact terminal arrangement	Connection	Relay type	Sold in lots of	Catalog number	Weight kg
Mixed	Screw clamp terminals	RPM1●●●	10	RPZF1	0.042
		RPM2●●●	10	RPZF2	0.054
		RPM3●●●	10	RPZF3	0.072
		RPM4●●●	10	RPZF4	0.094

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Manuf.: . PNo: Square D: RPZF1	Rev: 0	Device Tag: IR1-19	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1



52-137-002

Part Number	Description
52-137-002	Label, Multiple Supply Sources, Warning, 2.5"Wx1.5"H, Yellow



Part Number	Description
52-137-000	Label, High Voltage, Danger, 2.25"Wx4.0"H, White/Black/Red
52-137-001	Label, High Voltage, Danger, 6.5"Wx3.5"H, White/Black/Red

30.5 mm Push Buttons
Pilot Lights

Allen-Bradley

32-005-A005

800 T ___ – P T ___ 16 G
a b c d e f g

a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

c

Power Module Type		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
P	Transformer (or dual input)	PR
Q	Full voltage/ Universal	QR

d

Lamp Test Options	
Code	Description
Blank	No test option
T	Push-to-test
D	Dual input — diode▲
DT	Dual input — transformer relay

Note: Push-to-test supplied with factory jumpered contact block.

e

Illumination Options	
Code	Description
Blank	Incandescent
H	LED•

f

Voltage	
Transformer	
Code	Description
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz
Full Voltage — Incandescent	
12	12V AC/DC
24	24V AC/DC
48	48V AC/DC
10	120V AC/DC
20	240V AC/DC
Universal — LED	
2	12…130V AC/DC
Dual Input	
16	120V AC
24	24V AC/DC (Dual input diode only)



g

Lens Color		
Code	Color	Glass Code ▲
Blank	No lens	Blank
A	Amber	D
B	Blue	E
C	Clear	F
G	Green	H
R	Red	J
W	White	K

Specifications•

Electrical Ratings		
Contact ratings		Refer to the contact ratings tables on page 10-4.
Dielectric strength		2200V for one minute, 1300V for one minute (Logic Reed)
Electrical design life cycles		1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed)
Mechanical Ratings		
Vibration		10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./ 10 G max. (except Logic Reed)
Shock		1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G
Degree of protection		Type 1/4/12/13 (800T); Type 1/4/4X/12/13 (800H); EN/IEC 60529 IP66/65
Mechanical design life cycles		
Push buttons	(Momentary, non-illuminated)	10 000 000 min.
	(Momentary, illuminated)	250 000 min.
	(Push-pull/twist-to-release)	250 000 min.
Selector switches	(Non-illuminated)	1 000 000 min.
	(Illuminated, key-operated)	200 000 min.
Potentiometers		25 000 min.
All other devices		200 000 min.
Contact operation		Shallow, mini, and low-voltage contact blocks: Slow, double make and break Logic Reed and sealed switch contact blocks: Single break magnetic
Wire gauge/Terminal screw torque		#18…14 AWG (#18…10 Max Duty) / 6…8 lb•in
Typical operating forces		
Operators without contact blocks		Flush, extended button, standard mushroom, jumbo plastic mushroom: 2 lbs max. Jumbo and extended aluminum mushroom head: 3.95 lbs max. Maintained selector switch: 3.6 in•lb max.
Spring return selector switches		3.6 in•lb to stop, 0.2 in•lb to return
Illuminated push buttons and push-to-test pilot lights		5 lb max.
2-position push-pull		8.0 lb max. push or pull
3-position push-pull		8 lb max. push to in position or pull to center position (15 lb max. pull to out position)
Twist-to-release or push-pull		9 lbs max. push or pull 30 in•oz max. twist, 6 in•oz minimum return
Potentiometer		Rotational torque 3…12 in•oz; stopping torque 12 in•lb (minimum)
Contact blocks	Standard	1 lb
	Logic Reed	1 lb max.
	Sealed switch	3 lb max. at 0.205 in. plunger travel
	Stackable sealed switch	1 lb max.
	MaxDuty	1.4 lb max.
	PenTUFF	1.4 lb max.
	Self Monitoring	1.6 lb
Environment		
Temperature range	Operating	-40…+131 °F (-40…+55 °C)
	Storage	-40…+185 °F (-40…+85 °C)
Note: Operating temperatures below freezing are based on the absence of moisture and liquids. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for use in lower temperature applications.		
Humidity		50…95% RH from 77…140 °F (25…60 °C) per Procedure IV of MIL-STD-810C, Method 507.1 cycling test

30.5 mm Push Buttons
Pilot Lights

Allen-Bradley

32-005-A007

800 T ___ – P T ___ 16 G
a b c d e f g

a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

c

Power Module Type		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
P	Transformer (or dual input)	PR
Q	Full voltage/ Universal	QR

d

Lamp Test Options	
Code	Description
Blank	No test option
T	Push-to-test
D	Dual input — diode▲
DT	Dual input — transformer relay

Note: Push-to-test supplied with factory jumpered contact block.

e

Illumination Options	
Code	Description
Blank	Incandescent
H	LED•

f

Voltage	
Transformer	
Code	Description
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz
Full Voltage — Incandescent	
12	12V AC/DC
24	24V AC/DC
48	48V AC/DC
10	120V AC/DC
20	240V AC/DC
Universal — LED	
2	12…130V AC/DC
Dual Input	
16	120V AC
24	24V AC/DC (Dual input diode only)



g

Lens Color		
Code	Color	Glass Code ▲
Blank	No lens	Blank
A	Amber	D
B	Blue	E
C	Clear	F
G	Green	H
R	Red	J
W	White	K

Specifications•

Electrical Ratings		
Contact ratings		Refer to the contact ratings tables on page 10-4.
Dielectric strength		2200V for one minute, 1300V for one minute (Logic Reed)
Electrical design life cycles		1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed)
Mechanical Ratings		
Vibration		10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./ 10 G max. (except Logic Reed)
Shock		1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G
Degree of protection		Type 1/4/12/13 (800T); Type 1/4/4X/12/13 (800H); EN/IEC 60529 IP66/65
Mechanical design life cycles		
Push buttons	(Momentary, non-illuminated)	10 000 000 min.
	(Momentary, illuminated)	250 000 min.
	(Push-pull/twist-to-release)	250 000 min.
Selector switches	(Non-illuminated)	1 000 000 min.
	(Illuminated, key-operated)	200 000 min.
Potentiometers		25 000 min.
All other devices		200 000 min.
Contact operation		Shallow, mini, and low-voltage contact blocks: Slow, double make and break Logic Reed and sealed switch contact blocks: Single break magnetic
Wire gauge/Terminal screw torque		#18…14 AWG (#18…10 Max Duty) / 6…8 lb•in
Typical operating forces		
Operators without contact blocks		Flush, extended button, standard mushroom, jumbo plastic mushroom: 2 lbs max. Jumbo and extended aluminum mushroom head: 3.95 lbs max. Maintained selector switch: 3.6 in•lb max.
Spring return selector switches		3.6 in•lb to stop, 0.2 in•lb to return
Illuminated push buttons and push-to-test pilot lights		5 lb max.
2-position push-pull		8.0 lb max. push or pull
3-position push-pull		8 lb max. push to in position or pull to center position (15 lb max. pull to out position)
Twist-to-release or push-pull		9 lbs max. push or pull 30 in•oz max. twist, 6 in•oz minimum return
Potentiometer		Rotational torque 3…12 in•oz; stopping torque 12 in•lb (minimum)
Contact blocks	Standard	1 lb
	Logic Reed	1 lb max.
	Sealed switch	3 lb max. at 0.205 in. plunger travel
	Stackable sealed switch	1 lb max.
	MaxDuty	1.4 lb max.
	PenTUFF	1.4 lb max.
	Self Monitoring	1.6 lb
Environment		
Temperature range	Operating	-40…+131 °F (-40…+55 °C)
	Storage	-40…+185 °F (-40…+85 °C)
Note: Operating temperatures below freezing are based on the absence of moisture and liquids. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for use in lower temperature applications.		
Humidity		50…95% RH from 77…140 °F (25…60 °C) per Procedure IV of MIL-STD-810C, Method 507.1 cycling test

30.5 mm Push Buttons
Pilot Lights

Allen-Bradley

32-005-A008

800 T ___ – P T ___ 16 G
a b c d e f g

a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

c

Power Module Type		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
P	Transformer (or dual input)	PR
Q	Full voltage/ Universal	QR

d

Lamp Test Options	
Code	Description
Blank	No test option
T	Push-to-test
D	Dual input — diode▲
DT	Dual input — transformer relay

Note: Push-to-test supplied with factory jumpered contact block.

e

Illumination Options	
Code	Description
Blank	Incandescent
H	LED•

f

Voltage	
Transformer	
Code	Description
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz
Full Voltage — Incandescent	
12	12V AC/DC
24	24V AC/DC
48	48V AC/DC
10	120V AC/DC
20	240V AC/DC
Universal — LED	
2	12…130V AC/DC
Dual Input	
16	120V AC
24	24V AC/DC (Dual input diode only)



g

Lens Color		
Code	Color	Glass Code ▲
Blank	No lens	Blank
A	Amber	D
B	Blue	E
C	Clear	F
G	Green	H
R	Red	J
W	White	K

Specifications•

Electrical Ratings		
Contact ratings		Refer to the contact ratings tables on page 10-4.
Dielectric strength		2200V for one minute, 1300V for one minute (Logic Reed)
Electrical design life cycles		1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed)
Mechanical Ratings		
Vibration		10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./ 10 G max. (except Logic Reed)
Shock		1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G
Degree of protection		Type 1/4/12/13 (800T); Type 1/4/4X/12/13 (800H); EN/IEC 60529 IP66/65
Mechanical design life cycles		
Push buttons	(Momentary, non-illuminated)	10 000 000 min.
	(Momentary, illuminated)	250 000 min.
	(Push-pull/twist-to-release)	250 000 min.
Selector switches	(Non-illuminated)	1 000 000 min.
	(Illuminated, key-operated)	200 000 min.
Potentiometers		25 000 min.
All other devices		200 000 min.
Contact operation		Shallow, mini, and low-voltage contact blocks: Slow, double make and break Logic Reed and sealed switch contact blocks: Single break magnetic
Wire gauge/Terminal screw torque		#18…14 AWG (#18…10 Max Duty) / 6…8 lb•in
Typical operating forces		
Operators without contact blocks		Flush, extended button, standard mushroom, jumbo plastic mushroom: 2 lbs max. Jumbo and extended aluminum mushroom head: 3.95 lbs max. Maintained selector switch: 3.6 in•lb max.
Spring return selector switches		3.6 in•lb to stop, 0.2 in•lb to return
Illuminated push buttons and push-to-test pilot lights		5 lb max.
2-position push-pull		8.0 lb max. push or pull
3-position push-pull		8 lb max. push to in position or pull to center position (15 lb max. pull to out position)
Twist-to-release or push-pull		9 lbs max. push or pull 30 in•oz max. twist, 6 in•oz minimum return
Potentiometer		Rotational torque 3…12 in•oz; stopping torque 12 in•lb (minimum)
Contact blocks	Standard	1 lb
	Logic Reed	1 lb max.
	Sealed switch	3 lb max. at 0.205 in. plunger travel
	Stackable sealed switch	1 lb max.
	MaxDuty	1.4 lb max.
	PenTUFF	1.4 lb max.
	Self Monitoring	1.6 lb
Environment		
Temperature range	Operating	-40…+131 °F (-40…+55 °C)
	Storage	-40…+185 °F (-40…+85 °C)
Note: Operating temperatures below freezing are based on the absence of moisture and liquids. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for use in lower temperature applications.		
Humidity		50…95% RH from 77…140 °F (25…60 °C) per Procedure IV of MIL-STD-810C, Method 507.1 cycling test

TeSys Control
Deca Contactors - Auxilliary contact blocks

Schneider Electric



22-058-004

Instantaneous auxiliary contact blocks for connection by screw clamp terminals

For use in normal operating environments

Clip-on mounting	Number of contacts per block	Composition					Reference	
Front	1	–	–	–	1	–	LADN10	
		–	–	–	–	1	LADN01	
	2	–	–	–	1	1	LADN11	
		–	–	–	2	–	LADN20	
		–	–	–	–	2	LADN02	
	4	–	–	–	2	2	LADN22	LADN22S (1)
		–	–	–	1	3	LADN13	
		–	–	–	4	–	LADN40	
		–	–	–	–	4	LADN04	
		–	–	–	3	1	LADN31	
	4 incl. 1 N/O & 1 N/C make before break	–	–	–	2	2	LADC22	
Side (contact blocks compatible with AC coil contactors only)	2	–	–	–	1	1	LAD8N11	
		–	–	–	2	–	LAD8N20	
		–	–	–	–	2	LAD8N02	

Maximum number of auxiliary contacts that can be fitted:

Contactors			Instantaneous auxiliary contacts					Time delay
Type	Number of poles and size		Side mounted		Front mounted			Front mounted
					1 contact	2 contacts	4 contacts	
AC	3P	LC1D09…D38	1 on LH or 1 on RH side(3)	and	–	1	or 1	or 1
AC/DC		LC1D40A…D80A	1 on LH or 1 on RH side	and	–	1	or 1	or 1
		LC1D80 and D95 (50/60 Hz)	1 on each side	or	2	and 1	or 1	or 1
		LC1D80 and D95 (50 or 60 Hz)	1 on each side	and	2	and 1	or 1	or 1
		LC1D115 and D150	1 on LH side	and	–	1	or 1	or 1
	4P	LC1DT20…DT40	1 on LH side	and	–	1	or 1	or 1
		LC1DT60A and DT80A	1 on LH or 1 on RH side	and	–	1	or 1	or 1
		LC1D40008, D65008 and D80	1 on each side	or	1	or 1	or 1	or 1
		LC1D115	1 on each side	and	1	or 1	or 1	or 1
DC	3P	LC1D09…D38	–		–	1	or 1	or 1
		LC1D40A…D80A	–		–	1	or 1	or 1
		LC1D80 and D95	–		1	or 1	or 1	or 1
		LC1D115 and D150	1 on LH side	and	–	1	or 1	or 1
	4P	LC1DT20…DT40	–		–	1	or 1	or 1
		LC1DT60A and DT80A	–		–	1	or 1	or 1
		LC1D40008, D65008 and D80	–		2	and 1	or 1	or 1
		LC1D115	1 on each side		–	and 1	or 1	or 1
LC (4) (5)	3P	LC1D09…D38	–		–	1	–	–
	4P	LC1DT20…DT40	–		–	1	–	–

(1) With red front face - for safety chain indication.
(2) Device fitted with 4 earth screen continuity terminals.
(3) 1 on LH side for AC coils - 1 on RH side for AC/DC coils.
(4) LC: low consumption.
(5) LA1D●●● dust & damp proof auxiliary contact blocks not allowed.

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Rev: 0
Date: 02-16-2026
By: AJ

Device Tag: M1-F/R

Job Number: HBR10366

Page # 1/1

Manuf.: . PNo: Square D: LADN20

TeSys™ N Contactors and Starters

Schneider Electric

TeSys N contactors are used to switch heating loads, capacitors, transformers and electric motors where overload protection is provided separately. TeSys N contactors are available in NEMA Sizes 00–7. Target market segments include hospitals; retail; food and beverage; marine; oil and gas; and mining, metals, and minerals.



22-058-A001

Flexibility

- High-density, space-saving design
- Sizes 00 - 2 are DIN rail and panel mountable
- Common accessories across TeSys range to maximize convenience and reduce inventory
- Replaceable coils require no tools for easy installation

Safety Standards

- UL® Listed, CSA Certified, and CE marked
- Sizes 00-2 terminals offer IP 2X finger safe protection
- Reversing contactors electrically and mechanically interlocked

Table 16.34: TeSys N Non-Reversing Contactors, 3-Pole Polyphase, 600 Vac Max. (replace •• with the coil voltage code)

NEMA Size	Continuous Current Rating (A)	Motor Voltage	Max HP	Open Catalog No. *[2]*
00	9	200	1.5	T02AN13••
		230	1.5	
		460	2	
		575	2	
0	18	200	3	T02BN13••
		230	3	
		460	5	
		575	5	
1	27	200	7.5	T02CN13••
		230	7.5	
		460	10	
		575	10	
2	45	200	10	T02DN13••
		230	15	
		460	25	
		575	25	
3	90	200	25	T02EN13••*[3]*
		230	30	
		460	50	
		575	50	
4	135	200	40	T02FN13••*[3]*
		230	50	
		460	100	
		575	100	
5	270	200	75	T02GN13••*[3]*
		230	100	
		460	200	
		575	200	
6	540	200	150	T02HN13••*[3]*
		230	200	
		460	400	
		575	400	
7	810	200	—	T02JN13••*[3]*
		230	300	
		460	600	
		575	600	

Table 16.36: TeSys N Coil Voltage Codes

Voltage	Voltage Code by NEMA Size								
	Size 00	Size 0	Size 1	Size 2	Size 3	Size 4	Size 5	Size 6	Size 7
24 Vac	B7	B7	B7	B7	B6	B6	n/a		
120 Vac	G7	G7	G7	G7	G7	G7	G7	F7	F7

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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: M1-F/R

Job Number: HBR10366

Page # 1/1

Manuf.: . PNo: Square D: T02BN13G7

GV2 Manual Starter and Protector

Schneider Electric

23-058-005



GV2P21 with
GV2GH7 installed

Table 47: GV2 Manual Motor Controller and Protector Horsepower Ratings

Catalog Number		Thermal Trip Setting Range (A)	Maximum Horsepower Ratings						
			1 Ø			3 Ø			
Push Button GV2ME [1]	Rotary Handle GV2P		120 V	208 V	240 V	208 V	240 V	480 V	600 V [2]
GV2ME01	GV2P01	0.11–0.16	—	—	—	—	—	—	—
GV2ME02	GV2P02	0.016–0.25	—	—	—	—	—	—	—
GV2ME03	GV2P03	0.25–0.40	—	—	—	—	—	—	—
GV2ME04	GV2P04	0.40–0.63	—	—	—	—	—	—	—
GV2ME05	GV2P05	0.63–1	—	—	—	—	—	—	—
GV2ME06	GV2P06	1–1.6	—	—	0.1	—	—	0.75	0.75
GV2ME07	GV2P07	1.6–2.5	—	0.16	0.16	0.5	0.5	1	1.5
GV2ME08	GV2P08	2.5–4	0.125	0.25	0.33	0.75	0.75	2	3
GV2ME10	GV2P10	4–6.3	0.25	0.5	0.5	1	1.5	3	5
GV2ME14	GV2P14	6–10	0.5	1	1.5	2	3	5	7.5
GV2ME16	GV2P16	9–14	0.75	2	2	3	3	10	10
GV2ME20	GV2P20	13–18	1	2	3	5	5	10	15
GV2ME21	GV2P21	17–23	1.5	3	3	5	7.5	15	20
GV2ME22	GV2P22	20–25	2	3	—	7.5	—	15	20
GV2ME32 [3]	GV2P32	24–32	2	5	5	7.5	10	20	25

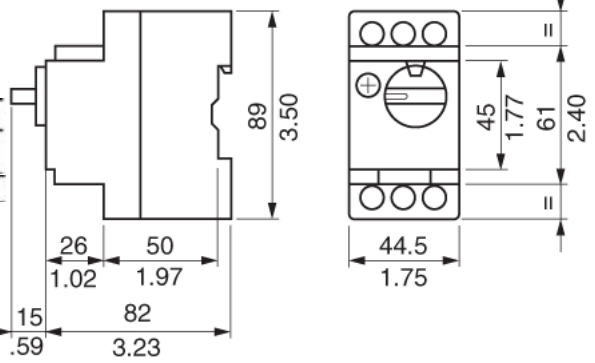
Additional GV2 Wiring Accessories

Description	Application	Sold in Lots of	Catalog Number	Weight, lb (kg)
Incoming line insulator	For GV2P when used in UL 508 Type E applications	10	GV2GH7	0.09 (0.040)

Table 55: Accessories for GV3P

Description	For Manual Motor Controllers	Catalog Number	Weight lb (kg)
Cover, large spacing, UL 508 Type E (only one cover is required on the supply side)	GV3P••	GV3G66 [1]	0.44 (0.02)

Product certifications: CCC, UL, DNV, GL, EAC, CSA, RINA, BV, ATEX



ELEMECH INC.
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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: MSP1

Manuf.: . PNo: Square D: GV2P05

Job Number: HBR10366

Page # 1/1

GV2 Manual Starter and Protector

Schneider Electric

23-058-011



GV2P21 with
GV2GH7 installed

Table 47: GV2 Manual Motor Controller and Protector Horsepower Ratings

Catalog Number		Thermal Trip Setting Range (A)	Maximum Horsepower Ratings						
			1 Ø			3 Ø			
Push Button GV2ME [1]	Rotary Handle GV2P		120 V	208 V	240 V	208 V	240 V	480 V	600 V [2]
GV2ME01	GV2P01	0.11–0.16	—	—	—	—	—	—	—
GV2ME02	GV2P02	0.016–0.25	—	—	—	—	—	—	—
GV2ME03	GV2P03	0.25–0.40	—	—	—	—	—	—	—
GV2ME04	GV2P04	0.40–0.63	—	—	—	—	—	—	—
GV2ME05	GV2P05	0.63–1	—	—	—	—	—	—	—
GV2ME06	GV2P06	1–1.6	—	—	0.1	—	—	0.75	0.75
GV2ME07	GV2P07	1.6–2.5	—	0.16	0.16	0.5	0.5	1	1.5
GV2ME08	GV2P08	2.5–4	0.125	0.25	0.33	0.75	0.75	2	3
GV2ME10	GV2P10	4–6.3	0.25	0.5	0.5	1	1.5	3	5
GV2ME14	GV2P14	6–10	0.5	1	1.5	2	3	5	7.5
GV2ME16	GV2P16	9–14	0.75	2	2	3	3	10	10
GV2ME20	GV2P20	13–18	1	2	3	5	5	10	15
GV2ME21	GV2P21	17–23	1.5	3	3	5	7.5	15	20
GV2ME22	GV2P22	20–25	2	3	—	7.5	—	15	20
GV2ME32 [3]	GV2P32	24–32	2	5	5	7.5	10	20	25

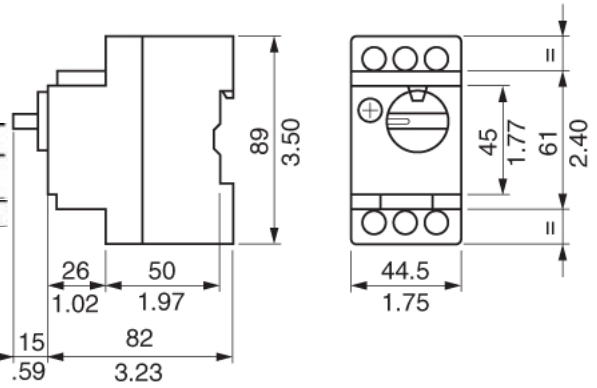
Additional GV2 Wiring Accessories

Description	Application	Sold in Lots of	Catalog Number	Weight, lb (kg)
Incoming line insulator	For GV2P when used in UL 508 Type E applications	10	GV2GH7	0.09 (0.040)

Table 55: Accessories for GV3P

Description	For Manual Motor Controllers	Catalog Number	Weight lb (kg)
Cover, large spacing, UL 508 Type E (only one cover is required on the supply side)	GV3P••	GV3G66 [1]	0.44 (0.02)

Product certifications: CCC UL DNV GL EAC CSA RINA BV ATEX



ELEMECH INC.
630-499-7080 · www.elemechinc.com

Manuf.: . PNo: Square D: GV2GH7

Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: MSP1

Job Number: HBR10366

Page # 1/1

Schneider Electric

23-058-031



GV AE113, GV AE203, GV AED 1013, GV AED 0113



GV AE11, GV AE20, GV AED 101, GV AED 011



GV AE1



GV AM11



GV AN●●



GV AD●●



GV3G66

Contact blocks

Description	Mounting	Maximum number	Type of contacts		Sold in lots of	Unit reference
Instantaneous auxiliary contacts	Front	1	N/O or N/C (1)		10	**GVAE1**
			N/O + N/C		10	**GVAE11** (2)
			N/O + N/O		10	**GVAE20** (2)
	Side (LH)	2	N/O + N/C		1	**GVAN11** (2)
			N/O + N/O		1	**GVAN20** (2)
Fault signalling contact + instantaneous auxiliary contact	Front	1	N/O (fault)	+ N/O	1	**GVAED101** (2)
			N/O (fault)	+ N/C	1	**GVAED011** (2)
	Side (3) (LH)	1	N/O (fault)	+ N/O	1	**GVAD1010**
				+ N/C	1	**GVAD1001**
			N/C (fault)	+ N/O	1	**GVAD0110**
				+ N/C	1	**GVAD0101**
Short-circuit signalling contact	Side (LH)	1	C/O common point		1	**GVAM11**

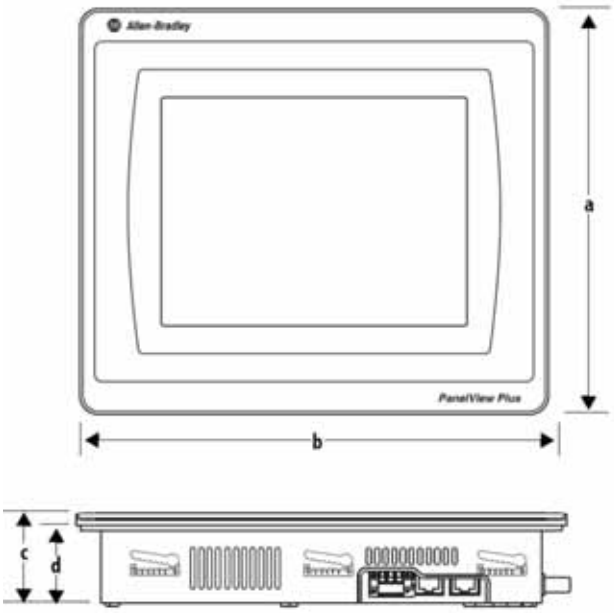
Accessories

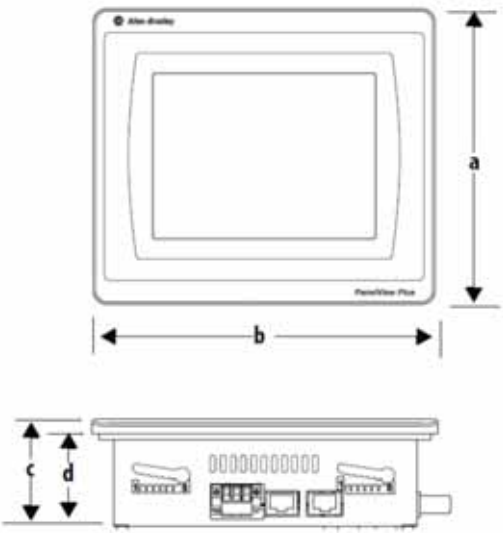
Description			Reference
Set of 3-pole busbars **Ie = 115 A** Pitch: 64 mm	2 tap-off	GV3P●● and GV3L●●	**GV3G264**
	3 tap-off	GV3P●● and GV3L●●	**GV3G364**
Cover "Large Spacing" UL 60947-4-1 type E (Only one cover required on supply side)		GV3P●●	**GV3G66**

(1) Choice of N/C or N/O contact operation, depending on which way round the reversible block is mounted.
*(2) Contact blocks available in version with spring terminal connections. Add a figure **3** at the end of the references selected above. Example: **GVAED101** becomes **GVAED1013**.*
*(3) The **GVAD●●** is always mounted next to the circuit breaker.*
*(4) To order an undervoltage trip: replace the dot (●) in the reference with a **U**, example: **GVAU025**. To order a shunt trip: replace the dot (●) in the reference with an **S**, example: **GVAS025**.*



Part Number	Description
25-000-A058	Nameplate Assembly, Yellow: Intrinsically Safe Circ: PR5202





Technical Specifications

Attribute	4-in. Touch 2711P-T4W21D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S, 2711P-T4W22D8S-B	6-in. Touch 2711P-T6C21D8S, 2711P-T6C21D8S-B, 2711P-T6C22D8S, 2711P-T6C22D8S-B
Operator input	Touch	Touch
Display type	Color TFT LCD	Color TFT LCD
Display size, diagonal	4.3 in. widescreen	5.7 in.
Viewing area	95 x 54 mm	115 x 86 mm
Display resolution	480 x 272 WQVGA, 18-bit color graphics	640 x 480 VGA, 18-bit color graphics
Aspect ratio	16:9	4:3

Attribute	7-in. Touch 2711P-T7C21D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S, 2711P-T7C22D8S-B	9-in. Touch 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S, 2711P-T9W22D8S-B	10-in. Touch 2711P-T10C21D8S, 2711P-T10C21D8S-B, 2711P-T10C22D8S, 2711P-T10C22D8S-B
Operator input	Touch	Touch	Touch
Display type	Color TFT LCD	Color TFT LCD	Color TFT LCD
Display size, diagonal	6.5 in.	9 in. widescreen	10.4 in.
Viewing area	132 x 99 mm	196 x 118 mm	211 x 158 mm
Display resolution	640 x 480 VGA, 18-bit color graphics	800 x 480 WVGA, 18-bit color graphics	800 x 600 SVGA, 18-bit color graphics
Aspect ratio	4:3	5:3	4:3

Attribute	12-in. Touch 2711P-T12W21D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S, 2711P-T12W22D8S-B	15-in. Touch 2711P-T15C21D8S, 2711P-T15C21D8S-B, 2711P-T15C22D8S, 2711P-T15C22D8S-B
Operator Input	Touch	Touch
Display type	Color TFT LCD	Color TFT LCD
Display size, diagonal	12.1 in. widescreen	15-in.
Viewing area	261 x 163 mm	304 x 228 mm
Display resolution	1280 x 800 WXGA, 18-bit color graphics	1024 x 768 XGA, 18-bit color graphics
Aspect ratio	5:3	4:3

Technical Specifications

Allen-Bradley

26-005-088

Brightness, typical	300 nits
Backlight life	50,000 h life, min. at 40° C to half-brightness. Backlight is not replaceable
Touch screen	Analog resistive Actuation rating: 1 million presses Operating force: 100 grams
Battery (real-time clock backup)	Accuracy: +/-2 minutes per month Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell
Memory	
System	512 MB RAM and 512 MB storage
User	80 MB nonvolatile storage for applications
Secure Digital (SD) card slot	One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB) and 1784-SD2 (2 GB)
USB ports	
Host	One USB 2.0 high-speed host port (type A) support removal flash drives for storage
Device	One high-speed 1.0 device port (type B) supports connection to host computer
Ethernet port	
Cat. Nos. with 21	One 10/100Base-T, Auto MDI/MDI-X Ethernet port with IEEE1588 support
Cat. Nos. with 22	Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports supporting star, linear, or DLR network topology
Operating system	Windows CE includes FTP, VNC client server, ActiveX controls, PDF reader, third-party device support
Software	FactoryTalk View Studio for Machine Edition, version 8.0 or later, FactoryTalk ViewPoint, version 2.6 or later
Electrical	
Input voltage, DC	24V DC nom (18…30V DC), nonisolated DC power supply
Power consumption, DC	50 W max (2.1A at 24V DC)
Power supply	DIN-rail power supply, AC-to-DC, 85…265V AC, 47…63 Hz Replacement: Allen-Bradley part number 2711P-RSACDIN

Environmental Specifications

Attribute	Value
Temperature, operating	0…55 °C (32…131 °F)
Temperature, nonoperating	-25…+70 °C (-13…+158 °F)
Relative humidity	5…95% without condensation
Heat dissipation	4 in., 15 W = 51 BTU 6 in., 15 W = 51 BTU 7 in., 15 W = 51 BTU 9 in., 20 W = 68 BTU 10 in., 20 W= 68 BTU 12 in., 30 W= 102 BTU 15 in., 30 W= 102 BTU
Altitude, operating	2000 M
Vibration	
4.3-in., 5.7-in., 6.5-in., 9.0-in., 10.4-in., 12.1-in., and 15-in.	0.012 pk-pk, 10…57 Hz 2g peak at 57…500 Hz
Shock, operating	15 g at 11 ms
Shock, nonoperating	30 g at 11 ms
Enclosure ratings	NEMA and UL Type 12, 13, 4X (indoor use only), also rated IP54 or IP66 as Classified by UL

Certifications

Certification[2]	Value
cULus	cULus Listed Industrial Control Equipment for use in Hazardous Locations (E10314) per standards ANSI / ISA 12.12.01 and CSA C22.2 No. 213. rated: • Class I, Division 2, Groups A, B, C and D • Class II, Division 2, Groups F and G • Class III Enclosure type ratings per UL50 and CSA C22.2 No. 94.2-07. Enclosure ingress protection classified by UL per IEC 60529
ATEX	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-0:2009; EN 60079-11:2012; EN 60079-15:2010; and EN 60079-31:2009 • II 3 GD • Ex ic nA IIC T4 Gc • Ex tc IIIC T135 °C (275 °F) Dc IP66 • Tamb = 0 °C to +55 °C (32 °F to +131 °F) • DEMKO 14 ATEX 1302X
INMETRO	ABNT NBR IEC 60079-0:2008+Errata 1:2011; ABNT NBR IEC 60079-11:2009; ABNT NBR IEC 60079-15:2012; ABNT NBR IEC 60079-31:2011 Ex ic nA IIC T4 Gc Ex tc IIIC T135 °C (275 °F) Dc IP66 Tamb = 0 °C to +55 °C (32 °F to +131 °F) UL-BR 14.0716X
CE (EMC)	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers
CE (LVD)	European Union 2006/95/EC Low Voltage Directive, compliant with: • EN 61131-2; Programmable Controllers
RCM	Australian Radio Communications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
EAC	Certificate of compliance
RoHS	China RoHS, Turkey RoHS, European RoHS
KCC	Certificate of compliance

Bulletin 800T/H

30.5 mm Push Buttons

Emergency Stop Operators

Allen-Bradley

29-005-117

2-Position Red Trigger Action Twist-to-Release, Non-Illuminated

- Tamper resistant – front-of-panel mounting and non-removable operator head
- Compliant with global E-stop standards, including EN ISO 13850 and EN 60947-5-5



Cat. No. 800T-TFXJET6



Cat. No. 800T-TFXLET6



Cat. No. 800T-TFXK6



Cat. No. 800H-TFRXT6

	Operator Position		Type 4/13			Type 4/4X/13
			45 mm Plastic	63 mm Metal	Key Release	45 mm Plastic
Contact Type	Out	In	Cat. No.*❄‡	Cat. No.*§	Cat. No.*♣	Cat. No.*❄‡
No contacts	—	—	**800T-TFXT6**	**800T-TFXLT6**	**800T-TFXK6**	**800H-TFRXT6**
1 N.C.	X	O	800T-TFXT6D2	800T-TFXLTD2	800T-TFXK6D2	800H-TFRXT6D2
1 N.O. - 1 N.C.	O X	X O	**800T-TFXT6A**	800T-TFXLT6A	**800T-TFXK6A**	**800H-TFRXT6A**
1 S.M.C.B.►	X	O	800TC-TFXT6D4S	800TC-TFXLT6D4S	800TC-TFXK6D4S	800HC-TFRXT6D4S

* For finger-safe contact block terminals, add a **C** to the cat. no. Example: Cat. No. 800T**C**-TFXT6 or 800H**C**-TFRXT6.
❄ To order a device with a jumbo (60 mm) plastic head add the letter **J** after **X**. Example: Cat. No. 800T-TFX**J**T6A or 800H-TFRX**J**T6A.
‡ To order a jumbo head device with "E-STOP" printed on the cap add the letters **JE** after **X**. Example: Cat. No. 800T-TFX**JE**T6 or 800H-TFRX**JE**T6.
§ To order a device with "E-STOP" engraved on the cap add the letter **E** after **L**. Example: Cat. No. 800TC-TFXL**E**T6D4S.
♣ Provided with two DO18 keys.
► Self-monitoring contact block.

800 T ___ – T FX T 6 D2
a b c d e

Standards Compliance

UL 508

CCC

Certifications

UL Listed
(File No. E14840, E10314
Guide No. NKCR, NOIV)

CSA Certified
(File No. LR1234, LR11924)

CSA C22.2, No. 14

EN/IEC: 60947-5-1

a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

800T Type 4/13 Code	Description	800H Type 4/4X/13 Code
FX	Standard (45 mm) mushroom head	FRX
FXJ	Jumbo (60 mm) mushroom head	FRXJ
FXJE	Jumbo (60 mm) mushroom head with "E-STOP"	FRXJE
FXK	45 mm mushroom head key release	—
FXL	63 mm anodized aluminum head	—
FXLE	63 mm anodized aluminum head with "E-STOP"	—

d

Release Function	
Code	Color
Blank	Key release⌘
T	Twise release

Note: X = Closed/O = Open
⌘Configurable only with **FXK** head type.

e

Contact Block(s)			
Code	Operator Position  Out	 In	Description
Blank	—	—	No contacts on operator
Standard			
D1	O	X	1 N.O.
D2	X	O	1 N.C.
D4	X	O	1 N.C.L.B.
A	O X	X O	1 N.O. - 1 N.C.
A1	O X	X O	1 N.O. - 1 N.C.L.B.
A5	X X	O O	2 N.C.L.B.
Pen*TUFF* (Low Voltage)			
D1V	O	X	1 N.O.
D2V	X	O	1 N.C.
D4V	X	O	1 N.C.L.B.
AV	O X	X O	1 N.O. - 1 N.C.
Class 1, Div. 2/Zone 2			
Logic Reed			
D1R	O	X	1 N.O.
D2R	X	O	1 N.C.
AR	O X	X O	1 N.O. - 1 N.C.
Sealed Switch			
D1P	O	X	1 N.O.
D2P	X	O	1 N.C.
AP	O X	X O	1 N.O. 1 N.C.
Stackable Sealed Switch			
D1Y	O	X	1 N.O.
D2Y	X	O	1 N.C.
AY	O X	X O	1 N.O. - 1 N.C.

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Rev: 0	Device Tag: PB1
Date: 02-16-2026	
By: AJ	Job Number: HBR10366
	Page # 1/1

Manuf.: . PNo:
Allen-Bradley: 800H-TFRXT6D2

30.5 mm Push Buttons

Allen-Bradley

29-005-002

800 T ___ – A 1 ___ A
a b c d e f



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Operator Type		
800T Type 4/13 Code	Description	800H Type 4/4X/13 Code
A	Flush head	AR
B	Extended head	BR
D	Mushroom head	DR
DX	Mushroom head less color cap	DRX
—	Bootless guarded head	GR
—	Booted head	R*

d

Color Cap	
Code	Description
Blank	Used only when ordering Operator Type DX/DRX
1	Green
2	Black
3	Orange*

Color Cap	
Code	Description
4	Grey*
5	White*
6	Red
7	Blue
9	Yellow

e

Special Mushroom Head	
Code	Description
J§	Jumbo mushroom head — plastic
L§	Jumbo mushroom head — metal

Note: Special mushroom head options only apply to mushroom head operator type code D/DR (Table c).

f

Contact Block(s)	
Code	Description
Blank	No contacts
Standard	
D1	1 N.O.
D2	1 N.C.
D3	1 N.O.E.M.
D4	1 N.C.L.B.
D5	1 N.O. (Mini)
D6	1 N.C. (Mini)
A1	1 N.C.L.B. - 1 N.O.
A2	2 N.O.‡
A4	2 N.C.
A7	1 N.C.L.B. - 1 N.C.
A	1 N.O. - 1 N.C.
B	2 N.O. - 2 N.C.

Certifications

UL Listed
(File No. E14840, E10314
Guide No. NKCR, NOIV)

CSA Certified
(File No. LR1234, LR11924)

CSA C22.2, No. 14

Specifications*

Electrical Ratings		
Contact ratings		Refer to the contact ratings tables on page 10-4.
Dielectric strength		2200V for one minute, 1300V for one minute (Logic Reed)
Electrical design life cycles		1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed)
Mechanical Ratings		
Vibration		10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./ 10 G max. (except Logic Reed)
Shock		1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G
Degree of protection		Type 1/4/12/13 (800T); Type 1/4/4X/12/13 (800H); EN/IEC 60529 IP66/65
Mechanical design life cycles		
Push buttons	(Momentary, non-illuminated)	10 000 000 min.
	(Momentary, illuminated)	250 000 min.
	(Push-pull/twist-to-release)	250 000 min.
Selector switches	(Non-illuminated)	1 000 000 min.
	(Illuminated, key-operated)	200 000 min.
Potentiometers		25 000 min.
All other devices		200 000 min.
Contact operation		Shallow, mini, and low-voltage contact blocks: Slow, double make and break Logic Reed and sealed switch contact blocks: Single break magnetic
Wire gauge/Terminal screw torque		#18…14 AWG (#18…10 Max Duty) / 6…8 lb•in
Typical operating forces		
Operators without contact blocks		Flush, extended button, standard mushroom, jumbo plastic mushroom: 2 lbs max. Jumbo and extended aluminum mushroom head: 3.95 lbs max. Maintained selector switch: 3.6 in•lb max.
Spring return selector switches		3.6 in•lb to stop, 0.2 in•lb to return
Illuminated push buttons and push-to-test pilot lights		5 lb max.
2-position push-pull		8.0 lb max. push or pull
3-position push-pull		8 lb max. push to in position or pull to center position (15 lb max. pull to out position)
Twist-to-release or push-pull		9 lbs max. push or pull 30 in•oz max. twist, 6 in•oz minimum return
Potentiometer		Rotational torque 3…12 in•oz; stopping torque 12 in•lb (minimum)
Contact blocks	Standard	1 lb
	Logic Reed	1 lb max.
	Sealed switch	3 lb max. at 0.205 in. plunger travel
	Stackable sealed switch	1 lb max.
	MaxDuty	1.4 lb max.
	PenTUFF	1.4 lb max.
	Self Monitoring	1.6 lb
Environment		
Temperature range	Operating	-40…+131 °F (-40…+55 °C)
	Storage	-40…+185 °F (-40…+85 °C)
Note: Operating temperatures below freezing are based on the absence of moisture and liquids. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for use in lower temperature applications.		
Humidity		50…95% RH from 77…140 °F (25…60 °C) per Procedure IV of MIL-STD-810C, Method 507.1 cycling test

RM22TR31

three-Phase Voltage control relay 200…240Vac

30-183-001

Main

Range of product	Zelio Control
Product or component type	Modular measurement and control relays
Relay type	Control relay
Phase	3 phase
Relay name	RM22TR
Relay monitored parameters	Phase sequence Phase failure detection Overvoltage and undervoltage detection
Time delay type	Adjustable 0.1...30 s, +/- 10 % of the full scale value on crossing the threshold Tt
Switching capacity in VA	2000 VA
Measurement range	200...240 V voltage AC



Complementary

Reset time	1500 ms at maximum voltage
Maximum switching voltage	250 V AC
Minimum switching current	10 mA 5 V DC
Maximum switching current	8 A AC
[Us] rated supply voltage	200...240 V AC
Supply voltage limits	160…288 V AC
Operating limits	- 20 % + 20 % Un
Power consumption in VA	10 VA 240 V AC 60 Hz
Voltage detection threshold	< 100 V AC
Supply voltage frequency	50...60 Hz +/- 10 %
Output contacts	2 C/O
Setting accuracy of the switching threshold	+/- 10 % of the full scale
Switching threshold drift	<= 0.05 % per degree centigrade depending permissible ambient air temperature
Setting accuracy of time delay	10 P
Time delay drift	<= 0.05 % per degree centigrade depending permissible ambient air temperature <= 1 % within the supply voltage range
Hysteresis	2 % fixed selectable
Run-up delay at power-up	650 ms
Maximum measuring cycle	150 ms measurement cycle as true rms value
Threshold adjustment voltage	2...20 % of Un selected
Voltage range	200...240 V phase to phase
Repeat accuracy	+/- 0.5 % input and measurement circuit +/- 3 % time delay
Measurement error	< 1 % over the whole range with voltage variation < 0.05 %/°C with temperature variation
Response time	<= 300 ms
Overvoltage category	III IEC 60664-1 III UL 508
Insulation resistance	> 100 MOhm 500 V DC IEC 60255-27
Mounting position	Any position
Connections - terminals	Screw terminals, 2 x 0.5...2 x 2.5 mm² AWG 20...AWG 14) solid without cable end Screw terminals, 2 x 0.2...2 x 1.5 mm² AWG 24...AWG 16) flexible with cable end Screw terminals, 1 x 0.5...1 x 3.3 mm² AWG 20...AWG 12) solid without cable end Screw terminals, 1 x 0.2...1 x 2.5 mm² AWG 24...AWG 14) flexible with cable end
Tightening torque	5.31…8.85 lbf.in (0.6…1 N.m) IEC 60947-1

Housing material	Self-extinguishing plastic
Status LED	Relay ON LED Yellow) Power ON LED Green)
Mounting support	35 mm DIN rail EN/IEC 60715
Electrical durability	100000 cycles
Mechanical durability	10000000 cycles
Utilisation category	AC-15 IEC 60947-5-1 DC-13 IEC 60947-5-1 AC-1 IEC 60947-4-1 DC-1 IEC 60947-4-1
Safety reliability data	MTTFd = 388.1 years B10d = 350000
Contacts material	Cadmium free
Maximum Width	0.89 in (22.5 mm)
Net Weight	0.20 lb(US) (0.09 kg)

Environment

Immunity to microbreaks	10 ms
Electromagnetic compatibility	Immunity for residential, commercial and light-industrial environments EN/IEC 61000-6-1 Immunity for industrial environments EN/IEC 61000-6-2 Emission standard for residential, commercial and light-industrial environments EN/IEC 61000-6-3 Emission standard for industrial environments EN/IEC 61000-6-4 Electrostatic discharge 6 kV contact discharge)level 3 IEC 61000-4-2 Electrostatic discharge 8 kV air discharge)level 3 IEC 61000-4-2 Radiated radio-frequency electromagnetic field immunity test 10 V/mlevel 3 IEC 61000-4-3 Electrical fast transient/burst immunity test 4 kV direct)level 4 IEC 61000-4-4 Electrical fast transient/burst immunity test 2 kV capacitive coupling)level 4 IEC 61000-4-4 Surge immunity test 4 kV common mode)level 4 IEC 61000-4-5 Surge immunity test 2 kV differential mode)level 4 IEC 61000-4-5 Conducted and radiated emissionsclass B group 1 CISPR 11 Conducted and radiated emissionsclass B CISPR 22
Standards	EN/IEC 60255-1
Product certifications	CSA CCC EAC China RoHS RCM CE GL UL
Ambient air temperature for storage	-40…158 °F (-40…70 °C)
Ambient air temperature for operation	-4…122 °F (-20…50 °C) 60 Hz -4…140 °F (-20…60 °C) 50 Hz AC/DC
Relative humidity	93…97 % 77…131 °F (25…55 °C) IEC 60068-2-30
Vibration resistance	0.075 mm 10…58.1 Hz) not in operation IEC 60068-2-6 1 gn 10…58.1 Hz) not in operation IEC 60068-2-6 0.035 mm 58.1…150 Hz) in operation IEC 60068-2-6 0.5 gn 58.1…150 Hz) in operation IEC 60068-2-6
Shock resistance	15 gn 11 ms) not in operation IEC 60068-2-27 5 gn 11 ms) in operation IEC 60068-2-27
IP degree of protection	IP20 IEC 60529 terminals) IP40 IEC 60529 housing) IP50 IEC 60529 front panel)
Pollution degree	3 IEC 60664-1 3 UL 508
Dielectric test voltage	2.5 kV AC 50 Hz, 1 min IEC 60255-27

5069-OW16 Digital 16-point Relay Output Module

Allen-Bradley



33-005-277

c UL us LISTED

Technical Specifications - 5069-OW16

Attribute	5069-OW16
Outputs	16 (Two groups of 8) - Form A (normally open)
Voltage and current ratings	
Output voltage range	5...125V DC, 5...264V AC
MOD power	Series A and B: 75 mA @ 18...32V DC Series C: 225 mA @ 18...32V DC
MOD power (passthrough)[1]	9.55 A @ 18...32V DC
SA power	Series A and B: 150 mA @ 18...32V DC Series C: -
SA power (passthrough)[1]	9.95 A @ 18...32V DC
Do not exceed 10 A MOD or SA power (passthrough) current draw. The module complies with UKEX/ATEX/IECEx when used at or below 125V AC or 30V DC.	
Power dissipation, max	3.0 W
Thermal dissipation, max	10.2 BTU/hr
Isolation voltage	250V (continuous), Basic Insulation Type Type tested at 1800V AC for 60 s No isolation between individual channels
Module keying	Electronic keying via programming software
Indicators	1 green/red module status indicator 16 yellow/red I/O status indicators
Wire category[2]	1 - relay port 1 - power port 1 wire per terminal for each signal port
Relay ratings	2 A resistive per channel @ 5...30V DC 2 A resistive per channel @ 5...264V AC, 50/60 Hz 2 A general use per channel @ 5...250V AC, 50/60 Hz 2 A @ 5...125V AC, UKEX/ATEX/IECEx **NOTE:** To extend the life of the module, connect surge suppressors across your external inductive load. For additional details, see the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.
Off-state leakage current per point, max	Series A: 0 mA (dry contact, no onboard snubbers) Series B and Series C: 0 mA (with onboard TVS snubber)
Output current per group, max	8 A
Output current per module, max	16 A
Output delay time, max	
Off to On	10 ms
On to Off	10 ms
Switching frequency	1 operation every 3 seconds (0.3 Hz at rated load)
Initial contact resistance, max	30 mΩ
Bounce time, mean	500 µs

Technical Specifications - 5069-OW16

Attribute	5069-OW16
Delay to fault	Supported
Fusing	Outputs are not fused
Minimum load current	1 mA
Expected contact life	300K cycles resistive, 100K cycles inductive
Pilot duty rating	5...240V AC, 50/60 Hz, C300 pilot duty per channel 5...125V DC, R150 pilot duty per channel
Output control in fault state per point	• Hold Last State • On • Off (default)
Output states in program mode per point	
Output states in fault mode per point	
Duration of fault mode per point	• 1, 2, 5, or 10 seconds • Forever (default)

Environmental Specifications

Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold) IEC 60068-2-2 (Test Bd, Operating Dry Heat) IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold) IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat) IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40...+85 °C (-40...+185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	5 g @ 10...500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g

5069-IY4 Analog Input Module

Allen-Bradley



33-005-278

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Technical Specifications - 5069-IY4

Attribute	5069-IY4
Inputs	4 differential
Input range, voltage	±10V 0…10V 0…5V
Input range, current	0…20 mA 4…20 mA
Input range, RTD	1…500 Ω 2…1000 Ω 4…2000 Ω 8…4000 Ω
Input type, RTD	100, 200, 500, 1000 Ω platinum, alpha=385 100, 200, 500, 1000 Ω platinum, alpha=3916 120 Ω nickel, alpha=672 100, 120, 200, 500 Ω nickel, alpha=618 10 Ω copper 427
Input range, thermocouple / millivolt	± 100 mV
Input type, thermocouple	B, C, D, E, J, K, L (TXK/XK), N, R, S, T
Input impedance	Voltage: >1 MΩ Current: 90 Ω typical, 70…110 Ω range RTD: >1 MΩ Thermocouple/millivolt: >1 MΩ
Common mode voltage (channel to channel)	±10V

Technical Specifications - 5069-IY4

Attribute	5069-IY4
Module conversion method	Sigma-Delta, One 24-bit multiplexed ADC
Resolution, voltage[1] (16 bits at 10 Hz notch filter)	±10.5V: <320 µV/count (15 bits plus sign bipolar) 0…10.5V: <160 µV/count (16 bits unipolar) 0…5.25V: <80 µV count (16 bits unipolar)
Resolution, current[1] (16 bits at 10 Hz notch filter)	0…21 mA: <0.32 µA/count (16 bits) 3.6…21 mA: <0.27 µA/count (16 bits)
Resolution, RTD[1] (16 bits at 10 Hz notch filter) 3 Wire mode	< 7.9 mΩ/cnt in 1…500 Ω mode < 15.8 mΩ/cnt in 2…1000 Ω mode < 31.7 mΩ/cnt in 4…2000 Ω mode < 63.4 mΩ/cnt in 8…4000 Ω mode
Resolution, thermocouple / millivolt[1] (16 bits at 10 Hz notch filter)	< 3.1 µV/cnt in ±100 mV mode
RTD excitation current	600 µA, 3 wire mode 100 µA, 2 wire mode
Wire impedance (3-wire RTD mode only)	25 Ω maximum for specified accuracy

General Specifications - 5069-IY4

Attribute	5069-IY4
Module Power bus (MOD Power) voltage range	18…32V DC
Module Power bus (MOD Power) current, max	75 mA
Module Power bus (MOD Power) Passthrough voltage range	18…32V DC
Module Power bus (MOD Power) current rating, max[21]	9.55 A
Sensor Actuator (SA) Field Power voltage range	18…32V DC
Sensor Actuator (SA) Field Power current, max	100 mA
Sensor Actuator Power bus (SA Power) Passthrough voltage range	0…32V DC
Sensor Actuator Power bus (SA Power) current rating, max[22]	9.95 A
Power dissipation, max	Voltage mode: 1.8 W Current mode: 2.1 W RTD mode: 2.1 W Thermocouple / millivolt mode: 1.8 W
Thermal dissipation, max	Voltage mode: 6.1 BTU/hr Current mode: 7.2 BTU/hr RTD mode: 7.2 BTU/hr Thermocouple/millivolt: 6.1 BTU/hr
Isolation voltage	100V (continuous), Basic Insulation Type 50V Functional Isolation between SA Power and input ports No isolation between individual input ports
Calibration methods	Factory calibrated User-performed (optional)
Module keying	Electronic, software configurable
Indicators	1 green/red module status indicator 4 yellow/red I/O status indicators 2 yellow/red CJC status indicators
Slot width	1
Common mode noise rejection ratio	130 dB @ 50/60 Hz
Normal mode noise rejection ratio	65 dB @ 50/60 Hz, notch filter dependent
Dimensions (HxWxD), approx	138 x 22 x 105 mm (5.43 x 0.87 x 4.15 in.)

Environmental Specifications - 5069-IY4

Attribute	5069-IY4
Temperature, operating IEC 60068-2-1 (Test Ab, Operating Cold), IEC 60068-2-2 (TestBb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…+85 °C (-40…+185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing

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Manuf.: . PNo: Allen-Bradley: 5069-IY4	Rev: 0	Device Tag: PLC1	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

Removable terminal blocks

Allen-Bradley

33-005-280



RTB	One of the following RTB types. • 5069-RTB18-SPRING RTB • 5069-RTB18-SCREW RTB **IMPORTANT**: You must order RTBs separately. RTBs do not ship with COMPACT 5000 I/O modules. We recommend that you order only the RTB type that your system requires.

Removable terminal blocks

Allen-Bradley

33-005-282



IMPORTANT: You must order RTBs separately. The RTBs are available in 5069 RTB kits.

- The 5069-RTB64-SCREW kit contains the 5069-RTB6-SCREW and 5069-RTB4-SCREW RTBs.
- The 5069-RTB64-SPRING kit contains the 5069-RTB6-SPRING and 5069-RTB4-SPRING RTBs.
- The 5069-RTB5-SCREW kit contains the 5069-RTB5-SCREW RTBs.
- The 5069-RTB5-SPRING kit contains the 5069-RTB5-SPRING RTBs.

We recommend that you order only the RTB type that your system requires.

Allen-Bradley

CompactLogix 5380 Controllers



33-005-336

Features - CompactLogix 5380 Controllers

Feature	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Controller tasks Continuous Periodic Event	32 tasks 1000 programs/task All event triggers							
Built-in communication ports	1 - USB port 2 - Ethernet ports **IMPORTANT**: Consider the following: When the controller operates in Dual-IP mode, each Ethernet port requires a unique IP address. When the controller operates in Linear/DLR mode, the controller uses only one IP address.							
USB port communication	USB 2.0, Type B Full speed (12 Mbps) Programming, configuration, firmware update, and online edits only							
Ethernet performance	10 Mbps, 100 Mbps, 1 Gbps Full-duplex only							
I/O Capacity (Class 0/1)(1)	128,000 packets/second							
Message Rate Capacity HMI/MSG (Class 3)(1)	2000 messages/second							
EtherNet/IP modes supported	Dual-IP mode (Available with the Studio 5000 Logix Designer® application, version 29.00.00 or later) Linear/DLR mode							
EtherNet/IP network topologies supported	DLR Star Linear							
EtherNet/IP nodes supported, max(2)	16	24	40	60	90	120	150	180
Socket interfaces supported, max	32							
Integrated motion(3)	5069-L306ERM	5069-L310ERM	5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ERM, 5069-L330ERMK	5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM

(1) I/O numbers are maximums; they assume no HMI/MSG. HMI/MSG numbers are maximums, they assume no I/O. Maximums assume the processor is target, not originator. Packet rates vary depending on packet size. For more details, see Troubleshoot EtherNet/IP Application Technique, publication ENET-AT003, and the EDS file for a specific catalog number.

(2) The maximum number of nodes that are listed represents when the controller is used with the Logix Designer application, version 31 or later. Some controllers can be used with earlier Logix Designer application versions. The maximum number of nodes that a controller supports can be fewer in Logix Designer application, versions 30 or earlier.

(3) Only CompactLogix 5380 controllers that have an M or P in their catalog number support Integrated Motion on EtherNet/IP networks.

CompactLogix 5380 Controllers

Allen-Bradley

Technical Specifications - CompactLogix 5380 Controllers

Attribute	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
User memory	0.6 MB	1 MB	2 MB	3 MB	4 MB	5 MB	8 MB	10 MB
Optional nonvolatile memory	• 1784-SD1 (1 GB) • 1784-SD2 (2 GB), ships with controller • 1784-SDHC8 (8 GB) • 1784-SDHC32 (32 GB) • 9509-CMSDCD4 (4 GB) CodeMeter CmCard card							
Local I/O modules, max	8	8	16	31[1]	31	31	31	31
MOD Power voltage range	18...32V DC							
MOD Power current, max	450 mA							
MOD Power inrush	850 mA for 125 ms							
MOD Power passthrough[2]	9.55 A @ 18...32V DC							
MOD Power current rating, max	10 A Do not exceed 10 A current draw at the MOD Power RTB.							
SA Power voltage ranges[3]	0...32V DC 0...240V AC, 47...63 Hz ATEX/IECEX, 125V AC max							
SA Power current, max[3]	10 mA (DC power) 25 mA (AC power)							
SA Power passthrough[3], [4]	9.95 A @ 0...32V DC 9.975 A @ 0...240V AC, 47...63 Hz ATEX/IECEX, 125V AC max							
SA Power current rating, max[3]	10 A (AC or DC power) Do not exceed 10 A current draw at the SA Power RTB.							
Power dissipation, max	8.5 W							
Thermal dissipation, max	29 BTU/hr							
Isolation voltage	300V (continuous), Basic Insulation Type, SA, and MOD Power to Backplane 300V (continuous), Basic Insulation Type, SA to MOD Power 300V (continuous), Basic Insulation Type, Ethernet to Backplane 300V (continuous), Double Insulation Type, Ethernet to MOD Power 300V (continuous), Double Insulation Type, Ethernet to SA Power 50V (continuous), Functional Insulation Type, Ethernet to USB 300V (continuous), Basic Insulation Type, USB to Backplane 300V (continuous), Double Insulation Type, USB to MOD Power 300V (continuous), Double Insulation Type, USB to SA Power No isolation between Ethernet ports Type tested at 1500V AC for 60 s							
Weight, approx	0.768 kg (1.693 lb)							

Technical Specifications - CompactLogix 5380 Controllers (Continued)

Attribute	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Dimensions (HxWxD), approx	143.97 x 98.10 x 136.81 mm (5.67 x 3.86 x 5.39 in.)							
Location	DIN rail mount (horizontal mount only)							
DIN rail	Compatible zinc-plated, chromate steel DIN rail. EN50022 - 35 x 7.5 mm (1.38 x 0.30 in.)							
Removable terminal block	RTBs are available in separately ordered 5069 RTB kits. The MOD power connection uses a 4-point RTB, and the SA power connection uses a 6-point RTB. The following kits are available: - Kit catalog number 5069-RTB64-SCREW contains RTB catalog numbers 5069-RTB6-SCREW and 5069-RTB4-SCREW. - Kit catalog number 5069-RTB64-SPRING contains RTB catalog numbers 5069-RTB6-SPRING and 5069-RTB4-SPRING.							
Terminal block torque	5069-RTB4-SCREW & 5069-RTB6-SCREW: 0.4 N•m (3.5 lb•in) 5069-RTB4-SPRING & 5069-RTB6-SPRING: Torque does not apply							
Wire size	5069-RTB4-SCREW, 5069-RTB6-SCREW connections: 0.5...1.5 mm^2 (22...16 AWG) solid or stranded copper wire that is rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only 5069-RTB4-SPRING, 5069-RTB6-SPRING connections: 0.5...1.5 mm^2 (22...16 AWG) solid or stranded copper wire that is rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only Ethernet connections: Ethernet Cabling and Installation according to IEC 61918 and IEC 61784-5-2							
Insulation stripping length	5069-RTB4-SCREW, 5069-RTB6-SCREW connections: 12 mm (0.47 in.) 5069-RTB4-SPRING, 5069-RTB6-SPRING connections: 10 mm (0.39 in.)							
Wire category(5)	3 - on USB port 1 - on power ports 2 - on Ethernet ports							
Enclosure	None (open-style)							
North American temperature code	T4							
ATEX temperature code	T4							
IECEx temperature code	T4							

(1) When you use these controllers with the Studio 5000 Logix Designer application, version 28.00.00, the application limits the number of local I/O modules in the project to 16. For more information, see the Rockwell Automation Knowledgebase article #942580, '5380 CompactLogix controllers limited to 16 local 5069 modules in version 28 of Studio 5000® environment.The document is available at http://www.rockwellautomation.com/knowledgebase.
With the Logix Designer application, version 30.00.00 or later, the controllers support as many as 31 local I/O modules.

(2) Maximum level of MOD Power current that the controller can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

(3) SA power specifications are based on the number and type of Compact 5000 I/O modules that are used in the system. If the set of I/O modules that are used in the system require AC and DC voltage, you must install a 5069-FPD field potential distributor to separate the module types.

(4) Maximum level of SA Power current that the controller can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

(5) Use this Conductor Category information for planning conductor routing. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

5069-OF4 and 5069-OF8 Analog Current/Voltage Output Module

Allen-Bradley

33-005-338



General Specifications - 5069-OF4, 5069-OF4K, and 5069-OF8

Attribute	5069-OF4, 5069-OF4K	5069-OF8
Voltage and current ratings		
Analog output ratings	+/-10V DC, 0...20 mA per channel	
MOD Power	75 mA @ 18...32V DC	
MOD Power Passthrough, max[1]	9.55 A @ 18...32V DC	
SA Power	150 mA @ 18...32V DC	250 mA @ 18...32V DC
SA Power Passthrough, max[2]	9.95 A @ 18...32V DC	
Power dissipation, max	3.3 W	5.3 W
Thermal dissipation, max	11.3 BTU/hr	18.1 BTU/hr
Isolation voltage	250V (continuous), Basic Insulation Type 50V Functional Isolation between SA power and output ports No isolation between individual output ports	
Calibration methods	Factory Calibrated User-performed (optional)	
Module keying	Electronic keying via programming software	
Indicators	1 green/red module status indicator 4 yellow/red I/O status indicators	1 green/red module status indicator 8 yellow/red I/O status indicators
Slot width	1	
Dimensions (HxWxD), approx	144.57 x 22 x 105.42 mm (5.69 x 0.87 x 4.15 in.)	
DIN rail	Compatible zinc-plated chromate-passivated steel DIN rail. You can use the EN50022 - 35 x 7.5 mm (1.38 x 0.30 in.) DIN rail.	
RTB	One of these RTB types. • 5069-RTB18-SPRING RTB • 5069-RTB18-SCREW RTB **IMPORTANT**: You must order RTBs separately. RTBs do not ship with Compact 5000 I/O modules. We recommend that you order only the RTB type that your system requires.	
RTB torque (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)	
RTB keying	None	
Wire category[3]	2 - shielded input ports 2 - power ports 1 wire per terminal for each signal port	
Wire size		
5069-RTB18-SPRING removable terminal block	0.5...1.5 mm² (22...16 AWG) solid or stranded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation	
5069-RTB18-SCREW removable terminal block	0.5...1.5 mm² (22...16 AWG) solid or stranded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation	
Insulation stripping length		
5069-RTB18-SPRING connections	10 mm (0.39 in.)	
5069-RTB18-SCREW connections	12 mm (0.47 in.)	

Technical Specifications - 5069-OF4, 5069-OF4K, 5069-OF8

Attribute	5069-OF4, 5069-OF4K	5069-OF8
Outputs	4 voltage or current	8 voltage or current
Output range, voltage	± 10V 0...10V 0...5V	
Output range, current	0...20 mA 4...20 mA	
Resolution	16 bits across ± 10.5V - 320 µV/bit 16 bits across 10.5V - 160 µV/bit 16 bits across 5.25V - 80 µV/bit 16 bits across 21 mA - 320 nA/bit	
Drive capability	Voltage - 1000 Ω min Current - 500 Ω max	
Capacitive load, max (voltage mode only)	1 µF	
Inductive load, max (current mode only)	1 mH	
Open circuit detection	Current mode only	
Short circuit detection	Voltage mode only – output electronically limited to 16 mA or less	
Data format	IEEE 32-bit floating point	
Module conversion method	R-Ladder DAC, monotonicity with no missing codes	
Conversion time per channel	25 µs	
Scan time • Per group 0...3 (OF4/OF8) • Per group 0...7 (OF8 only)	 1.0 ms 2.0 ms	
Step response time to 63% of value	Voltage mode – 18 µs max Current mode – 1 ms max	
Overvoltage protection, max	± 32V DC	
Repeatability	0.05%	
Calibrated accuracy at 25 °C (77 °F)	Voltage - 0.10% full scale Current - 0.10% full scale	
Accuracy drift with temperature	Voltage - 0.30% full scale Current - 0.50% full scale	

Environmental Specifications - 5069-OF4, 5069-OF4K, and 5069-OF8

Attribute	5069-OF4, 5069-OF4K, 5069-OF8
Temperature, operating IEC 60068-2-1 (Test Ab, Operating Cold), IEC 60068-2-2 (TestBb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Operating Thermal Shock)	0...60 °C (32...140 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40...+85 °C (-40...+185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	5 g @ 10...500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80...200 MHz 10V/m with 200 Hz 50% pulse 100% AM at 900 MHz 10V/m with 200 Hz 50% pulse 100% AM at 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz

5069-IB16 Compact I/O Digital 16-point 24VDC Input Module

Allen-Bradley



33-005-347

c UL us LISTED

Certifications - 5069-IB16 and 5069-IB16F

Certification[1]	5069-IB16, 5069-IB16F
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.

Technical Specifications - 5069-IB16 and 5069-IB16F

Attribute	5069-IB16
On-state voltage, min	10V DC
On-state voltage, nom	24V DC
On-state voltage, max	32V DC
On-state current, min	4 mA @ 10V
On-state current, nom	6 mA @ 24V DC
On-state current, max	7.4 mA @ 32V DC
Off-state voltage, max	5V DC
Off-state current, max	1.5 mA
Input impedance, min	1.33 kΩ
Input impedance, nom	4.1 kΩ
Input impedance, max	7.0 kΩ
Inrush current, max	< 250 mA peak (decaying to, 37% in 22 ms, without act
Input delay time (screw to backplane)	
Off to On	≤ 100 µs, ±10 µs @ 25 °C (77 °F)
On to Off	≤ 100 µs, ±10 µs @ 25 °C (77 °F)
Input drift over temperature span	±100 ns/°C (55.6 ns/°F) from 0…60 °C (32…140 °F)
Input On to Off minimum pulse width	60 µs
Input Off to On minimum pulse width	60 µs

General Specifications - 5069-IB16 and 5069-IB16F

Attribute	5069-IB16
Inputs	16 Channels (1 group of 16), sinking
Voltage category	12/24V DC Sink
Voltage and current ratings	
Input ratings	4…7.4 mA per channel @ 10…32V DC
MOD Power	75 mA @ 18…32V DC
MOD Power Passthrough, max[1]	9.55 A @ 18…32V DC
SA Power	200 mA @ 10…32V DC
SA Power Passthrough, max[2]	9.95 A @ 10…32V DC
Power dissipation, max	3.9 W
Thermal dissipation, max	13.3 BTU/hr
Isolation voltage	250V (continuous), Basic Insulation Type No isolation between SA Power and input ports No isolation between individual input ports
Module keying	Electronic keying via programming software
Indicators	1 green/red module status indicator 16 yellow/red I/O status indicators
Slot width	1
Dimensions (HxWxD), approx	144.57 x 22 x 105.42 mm (5.69 x 0.87 x 4.15 in.)

Environmental Specifications - 5069-IB16 and 5069-IB16F

Attribute	5069-IB16, 5069-IB16F
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% pulse 100% AM at 900 MHz 10V/m with 200 Hz 50% pulse 100% AM at 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV @ 5 kHz on power ports ±3 kV @ 5 kHz on input ports
Surge transient immunity IEC 61000-4-5	±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports ±1 kV line-line (DM) and ±2 kV line-earth (CM) on input ports
Conducted RF immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz
Voltage variation IEC 61000-4-29	10 ms interruption on MOD Power port

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Rev: 0	Device Tag: PLC1	
Date: 02-16-2026		
By: AJ	Job Number: HBR10366	Page # 1/1

Manuf.: . PNo: Allen-Bradley: 5069-IB16

Power supply unit - UNO

UNO2-PS/1AC/24DC/120W

1110466

37-098-020



Input data

AC operation

Supply system configuration	Star network (TN, TT, IT (PE))
Nominal input voltage range	100 V AC ... 240 V AC
Input voltage range	100 V AC ... 240 V AC -15 % ... +10 %
Derating	< 100 V AC (1 %/V)
Typical national grid voltage	120 V AC
	230 V AC
Voltage type of supply voltage	AC
Inrush current	typ. 35 A (at 25 °C)
Inrush current integral (I^2t)	< 0.7 A^2s
Frequency range (f_N)	50 Hz ... 60 Hz ±10 %
Mains buffering time	typ. 25 ms (120 V AC)
	typ. 25 ms (230 V AC)
Current consumption	1.34 A (100 V AC)
	1.1 A (120 V AC)
	0.59 A (230 V AC)
	0.57 A (240 V AC)
Protective circuit	Transient surge protection; Varistor
Switch-on time	typ. 1 s
Device mains fuse	3.15 A internal (device protection), slow-blow
Recommended breaker for input protection	6 A ... 16 A (Characteristic B, C, D, K or comparable)
Discharge current to PE	< 0.25 mA

Output data

Efficiency	typ. 93 % (120 V AC)
	typ. 94 % (230 V AC)
Nominal output voltage	24 V DC
Setting range of the output voltage (U_{Set})	24 V DC ... 28 V DC (> 24 V DC, constant capacity restricted)
Nominal output current (I_N)	5 A
Short-circuit-proof	yes
No-load proof	yes
Crest factor	typ. 1.93 (120 V AC)
	typ. 2.05 (230 V AC)
Output power (P_N)	120 W
Connection in parallel	yes, for increasing power and redundancy with diode
Connection in series	yes, for increased output voltage
Feedback voltage resistance	≤ 35 V DC
Protection against overvoltage at the output (OVP)	≤ 35 V DC
Residual ripple	typ. 70 mV_{PP} (with nominal values)
	< 1 % (change in load, static 10 % ... 90 %)
Control deviation	< 3 % (change in load, dynamic 10 % ... 90 %)
	< 0.1 % (change in input voltage ±10 %)
Rise time	< 1 s (U_{Out} = 10 % ... 90 %)
Minimum no-load power dissipation	< 0.4 W (120 V AC)
Maximum no-load power dissipation	< 0.75 W (230 V AC)
Minimum nominal load power dissipation	< 9 W (120 V AC)
Power loss nominal load max.	< 7.5 W (230 V AC)

Zelio® Plug-In Relays

RPM power relays



Telemecanique

06-058-021

General characteristics

Conforming to standards			IEC/EN 61810-1 (iss. 2), UL 508, CSA C22-2 n° 14
Product certifications			cULus File E164862 CCN NLDX, NLDX7; cURus File E164862 CCN NLDX2, NLDX8; CSA; CE; RoHS compliant
Ambient air temperature around the device	Storage	°C (F)	- 40... + 85 (-40... +185)
	Operation	°C (F)	- 40... + 55 (-40... +131)
Vibration resistance conforming to IEC/EN 60068-2-6	In operation		3 gn (10...150 Hz/± 1 mm / 5g/5 cycles)
	Not operating		5 gn (10...150 Hz/± 1 mm / 5g/5 cycles)
Degree of protection	Conforming to IEC/EN 60529		IP 40
Shock resistance conforming to IEC/EN 60068-2-27	Opening		15 gn
	Closing		15 gn
Protection category			RT I
Mounting position			Any

Insulation characteristics

Rated insulation voltage (Ui)	Conforming to IEC/EN 60947	V	250 (IEC), 300 (UL, CSA)
Rated impulse withstand voltage (Uimp)		kV	4 (1.2/50 µs)
Dielectric strength (rms voltage)	Between coil and contact	∼ V	1550
	Between poles	∼ V	1550
	Between contacts	∼ V	1500

Contact characteristics

Relay type				RPM1●●●	RPM2●●●	RPM3●●●	RPM4●●●
Number and type of contacts				1 C/O	2 C/O	3 C/O	4 C/O
Contact materials				AgNi			
Conventional thermal current (Ith)	For ambient temperature ≤ 55 °C		A	15			
Rated operational current in utilization categories AC-1 and DC-1	Conforming to IEC	NO	A	15			
		NC	A	7.5			
	Conforming to UL		A	15			
Switching current	Minimum		mA	10			
Switching voltage	Maximum		V	∼/⎓ 250 (IEC)			
	Minimum		V	17			
Nominal load (resistive)			A	15 / 250 ∼ V			
			A	15 / 28 ⎓ V			
Switching capacity	Maximum	∼	VA	3750			
		⎓	W	420			
	Minimum		mW	170			
Maximum operating rate In operating cycles/hour	No-load			18 000			
	Under load			1200			
Utilization coefficient				20 %			
Mechanical durability	In millions of operating cycles			10			
Electrical durability In millions of operating cycles	Resistive load			0.1		0.06	
	Inductive load			See curves below			

Electrical durability of contacts
Resistive load ∼

Reduction coefficient for inductive load ∼ (depending on power factor cos φ)

Maximum switching capacity on resistive load ⎓

Telemecanique

06-058-021

Power relays without LED (sold in lots of 10)

Control circuit voltge	Number and type of contacts - Thermal current (Ith)							
	1 C/O - 15 A		2 C/O - 15 A		3 C/O - 15 A		4 C/O - 15 A	
	Catalog number	Weight	Catalog number	Weight	Catalog number	Weight	Catalog number	Weight
V		kg		kg		kg		kg
⎓ 12	RPM11JD	0.026	RPM21JD	0.036	RPM31JD	0.054	RPM41JD	0.071
⎓ 24	RPM11BD	0.026	RPM21BD	0.036	RPM31BD	0.054	RPM41BD	0.071
⎓ 48	RPM11ED	0.026	RPM21ED	0.036	RPM31ED	0.054	RPM41ED	0.071
⎓ 110	RPM11FD	0.026	RPM21FD	0.036	RPM31FD	0.054	RPM41FD	0.071
~ 24	RPM11B7	0.026	RPM21B7	0.036	RPM31B7	0.054	RPM41B7	0.071
~ 48	RPM11E7	0.026	RPM21E7	0.036	RPM31E7	0.054	RPM41E7	0.071
~ 120	RPM11F7	0.026	RPM21F7	0.036	RPM31F7	0.054	RPM41F7	0.071
~ 230	RPM11P7	0.026	RPM21P7	0.036	RPM31P7	0.054	RPM41P7	0.071

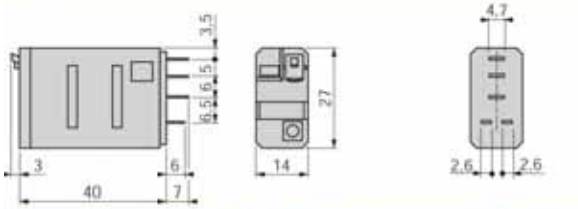
Power relays with LED (sold in lots of 10)

⎓ 12	RPM12JD	0.026	RPM22JD	0.036	RPM32JD	0.054	RPM42JD	0.071
⎓ 24	RPM12BD	0.026	RPM22BD	0.036	RPM32BD	0.054	RPM42BD	0.071
⎓ 48	RPM12ED	0.026	RPM22ED	0.036	RPM32ED	0.054	RPM42ED	0.071
⎓ 110	RPM12FD	0.026	RPM22FD	0.036	RPM32FD	0.054	RPM42FD	0.071
~ 24	RPM12B7	0.026	RPM22B7	0.036	RPM32B7	0.054	RPM42B7	0.071
~ 48	RPM12E7	0.026	RPM22E7	0.036	RPM32E7	0.054	RPM42E7	0.071
~ 120	RPM12F7	0.026	RPM22F7	0.036	RPM32F7	0.054	RPM42F7	0.071
~ 230	RPM12P7	0.026	RPM22P7	0.036	RPM32P7	0.054	RPM42P7	0.071

Dimensions (mm):

Power relays

RPM 1



Common side view

RPM2

RPM 3

RPM 4



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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: R1,2

Job Number: HBR10366

Page # 2/2

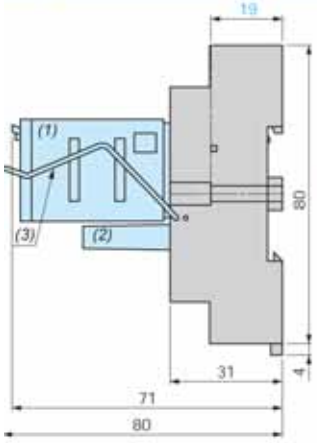
Manuf.: . PNo: Square D: RPM22F7

Sockets

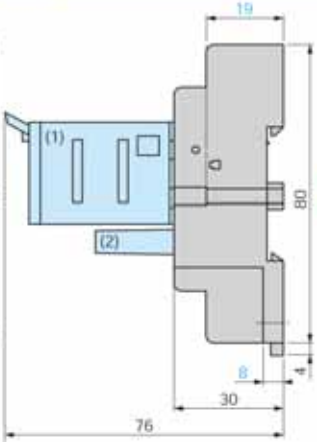
Telemecanique

38-058-008

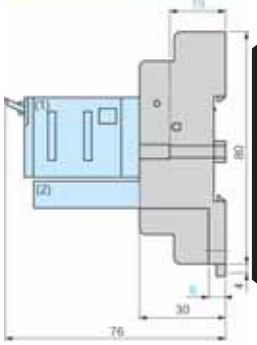
RPZF1



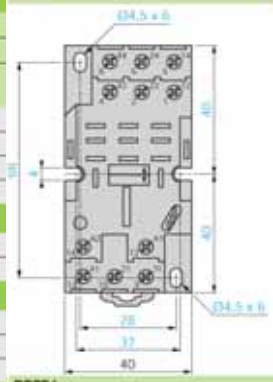
RPZF2



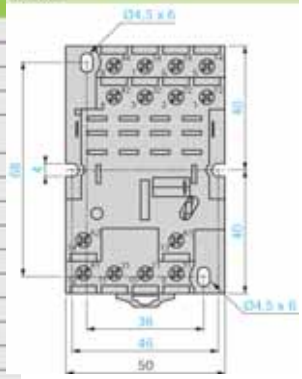
Common side view



RPZF3



RPZF4



Socket characteristics

Socket type			RPZF1	RPZF2	RPZF3	RPZF4
Relay types used			RPM1●●●	RPM2●●●	RPM3●●●	RPM4●●●
Protection module types used			RXM02●●● RXM04●●●	RXM02●●● RXM04●●●	RUW24●●●	RUW24●●●
Contact terminal arrangement			Mixed			
Wire connection method			Screw clamp terminals			
Product certifications			cURus File E172326 CCN SWIV2, SWIV8; CSA; CE; RoHS compliant			
Conforming to standards			IEC 61984, CE			

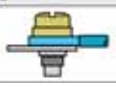
Electrical characteristics

Conventional thermal current (Ith)		A	16	
Maximum operating voltage		V	250 (IEC)	

Insulation characteristics

Between adjacent output contacts		Vrms	2500	
Between input and output contacts		Vrms	2500	
Between contacts and DIN rail		Vrms	2500	

General characteristics

Ambient air temperature around the device	Operation		°C	- 40…+ 55	
	Storage		°C	- 40…+ 85	
Degree of protection	Conforming to IEC/EN 60529			IP 20	
Connection	Solid wire without cable end	1 conductor		0.5…1.5 mm² - AWG 20…AWG 16	0.5…2.5 mm² - AWG 20…AWG 14
		2 conductors		0.5…1.5 mm² - AWG 20…AWG 16	0.5…2.5 mm² - AWG 20…AWG 14
	Flexible wire with cable end	1 conductor		0.25…1 mm² - AWG 22…AWG 17	0.25…1.5 mm² - AWG 22…AWG 16
		2 conductors		0.25…1 mm² - AWG 22…AWG 17	0.25…1.5 mm² - AWG 22…AWG 16
Maximum tightening torque / Screw size			Nm	1 / M3 screw	1 / M3.5 screw
Mounting				35 mm DIN rail / panel mount	
Mounting on DIN rail				By red plastic clip	
Terminal referencing				IEC, NEMA	
Compatibility with the metal hold-down clip				Yes	No
Timer module compatibility				No	Yes
Protection module				RXM040W, RXM041●●, RXM021●●	RUW24●●
Clip-in ID tags				No	
Wire connection method	Screw clamp terminals				

Sockets

Contact terminal arrangement	Connection	Relay type	Sold in lots of	Catalog number	Weight kg
Mixed	Screw clamp terminals	RPM1●●●	10	RPZF1	0.042
		RPM2●●●	10	RPZF2	0.054
		RPM3●●●	10	RPZF3	0.072
		RPM4●●●	10	RPZF4	0.094

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Manuf.: . PNo: Square D: RPZF2	Rev: 0	Device Tag: R1,2	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

Receptacles

Altech®

14-543-001

DMRBU BLACKBOX



Features:

- DIN Rail, Panel Mount or Wall Mount
- Rating: 15A/125V AC
- Finger Protection: IP54
- Available in 3 colors.

Includes Sealing Gasket

External Dimension (HxWxL mm)	58.5 x 84 x 53.5
Stripping Length	10 mm
Insulation Material	Thermoplastic
Type of Connection	3 screw clamps
Approvals *	c UL us E154664
Voltage Rating	125 V
Current Rating	15 A

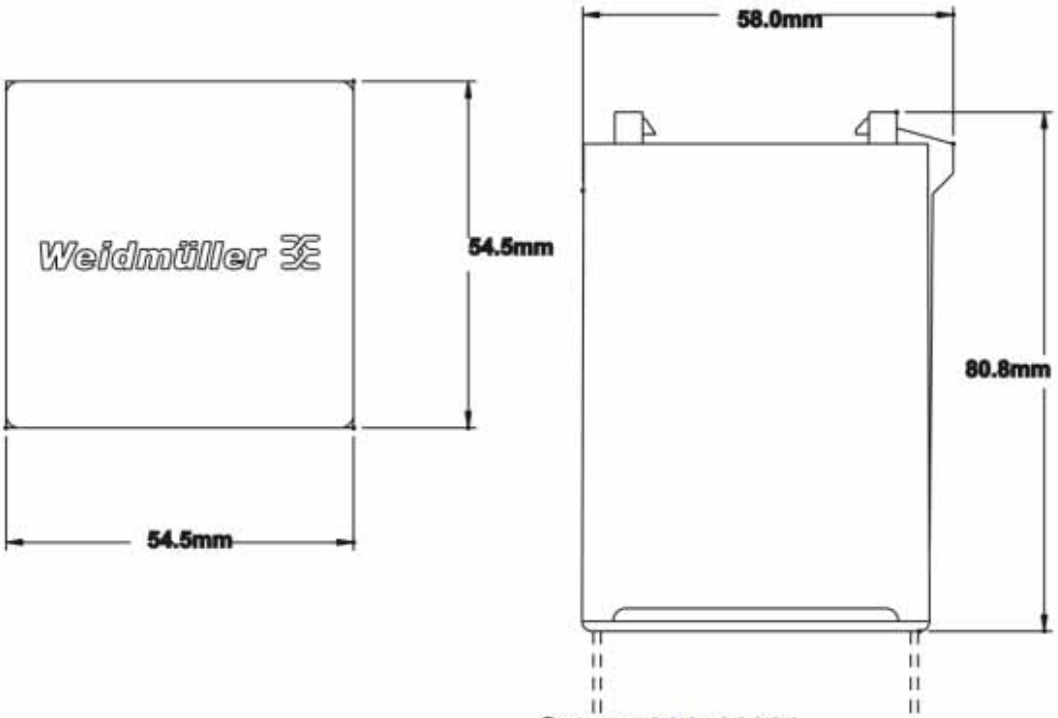
WEIDMULLER 7914760001

Accessory, Weidmuller DIN Rail Fuse Terminal Blocks, Component Drawer

13-000-A000



The spare fuse holder is a 35mm DIN rail mounted plastic drawer. It can hold dozens of spare fuses or anything else you might want to keep in the control cabinet-extra marking tags, jumpers, lamps, etc. It can mount on vertical and horizontal rails.



Cat, # 7914760001

ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Device Tag: SP1	
	Date: 02-16-2026		
Manuf.: . PNo: EleMech: 13-000-A000 Assembly	By: AJ	Job Number: HBR10366	Page # 1/1

30.5 mm Push Buttons
Selector Switches

Allen-Bradley

39-005-009



800 T ___ – J 2 ___ C

a b c d e f

a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Knob Insert Colors		
800T Type 4/13 Code	Description	800H Type 4/4X/13 Code
J	White	JR
JX	Packet of colored inserts•	JRX
Metal Wing Lever Colors◉		
Code	Color	Code
JA	Red	—
JG	Grey	—

d

Knob/Lever Type Operators	
Standard Knob	
Code	Operator Function
2	Maintained
4	Spring return from left
5	Spring return from right
91	Spring return from both
Knob Lever◉	
Code	Operator Function
17	Maintained
18	Spring return from left
19	Spring return from right
20	Spring return from both
Metal Wing Lever◉	
Code	Operator Function
11	Maintained
15	Spring return from left
16	Spring return from right
141	Spring return from both
Coin Slot◉	
Code	Operator Function
10	Spring return from both

e

Cam Option‡▲	
Code	Description
Blank	KB7 cam (std.)
KA1	KA1 cam
KA7	KA7 cam

e (cont'd)

Cam Option‡▲	
Code	Description
KC1	KC1 cam
KC7	KC7 cam
KD7	KD7 cam
KE7§	KE7 cam
KQ1	KQ1 cam
KQ7	KQ7 cam
KR1§	KR1 cam
KR7§	KR7 cam
KT1§	KT1 cam
KT7§	KT7 cam
KU7§	KU7 cam

f

Contact Blocks	
Code	Description
Blank	No contacts on operator
Standard	
A	1 N.O. - 1 N.C. 1-**800T-XA** on white side
B	2 N.O. - 2 N.C. 2-**800T-XA**s — 1 on white side/1 on black side
PenTUFF (Low Voltage)	
AV	1 N.O. - 1 N.C. 1-**800T-XAV** on white side
BV	2 N.O. - 2 N.C. 2-**800T-XAV**s — 1 on white side/1 on black side

f (cont'd)

Contact Blocks▲	
Code	Description
Blank	No contacts
Class 1, Div. 2/Zone 2	
Logic Reed	
AR	1 N.O. - 1 N.C. 1-**800T-XAR** on white side
BR	2 N.O. - 2 N.C. 2-**800T-XAR**s — 1 on white side/1 on black side
Sealed Switch	
AP	1 N.O. - 1 N.C. 1-**800T-XAP** on white side
BP	2 N.O. - 2 N.C. 2-**800T-XAP**s — 1 on white side/1 on black side
Stackable Sealed Switch	
AY	1 N.O. - 1 N.C. 1-**800T-XAY** on white side
BY	2 N.O. - 2 N.C. 2-**800T-XAY**s — 1 on white side/1 on black side

• One insert of each color (blue, green, orange, red, and yellow).
◉ Only available on Bul. 800T, Type 4/13 operators.
‡ If an overlapping cam is required, consult your local distributor.
§ Not available with wing levers.
▲ See Table 1 for cam selections and associated targets.

Specifications•

Electrical Ratings		
Contact ratings		Refer to the contact ratings tables on page 10-4.
Dielectric strength		2200V for one minute, 1300V for one minute (Logic Reed)
Electrical design life cycles		1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed)
Mechanical Ratings		
Vibration		10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./ 10 G max. (except Logic Reed)
Shock		1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G
Degree of protection		Type 1/4/12/13 (800T); Type 1/4/4X/12/13 (800H); EN/IEC 60529 IP66/65
Mechanical design life cycles		
Push buttons	(Momentary, non-illuminated)	10 000 000 min.
	(Momentary, illuminated)	250 000 min.
	(Push-pull/twist-to-release)	250 000 min.
Selector switches	(Non-illuminated)	1 000 000 min.
	(Illuminated, key-operated)	200 000 min.
Potentiometers		25 000 min.
All other devices		200 000 min.
Contact operation		Shallow, mini, and low-voltage contact blocks: Slow, double make and break Logic Reed and sealed switch contact blocks: Single break magnetic
Wire gauge/Terminal screw torque		#18…14 AWG (#18…10 Max Duty) / 6…8 lb•in
Typical operating forces		
Operators without contact blocks		Flush, extended button, standard mushroom, jumbo plastic mushroom: 2 lbs max. Jumbo and extended aluminum mushroom head: 3.95 lbs max. Maintained selector switch: 3.6 in•lb max.
Spring return selector switches		3.6 in•lb to stop, 0.2 in•lb to return
Illuminated push buttons and push-to-test pilot lights		5 lb max.
2-position push-pull		8.0 lb max. push or pull
3-position push-pull		8 lb max. push to in position or pull to center position (15 lb max. pull to out position)
Twist-to-release or push-pull		9 lbs max. push or pull 30 in•oz max. twist, 6 in•oz minimum return
Potentiometer		Rotational torque 3…12 in•oz; stopping torque 12 in•lb (minimum)
Contact blocks	Standard	1 lb
	Logic Reed	1 lb max.
	Sealed switch	3 lb max. at 0.205 in. plunger travel
	Stackable sealed switch	1 lb max.
	MaxDuty	1.4 lb max.
	PenTUFF	1.4 lb max.
	Self Monitoring	1.6 lb
Environment		
Temperature range	Operating	-40…+131 °F (-40…+55 °C)
	Storage	-40…+185 °F (-40…+85 °C)
Note: Operating temperatures below freezing are based on the absence of moisture and liquids. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for use in lower temperature applications.		
Humidity		50…95% RH from 77…140 °F (25…60 °C) per Procedure IV of MIL-STD-810C, Method 507.1 cycling test

Certifications

UL Listed
(File No. E14840, E10314
Guide No. NKCR, NOIV)

CSA Certified
(File No. LR1234, LR11924)

CSA C22.2, No. 14

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Rev: 0
Date: 02-16-2026
By: AJ

Device Tag: SS1,3,4

Manuf.: . PNo: Allen-Bradley: 800H-JR2A

Job Number: HBR10366

Page # 1/1

800T/H 30.5 mm

3-Position Selector Switch Devices, Non-Illuminated

800 T ___ – J 2 ___ C
a b c d e f



39-005-011

a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Knob Insert Colors		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
J	White	JR
JX	Packet of colored inserts★	JRX
Metal Wing Lever Colors‡		
Code	Color	Code
JA	Red	—
JG	Grey	—

d

Knob/Lever Type Operators	
Standard Knob	
Code	Operator Function
2	Maintained
4	Spring return from left
5	Spring return from right
91	Spring return from both
Knob Lever‡	
Code	Operator Function
17	Maintained
18	Spring return from left
19	Spring return from right
20	Spring return from both
Metal Wing Lever‡	
Code	Operator Function
11	Maintained
15	Spring return from left
16	Spring return from right
141	Spring return from both
Coin Slot‡	
Code	Operator Function
10	Spring return from both

e

Cam Option§Δ	
Code	Description
Blank	KB7 cam (std.)
KA1	KA1 cam
KA7	KA7 cam

Cam Option§Δ	
Code	Description
KC1	KC1 cam
KC7	KC7 cam
KD7	KD7 cam
KE7▲	KE7 cam
KQ1	KQ1 cam
KQ7	KQ7 cam
KR1▲	KR1 cam
KR7▲	KR7 cam
KT1▲	KT1 cam
KT7▲	KT7 cam
KU7▲	KU7 cam

f

Contact Blocks	
Code	Description
Blank	No contacts on operator
Standard	
A	1 N.O. - 1 N.C. 1-**800T-XA** on white side
B	2 N.O. - 2 N.C. 2-**800T-XA**s — 1 on white side/1 on black side
PenTUFF (Low Voltage)	
AV	1 N.O. - 1 N.C. 1-**800T-XAV** on white side
BV	2 N.O. - 2 N.C. 2-**800T-XAV**s — 1 on white side/1 on black side
Code	Description
Blank	No contacts
Class 1, Div. 2	
Logic Reed	
AR	1 N.O. - 1 N.C. 1-**800T-XAR** on white side
BR	2 N.O. - 2 N.C. 2-**800T-XAR**s — 1 on white side/1 on black side
Sealed Switch	
AP	1 N.O. - 1 N.C. 1-**800T-XAP** on white side
BP	2 N.O. - 2 N.C. 2-**800T-XAP**s — 1 on white side/1 on black side
Stackable Sealed Switch	
AY	1 N.O. - 1 N.C. 1-**800T-XAY** on white side
BY	2 N.O. - 2 N.C. 2-**800T-XAY**s — 1 on white side/1 on black side

- CE Marked
- CSA Certified — File Nos. LR1234, LR11924
- CSA C22.2 — No. 14
- EN/IEC 60947-5-1
- EN/IEC 60947-5-5
- EN ISO 13850
- UL Listed — File Nos. E14840, E10314; Guide Nos. NKCR, NOIV, NISD

Table 1. Cam and Contact Block Functionality Table

Contact Block Suffix Code	Contact Block Side	Circuits	Cam Codes: KB7 (Std.)	KA1	KA7	KC1	KC7	KD7	KE7	KQ1	KQ7	KR1	KR7	KT1	KT7	KU7
A, B, C, HL	White	A	X O O	X O O	O O X	O O X	X O O	O O X	O O X	O O X	X O O	O O X	X O O	O O X	X O O	O O X	O O X
		B	O O X	O X O	O X O	O X O	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O X O
	Black	A	X O O	X O O	O O X	O O X	X O O	O O X	O O X	O O X	O O X	O O X	X O O	O O X	O O X	O O X	O O X
		B	O O X	O X O	O X O	O X O	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O X O
	White	A	X O O	X O O	O O X	O O X	X O O	O O X	O O X	O O X	X O O	O O X	X O O	O O X	X O O	O O X	O O X
		B	O O X	O X O	O X O	O X O	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O X O
	Black	A	X O O	X O O	O O X	O O X	X O O	O O X	O O X	O O X	O O X	O O X	X O O	O O X	O O X	O O X	O O X
		B	O O X	O X O	O X O	O X O	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O O X	O X O

Note: X = Closed/O = Open

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Rev:	Device Tag:
0	SS2
Date: 02-16-2026	
Manuf.: . PNo: Allen-Bradley: 800H-JR5A	By: AJ
Job Number: HBR10366	Page # 1/1

STP Series Pluggable

Surge-Trap®

SURGE PROTECTIVE DEVICE

DIN-RAIL PLUGGABLE SPD FOR
ANSI/UL 1449 TYPE 1 AND 2 APPLICATIONS

MERSEN
Expertise, our source of energy

40-030-002



RATINGS:

- **Volts (U_n):** 120-690VAC
- **Nominal Discharge Current Rating (I_n):** 10-20kA
- **Surge Capacity:** 75kA
- **Short-Circuit Current Rating (SCCR):** 200kA

APPROVALS:

- ANSI/UL 1449 4th Edition, Type 1 Component Assembly SPD, File E210793
- ANSI/IEEE C62.41.1, C62.41.2, C62.45
- RoHS Compliant

GENERAL PRODUCT SPECIFICATIONS

Mounting:	35mm DIN-Rail	Operating & Storage Temperature:	– 40°C to + 85°C
Wire Range:	4-14AWG Solid / Stranded CU	Visual End of Life Indicator:	RED = End of Life
Terminal Torque:	35.4 lbs-in	Remote End of Life Indicator:	NO/NC Dry Contact
Degree of Protection:	IP 20	Frequency:	50-60 Hz
Flammability:	UL94 V0		

1-POLE, SINGLE-PHASE, 2-WIRE

Catalog Number	Nominal Voltage (VAC)	Maximum Continuous Operating Voltage (MCOV, VAc)				Voltage Protection Rating (VPR, VAC)				replacement plug	I_n (kA)
		L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-1	
STP120P07(M)	120	175	-	-	-	600	-	-	-	SP07U175	20
STP230P07(M)	240	275	-	-	-	600	-	-	-	SP07U275	20
STP277P07(M)	277	320	-	-	-	600	-	-	-	SP07U320	20
STP347P07(M)	347	420	-	-	-	800	-	-	-	SP07U420	10

2-POLE, SPLIT-PHASE, 3-WIRE

Catalog Number	Nominal Voltage (VAC)	Maximum Continuous Operating Voltage (MCOV, VAc)				Voltage Protection Rating (VPR, VAC)				replacement plug	I_n (kA)
		L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L1, L2	
STP240S07(M)	120/240	175	-	-	350	600	-	-	1800	SP07U175	20
STP480S07(M)	240/480	275	-	-	550	600	-	-	1200	SP07U275	20

3-POLE, 3-PHASE DELTA, 4-WIRE

Catalog Number	Nominal Voltage (VAC)	Maximum Continuous Operating Voltage (MCOV, VAc)				Voltage Protection Rating (VPR, VAC)				replacement plug	I_n (kA)
		L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L1, L2, L3	
STP240D07(M)	240	-	275	-	550	-	900	-	1800	SP07U275	20
STP480D07(M)	480	-	550	-	1100	-	1500	-	3000	SP07U550	10

3-POLE, 3-PHASE WYE, 4-WIRE

Catalog Number	Nominal Voltage (VAC)	Maximum Continuous Operating Voltage (MCOV, VAc)				Voltage Protection Rating (VPR, VAC)				replacement plug	I_n (kA)
		L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L1, L2, L3	
STP208Y07(M)	120/208	175	-	-	350	600	-	-	1200	SP07U175	20
STP480Y07(M)	277/480	320	-	-	640	1500	-	-	2500	SP07U320	20
STP600Y07(M)	347/600	420	-	-	840	1500	-	-	2500	SP07U420	10
STP690Y07(M)	400/690	550	-	-	1100	1500	-	-	2500	SP07U550	10

STP Series Pluggable

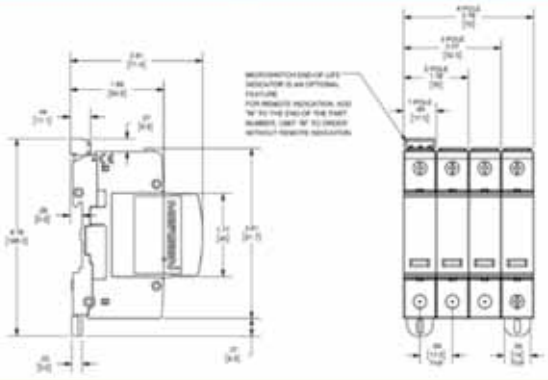
Surge-Trap®

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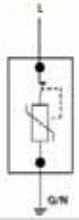
DIMENSIONS - STP SERIES

poles	a	
	IN	MM
1 Pole	0.69	17.5
2 Pole	1.38	35
3 Pole	2.07	52.5
4 Pole	2.76	70

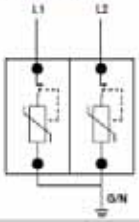


WIRING DIAGRAMS

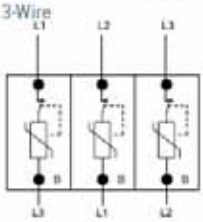
1-POLE, SINGLE-Phase, 2-Wire



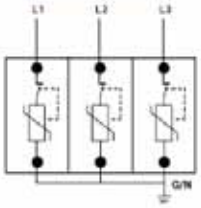
2-POLE, SPLIT-Phase, 3-Wire



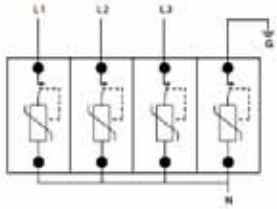
3-POLE, 3-Phase DELTA, 3-Wire



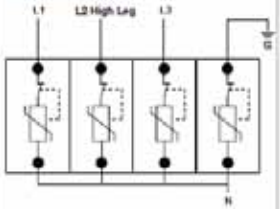
3-POLE, 3-Phase DELTA, 3-Phase WYE, 4-Wire



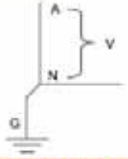
4-POLE, 3-Phase WYE, 5-Wire



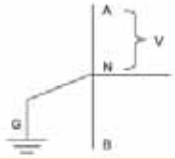
4-POLE, 3-Phase DELTA HIGH-LEG, 5-Wire



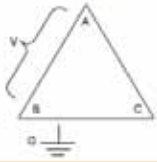
Single Phase 2 Wire + Ground



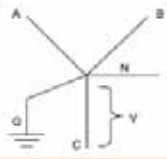
Split Phase 3 Wire + Ground



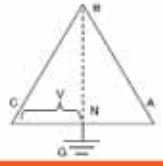
3 Phase Delta 3 Wire + Ground



3 Phase Wye 4 Wire + Ground

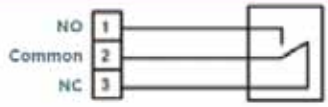


Hi-leg Grounded Delta

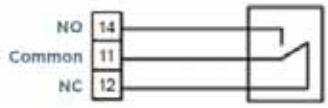


REMOTE STATUS INDICATOR

ST Series



STP Series





Signal Wire Range	#16 to #30 AWG
Terminal Torque	2.2 lb-in
Cont. between Comm + NO	Product Offline, Not Protected
Cont. between Comm + NC	Product Online, Protected
125 VAC - 3A max	

ST and STP Series: *for remote indication, add "M" to the end of the catalog number. For example, ST4803PYGM.*

Industrial Ethernet Switch - FL SWITCH 1005N - 1085039

PHOENIX CONTACT

33-098-028

- Auto negotiation and autocrossing detection simplifies installation and setup
- Local diagnostic indicators with LEDs
- RJ45 ports support a transmission speed of 10/100 Mbps
- QoS-prioritized (Quality of Service) messages
- PROFINET conformance Class A for real-time data exchange
- Energy-efficient Ethernet in accord. with IEEE 802.3az
- PROFINET PTCP filter for reliable communication on PROFINET networks
- Enhanced traffic prioritization for automation protocols



Ambient conditions

Degree of protection	IP30
Ambient temperature (operation)	-10 °C ... 60 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	5 % ... 95 % (non-condensing)
Air pressure (operation)	79 kPa ... 108 kPa up to 2000 m above mean sea level (Without derating)
Air pressure (storage/transport)	79 kPa ... 108 kPa up to 2000 m above mean sea level (Without derating)

Interfaces

Interface	Ethernet (RJ45)
No. of ports	5 (RJ45 ports)
Note on the connection method	Auto negotiation and autocrossing
Transmission physics	Ethernet in RJ45 twisted pair
Transmission speed	10/100 Mbps
Transmission length	100 m (per segment)
Signal LEDs	Data receive, link status

Function

Basic functions	Unmanaged switch
	Autonegotiation
	Store and Forward switching mode
Additional functions	100 BASE-TX/100BASE-FX (IEEE 802.3u)
	Quality of Service (QoS) prioritization (IEEE 802.1p)
	Energy-efficient Ethernet (IEEE 802.3az)
	10Base-T (IEEE 802.3)
MAC address table	2k
PROFINET conformance class	Conformance-Class A
Status and diagnostic indicators	LEDs: U_S, link and activity per port

Network expansion parameters

Cascading depth	Network, linear, and star structure: any
Maximum conductor length (twisted pair)	100 m

Supply voltage

Supply voltage	24 V DC
	24 V AC (50/60 Hz)
Residual ripple	3.6 V_{PP} (within the permitted voltage range)
Supply voltage range	9 V DC ... 32 V DC
	18 V AC ... 30 V AC (50/60 Hz)

33-098-028

Supply voltage

Typical current consumption	19 mA
Max. current consumption	110 mA

General

Mounting type	DIN rail
Net weight	161.3 g
Housing material	Polycarbonate fiber reinforced
MTTF	167.2 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%)
	1627 Years (SN 29500 standard, temperature 25°C, operating cycle 21%)
	1526 Years (Telcordia standard, 25°C temperature, 21% operating cycle (5 days a week, 8 hours a day))

Connection data

Connection method	Push-in spring connection
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section flexible min.	0.2 mm²
Conductor cross section flexible max.	2.5 mm²
Conductor cross section AWG min.	24
Conductor cross section AWG max.	12
Stripping length	10 mm

Standards and Regulations

Electromagnetic compatibility	Conformance with EMC Directive 2014/30/EU
Interference emission	EN 61000-6-2 EN 61000-4-8 (electromagnetic fields) Criterion A
Conducted noise emission	EN 61000-6-2 Class A
Immunity to surge	EN 61000-6-2 EN 61000-4-5 (surge) Criterion B
Immunity to burst	EN 61000-6-2 EN 61000-4-4 (EFT burst) Criterion A
Immunity to EF	EN 61000-6-2 EN 61000-4-3 (electromagnetic fields) Criterion A
Immunity to ESD	EN 61000-6-2 EN 61000-4-2 (ESD) Criterion B
Immunity to conducted interference	EN 61000-6-2 EN 61000-4-6 (line noise immunity) Criterion A
Type of test	Free fall in accordance with EN 61131-2
Noise emission	EN 61000-6-4:2007 + A1:2011
Noise immunity	EN 61000-6-2:2005
Vibration (storage/transport)	5g, 150 Hz, in acc. with IEC 60068-2-6
Free from substances that could impair the application of coating	In acc. with VW specification
Vibration (operation)	in acc. with IEC 60068-2-6: 5g, 150 Hz
Shock (operation)	30g (EN 60068-2-27)
UL, USA / Canada	UL 61010-1, UL 61010-2-201, UL 62368-1

Approvals

UL Listed	UL LISTED	http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 238705
cUL Listed	cUL LISTED	http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 238705

General-Purpose Encapsulated Transformers



Standards and Certifications

- UL listed
- CSA certified

Listed

Enclosures

- Encapsulated design
- Suitable for indoor or outdoor applications
- Mountable in any position indoors and upright-only outdoors

120 x 240 Volts to 120/240 Volts ①

kVA	Full Capacity Taps FCAN	FCBN	Type	°C Temp. Rise	Frame	Wiring Diagram Number	Weight Lbs (kg)	Weathershield	Style Number
0.5	—	—	EP	115	FR57P	3E	16 (7)	Indoor–Outdoor	**S10N11P51P**
1	—	—	EP	115	FR67P	3E	31 (14)	Indoor–Outdoor	**S10N11P01P**
1.5	—	—	EP	115	FR67P	3E	42 (19)	Indoor–Outdoor	**S10N11P16P**
2	—	—	EP	115	FR68P	3E	42 (19)	Indoor–Outdoor	**S10N11P02P**
3	—	—	EP	115	FR176	3E	55 (25)	Indoor–Outdoor	**S10N11S03N**
5	—	—	EP	115	FR177	3E	113 (51)	Indoor–Outdoor	**S10N11S05N**
7.5	—	—	EP	115	FR178	3E	123 (56)	Indoor–Outdoor	**S10N11S07N**
10	—	—	EP	115	FR179	3E	193 (88)	Indoor–Outdoor	**S10N11S10N**
15	—	—	EP	115	FR180	3E	216 (98)	Indoor–Outdoor	**S10N11S15N**
25	—	—	EP	115	FR182	3E	375 (170)	Indoor–Outdoor	**S10N11S25N**

240 x 480 Volts to 120/240 Volts Stainless Steel ②

kVA	Full Capacity Taps FCAN	FCBN	Type	°C Temp. Rise	Frame	Wiring Diagram Number	Weight Lbs (kg)	Weathershield	Style Number
3	—	—	EP	115	FR176	3A	65 (30)	Indoor–Outdoor	**S20N11S03SS**
5	—	—	EP	115	FR177	3A	113 (51)	Indoor–Outdoor	**S20N11S05SS**
7.5	—	—	EP	115	FR178	3A	123 (56)	Indoor–Outdoor	**S20N11S07SS**
10	—	—	EP	115	FR179	3A	193 (88)	Indoor–Outdoor	**S20N11S10SS**
15	—	—	EP	115	FR180	3A	205 (93)	Indoor–Outdoor	**S20N11S15SS**
25	—	—	EP	115	FR182	3A	375 (170)	Indoor–Outdoor	**S20N11S25SS**

208 Volts to 120/240 Volts ①

kVA	Full Capacity Taps FCAN	FCBN	Type	°C Temp. Rise	Frame	Wiring Diagram Number	Weight Lbs (kg)	Weathershield	Style Number
0.5	—	—	EP	115	FR57P	26A	16 (7)	Indoor–Outdoor	**S29N11P51P**
1	—	—	EP	115	FR67P	26A	31 (14)	Indoor–Outdoor	**S29N11P01P**
1.5	—	—	EP	115	FR67P	26A	42 (19)	Indoor–Outdoor	**S29N11P16P**
2	—	—	EP	115	FR68P	26A	42 (19)	Indoor–Outdoor	**S29N11P02P**
3	—	—	EP	115	FR176	26A	65 (30)	Indoor–Outdoor	**S29N11S03N**
5	—	—	EP	115	FR177	26A	113 (51)	Indoor–Outdoor	**S29N11S05N**
7.5	—	—	EP	115	FR178	26A	123 (56)	Indoor–Outdoor	**S29N11S07N**
10	—	—	EP	115	FR179	26A	193 (88)	Indoor–Outdoor	**S29N11S10N**
15	—	—	EP	115	FR180	26A	216 (98)	Indoor–Outdoor	**S29N11S15N**
25	—	—	EP	115	FR182	26A	395 (179)	Indoor–Outdoor	**S29N11S25N**

Notes

For 304 grade stainless steel enclosure, replace 10th character of catalog number with an "SS" suffix, e.g., P48G11S03SS, or add "SS" suffix before the addition of "CUB."
For 316 grade stainless steel enclosure, replace 10th character of catalog number with an "S6" suffix, e.g., P48G11S03S6, or add "S6" suffix before the addition of "CUB."
For other ratings or catalog numbers not shown, or for special enclosure types (including stainless steel), refer to Eaton. Frame drawings/dimensions information begins on **Page V2-T2-215**.

240 x 480 Volts to 120/240 Volts

kVA	Full Capacity Taps FCAN	FCBN	Type	°C Temp. Rise	Frame	Wiring Diagram Number	Weight Lbs (kg)	Weathershield	Style Number
0.050	—	—	EP	115	FR52	3A	7 (3)	Indoor–Outdoor	S20N11S81N
0.075	—	—	EP	115	FR54	3A	7 (3)	Indoor–Outdoor	S20N11S85N
0.100	—	—	EP	115	FR54	3A	7 (3)	Indoor–Outdoor	S20N11S82N
0.150	—	—	EP	115	FR55	3A	8 (4)	Indoor–Outdoor	S20N11S83N
0.25	—	—	EP	115	FR57P	3A	12 (5)	Indoor–Outdoor	S20N11P26P
0.5	—	—	EP	115	FR57P	3A	16 (7)	Indoor–Outdoor	S20N11P51P
0.75	—	—	EP	115	FR58AP	3A	26 (12)	Indoor–Outdoor	S20N11P76P
1	—	—	EP	115	FR67P	3A	31 (14)	Indoor–Outdoor	S20N11P01P
1.5	—	—	EP	115	FR67P	3A	42 (19)	Indoor–Outdoor	S20N11P16P
2	—	—	EP	115	FR68P	3A	42 (19)	Indoor–Outdoor	S20N11P02P
3	—	—	EP	115	FR176	3A	65 (30)	Indoor–Outdoor	S20N11S03N
3	②	②	EP	115	FR176	3A	65 (30)	Indoor–Outdoor	S20K11S03N
5	—	—	EP	115	FR177	3A	113 (51)	Indoor–Outdoor	S20N11S05N
5	②	②	EP	115	FR177	9A	105 (48)	Indoor–Outdoor	S20K11S05N
7.5	—	—	EP	115	FR178	3A	105 (48)	Indoor–Outdoor	S20N11S07N
7.5	②	②	EP	115	FR178	9A	123 (56)	Indoor–Outdoor	S20K11S07N
10	—	—	EP	115	FR179	3A	193 (88)	Indoor–Outdoor	S20N11S10N
10	②	②	EP	115	FR179	9A	193 (88)	Indoor–Outdoor	S20K11S10N
15	—	—	EP	115	FR180	3A	216 (98)	Indoor–Outdoor	S20N11S15N
15	③	③	EP	115	FR180	23A	216 (98)	Indoor–Outdoor	S20L11S15N
25	—	—	EP	115	FR182	3A	385 (175)	Indoor–Outdoor	S20N11S25N
25	③	③	EP	115	FR182	23A	375 (170)	Indoor–Outdoor	S20L11S25N
37.5	③	③	EP	115	FR300A	248A	735 (334)	Indoor–Outdoor	S20L11S37 ④

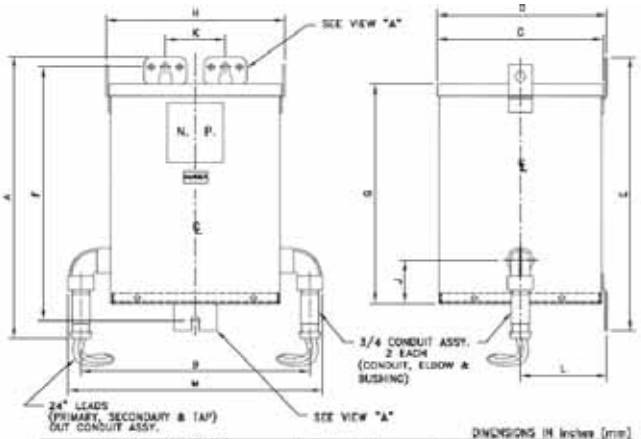
600 Volts to 120/240 Volts

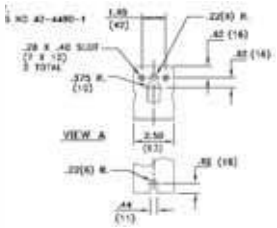
kVA	Full Capacity Taps FCAN	FCBN	Type	°C Temp. Rise	Frame	Wiring Diagram Number	Weight Lbs (kg)	Weathershield	Style Number
0.5	—	2 at –5%	EP	115	FR57P	2I	16 (7)	Indoor–Outdoor	S60G11P51P
0.75	—	2 at –5%	EP	115	FR58AP	2I	26 (12)	Indoor–Outdoor	S60G11P76P
1	—	2 at –5%	EP	115	FR67P	2I	31 (14)	Indoor–Outdoor	S60G11P01P
1.5	—	2 at –5%	EP	115	FR67P	2I	42 (19)	Indoor–Outdoor	S60G11P16P
2	—	2 at –5%	EP	115	FR68P	2I	42 (19)	Indoor–Outdoor	S60G11P02P
3	—	2 at –5%	EP	115	FR176	2I	65 (30)	Indoor–Outdoor	S60G11S03N
5	—	2 at –5%	EP	115	FR177	2I	105 (48)	Indoor–Outdoor	S60G11S05N
7.5	—	2 at –5%	EP	115	FR178	2I	123 (56)	Indoor–Outdoor	S60G11S07N
10	—	2 at –5%	EP	115	FR179	2I	193 (88)	Indoor–Outdoor	S60G11S10N
15	—	4 at –2.5%	EP	115	FR180	527A	216 (98)	Indoor–Outdoor	S60J11S15N
25	—	4 at –2.5%	EP	115	FR182	527A	385 (175)	Indoor–Outdoor	S60J11S25N
25	2 at 2.5%	4 at –2.5%	EP	115	FR132	83B	395 (180)	Indoor–Outdoor	S60M11S25N

Notes

① Contact Eaton for availability of 0.05–0.25 kVA designs.
② 1 at +10% FCBN at 240 volts; 2 at +5% FCBN at 480 volts.
③ 2 at +5% FCBN at 240 volts; 4 at +2.5% FCBN at 480 volts.
④ Floor-mount only.

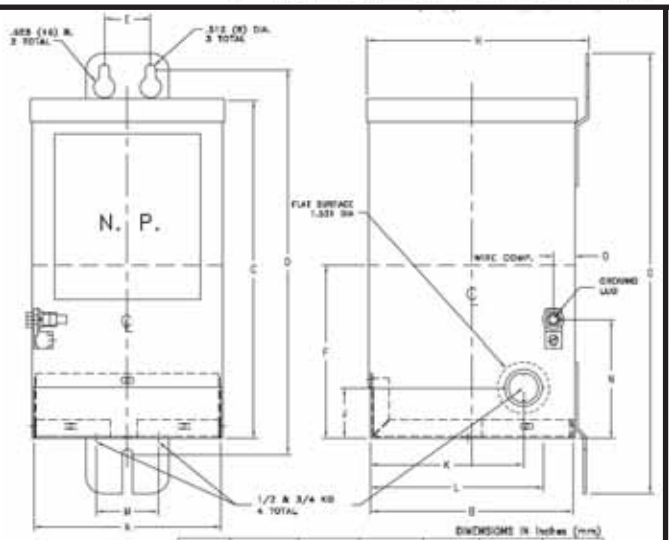
Contact your local Eaton sales office for CE Mark transformer requirements. For other ratings or styles not shown, or for special enclosure types (including stainless steel), refer to Eaton. Frame drawings/dimensions information begins on **Page V2-T2-213**.





DIMENSIONS IN Inches [mm]

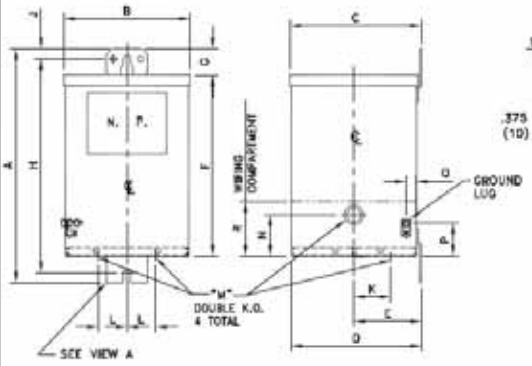
FRAME	APPROX. NET WT. LBS(KG) ALUMINUM	APPROX. NET WT. LBS(KG) COPPER	A	B	C	D	E	F
FR177H	113(51)	120(56)	16.53(420)	13.79(350)	9.67(246)	9.88(251)	16.15(410)	14.90(378)
			G	H	J	K	L	M
			12.82(326)	10.06(256)	2.50(64)	3.50(89)	5.06(129)	15.54(395)



DIMENSIONS IN Inches (mm)

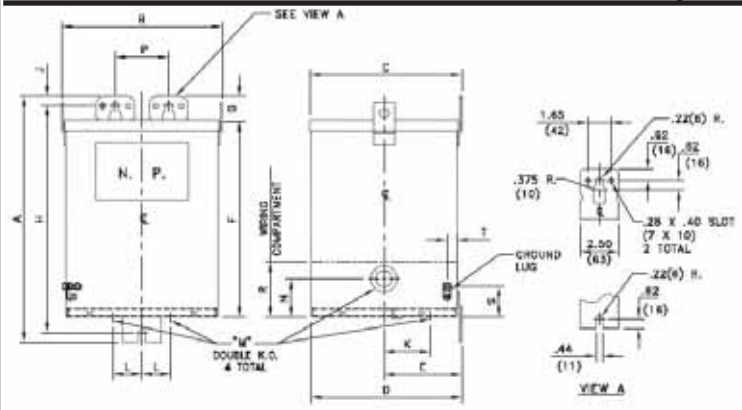
FRAME	A	B	C	D	E	F
FR67P	5.53(141)	5.99(152)	10.00(254)	11.40(251)	1.37(35)	5.12(130)
	G	H	J	K	L	M
	13.03(331)	6.56(167)	1.30(36)	4.32(110)	5.11(130)	1.85(47)
	N	O				
	3.50(89)	0.64(16)				

Rev1 - MAR/10



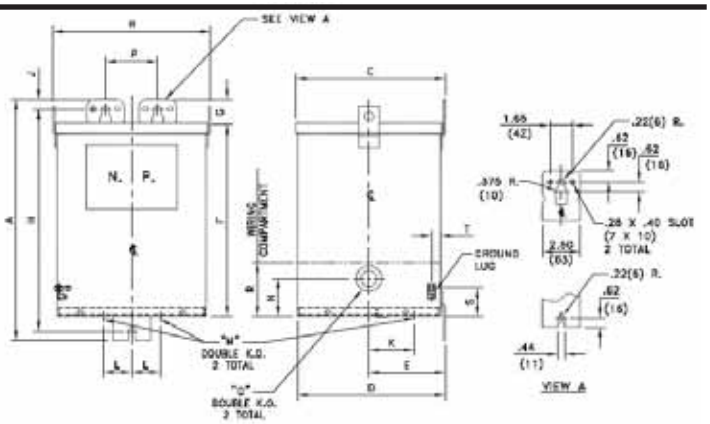
DIMENSIONS IN In(mm)

FRAME	APPROX. NET WT LBS(KG) ALUMINUM	APPROX. NET WT LBS(KG) COPPER	A	B	C	D	E	F	G	H	J
FR176	65(30)	69(31)	14.25(362)	7.69(195)	8.00(203)	7.94(202)	4.06(103)	11.06(281)	1.63(41)	13.00(330)	.63(16)
			K	L	M	N	R	P	Q		
			2.25(57)	1.75(44)	.5, .75(13,19)	2.50(64)	5.32(84)	2.00(51)	.65(17)		



DIMENSIONS IN In(mm)

FRAME	APPROX. NET WT LBS(KG) ALUMINUM	APPROX. NET WT LBS(KG) COPPER	A	B	C	D	E	F	G	H
FR178	123(55)	132(60)	16.00(406)	10.38(264)	9.89(251)	9.88(249)	5.06(129)	12.82(326)	1.63(41)	14.70(370)
			J	K	L	M	N	P	R	
			.63(16)	3.00(76)	1.88(48)	.75, 1.25(19, 32)	2.50(64)	5.48(88)	3.61(92)	
								S	T	
								2.00(51)	.65(17)	



DIMENSIONS IN In(mm)

FRAME	APPROX. NET WT LBS(KG) ALUMINUM	APPROX. NET WT LBS(KG) COPPER	A	B	C	D	E	F	G	H	J
FR178	193(87)	222(101)	16.00(406)	13.38(340)	10.50(267)	10.46(266)	5.43(138)	15.82(402)	1.63(41)	17.75(451)	.63(16)
			K	L	M	N	P	Q	R		
			3.38(86)	1.88(48)	.75, 1.25 (19, 32)	2.50(64)	3.48(88)	1.00, 1.50 (25, 38)		3.75(95)	
									S	T	
									2.00(51)	.65(17)	

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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: T1

Job Number: HBR10366

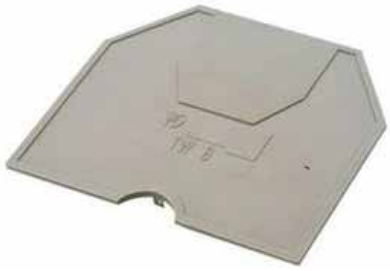
Page # 3/3

Manuf.: . PNo:
Cutler-Hammer: S20N11P16PS6 Assembly

wieland

42-063-001

Datasheet



Art.No. 07.311.0155.0

End plate AP 2,5 -4 /V0

End plate for DIN rail terminal blocks type WK ..., color gray

Art.No.	07.311.0155.0
EAN	4015573392663
Order unit	10 pieces

Approvals

Technical data

General

Colour	Grey
Type of end plate	Yes
Type of partition	No
Thickness	1.5 mm
Snap in	Yes
Inflammability class of insulation material acc. with UL94	V0

Accessories

Type of end plate	Yes
Type of partition	No
Colour	Grey
Thickness	1.5 mm
Snap in	Yes
Inflammability class of insulation material acc. with UL94	V0

Feed-through blocks with screw connection

selos

wieland

42-063-003

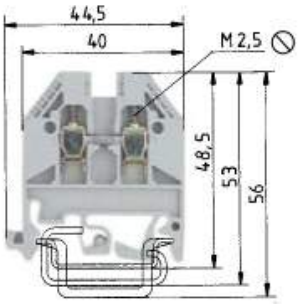


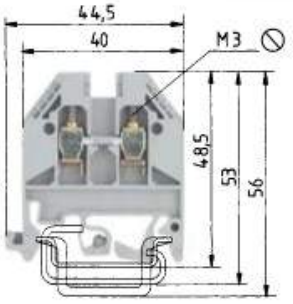
UL wire connection versions

[4] or 2x no. 14 sol/str AWG
or 2x no. 16 sol/str AWG
or 2x no. 18 sol/str AWG
or 3x no. 20 sol/str AWG or 3x no. 22 sol/str AWG

[5] or 2x no. 12 sol/str AWG
or 2x no. 16 sol/str AWG
or 3x no. 18 sol/str AWG or 3x no. 22 sol/str AWG

[6] or 2x no. 12 sol/str AWG
or 2x no. 14 sol/str AWG
or 3x no. 16 sol/str AWG





0344 Ex II 2GD IM2
Ex e I/II
EN 60947-7-1:2002
UL ratings — Field/factory wiring
CSA ratings
KEMA 02 ATEX 2114 U[1] EN 60079-0/EN 60079-7
Width — Wire strip length
Approvals

WK 2,5/U				WK 4/U			
fine-stranded	solid	V	A	fine-stranded	solid	V	A
0.5-2.5 mm²	0.5-4 mm²	800V/8 kV/3	24	0.5-4 mm²	0.5-6 mm²	800V/8kV/3	32
No. 22-12 AWG		600V	20/30	No. 22-10 AWG[4]		600V	30/35
No. 24-12 AWG		600V	25	No. 20-10 AWG		600V	40
0.5-2.5 mm²	0.5-4 mm²	690V	23	0.5-4 mm²	0.5-6 mm²	690V	14/27[3]
5 mm			9 mm	6 mm			9 mm

		Type	Part No.	Std. Pack	Type	Part No.	Std. Pack
Feed-through block	gray	WK 2,5/U	57.503.0055.0	100	WK 4/U	57.504.0055.0	100
Feed-through block Exi	blue	WK 2,5/U BLAU	57.503.0055.6	100	WK 4/U BLAU	57.504.0055.6	100
Accessories							
1. Mounting rail TS 35, DIN rail 7.5 mm high	L = 2 m	35 x 27 x 7,5 EN 60715	98.300.0000.0	1	35 x 27 x 7,5 EN 60715	98.300.0000.0	1
Mounting rail TS 35, DIN rail, 15 mm high	L = 2 m	35 x 24 x 15 EN 60715	98.360.0000.0	1	35 x 24 x 15 EN 60715	98.360.0000.0	1
Mounting rail TS 32, G rail[2]	L = 2 m	9006 EN 60715 G-32	98.190.0000.0	1	9006 EN 60715 G-32	98.190.0000.0	1
2. End clamp with U-foot[2]	10mm wide	WE 1/U	Z5.523.5753.0	100	WE 1/U	Z5.523.5753.0	100
End clamp TS 35, with screw	8mm wide	9708/2 S35	Z5.522.8553.0	100	9708/2 S35	Z5.522.8553.0	100
End clamp TS 35, without screw	8mm wide	WEF 1/35	Z5.523.9353.0	100	WEF 1/35	Z5.523.9353.0	100
3. End plate	gray	AP 2,5 - 4	07.311.0155.0	10	AP 2,5 - 4	07.311.0155.0	10
	blue	AP 2,5 - 4 BLAU	07.311.0155.6	10	AP 2,5 - 4 BLAU	07.311.0155.6	10
4. Partition	gray	TW 2,5 - 4	07.311.1155.0	10	TW 2,5 - 4	07.311.1155.0	10
	blue	TW 2,5 - 4 BLAU	07.311.1155.6	10	TW 2,5 - 4 BLAU	07.311.1155.6	10
5. Cross connector with screws	2 pole	IVB WK 2,5 - 2	Z7.280.2227.0	10	IVB WK 4 - 2	Z7.281.1227.0	10
insulated	3 pole	IVB WK 2,5 - 3	Z7.280.2327.0	10	IVB WK 4 - 3	Z7.281.1327.0	10
	up to 12 pole	IVB WK 2,5 - 12	Z7.280.3227.0	10	IVB WK 4 - 12	Z7.281.2227.0	10
6. Partition plate with marking facility		TS 2,5 GELB	07.311.2053.8	10	TS 4 GELB	07.311.2153.8	10
7. Single cover with marking facility		AD VB 2,5 GELB	04.326.2053.8	10	AD VB 4 GELB	04.326.2153.8	10
8. Cover with warning symbol over 4 blocks		AD VB 5/4 GELB	04.343.4756.8	10	AD VB 6/4 GELB	04.343.4856.8	10

For more accessories see pages 60-77
For marking systems see pages 70-75

*) For maintaining the proper isolation distances, the open side of a feed-through terminal block as well as both sides of a jumper are to be enclosed by partitions.
1) Please note the mounting instructions on the cover page. 2) Do not use in Ex environments. 3) With/without jumper

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Manuf.: . PNo: Wieland: 57.504.0055.0

Rev: 0
Date: 02-16-2026
By: AJ

Device Tag: TB
Job Number: HBR10366
Page # 1/1

wieland

42-063-015

Item No. Z7.281.1227.0

Insulated jumper bar IVBWK 4 - 2

Cross connector, insulated for DIN rail terminal blocks type WK ..., 2 -pole





Item No.	Z7.281.1227.0
EAN	4015573156081
order unit	10 Piece(s)

Technical data

Accessories

ArticlePrice	
Colour	Yellow
Type	Cross connector
Modular spacing	5.95 mm
Number of bridged clamps	2
Mounting method	Screwable
Insulated	Yes

Type	Part no.	Std. pack
for terminal blocks type		
WK 2,5/U	**5 mm spacing Screw: M 2.5**	
WK 2,5 - 4 KOI/U		
WK 2,5 U/8113 S/H		
WKN 2,5 E/U		
2pole VB WK 2,5-2	Z7.280.0227.0	10
3pole VB WK 2,5-3	Z7.280.0327.0	10
4pole VB WK 2,5-4	Z7.280.0427.0	10
5pole VB WK 2,5-5	Z7.280.0527.0	10
6pole VB WK 2,5-6	Z7.280.0627.0	10
80pole VB WK 2,5 M-80	Z7.280.0027.0	10
WKM 2,5/15	**5 mm spacing Screw: M 2.5**	
WKM 2,5 F1/15		
WKM 2,5 F2/15		
WKM 2,5/2 S 2,8 1 K/15		
WKM 2,5 TP1 O/15		
WKM 2,5 TP2 O/15		
2pole VB WKM 2,5/15-2	Z7.215.4227.0	50
3pole VB WKM 2,5/15-3	Z7.215.4327.0	50
4pole VB WKM 2,5/15-4	Z7.215.4427.0	50
5pole VB WKM 2,5/15-5	Z7.215.4527.0	50
6pole VB WKM 2,5/15-6	Z7.215.4627.0	50
60pole VB WKM 2,5/15 M-60	Z7.215.4027.0	10
WK/3 S/IW/U	**6 mm spacing Screw: M 3**	
WK/3 - 6 S/IW/U		
WK/4 S/IW/U		
WK/4-8 S/IW/U		
2pole VB WK/...S/IW/U-2	Z7.281.3227.0	10
3pole VB WK/...S/IW/U-3	Z7.281.3327.0	10
4pole VB WK/...S/IW/U-4	Z7.281.3427.0	10
5pole VB WK/...S/IW/U-5	Z7.281.3527.0	10
6pole VB WK/...S/IW/U-6	Z7.281.3627.0	10
20pole VB WK/...S/IW/U-20	Z7.281.3027.0	10

Type	Part no.	Std. pack
WK 4/U	**6 mm spacing Screw: M 3**	
WK 4TKS D/U		
WK 4 3 S 1 K/U		
WK 4 3-6 S 1 K/U		
WK 4 5 S 2,8 1 K/U		
WK 4 3 S 1 K/IW/U		
WK 4 3-6 S 1 K/IW/U		
WK 4/U F1		
WK 4/U F2		
2pole VB WK 4-2	Z7.281.0227.0	10
3pole VB WK 4-3	Z7.281.0327.0	10
4pole VB WK 4-4	Z7.281.0427.0	10
5pole VB WK 4-5	Z7.281.0527.0	10
6pole VB WK 4-6	Z7.281.0627.0	10
70pole VB WK 4 M-70	Z7.281.0027.0	10
WK 4/D 1/2 U	**6 mm spacing Screw: M 3**	
WK 4/D 2/2 U		
2pole VB WK 4 D...-2	Z7.281.6227.0	10
3pole VB WK 4 D...-3	Z7.281.6327.0	10
4pole VB WK 4 D...-4	Z7.281.6427.0	10
5pole VB WK 4 D...-5	Z7.281.6527.0	10
6pole VB WK 4 D...-6	Z7.281.6627.0	10
70pole VB WK 4 D.. M-70	Z7.281.6027.0	10
WKM 4/15	**6 mm spacing Screw: M 3**	
WK 4/D EU		
WK 4 E/U for upper tier block		
WK 4 E/U GU ORANGE		
WK 4 E/U GO		
WK 4 E/U G2		
WK 4 E/U G1 ORANGE		
WK 4 E/U G-URL		
WK 4 E/U G-ULR		
WK 4 E/U VB SCHWARZ		
2pole 9215 - 2	Z7.210.3227.0	50
3pole 9215 - 3	Z7.210.3327.0	50
4pole 9215 - 4	Z7.210.3427.0	50
5pole 9215 - 5	Z7.210.3527.0	50
6pole 9215 - 6	Z7.210.3627.0	50
70pole 9215 M-70	Z7.210.3027.0	10

Type	Part no.	Std. pack
WK 4/3-6 SKO	**6 mm spacing Screw: M 3**	
2pole 2072/2	Z7.220.0227.0	50
3pole 2072/3	Z7.220.0327.0	50
4pole 2072/4	Z7.220.0427.0	50
5pole 2072/5	Z7.220.0527.0	50
6pole 2072/6	Z7.220.0627.0	50
70pole 2072/M	Z7.210.1027.0	10
WK/5 S/U	**6 mm spacing Screw: M 3**	
WK/5-10 S/U		
WK/3-6 S/U		
WK/4 S/U		
WK/4-8 S/U		
2pole 9703/6-2	Z7.211.0227.0	50
3pole 9703/6-3	Z7.211.0327.0	50
4pole 9703/6-4	Z7.211.0427.0	50
5pole 9703/6-5	Z7.211.0527.0	50
6pole 9703/6-6	Z7.211.0627.0	50
70pole 9703/6 M-70	Z7.211.0027.0	10

fasis

wieland

42-063-000







2,5 mm²/5 mm Width

4 mm²/6 mm Width

10 mm²/10 mm Width

16 mm²/12 mm Width

35 mm²/16 mm Width

Type	Part no.	Std. pack
Marking strips, unmarked		
9705 A/5/10	04.242.5053.0	25
Marking strips, marked		
9705 A/5/9 B 1 - 9	04.842.4953.0	25
9705 A/5/10 B*	04.842.5053.0	25
9705 A/5/10 B 1 - 10	04.845.0153.0	25
11 - 20	04.845.0253.0	25
21 - 30	04.845.0353.0	25
31 - 40	04.845.0453.0	25
41 - 50	04.845.0553.0	25
51 - 60	04.845.0653.0	25
61 - 70	04.845.0753.0	25
71 - 80	04.845.0853.0	25
81 - 90	04.845.0953.0	25
91 - 100	04.845.1053.0	25
⊕ (10 x)	04.855.0053.0	25
⏚ (10 x)	04.855.0153.0	25
+ (10 x)	04.855.0253.0	25
– (10 x)	04.855.0353.0	25
L1 (10 x)	04.855.0453.0	25
L2 (10 x)	04.855.0553.0	25
L3 (10 x)	04.855.0653.0	25
PE (10 x)	04.855.0753.0	25
SL (10 x)	04.855.3153.0	25
N (10 x)	04.855.3253.0	25
F1 (10 x)	04.855.0953.0	25
F2 (10 x)	04.855.1053.0	25
L1, L2, L3, N, PE (2 x)	04.855.0853.0	25
with enlarged marking area		
9705 AL/5/10	04.242.5153.0	25
*Custom marking upon request		

Type	Part no.	Std. pack
Marking strips, unmarked		
9705 A/6/10	04.242.6053.0	25
Marking strips, marked		
9705 A/6/9 B 1 - 9	04.842.5953.0	25
9705 A/6/10 B*	04.842.6053.0	25
9705 A/6/10 B 1 - 10	04.846.0153.0	25
11 - 20	04.846.0253.0	25
21 - 30	04.846.0353.0	25
31 - 40	04.846.0453.0	25
41 - 50	04.846.0553.0	25
51 - 60	04.846.0653.0	25
61 - 70	04.846.0753.0	25
71 - 80	04.846.0853.0	25
81 - 90	04.846.0953.0	25
91 - 100	04.846.1053.0	25
⊕ (10 x)	04.856.0053.0	25
⏚ (10 x)	04.856.0153.0	25
+ (10 x)	04.856.0253.0	25
– (10 x)	04.856.0353.0	25
L1 (10 x)	04.856.0453.0	25
L2 (10 x)	04.856.0553.0	25
L3 (10 x)	04.856.0653.0	25
PE (10 x)	04.856.0753.0	25
SL (10 x)	04.856.3153.0	25
N (10 x)	04.856.3253.0	25
F1 (10 x)	04.856.0953.0	25
F2 (10 x)	04.856.1053.0	25
L1, L2, L3, N, PE (2 x)	04.856.0853.0	25
with enlarged marking area		
9705 AL/6/10	04.242.6353.0	25
*Custom marking upon request		

Type	Part no.	Std. pack
10 mm²/10 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/5/10/5 B	04.842.5553.0	25
16 mm²/12 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/6/10/5 B	04.842.6553.0	25
35 mm²/16 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/8/10/5 B	04.842.8553.0	25
* indicate required marking with part no.		

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Manuf.: . PNo:
Wieland: 04.242.6353-CUSTOM

Rev: 0

Date: 02-16-2026

By: AJ

Device Tag:
TB,DB

Job Number:
HBR10366

Page # 1/1

Item No. 57.504.9055.0

wieland

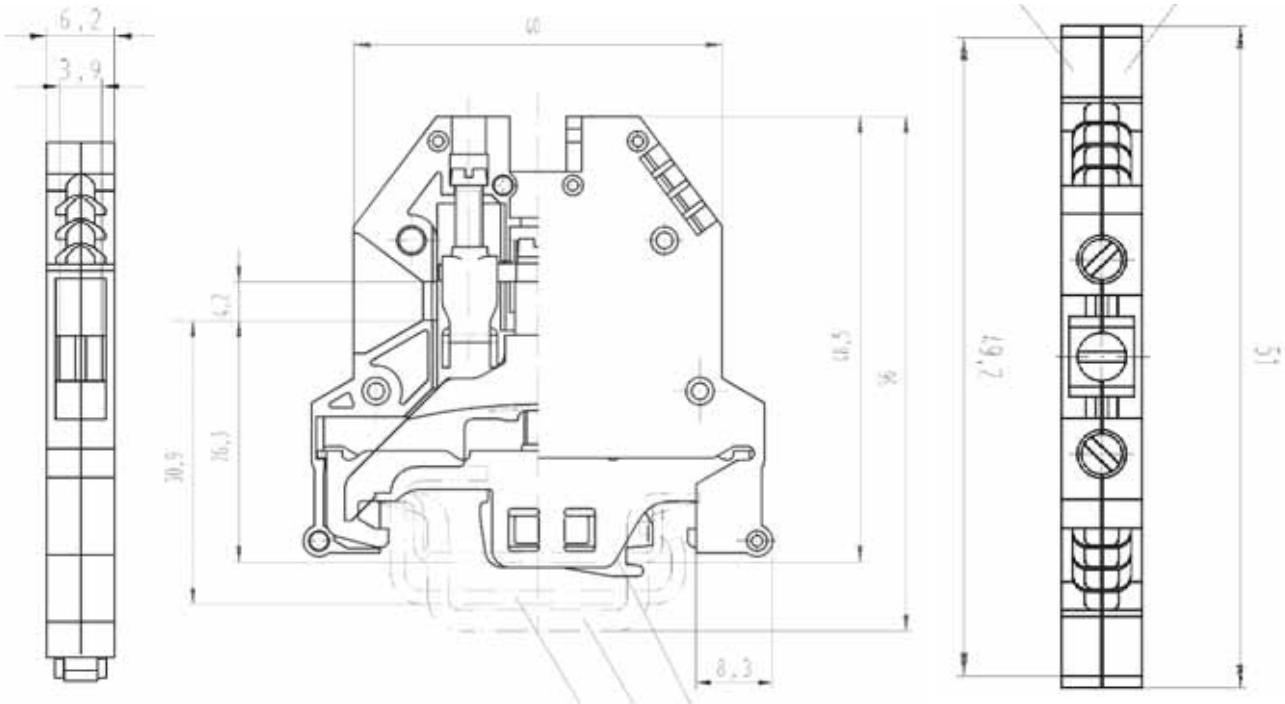
Earth terminal WK 4 SL/ U /V0

Ground DIN rail terminal block with screw connection for mounting on TS 35 and TS 32, nominal cross section 4 mm², width 6 mm, color green/yellow



42-063-004

Rated impulse voltage	8 kV
Pollution degree	3
Closing plate required	No
Length	51 mm
Type of insulation material	Thermoplastic
Cross section UL	22-10 AWG
Cross section CSA	20-10 AWG
Maximum cross section fine stranded	4 mm²
Wire strip length	9 mm
Torque conductor mounting	0.5 Nm
Torque rail mounting	0,5



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Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: TB,DB

Job Number: HBR10366

Page # 1/1

Manuf.: . PNo: Wieland: 57.504.9055.0

Item No. Z5.522.8553.0
End bracket 9708 / 2 S 35
End clamp for mounting rail TS 35

wieland

42-063-009

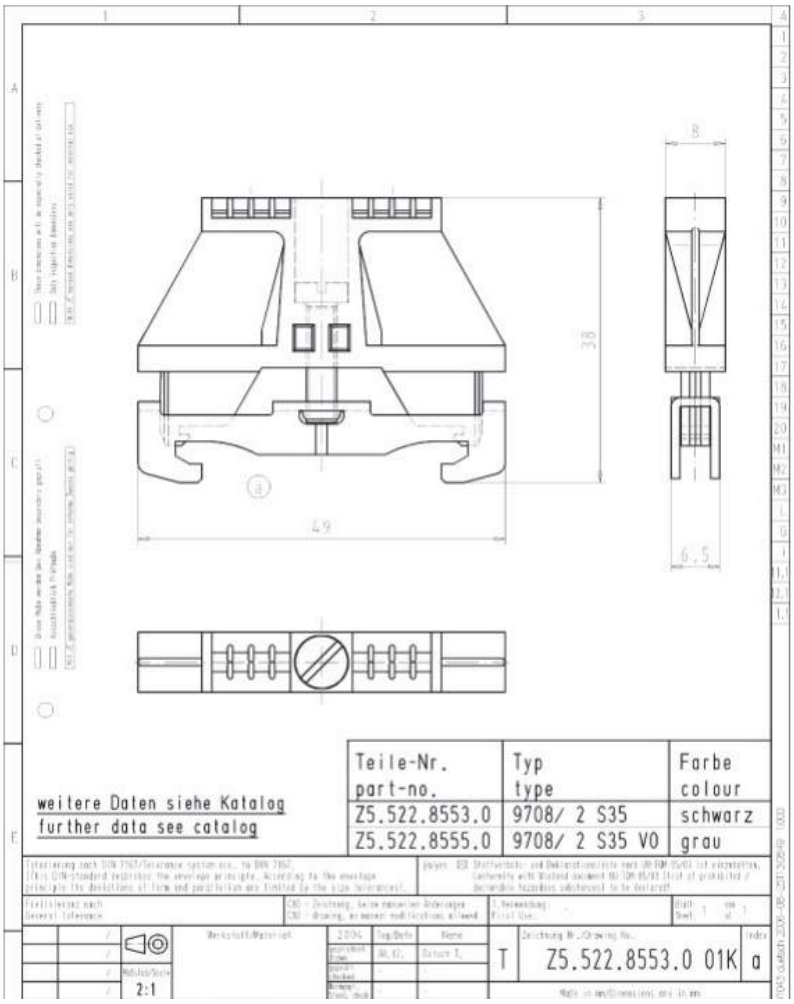


Item No.	Z5.522.8553.0
EAN	4015573141766
order unit	100 Piece(s)

Technical data

Accessories

ArticlePrice	udp_no_price
Colour	Black
Inflammability class of insulation material acc. with UL94	V2
Width/grid dimension	8 mm
Latching	Screwable
Length	49 mm
Material	Metal
Mounting method	DIN rail (top hat rail) 35/7.5 mm



ELEMECH INC. 630-499-7080 · www.elemechinc.com	Rev: 0	Device Tag: TB,DB	
	Date: 02-16-2026		
Manuf.: . PNo: Wieland: Z5.522.8553	By: AJ	Job Number: HBR10366	Page # 1/1

fasis

wieland

42-063-008







2,5 mm²/5 mm Width

4 mm²/6 mm Width

10 mm²/10 mm Width

16 mm²/12 mm Width

35 mm²/16 mm Width

Type	Part no.	Std. pack
Marking strips, unmarked		
9705 A/5/10	04.242.5053.0	25
Marking strips, marked		
9705 A/5/9 B 1 - 9	04.842.4953.0	25
9705 A/5/10 B*	04.842.5053.0	25
9705 A/5/10 B 1 - 10	04.845.0153.0	25
11 - 20	04.845.0253.0	25
21 - 30	04.845.0353.0	25
31 - 40	04.845.0453.0	25
41 - 50	04.845.0553.0	25
51 - 60	04.845.0653.0	25
61 - 70	04.845.0753.0	25
71 - 80	04.845.0853.0	25
81 - 90	04.845.0953.0	25
91 - 100	04.845.1053.0	25
⊕ (10 x)	04.855.0053.0	25
⏚ (10 x)	04.855.0153.0	25
+ (10 x)	04.855.0253.0	25
– (10 x)	04.855.0353.0	25
L1 (10 x)	04.855.0453.0	25
L2 (10 x)	04.855.0553.0	25
L3 (10 x)	04.855.0653.0	25
PE (10 x)	04.855.0753.0	25
SL (10 x)	04.855.3153.0	25
N (10 x)	04.855.3253.0	25
F1 (10 x)	04.855.0953.0	25
F2 (10 x)	04.855.1053.0	25
L1, L2, L3, N, PE (2 x)	04.855.0853.0	25
with enlarged marking area		
9705 AL/5/10	04.242.5153.0	25
*Custom marking upon request		

Type	Part no.	Std. pack
Marking strips, unmarked		
9705 A/6/10	04.242.6053.0	25
Marking strips, marked		
9705 A/6/9 B 1 - 9	04.842.5953.0	25
9705 A/6/10 B*	04.842.6053.0	25
9705 A/6/10 B 1 - 10	04.846.0153.0	25
11 - 20	04.846.0253.0	25
21 - 30	04.846.0353.0	25
31 - 40	04.846.0453.0	25
41 - 50	04.846.0553.0	25
51 - 60	04.846.0653.0	25
61 - 70	04.846.0753.0	25
71 - 80	04.846.0853.0	25
81 - 90	04.846.0953.0	25
91 - 100	04.846.1053.0	25
⊕ (10 x)	04.856.0053.0	25
⏚ (10 x)	04.856.0153.0	25
+ (10 x)	04.856.0253.0	25
– (10 x)	04.856.0353.0	25
L1 (10 x)	04.856.0453.0	25
L2 (10 x)	04.856.0553.0	25
L3 (10 x)	04.856.0653.0	25
PE (10 x)	04.856.0753.0	25
SL (10 x)	04.856.3153.0	25
N (10 x)	04.856.3253.0	25
F1 (10 x)	04.856.0953.0	25
F2 (10 x)	04.856.1053.0	25
L1, L2, L3, N, PE (2 x)	04.856.0853.0	25
with enlarged marking area		
9705 AL/6/10	04.242.6353.0	25
*Custom marking upon request		

Type	Part no.	Std. pack
10 mm²/10 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/5/10/5 B	04.842.5553.0	25
16 mm²/12 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/6/10/5 B	04.842.6553.0	25
35 mm²/16 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/8/10/5 B	04.842.8553.0	25
* indicate required marking with part no.		

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Manuf.: . PNo:
Wieland: Z4.242.6353

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By: AJ

Device Tag: TB1
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Fast-Acting ¼" x 1 ¼" Glass Tube Fuses

AGC Series



COOPER Bussmann

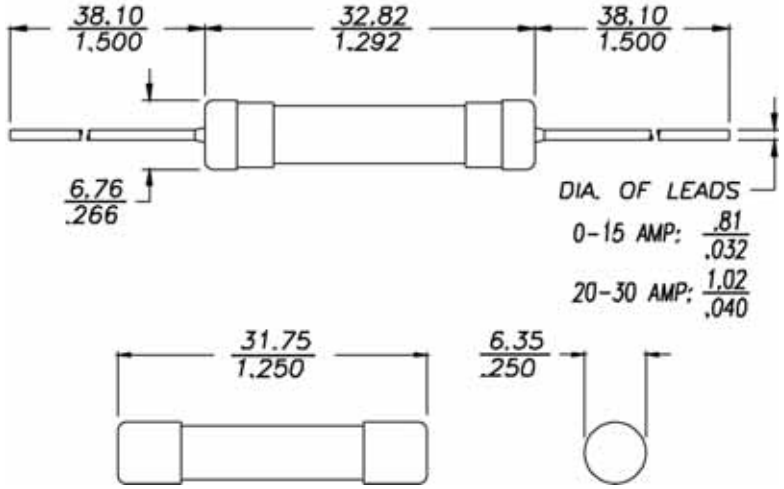
13-012-034

Non-RoHS Part Number	RoHS Part Number	AC Voltage Rating	SPECIFICATIONS AC Interrupting Rating (amps) 250	125	32	Typical DC Cold Resistance* (Ω)	Typical Melting I²t† AC	Typical Voltage Drop‡
AGC-1/16	AGC-1/16-R	250	35	10,000	—	4.500	0.00773	0.67
AGC-1/8	AGC-1/8-R	250	35	10,000	—	12.565	0.000787	6.00
AGC-¼	AGC-¼-R	250	35	10,000	—	6.800	0.00131	4.67
AGC-3/16	AGC-3/16-R	250	35	10,000	—	4.900	0.00637	4.12
AGC-2/10	AGC-2/10-R	250	35	10,000	—	3.360	0.00435	4.51
AGC-¼	AGC-¼-R	250	35	10,000	—	2.300	0.0148	0.89
AGC-3/10	AGC-3/10-R	250	35	10,000	—	1.670	0.0208	2.88
AGC-⅜	AGC-⅜-R	250	35	10,000	—	1.203	0.0321	4.59
AGC-½	AGC-½-R	250	35	10,000	—	0.615	0.269	0.59
AGC-¾	AGC-¾-R	250	35	10,000	—	0.312	0.815	0.37
AGC-1	AGC-1-R	250	35	10,000	—	0.190	1.615	0.31
AGC-1-¼	AGC-1-¼-R	250	100	10,000	—	0.145	0.018	0.35
AGC-1-½	AGC-1-½-R	250	100	10,000	—	0.115	0.0149	0.27
AGC-2	AGC-2-R	250	100	10,000	—	0.078	0.00509	0.28
AGC-2-¼	AGC-2-¼-R	250	100	10,000	—	0.067	0.00588	0.26
AGC-2-½	AGC-2-½-R	250	100	10,000	—	0.057	0.00879	0.31
AGC-3	AGC-3-R	250	100	10,000	—	0.045	0.0167	0.25
AGC-4	AGC-4-R	250	200	10,000	—	0.030	0.0305	0.22
AGC-5	AGC-5-R	250	200	10,000	—	0.024	0.045	0.23
AGC-6	AGC-6-R	250	200	10,000	—	0.020	0.071	0.23
AGC-7	AGC-7-R	250	200	10,000	—	0.017	0.105	0.23
AGC-7-½	AGC-7-½-R	250	200	10,000	—	0.0146	—	—
AGC-8	AGC-8-R	250	200	10,000	—	0.014	0.152	0.19
AGC-9	AGC-9-R	250	200	10,000	—	0.012	0.21	0.18
AGC-10	AGC-10-R	250	200	10,000	—	0.008	0.492	0.20
AGC-12	AGC-12-R	32	—	—	1000	0.0070	—	—
AGC-14	AGC-14-R	32	—	—	1000	0.0062	—	—
AGC-15	AGC-15-R	32	—	—	1000	0.006	0.566	0.14
AGC-20	AGC-20-R	32	—	—	1000	0.004	1.438	0.12
AGC-25	AGC-25-R	32	—	—	1000	0.003	2.109	0.11
AGC-30	AGC-30-R	32	—	—	1000	0.002	3.807	0.12
AGC-35	AGC-35-R	32	—	—	70	0.0014	—	—
AGC-40	AGC-40-R	32	—	—	80	0.0019	—	—

* DC Cold Resistance (Measured at ≤10% of rated current)
† Typical Melting I²t (A²Sec) (I²t was measured at listed interrupting rating and rated voltage.)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C ambient temperature at rated current)

Dimensions (mm/in)

Drawing Not to Scale



Agency Information

- UL Listed Card: AGC 1/500-10
- UL Recognition Card: AGC 11-45
- CSA Component Acceptance Card (Class No. 1422 30)
- CSA Certification Card (Class No. 1422 01)

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Datasheet

wieland

42-063-014

Art.No. 07.311.6655.0

End plate APN 10 /V0

End plate for DIN rail terminal blocks type WKN..., color gray



Approvals

Technical data

General

Colour	Grey
Type of end plate	Yes
Type of partition	No
Thickness	1.5 mm
Snap in	Yes
Inflammability class of insulation material acc. with UL94	V0
Length	51 mm

Accessories

Type of end plate	Yes
Type of partition	No
Colour	Grey
Thickness	1.5 mm
Snap in	Yes
Inflammability class of insulation material acc. with UL94	V0

57.504.4055.0

fuse terminal WK 4 TKG/U /V0

Disconnect block for fuse holder,component plug and fuse disconnect lever with screw connection for mounting on TS 35 and TS 32, no minal cross section 4 mm², width 6 mm, color gray



42-063-073

Technical data

general

nominal cross section	4 mm²
color	grey
number of levels	1
number of clamp positions per level	2
width/grid dimension	6 mm
insulating housing	PA666
inflammability class of insulation material acc. with UL94	V0
mounting method	DIN rail (top hat rail)/G-rail
terminal blocks for electrical installations	no

technical data

rated voltage	800 V
rated impulse voltage	6 kV
pollution degree	3
closing plate required	yes
type of insulation material	thermoplastic
length	48 mm

connection data

connection type 1	screw connection
connection type 2	screw connection
minimum cross section solid	0.5 mm²

maximum cross section solid	6 mm²
minimum cross section fine stranded	0.5 mm²
maximum cross section fine stranded	4 mm²
wire strip length	9 mm
torque conductor mounting	0.5 Nm

Z1.298.1753.0

wieland

42-063-074

fuse disconnect lever THSI 6,3X32 LED 24

Fuse disconnect lever to stick on disconnect block type WKFN 4 TKG/35,for fuse 5x20 mm, with LED 12-24 V, Color: grey



Technical data

general

color	grey
width/grid dimension	8 mm
insulating housing	PA666
inflammability class of insulation material acc. with UL94	V0
mounting method	direct mounting
fuse insert	G-fuse 6.3x32 mm

technical data

rated voltage	500 V
closing plate required	no
type of insulation material	thermoplastic
length	57.3 mm

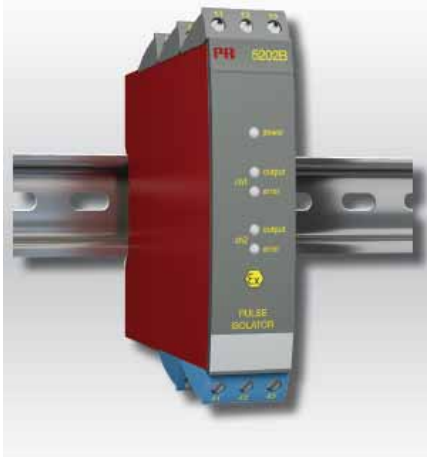
additional data

remark to rated voltage	note fuse insert
remark to rated current	note fuse insert
defect indicator	LED
voltage type for defect indication	AC/DC
minimum operating voltage of defective display	12 V
maximum operating voltage of defective display	24 V

Pulse isolator

5202B

- 2 channels - 2 or 4 outputs
- Dual output
- 5-port 3.75 kVAC galvanic isolation
- Cable error detection
- Universal supply by AC or DC



18-247-001

Environmental Conditions

Operating temperature	-20°C to +60°C
Calibration temperature	20...28°C
Relative humidity	< 95% RH (non-cond.)
Protection degree	IP20

Mechanical specifications

Dimensions (HxWxD)	109 x 23.5 x 130 mm
Weight approx.	230 g
Wire size	1 x 2.5 mm^2 stranded wire
Screw terminal torque	0.5 Nm

Common specifications

Supply

Supply voltage, universal	21.6...253 VAC, 50...60 Hz or 19.2...300 VDC
Fuse	400 mA SB / 250 VAC
Max. required power	≤ 1.5 W (2 channels), 5202B1 and 5202B2
Max. required power	≤ 2.0 W (2 channels), 5202B4
Internal power dissipation	≤ 1.5 W (2 channels), 5202B1 and 5202B2
Internal power dissipation	≤ 2.0 W (2 channels), 5202B4

Isolation voltage

Isolation voltage, test / working	3.75 kVAC / 250 VAC
PELV/SELV	IEC 61140

Auxiliary supplies

NAMUR supply	8 VDC / 8 mA
EMC immunity influence	< ±0.5%
Extended EMC immunity: NAMUR NE21, A criterion, burst	< ±1%

Input specifications

Sensor types	NAMUR according to EN 60947-5-6 / mechanical contact
Frequency range	0...5 kHz
Pulse length	> 0.1 ms
Input resistance	1 kΩ
Trig level, signal	< 1.2 mA, > 2.1 mA
Trig level, cable fault	< 0.1 mA, > 6.5 mA

Output specifications

Relay output

Max. switching frequency	20 Hz
Max. voltage	250 VRMS
Max. current	2 AAC
Max. AC power	100 VA
Max. load at 24 VDC	1 A

NPN outputs

Max. switching frequency	5 kHz
Min. pulse length	> 0.1 ms
Max. load, current / voltage	80 mA / 30 VDC
Voltage drop at 25 mA / 80 mA	< 0.75 VDC / < 2.5 VDC

Observed authority requirements

EMC	2014/30/EU
LVD	2014/35/EU
EAC	TR-CU 020/2011

Approvals

ATEX	DEMKO 99ATEX127186, II (1) GD [EEx ia] IIC
UL	UL 913, UL 508
EAC Ex	RU C-DK.HA65.B.00355/19
SIL	Hardware assessed for use in SIL applications

Wire – MTW Type

51-000-062

CONDUCTORS:
- 22 AWG - 8AWG Stranded Tinned Copper per ASTM B-33
- 22 AWG - 10 AWG Solid Tinned Copper per ASTM M-33

INSULATION:
- Color-Coded Polyvinyl Chloride (PVC)

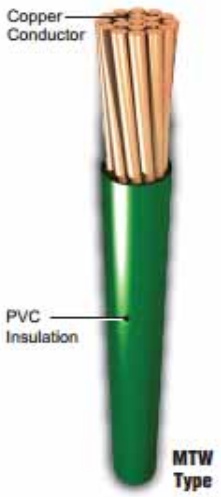
TEMPERATURE RANGE/ VOLTAGE RATING:
- UL 1011/1015/1028/BC-5W2: 105°C/600V
- UL MTW: 90°C/600V
- CSA AWM I A/B & TEW: 105°C/600V

FLAME COMPLIANCES:
- UL VW-1
- CSA FT-1

INDUSTRY APPROVALS:
- UL Standard 758 - Styles 1011/1015/1028/1032/1230/1231/1335/1344
- UL Standard 1063 - MTW
- UL Standard 1426 - BC-5W2: 16 AWG - 8 AWG
- CSA AWM I A/B & TEW
- UL THHW
- UL CT Tray Rated
- SAE J378

STANDARD COLORS:
- Black, Orange, Blue, Violet, White, Yellow, Brown, Green/Yellow, Red, Green, Gray

OPTIONS:
- Stripes available upon request (minimums may apply)
- Other copper constructions available upon request (minimums may apply)



Catalog Number	Description
F22027	22 AWG (7/.0096) TC AWM 1015
F20037	20 AWG (10/30) TC AWM 1015
F18054	18 AWG (16/30) TC AWM 1015
F16032	16 AWG (26/30) TC AWM 1015
F14037	14 AWG (41/30) TC AWM 1015
F12024	12 AWG (65/30) TC AWM 1015
F10012	10 AWG (105/30) TC AWM 1015
F08010	8 AWG (7X19/29) TC AWM 1028

TEW/MTW Wire (Tinned Copper) Applications:

› This tinned copper hook up wire may be used for wiring of machine tools, appliances, and control cabinets.

UL LISTED

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Rev: 0	Device Tag:		
Date: 02-16-2026			
Manuf.: . PNo: EleMech: 51-000-062	By: AJ	Job Number: HBR10366	Page # 1/1

Polyurethane Tubing

94-255-009

Specifications



Operating Fluid	Air, Water
Max. Operating Pressure	115 psi (0.8MPa) at 68˚F (20˚C)
Burst Pressure	Refer to burst pressure characteristic chart
Operating Temperature	Air: -4˚ to 140˚F (-20˚ to 60˚C) Water: 40˚ to 105˚F (5˚ to 40˚C)
Material	Polyurethane
Hardness	Shore A 95

Dimensions

Inch **Series TIUB**

Model	TIUB01		TIUB05	TIUB07		TIUB11	TIUB13
Tube OD (Inches)	1/8	5/32	3/16	1/4	5/16	3/8	1/2
Tube ID (Inches)	0.08	0.1	0.13	0.17	0.2	0.25	0.33
Min. bending radius (Inches)	0.39	0.39	0.6	0.91	0.79	1.06	1.38

How To Order

TIUB **05** **BU** **-** **33**

Polyurethane

Inch Size

Symbol	Tube Size
01	1/8
See Note*	5/32
05	3/16
07	1/4
See Note*	5/16
11	3/8
13	1/2

*Color Indication

Symbol	Color
B	Black
W	White
R	Red
BU	Blue
Y	Yellow
G	Green
C	Clear
YR	Orange

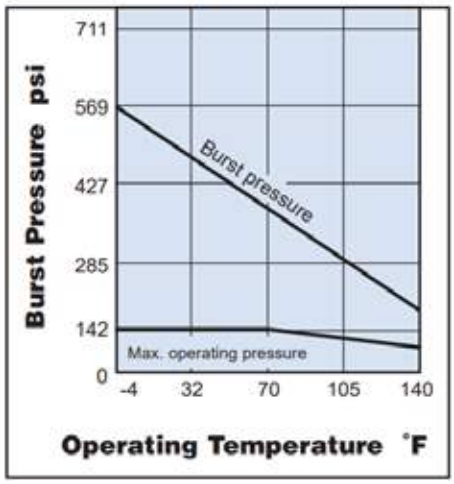
Length Per Roll

Symbol	Roll Size
20	66ft
33[1]	100ft
153[1]	500ft
305[1]	1000ft

Longer lengths available upon request

[1] Stocked item

Burst Pressure Characteristics Chart



⚠ Caution

1. Can be used with general industrial water. For other fluids, please consult SMC.
2. Max. operating pressure and minimum bending radius are measured at 68˚F.
3. When using tubing with SMC fittings, the chemical resistance of the fitting has to be investigated as well.

Stainless Steel 316 One-touch Fittings *Series KQG2*

Applicable Tube: Inch Size, Connection Thread: UNF, NPT

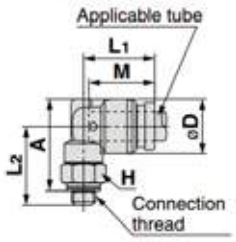
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Male Elbow: KQG2L

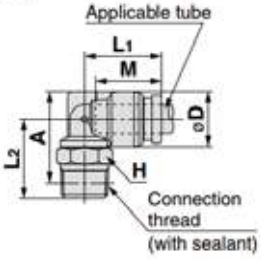


Applicable tube O.D. (inch)	Connection thread UNF, NPT	Model	H (Width across flat)	Note 1) øD	L1	L2	A*	M	Note 2) Effective area (mm²)	Weight (g)
ø1/8"	10-32UNF	KQG2L01-32	8	8.3	13.1	14.8	16	12	2.6	6.3
	1/8	KQG2L01-N01S	12		13.6	14.9	15.8		3	9
	1/4	KQG2L01-N02S	14			18.7	18.4			16.7
ø5/32"	10-32UNF	KQG2L03-32	8	9.1	13.7	15.2	16.8	12.6	3.5	6.9
	1/8	KQG2L03-N01S	12		14.4	15.3	16.6		4.2	9.9
	1/4	KQG2L03-N02S	14			19.1	19.2			17.6
ø1/4"	10-32UNF	KQG2L07-32	8	11.7	14.7	16.5	19.3	13.5	3.5	8.9
	1/8	KQG2L07-N01S	12		15.9	16.6	19.2		11.4	11.7
	1/4	KQG2L07-N02S	14			20.4	21.8			19.4
	3/8	KQG2L07-N03S	19			22.2	23.3			34.2
ø5/16"	1/8	KQG2L09-N01S	12	13.7	18.6	18.3	21.9	16.1	21.6	15.1
	1/4	KQG2L09-N02S	14		19.1	21.5	23.9			21.1
	3/8	KQG2L09-N03S	19			23.3	25.4			35.7
ø3/8"	1/8	KQG2L11-N01S	12	16	20	19.4	24.2	16.6	21.6	19.7
	1/4	KQG2L11-N02S	14		21	22.6	26.2		35.2	23.2
	3/8	KQG2L11-N03S	19			24.4	27.7			36.7
	1/2	KQG2L11-N04S	22			28.2	29.8			60.2
ø1/2"	1/4	KQG2L13-N02S	14	19.6	22.7	24.4	29.8	18.5	50.2	29.4
	3/8	KQG2L13-N03S	19		23.7	26.1	31.2			39.2
	1/2	KQG2L13-N04S	22			29.9	33.3			61.3

(10-32UNF)



(NPT)

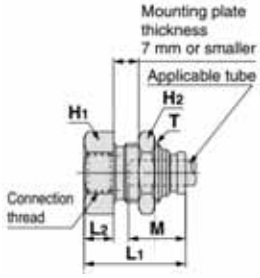


* Reference dimensions after installation of NPT thread
Note 1) øD is maximum diameter.
Note 2) Value of FEP tube.

Bulkhead Connector: KQG2E



Applicable tube O.D. (inch)	Connection thread NPT	Model	T (UNF)	Width across flat H1	Width across flat H2	L1	L2	Mounting hole	M	Note) Effective area (mm²)	Weight (g)
ø1/8"	1/4	KQG2E01-N02	7/16-20UNF	17	14	32.8	15.3	12.5	12	3.4	30.6
ø5/32"	1/4	KQG2E03-N02	7/16-20UNF	17	14	32.6	15.3	12.5	12.6	5.6	30.1
ø1/4"	1/4	KQG2E07-N02	1/2-20UNF	17	17	32.7	14.8	14	13.5	13.1	32.6
ø5/16"	3/8	KQG2E09-N03	5/8-18UNF	19	19	35	15.1	17	16.1	26.1	38.2
ø3/8"	3/8	KQG2E11-N03	3/4-16UNF	21	22	33.8	13.3	20.5	16.6	41.5	51.7
ø1/2"	3/8	KQG2E13-N03	7/8-14UNF	24	26	34.6	12.3	23.5	18.5	58.3	73.2
	1/2	KQG2E13-N04				41.4	19.1				74.7



Note) Value of FEP tube.

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Rev: 0	Device Tag: BU2
Date: 02-16-2026	
By: AJ	Job Number: HBR10366
Manuf.: . PNo: SMC USA: KQG2E11-N03	Page # 1/1

Continuous Hinge, Type 4X

PENTAIR

11-035-1077



Industry Standards

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A Listed; Type 4, 4X, 12, 13; File No. E61997
cUL Listed per CSA C22.2 No 94; Type 4, 4X, 12, 13; File No. E61997
Enclosure flammability evaluated per UL 508A
Window flammability evaluated per UL 508A

NEMA/EEMAC Type 4, 4X, 12, 13
CSA File No. 42186: Type 4, 4X, 12, 13
IEC 60529, IP66

Specifications

- Compression-molded fiberglass has outstanding chemical- and temperature-resistance qualities and exhibits excellent weatherability and physical properties
- Fiberglass is easily punched, drilled, filed or sawed
- Gasket assures water-tight and dust-tight seal
- Polyester mounting brackets and stainless steel attachment screws are provided with each enclosure
- Scratch-resistant polycarbonate windows are permanently bonded in place
- Molded-in-place threaded brass inserts and plated steel screws are provided for mounting optional panels and terminal block kits
- Removable hinged cover attached to body with Type 316 stainless steel hinge pin
- Screw-cover enclosures are secured with two captivated Type 316 stainless steel slotted cover screws
- Enclosures with quick-release latches have corrosion-resistant polyester latches located in corners that provide unobstructed access to enclosure
- Hinge pin and bail are corrosion-resistant Type 316 stainless steel
- Padlock provisions included in each latch

Standard Product **Window Cover**

Catalog Number	AxBxC in./mm	Type	Steel Panel	Alum. Panel	Panel Size D x E in./mm	Mounting G x H in./mm	Overall L x W in./mm	F in./mm	J in./mm	K in./mm	M in./mm	N in./mm	O in./mm	P in./mm	Q in./mm	T in./mm	U in./mm
A664CHSCFGW	6.00 x 6.00 x 4.00	Screw	A6P6	A6P6AL	4.88 x 4.88	6.94 x 4.00	6.50 x 6.50	3.45	3.25	1.00	4.25	4.25	4.25	4.25	5.64	0.12	5.64
	152 x 152 x 102	Cover			124 x 124	176 x 102	165 x 165	88	83	25	108	108	108	108	143	3	143
A664CHQRFGW	6.00 x 6.00 x 4.00	Quick	A6P6	A6P6AL	4.88 x 4.88	6.94 x 4.00	6.50 x 6.50	3.45	3.25	1.00	4.25	4.25	4.25	4.25	5.64	0.12	5.64
	152 x 152 x 102	Release			124 x 124	176 x 102	165 x 165	88	83	25	108	108	108	108	143	3	143
A864CHSCFGW	8.00 x 6.00 x 4.00	Screw	A8P6	A8P6AL	6.75 x 4.88	8.94 x 4.00	8.50 x 6.50	3.45	3.25	1.00	6.25	4.25	4.25	6.25	7.64	0.12	5.64
	203 x 152 x 102	Cover			171 x 124	227 x 102	216 x 165	88	83	25	159	108	108	159	194	3	143
A864CHQRFGW	8.00 x 6.00 x 4.00	Quick	A8P6	A8P6AL	6.75 x 4.88	8.94 x 4.00	8.50 x 6.50	3.45	3.25	1.00	6.25	4.25	4.25	6.25	7.64	0.12	5.64
	203 x 152 x 102	Release			171 x 124	227 x 102	216 x 165	88	83	25	159	108	108	159	194	3	143
A1086CHSCFGW	10.00 x 8.00 x 6.00	Screw	A10P8	A10P8AL	8.75 x 6.88	10.94 x 6.00	10.50 x 8.50	5.45	4.94	1.31	8.25	6.25	6.25	8.25	9.61	0.12	7.61
	254 x 203 x 152	Cover			222 x 175	278 x 152	267 x 216	138	125	33	210	159	159	210	244	3	193
A1086CHQRFGW	10.00 x 8.00 x 6.00	Quick	A10P8	A10P8AL	8.75 x 6.88	10.94 x 6.00	10.50 x 8.50	5.45	4.94	1.31	8.25	6.25	6.25	8.25	9.61	0.12	7.61
	254 x 203 x 152	Release			222 x 175	278 x 152	267 x 216	138	125	33	210	159	159	210	244	3	193
A12106CHSCFGW	12.00 x 10.00 x 6.00	Screw	A12P10	A12P10AL	10.75 x 8.88	12.94 x 8.00	12.50 x 10.50	5.45	4.69	1.56	10.25	8.25	8.25	10.25	11.58	0.12	9.58
	305 x 254 x 152	Cover			273 x 226	329 x 203	318 x 267	138	119	40	260	210	210	260	294	3	243
A12106CHQRFGW	12.00 x 10.00 x 6.00	Quick	A12P10	A12P10AL	10.75 x 8.88	12.94 x 8.00	12.50 x 10.50	5.45	4.69	1.56	10.25	8.25	8.25	10.25	11.58	0.12	9.58
	305 x 254 x 152	Release			273 x 226	329 x 203	318 x 267	138	119	40	260	210	210	260	294	3	243
A14128CHSCFGW	14.00 x 12.00 x 8.00	Screw	A14P12	A14P12AL	12.75 x 10.88	14.94 x 10.00	14.55 x 12.55	7.45	6.50	1.81	12.25	10.25	10.25	12.25	13.59	0.15	11.59
	356 x 305 x 203	Cover			324 x 276	379 x 254	370 x 319	189	165	46	311	260	260	311	345	4	294
A14128CHQRFGW	14.00 x 12.00 x 8.00	Quick	A14P12	A14P12AL	12.75 x 10.88	14.94 x 10.00	14.55 x 12.55	7.45	6.50	1.81	12.25	10.25	10.25	12.25	13.59	0.15	11.59
	356 x 305 x 203	Release			324 x 276	379 x 254	370 x 319	189	165	46	311	260	260	311	345	4	294
A16148CHSCFGW	16.00 x 14.00 x 8.00	Screw	A16P14	A16P14AL	14.75 x 12.88	16.94 x 12.00	16.55 x 14.55	7.45	6.23	2.08	14.25	12.25	12.25	14.25	15.56	0.15	13.56
	406 x 356 x 203	Cover			375 x 327	430 x 305	420 x 370	189	158	53	362	311	311	362	395	4	344
A16148CHQRFGW	16.00 x 14.00 x 8.00	Quick	A16P14	A16P14AL	14.75 x 12.88	16.94 x 12.00	16.55 x 14.55	7.45	6.23	2.08	14.25	12.25	12.25	14.25	15.56	0.15	13.56
	406 x 356 x 203	Release			375 x 327	430 x 305	420 x 370	189	158	53	362	311	311	362	395	4	344
A181610CHSCFGW	18.00 x 16.00 x 10.00	Screw	A18P16	A18P16AL	16.75 x 14.88	18.94 x 14.00	18.58 x 16.58	9.45	7.66	2.66	16.25	14.25	14.25	16.25	17.53	0.16	15.53
	457 x 406 x 254	Cover			425 x 378	481 x 356	472 x 421	240	195	68	413	362	362	413	445	4	394
A181610CHQRFGW	18.00 x 16.00 x 10.00	Quick	A18P16	A18P16AL	16.75 x 14.88	18.94 x 14.00	18.58 x 16.58	9.45	7.66	2.66	16.25	14.25	14.25	16.25	17.53	0.16	15.53
	457 x 406 x 254	Release			425 x 378	481 x 356	472 x 421	240	195	68	413	362	362	413	445	4	394

Purchase panels separately. Optional stainless steel, aluminum, conductive and composite material panels available for most sizes.

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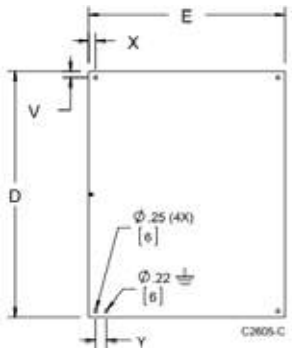
Rev: 0	Device Tag: EN1		
Date: 02-16-2026			
Manuf.: . PNo: Hoffman: A-16148CHQRFGW	By: AJ	Job Number: HBR10366	Page # 1/1

PANELS FOR JUNCTION BOXES

SUB-PANEL CATALOG NUMBER	SUB-PANEL DIMENSIONS (IN.)
A-DPESS	D x E

NOTE:

1. 6 indicates 316 Stainless Steel.
2. AL indicates Aluminum
3. G indicates Conductive Steel





11-035-129

Catalog Number	Material	Panel Size D x E (in.)	Panel Size D x E (mm)	V (in.)	V (mm)	X (in.)	X (mm)	Y (in.)	Y (mm)
A4P4G	Conductive	2.88 x 2.88	73 x 73	.31	8	.31	8	1.25	32
A6P4	Painted steel	4.88 x 2.88	124 x 73	.31	8	.31	8	1.25	32
A6P4G	Conductive steel	4.88 x 2.88	124 x 73	.31	8	.31	8	1.25	32
A6P4SS	Stainless Steel	4.88 x 2.88	124 x 73	.31	8	.31	8	1.25	32
A6P4AL	Aluminum	4.88 x 2.88	124 x 73	.31	8	.31	8	1.25	32
A6P6	Painted steel	4.88 x 4.88	124 x 124	.31	8	.31	8	1.25	32
A6P6G	Conductive steel	4.88 x 4.88	124 x 124	.31	8	.31	8	1.25	32
A6P6SS	Stainless Steel	4.88 x 4.88	124 x 124	.31	8	.31	8	1.25	32
A6P6AL	Aluminum	4.88 x 4.88	124 x 124	.31	8	.31	8	1.25	32
A7P7G	Conductive	5.88 x 5.88	149 x 149	.31	8	.31	8	1.25	32
A8P6	Painted steel	6.75 x 4.88	171 x 124	.25	6	.31	8	1.25	32
A8P6G	Conductive steel	6.75 x 4.88	171 x 124	.25	6	.31	8	1.25	32
A8P6SS	Stainless Steel	6.75 x 4.88	171 x 124	.25	6	.31	8	1.25	32
A8P6AL	Aluminum	6.75 x 4.88	171 x 124	.25	6	.31	8	1.25	32
A8P8	Painted steel	6.75 x 6.88	171 x 175	.25	6	.31	8	1.25	32
A8P8G	Conductive Steel	6.75 x 6.88	171 x 175	.25	6	.31	8	1.25	32
A8P8AL	Aluminum	6.75 x 6.88	171 x 175	.25	6	.31	8	1.25	32
A9P6G	Conductive	7.38 x 4.63	187 x 118	.31	8	.31	8	1.25	32
A10P8	Painted steel	8.75 x 6.88	222 x 175	.25	6	.31	8	1.25	32
A10P8G	Conductive steel	8.75 x 6.88	222 x 175	.25	6	.31	8	1.25	32
A10P8SS	Stainless Steel	8.75 x 6.88	222 x 175	.25	6	.31	8	1.25	32
A10P8AL	Aluminum	8.75 x 6.88	222 x 175	.25	6	.31	8	1.25	32
A10P10	Painted steel	8.75 x 8.88	222 x 226	.25	6	.31	8	1.25	32
A10P10G	Conductive steel	8.75 x 8.88	222 x 226	.25	6	.31	8	1.25	32
A10P10AL	Aluminum	8.75 x 8.88	222 x 226	.25	6	.31	8	1.25	32
A12P6	Painted steel	10.75 x 4.88	273 x 124	.25	6	.31	8	1.25	32
A12P6G	Conductive steel	10.75 x 4.88	273 x 124	.25	6	.31	8	1.25	32
A12P10	Painted steel	10.75 x 8.88	273 x 226	.25	6	.31	8	1.25	32
A12P10G	Conductive steel	10.75 x 8.88	273 x 226	.25	6	.31	8	1.25	32
A12P10SS	Stainless Steel	10.75 x 8.88	273 x 226	.25	6	.31	8	1.25	32
A12P10AL	Aluminum	10.75 x 8.88	273 x 226	.25	6	.31	8	1.25	32
A12P12	Painted steel	10.75 x 10.88	273 x 276	.25	6	.31	8	1.25	32
A12P12G	Conductive steel	10.75 x 10.88	273 x 276	.25	6	.31	8	1.25	32
A12P12SS	Stainless Steel	10.75 x 10.88	273 x 276	.25	6	.31	8	1.25	32
A14P8	Painted steel	12.75 x 6.88	324 x 175	.25	6	.31	8	1.25	32
A14P8G	Conductive steel	12.75 x 6.88	324 x 175	.25	6	.31	8	1.25	32
A14P12	Painted steel	12.75 x 10.88	324 x 276	.25	6	.31	8	1.25	32
A14P12G	Conductive steel	12.75 x 10.88	324 x 276	.25	6	.31	8	1.25	32
A14P12SS	Stainless Steel	12.75 x 10.88	324 x 276	.25	6	.31	8	1.25	32
A14P12AL	Aluminum	12.75 x 10.88	324 x 276	.25	6	.31	8	1.25	32
A16P10	Painted steel	14.75 x 8.88	375 x 226	.25	6	.31	8	1.25	32
A16P10G	Conductive steel	14.75 x 8.88	375 x 226	.25	6	.31	8	1.25	32
A16P14	Painted steel	14.75 x 12.88	375 x 327	.25	6	.31	8	1.25	32
A16P14G	Conductive steel	14.75 x 12.88	375 x 327	.25	6	.31	8	1.25	32
A16P14SS	Stainless Steel	14.75 x 12.88	375 x 327	.25	6	.31	8	1.25	32
A16P14AL	Aluminum	14.75 x 12.88	375 x 327	.25	6	.31	8	1.25	32
A18P16	Painted steel	16.75 x 14.88	425 x 378	.25	6	.31	8	1.25	32
A18P16G	Conductive steel	16.75 x 14.88	425 x 378	.25	6	.31	8	1.25	32
A18P16SS	Stainless Steel	16.75 x 14.88	425 x 378	.25	6	.31	8	1.25	32
A18P16AL	Aluminum	16.75 x 14.88	425 x 378	.25	6	.31	8	1.25	32
A20P16J	Painted	18.75 x 14.88	476 x 378	.47	12	.54	14	.81	21
A20P16JAL	Aluminum	18.75 x 14.88	476 x 378	.47	12	.54	14	.81	21

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Manuf.: . PNo: Hoffman: A-16P14

Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: EN1

Job Number: HBR10366

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One-touch Fittings

Series KQ2

Applicable Tubing: Metric Size
Connection Thread: M, R, Rc

94-255-020

KQ 2 H 06 – 01 S

One-touch fittings

Product's color

Symbol	Body	Release button
2	White	Light gray
Nil	Black	Blue

Applicable tubing O.D.

23	ø3.2
04	ø4
06	ø6
08	ø8
10	ø10
12	ø12
16	ø16

Port size/Applicable tubing O.D.

Thread connection	M5	M5 x 0.8	
	M6	M6 x 1.0	
	01	R 1/8, Rc 1/8	
	02	R 1/4, Rc 1/4	
	03	R 3/8, Rc 3/8	
	04	R 1/2, Rc 1/2	
Tubing (Rod) connection	00	Same dia. tubing	
	04	ø4	(Reducer) Different dia. tubing
	06	ø6	
	08	ø8	
	10	ø10	
	12	ø12	
	16	ø16	
	99	Same dia. rod	

With thread seal

Nil	None
S	With thread seal

Note) Port size with seal: Only
R 1/8
R 1/4
R 3/8
R 1/2

Model

H	Male connector	T	Male branch tee
	Straight union		Union tee
	Different diameter straight		Different diameter tee * Note)
S	Hex. socket head male connector	TW	Cross*
F	Female connector	TX	Different diameter cross*
L	Male elbow	TY	Different diameter cross*
	Union elbow	Y	Male run tee
	Plug-in elbow	D	Male delta union
	Reducer elbow		Delta union
LU	Male branch connector	U	Branch
	Branch union elbow		Union "Y"
K	45° male elbow		Different dia. union "Y"
V	Universal male elbow		Plug-in "Y"
VS	Hexagon socket head universal male elbow	UD	Delta branch
VF	Universal female elbow		Different dia. double union "Y"
LF	Female elbow	XD	Double plug-in "Y"
VD	Double universal male elbow	X	Different diameter plug-in "Y"
VT	Triple universal male elbow	R	Plug-in reducer
Z	Branch universal male elbow	E	Bulkhead union
ZF	Branch universal female elbow		Bulkhead connector
ZD	Double branch universal male elbow	LE	Bulkhead male elbow
ZT	Triple branch universal male elbow		
W	Extended plug-in elbow		
	Extended male elbow		

* Available only for white color body.
Note) KQT06-04, KQT08-06, KQT10-08, and KQT12-10 are available as made to order.

Accessory

Symbol	Name
KQ2N	Nipple
	Reducer nipple
	Adaptor
KQ2C	Tube cap
KQ2C	Color cap
KQ2P	Plug (White)
KQP	Plug (Blue)

Use the below part number to order the gasket for M5 and M6 threads.
Gasket for M5 thread: M-5G2
Gasket for M6 thread: M-6G

Male run tee

KQ2Y P. 24



Use to branch line in the same direction from female thread and in 90° direction.

Applicable tubing O.D. (inch)	Connection thread NPT	Model	H (Width across flats)	Note) øD1	øD2	L1	L2	A *	M	Min. port size	Weight (g)
3/8	1/4	KQ2Y11-35S	17.46	17.9	17	25.5	29.5	49	21	7	29
	3/8	KQ2Y11-36S					31.5	51			38
	1/2	KQ2Y11-37S	22.23				35.5	53			64

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Manuf.: . PNo: SMC USA: KQ2Y11-36AS	Rev: 0	Device Tag: FIT	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

SMC One-Touch Fittings
Manufacturing Pneumatics Worldwide

94-255-048

Series KQ2

Applicable Tubing: Metric Size



Threaded Type KQ2 [H] [07] – [34] [A] [S]

Model

H	Male Connector
S	Hexagon Socket Head Male Connector
F	Female Union
L	Male Elbow
K	45 Degree Male Elbow
V	Universal Male
VS	Hexagon Socket Head Universal Male Elbow
VF	Universal Female Elbow
LF	Female Elbow
VD	Double Universal Male Elbow
VT	Triple Universal Male Elbow
Z	Branch Universal Male Elbow
ZD	Double Branch Universal Male Elbow
ZT	Triple Branch Universal Male Elbow
W	Extended Male Elbow
T	Male Branch Tee
Y	Male Run Tee
U	Branch "Y"
X	Different Diameter Plug In "Y"
E	Bulkhead Union
	Bulkhead Connector
LE	Bulkhead Union Elbow
N	Reducer Nipple

Tube O.D.

01	1/8"
03	5/32"
05	3/16"
07	1/4"
09	5/16"
11	3/8"
13	1/2"

Applicable Thread Type

32	10-32UNF
33	NPT 1/16
34	NPT 1/8
35	NPT 1/4
36	NPT 3/8
37	NPT 1/2
*00	Same Diameter Tubing

*Only for "Bulkhead union" and "Bulkhead union elbow"

Thread Sealing Method

S	With Thread Sealant

Thread Material/Plating

A	Brass
N	Electroless Nickel Plated Brass
☐J	Interchangeable with KJE

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Rev: 0
Date: 02-16-2026
By: AJ

Device Tag: FIT

Manuf.: . PNo: SMC USA: KQ2VD11-35AS

Job Number: HBR10366

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SMC One-Touch Fittings
Manufacturing Pneumatics Worldwide

94-255-049

Series KQ2

Applicable Tubing: Metric Size



Threaded Type KQ2 [H] [07] – [34] [A] [S]

Model

H	Male Connector
S	Hexagon Socket Head Male Connector
F	Female Union
L	Male Elbow
K	45 Degree Male Elbow
V	Universal Male
VS	Hexagon Socket Head Universal Male Elbow
VF	Universal Female Elbow
LF	Female Elbow
VD	Double Universal Male Elbow
VT	Triple Universal Male Elbow
Z	Branch Universal Male Elbow
ZD	Double Branch Universal Male Elbow
ZT	Triple Branch Universal Male Elbow
W	Extended Male Elbow
T	Male Branch Tee
Y	Male Run Tee
U	Branch "Y"
X	Different Diameter Plug In "Y"
E	Bulkhead Union
	Bulkhead Connector
LE	Bulkhead Union Elbow
N	Reducer Nipple

Tube O.D.

01	1/8"
03	5/32"
05	3/16"
07	1/4"
09	5/16"
11	3/8"
13	1/2"

Applicable Thread Type

32	10-32UNF
33	NPT 1/16
34	NPT 1/8
35	NPT 1/4
36	NPT 3/8
37	NPT 1/2
*00	Same Diameter Tubing

*Only for "Bulkhead union" and "Bulkhead union elbow"

Thread Sealing Method

S	With Thread Sealant

Thread Material/Plating

A	Brass
N	Electroless Nickel Plated Brass
☐J	Interchangeable with KJE

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Rev: 0	Device Tag: FIT		
Date: 02-16-2026			
Manuf.: . PNo: SMC USA: KQ2L11-35AS	By: AJ	Job Number: HBR10366	Page # 1/1

Modular Type
Filter Regulators

SMC

94-255-004

AW 30 K — 03 BE —

❷ ❸ ❹ ❺ ❻

❷	With backflow mechanism	Nil	Without backflow mechanism
		K (Note 1)	With backflow mechanism

+

❸	Thread type	Nil	Rc
		N (Note 2)	NPT
		F (Note 3)	G

+

❹	Port size	02	1/4
		03	3/8

+

❺ Option (Note 4)

a	Mounting	Nil	Without mounting option
		B (Note 5)	With bracket
		H	With set nut (for panel fitting)

+

b	Float type auto drain	Nil	Without auto drain
		C	Float type auto drain (N.C.)
		D	Float type auto drain (N.O.)

+

c	Pressure gauge	Nil	Without pressure gauge
		E	Square embedded type pressure gauge (with limit indicator)
		G	Round type pressure switch (without limit indicator)
			Round type pressure switch (with limit indicator)
	Digital pressure switch	E1 (Note 6)	Output: NPN output / Electrical entry: Wiring bottom entry
		E2 (Note 6)	Output: NPN output / Electrical entry: Wiring top entry
		E3 (Note 6)	Output: PNP output / Electrical entry: Wiring bottom entry
		E4 (Note 6)	Output: PNP output / Electrical entry: Wiring top entry

+

❻ Semi-standard

d	Set pressure	Nil	0.05 to 0.85 MPa set
		1 (Note 7)	0.02 to 0.2 MPa set

+

e	Bowl	Nil	Polycarbonate bowl
		2	Metal bowl
		6	Nylon bowl
		8	Metal bowl with level gauge

❻ Semi-standard

f	Drain port (Note 8)	Nil	With drain cock
		J (Note 9)	Drain guide 1/8
			Drain guide 1/4
		W (Note 10)	Drain cock with barb fitting: For ø6 x ø4 nylon tube

+

g	Exhaust mechanism	Nil	Relieving type
		N	Non-relieving type

+

h	Flow direction	Nil	Flow direction: Left to right
		R	Flow direction: Right to left

+

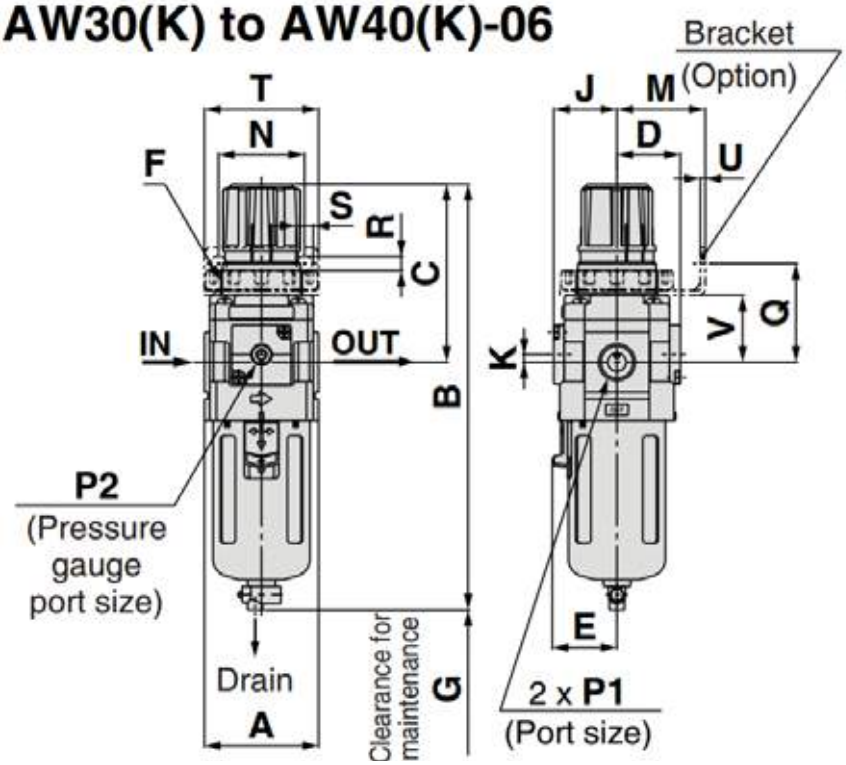
i	Pressure unit	Nil	Name plate, caution plate for bowl, and pressure gauge in imperial units: MPa
		Z (Note 11)	Name plate, caution plate for bowl, and pressure gauge in imperial units (PSI, F)
		ZA (Note 12)	Digital pressure switch: With unit switching function

Standard Specifications

Model	AW30(K)
Port size	1/4, 3/8
Pressure gauge port size Note 1)	1/8
Fluid	Air
Ambient and fluid temperature Note 3)	–5 to 60°C
Proof pressure	1.5 MPa
Maximum operating pressure	1.0 MPa
Set pressure range	0.05 to 0.85 MPa
Relief pressure	Set pressure + 0.05 MPa
Nominal filtration rating	5 m
Drain capacity (cm³)	25
Bowl material	Polycarbonate
Bowl guard	Standard
Construction	Relieving type
Weight (kg)	0.40

Model	Standard specifications											Optional specifications					
												Square type pressure gauge		Digital pressure gauge		Round type pressure gauge	
	P1	P2	A	B Note)	C	D	E	F	G	J	K	H	J	H	J	H	J
AW30(K)	1/4, 3/8	1/8	53	201	86	29.5	30	M38 x 1.5	55	29.5	3.5	□28	30.5	□27.8	41	ø37.5	66

AW30(K) to AW40(K)-06



Panel fitting dimension

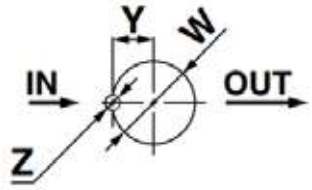


Plate thickness
AW30(K): Max. 3.5
AW40(K): Max. 5

94-255-004

Silencer
Compact Resin Type/Male Thread

Series AN05 to 40



74-255-004

AN 20 – □ 02

Body size

Symbol
05
10
15
20
30
40

Thread type

Nil	M thread
	R
N	NPT

Thread connection port size

Symbol	Port size	Applicable model
M5	M5 x 0.8	AN05
01	1/8	AN10
02	1/4	AN15/20
03	3/8	AN30
04	1/2	AN40

Specifications

Fluid	Compressed air
Max. operating pressure Note 1)	145psi (1.0 MPa)
Noise reduction	30 dB(A) Note 2)
Ambient and fluid temperature	41 to 140°F (5 to 60°C) Note 3)

Note 1) It indicates the inlet pressure for solenoid valve.
Note 2) The value may vary, depending on the pneumatic circuit or pressure that is exhausted from the solenoid valve.
Note 3) The product can be used in temperatures 14 to 140°F (–10 to 60°C) if there is no risk of water droplets forming and freezing.

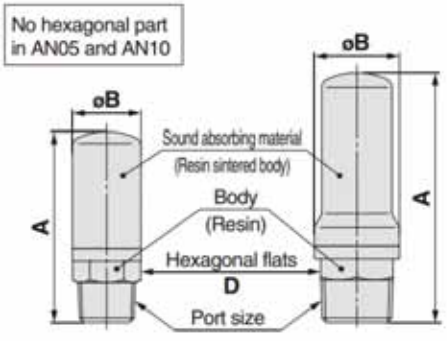
Performance

Model	Effective area mm²	Sonic conductance C [dm³/(s·bar)]	Recommended flow m³/min(ANR)	Weight g
AN05-M5	5	1	0.4 or less	0.5
AN10-01	10	2	0.8 or less	1
AN15-02	15	3	1.0 or less	2.5
AN20-02	35	7	3.0 or less	4
AN30-03	60	12	5.0 or less	5.5
AN40-04	90	18	8.0 or less	8.5

Note) Recommended flow rate is the flow at 72.5psi (0.5 MPa) in the inlet pressure.

Construction/Parts/Dimensions

AN05/10/20 **AN15/30/40**



Dimensions (mm)

Model	Port size R, NPT	A	B	D
AN05-M5	M5 x 0.8	15	6.5	–
AN10-01	1/8	23	11	–
AN15-02	1/4	32	16	14
AN20-02	1/4	45	16.5	14
AN30-03	3/8	58.5	20	17
AN40-04	1/2	68	24	21

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Rev: 0
Date: 02-16-2026
By: AJ

Device Tag: RV1

Manuf.: . PNo: SMC USA: AN20-NO2

Job Number: HBR10366

Page # 1/1

Conforming to OSHA Standard

Pressure Relief 3 Port Valve With Locking Holes

94-255-016

VHS 30 – □ 03 – RZ – □

Made to Order

Nil	Standard
X1	Body: Red
X502	Built-in silencer (EXH port)

Pressure relief 3 port valve

Body size

Symbol	Standard port size
20	1/8
30	3/8
40	1/2
50	3/4

Optional specifications

Symbol	Description
B	Knob color: Black
R	Flow direction: Right to left
Z Note)	PSI as unit displayed on label

Note) Only for the NPT thread. Under the New Measurement Law, products for overseas use only (SI unit type for use in Japan).

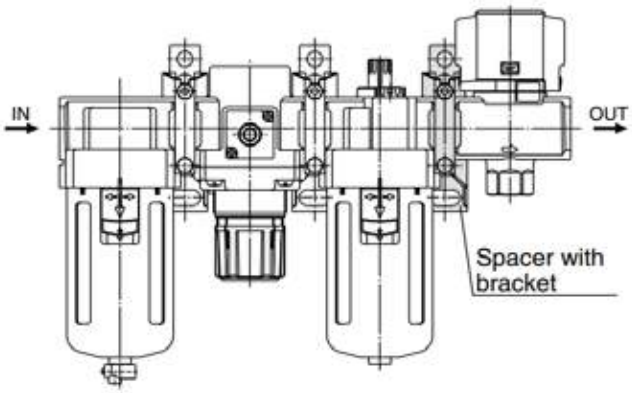
Thread type

Nil	Rc
N	NPT
F	G

Port size

Symbol	Port size	Body size			
		20	30	40	50
01	1/8	●	–	–	–
02	1/4	●	●	●	–
03	3/8	–	●	●	–
04	1/2	–	–	●	–
06	3/4	–	–	●	●
10	1	–	–	–	●

Pressure relief 3 port valve	Spacer part no.	Spacer with bracket part no.	Applicable air preparation equipment
VHS20	Y200	Y200T	AC20
VHS30	Y300	Y300T	AC25, AC30



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Manuf.: . PNo: SMC USA: VHS30-N03-Z	Rev: 0	Device Tag: RV1	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

Conforming to OSHA Standard

Pressure Relief 3 Port Valve With Locking Holes

94-255-017

VHS 30 – □ 03 – RZ – □

Made to Order

Nil	Standard
X1	Body: Red
X502	Built-in silencer (EXH port)

Pressure relief 3 port valve

Body size

Symbol	Standard port size
20	1/8
30	3/8
40	1/2
50	3/4

Optional specifications

Symbol	Description
B	Knob color: Black
R	Flow direction: Right to left
Z Note)	PSI as unit displayed on label

Note) Only for the NPT thread. Under the New Measurement Law, products for overseas use only (SI unit type for use in Japan).

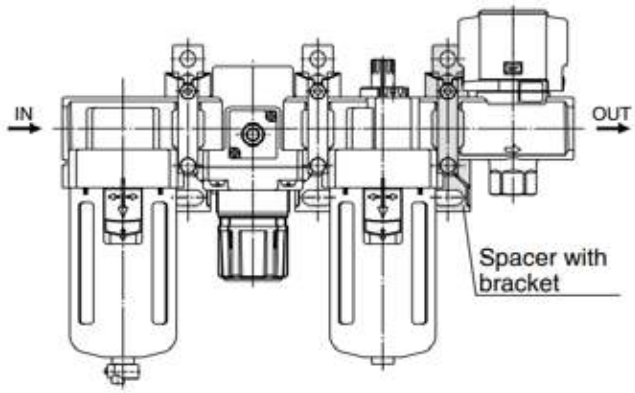
Thread type

Nil	Rc
N	NPT
F	G

Port size

Symbol	Port size	Body size			
		20	30	40	50
01	1/8	●	–	–	–
02	1/4	●	●	●	–
03	3/8	–	●	●	–
04	1/2	–	–	●	–
06	3/4	–	–	●	●
10	1	–	–	–	●

Pressure relief 3 port valve	Spacer part no.	Spacer with bracket part no.	Applicable air preparation equipment
VHS20	Y200	Y200T	AC20
VHS30	Y300	Y300T	AC25, AC30



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Manuf.: . PNo: SMC USA: Y300T	Rev: 0	Device Tag: RV1	
	Date: 02-16-2026	Job Number: HBR10366	Page # 1/1
	By: AJ		

5 Port Pilot Operated Solenoid Valve
Metal Seal, Body Ported
Series VFS3000

74-255-006

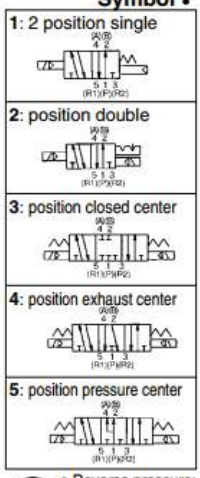
Model

Type of actuation		Model: Plug-in	Model: Non plug-in	Port size Rc	Flow characteristics: 1→4/2(P→A/B) C [dm³/(s·bar)]	1→4/2(P→A/B) b	1→4/2(P→A/B) Cv	4/2→5/3(A/B→R1/R2) C [dm3/(s·bar)]	4/2→5/3(A/B→R1/R2) b	4/2→5/3(A/B→R1/R2) Cv	Max.(1) operating cycle (cpm)	Response time(2) (ms)	Mass(3) (kg)
2 position	Single	VFS3120	VFS3130	1/4	5.0	0.20	1.1	6.8	0.30	1.7	1200	20 or less	0.33
				3/8	6.1	0.14	1.4	7.3	0.23	1.8			
	Double	VFS3220	VFS3230	1/4	5.0	0.20	1.1	6.8	0.3	1.7	1500	15 or less	0.43
				3/8	6.1	0.14	1.4	7.3	0.23	1.8			
3 position	Closed center	VFS3320	VFS3330	1/4	5.0	0.20	1.1	6.3	0.27	1.6	600	40 or less	0.45
				3/8	5.7	0.20	1.4	6.8	0.21	1.7			
	Exhaust center	VFS3420	VFS3430	1/4	4.9	0.24	1.1	6.5	0.28	1.6	600	40 or less	0.45
				3/8	5.8	0.15	1.4	7.0	0.22	1.7			
	Pressure center	VFS3520	VFS3530	1/4	4.9	0.23	1.1	6.6	0.28	1.6	600	40 or less	0.45
				3/8	6.5	0.15	1.6	7.0	0.23	1.7			

Note 1) Based on JIS B 8375 (once per 30 days) for the minimum operating frequency.
Note 2) Based on JIS B 8375-1981. (The value at supply pressure 0.5 MPa.)
Note 3) In the case of grommet type.
Note 4) Factors of "Note1)" and "Note 2)" are achieved in controlled clean air.

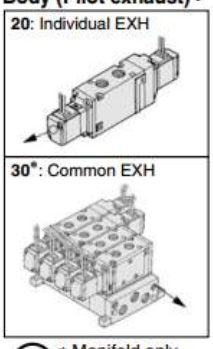
VFS3 1 20 □ – 1 G □ □ – 02 □ – □

Symbol
- 1: 2 position single
- 2: position double
- 3: position closed center
- 4: position exhaust center
- 5: position pressure center



* Reverse pressure: Can be used by external pilot specifications.

Body (Pilot exhaust)
- 20: Individual EXH
- 30*: Common EXH



* Manifold only

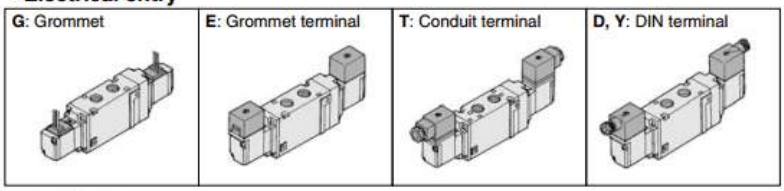
Pilot type
Nil	Internal pilot
R*	External pilot

* Option. It will be an individual external pilot.
(External pilot port: Body side. For 30 type, common external pilot (on manifold side).)

Coil rated voltage
1	100 VAC (50/60 Hz)
2	200 VAC (50/60 Hz)
3*	110 to 120 VAC (50/60 Hz)
4*	220 VAC (50/60 Hz)
5	24 VDC
6*	12 VDC
7*	240 VAC (50/60 Hz)
9*	Other

* Option

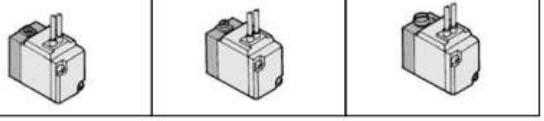
Electrical entry
- G: Grommet
- E: Grommet terminal
- T: Conduit terminal
- D, Y: DIN terminal



Light/Surge voltage suppressor
Nil	None
Z	With light/surge voltage suppressor
S*	With surge voltage suppressor

* Grommet type is available only w/ surge voltage suppressor, not w/ indicator light.

Manual override
- Nil: Non-locking push type (Flush)
- A*: Non-locking push type (Extended)
- B*: Locking type (Tool required)



* Option

Port size
02	Rc 1/4
03	Rc 3/8

Thread type
Nil	Rc
N*	NPT
T*	NPTF
F*	G

* Option

Option
F: With foot bracket



* Mountable only for VFS3120.

ELEMECH INC. 630-499-7080 · www.elemechinc.com		Rev: 0	Device Tag: SOV1
		Date: 02-16-2026	
Manuf.: . PNo: SMC USA: VFS3120-3DZ-03T		By: AJ	Job Number: HBR10366
			Page # 1/1

Push-to-Connect Tube Fitting for Air

Adapter, for 3/8" Tube OD x 10 mm Tube OD

McMASTER-CARR

5779K259



94-215-004

For Use With	Air
Shape	Straight
Type	Adapter
Tube Connections	
Type	Push to Connect
Gender	Female
For Tube OD	
(A)	3/8"
(B)	10mm
Material	Nylon Plastic
Maximum Pressure	290 psi @ 72° F
Maximum Vacuum	28 in. of Hg @ 72° F
Temperature Range	0° to 170° F
For Tubing	Firm (Durometer A95) Polyurethane, Firm (Durometer D44) Polyethylene Plastic, and Hard (Durometer D62) Nylon Plastic
Release Ring	
Material	Plastic
Color	Black
Color	Black
Specifications Met	ISO 14743
RoHS	Compliant

fasis

wieland

42-063-000







2,5 mm²/5 mm Width

4 mm²/6 mm Width

10 mm²/10 mm Width

16 mm²/12 mm Width

35 mm²/16 mm Width

Type	Part no.	Std. pack
Marking strips, unmarked		
9705 A/5/10	04.242.5053.0	25
Marking strips, marked		
9705 A/5/9 B 1 - 9	04.842.4953.0	25
9705 A/5/10 B*	04.842.5053.0	25
9705 A/5/10 B 1 - 10	04.845.0153.0	25
11 - 20	04.845.0253.0	25
21 - 30	04.845.0353.0	25
31 - 40	04.845.0453.0	25
41 - 50	04.845.0553.0	25
51 - 60	04.845.0653.0	25
61 - 70	04.845.0753.0	25
71 - 80	04.845.0853.0	25
81 - 90	04.845.0953.0	25
91 - 100	04.845.1053.0	25
⊕ (10 x)	04.855.0053.0	25
⏚ (10 x)	04.855.0153.0	25
+ (10 x)	04.855.0253.0	25
– (10 x)	04.855.0353.0	25
L1 (10 x)	04.855.0453.0	25
L2 (10 x)	04.855.0553.0	25
L3 (10 x)	04.855.0653.0	25
PE (10 x)	04.855.0753.0	25
SL (10 x)	04.855.3153.0	25
N (10 x)	04.855.3253.0	25
F1 (10 x)	04.855.0953.0	25
F2 (10 x)	04.855.1053.0	25
L1, L2, L3, N, PE (2 x)	04.855.0853.0	25
with enlarged marking area		
9705 AL/5/10	04.242.5153.0	25
*Custom marking upon request		

Type	Part no.	Std. pack
Marking strips, unmarked		
9705 A/6/10	04.242.6053.0	25
Marking strips, marked		
9705 A/6/9 B 1 - 9	04.842.5953.0	25
9705 A/6/10 B*	04.842.6053.0	25
9705 A/6/10 B 1 - 10	04.846.0153.0	25
11 - 20	04.846.0253.0	25
21 - 30	04.846.0353.0	25
31 - 40	04.846.0453.0	25
41 - 50	04.846.0553.0	25
51 - 60	04.846.0653.0	25
61 - 70	04.846.0753.0	25
71 - 80	04.846.0853.0	25
81 - 90	04.846.0953.0	25
91 - 100	04.846.1053.0	25
⊕ (10 x)	04.856.0053.0	25
⏚ (10 x)	04.856.0153.0	25
+ (10 x)	04.856.0253.0	25
– (10 x)	04.856.0353.0	25
L1 (10 x)	04.856.0453.0	25
L2 (10 x)	04.856.0553.0	25
L3 (10 x)	04.856.0653.0	25
PE (10 x)	04.856.0753.0	25
SL (10 x)	04.856.3153.0	25
N (10 x)	04.856.3253.0	25
F1 (10 x)	04.856.0953.0	25
F2 (10 x)	04.856.1053.0	25
L1, L2, L3, N, PE (2 x)	04.856.0853.0	25
with enlarged marking area		
9705 AL/6/10	04.242.6353.0	25
*Custom marking upon request		

Type	Part no.	Std. pack
10 mm²/10 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/5/10/5 B	04.842.5553.0	25
16 mm²/12 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/6/10/5 B	04.842.6553.0	25
35 mm²/16 mm Width		
marked for 5 blocks (every 2nd tag) *		
9705 A/8/10/5 B	04.842.8553.0	25
* indicate required marking with part no.		

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Manuf.: . PNo:
Wieland: 04.242.6353-CUSTOM

Rev: 0

Date: 02-16-2026

By: AJ

Device Tag: TB1

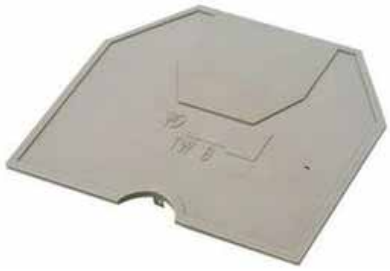
Job Number: HBR10366

Page # 1/1

wieland

42-063-001

Datasheet



Art.No. 07.311.0155.0

End plate AP 2,5 -4 /V0

End plate for DIN rail terminal blocks type WK ..., color gray

Art.No.	07.311.0155.0
EAN	4015573392663
Order unit	10 pieces

Approvals

Technical data

General

Colour	Grey
Type of end plate	Yes
Type of partition	No
Thickness	1.5 mm
Snap in	Yes
Inflammability class of insulation material acc. with UL94	V0

Accessories

Type of end plate	Yes
Type of partition	No
Colour	Grey
Thickness	1.5 mm
Snap in	Yes
Inflammability class of insulation material acc. with UL94	V0

Feed-through blocks with screw connection

selos

wieland

42-063-003

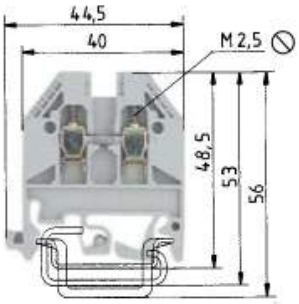


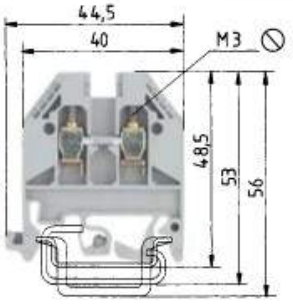
UL wire connection versions

[4] or 2x no. 14 sol/str AWG
or 2x no. 16 sol/str AWG
or 2x no. 18 sol/str AWG
or 3x no. 20 sol/str AWG or 3x no. 22 sol/str AWG

[5] or 2x no. 12 sol/str AWG
or 2x no. 16 sol/str AWG
or 3x no. 18 sol/str AWG or 3x no. 22 sol/str AWG

[6] or 2x no. 12 sol/str AWG
or 2x no. 14 sol/str AWG
or 3x no. 16 sol/str AWG





0344 Ex II 2GD IM2
Ex e I/II
EN 60947-7-1:2002
UL ratings — Field/factory wiring
CSA ratings
KEMA 02 ATEX 2114 U[1] EN 60079-0/EN 60079-7
Width — Wire strip length
Approvals

WK 2,5/U				WK 4/U			
fine-stranded	solid	V	A	fine-stranded	solid	V	A
0.5-2.5 mm²	0.5-4 mm²	800V/8 kV/3	24	0.5-4 mm²	0.5-6 mm²	800V/8kV/3	32
No. 22-12 AWG		600V	20/30	No. 22-10 AWG[4]		600V	30/35
No. 24-12 AWG		600V	25	No. 20-10 AWG		600V	40
0.5-2.5 mm²	0.5-4 mm²	690V	23	0.5-4 mm²	0.5-6 mm²	690V	14/27[3]
5 mm			9 mm	6 mm			9 mm

		Type	Part No.	Std. Pack	Type	Part No.	Std. Pack
Feed-through block	gray	WK 2,5/U	57.503.0055.0	100	WK 4/U	57.504.0055.0	100
Feed-through block Exi	blue	WK 2,5/U BLAU	57.503.0055.6	100	WK 4/U BLAU	57.504.0055.6	100
Accessories							
1. Mounting rail TS 35, DIN rail 7.5 mm high	L = 2 m	35 x 27 x 7,5 EN 60715	98.300.0000.0	1	35 x 27 x 7,5 EN 60715	98.300.0000.0	1
Mounting rail TS 35, DIN rail, 15 mm high	L = 2 m	35 x 24 x 15 EN 60715	98.360.0000.0	1	35 x 24 x 15 EN 60715	98.360.0000.0	1
Mounting rail TS 32, G rail[2]	L = 2 m	9006 EN 60715 G-32	98.190.0000.0	1	9006 EN 60715 G-32	98.190.0000.0	1
2. End clamp with U-foot[2]	10mm wide	WE 1/U	Z5.523.5753.0	100	WE 1/U	Z5.523.5753.0	100
End clamp TS 35, with screw	8mm wide	9708/2 S35	Z5.522.8553.0	100	9708/2 S35	Z5.522.8553.0	100
End clamp TS 35, without screw	8mm wide	WEF 1/35	Z5.523.9353.0	100	WEF 1/35	Z5.523.9353.0	100
3. End plate	gray	AP 2,5 - 4	07.311.0155.0	10	AP 2,5 - 4	07.311.0155.0	10
	blue	AP 2,5 - 4 BLAU	07.311.0155.6	10	AP 2,5 - 4 BLAU	07.311.0155.6	10
4. Partition	gray	TW 2,5 - 4	07.311.1155.0	10	TW 2,5 - 4	07.311.1155.0	10
	blue	TW 2,5 - 4 BLAU	07.311.1155.6	10	TW 2,5 - 4 BLAU	07.311.1155.6	10
5. Cross connector with screws	2 pole	IVB WK 2,5 - 2	Z7.280.2227.0	10	IVB WK 4 - 2	Z7.281.1227.0	10
insulated	3 pole	IVB WK 2,5 - 3	Z7.280.2327.0	10	IVB WK 4 - 3	Z7.281.1327.0	10
	up to 12 pole	IVB WK 2,5 - 12	Z7.280.3227.0	10	IVB WK 4 - 12	Z7.281.2227.0	10
6. Partition plate with marking facility		TS 2,5 GELB	07.311.2053.8	10	TS 4 GELB	07.311.2153.8	10
7. Single cover with marking facility		AD VB 2,5 GELB	04.326.2053.8	10	AD VB 4 GELB	04.326.2153.8	10
8. Cover with warning symbol over 4 blocks		AD VB 5/4 GELB	04.343.4756.8	10	AD VB 6/4 GELB	04.343.4856.8	10

For more accessories see pages 60-77
For marking systems see pages 70-75

[1] For maintaining the proper isolation distances, the open side of a feed-through terminal block as well as both sides of a jumper are to be enclosed by partitions.
[2] Please note the mounting instructions on the cover page. [3] Do not use in Ex environments. [4] With/without jumper

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Rev: 0	Device Tag: TB1
Date: 02-16-2026	
By: AJ	Job Number: HBR10366
Page # 1/1	

Manuf.: . PNo: Wieland: 57.504.0055.0

Item No. 57.504.9055.0

wieland

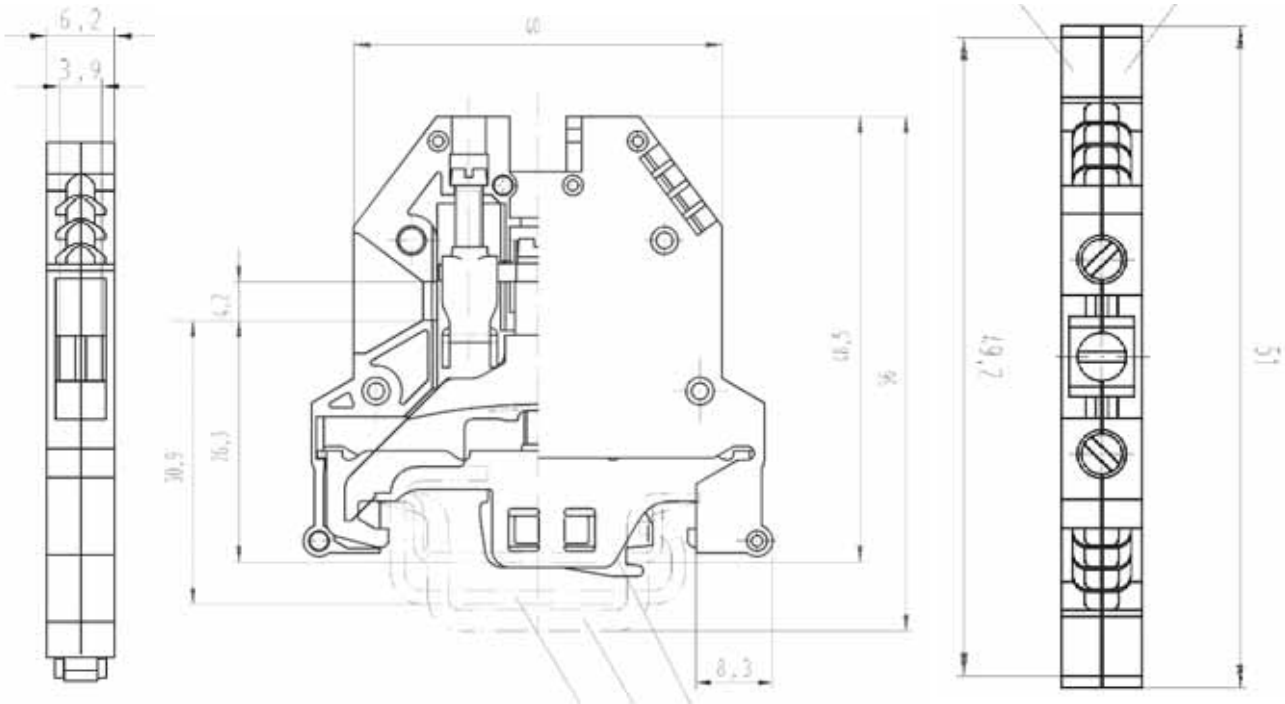
Earth terminal WK 4 SL/ U /V0

Ground DIN rail terminal block with screw connection for mounting on TS 35 and TS 32, nominal cross section 4 mm², width 6 mm, color green/yellow



42-063-004

Rated impulse voltage	8 kV
Pollution degree	3
Closing plate required	No
Length	51 mm
Type of insulation material	Thermoplastic
Cross section UL	22-10 AWG
Cross section CSA	20-10 AWG
Maximum cross section fine stranded	4 mm²
Wire strip length	9 mm
Torque conductor mounting	0.5 Nm
Torque rail mounting	0,5



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Rev: 0

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Device Tag: TB1

Job Number: HBR10366

Page # 1/1

Manuf.: . PNo: Wieland: 57.504.9055.0

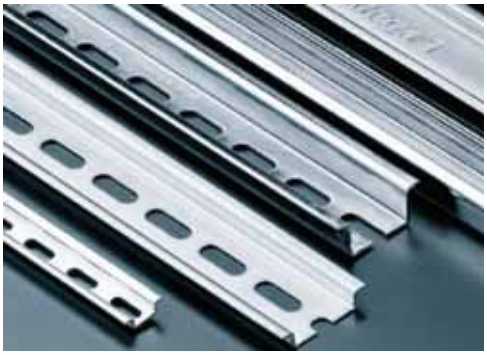
DIN RAILS

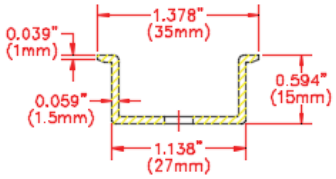
IBOCO Integrated Panel Management

42-063-007

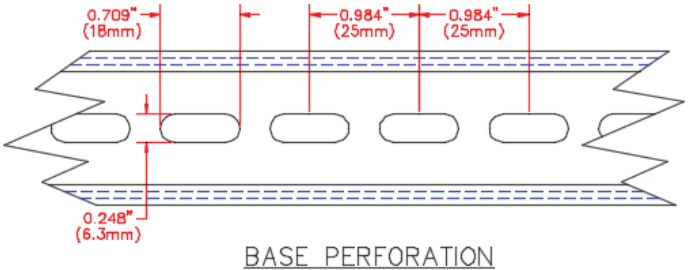
Catalog Number	Lengths per Pack
G1	12
G1F	12
G1F1	24
OMEGA 2F	20
OMEGA 2F1	40*
OMEGA 3	20
OMEGA 3F	20
OMEGA 3F1	40*
OMEGA 3FD	20
OMEGA 3A	10
OMEGA 3AF	10
OMEGA 3AF1	20*
OMEGA 3AFD	10
OMEGA 3B	10
OMEGA 3B1	10*
OMEGA 75	2

Treated with galvanic zinc plating and passivation (gal Zn 8c according to Din 50960)
Minimum thickness 6 microns
Standard length: 2 meters (6'6¾")

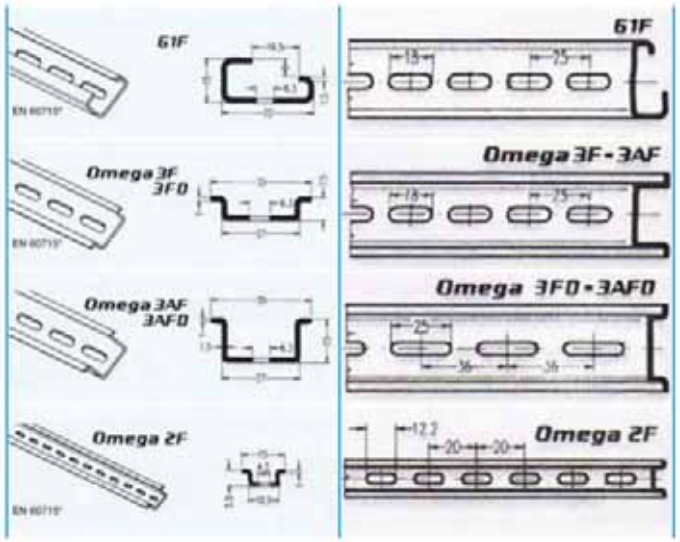


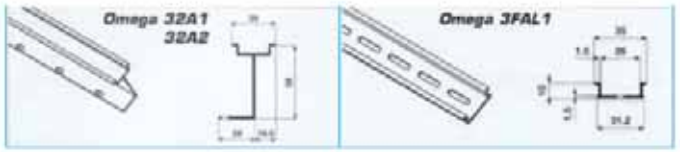


FRONT SECTION



BASE PERFORATION





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Manuf.: . PNo: Iboco: Omega 3 AF	Rev: 0	Device Tag: TB1	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

Item No. Z5.522.8553.0
End bracket 9708 / 2 S 35
End clamp for mounting rail TS 35

wieland

42-063-009

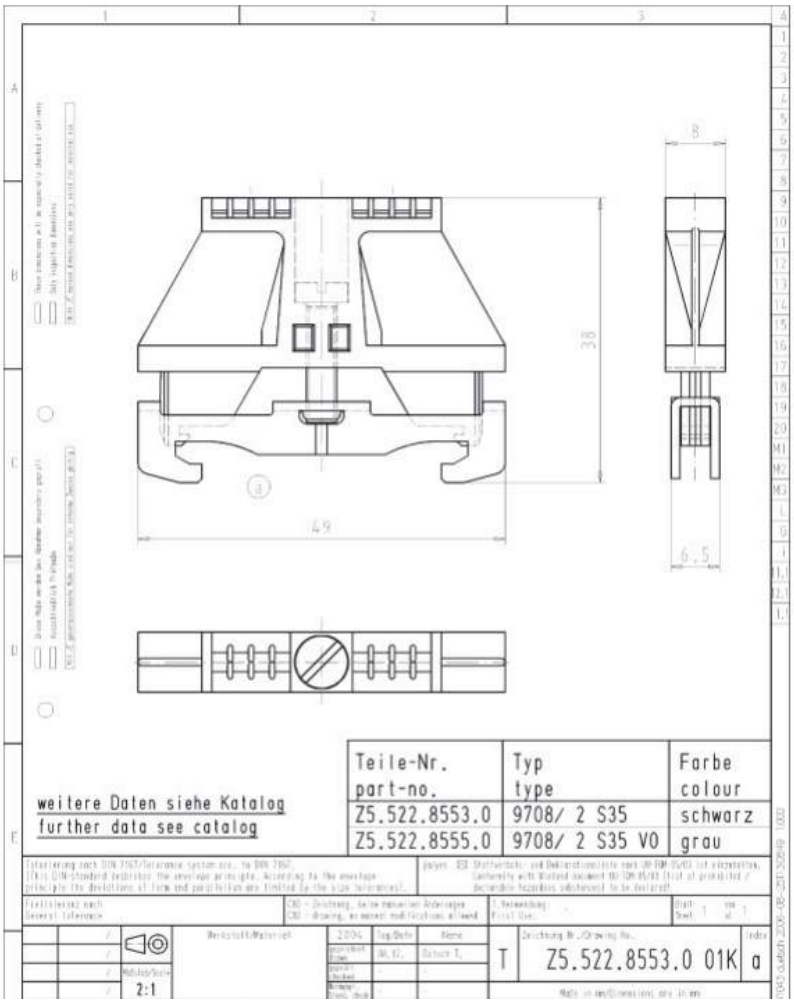


Item No.	Z5.522.8553.0
EAN	4015573141766
order unit	100 Piece(s)

Technical data

Accessories

ArticlePrice	udp_no_price
Colour	Black
Inflammability class of insulation material acc. with UL94	V2
Width/grid dimension	8 mm
Latching	Screwable
Length	49 mm
Material	Metal
Mounting method	DIN rail (top hat rail) 35/7.5 mm



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Manuf.: . PNo: Wieland: Z5.522.8553	Rev: 0	Device Tag: TB1	
	Date: 02-16-2026		
	By: AJ	Job Number: HBR10366	Page # 1/1

Fast-Acting ¼" x 1 ¼" Glass Tube Fuses

AGC Series



COOPER Bussmann

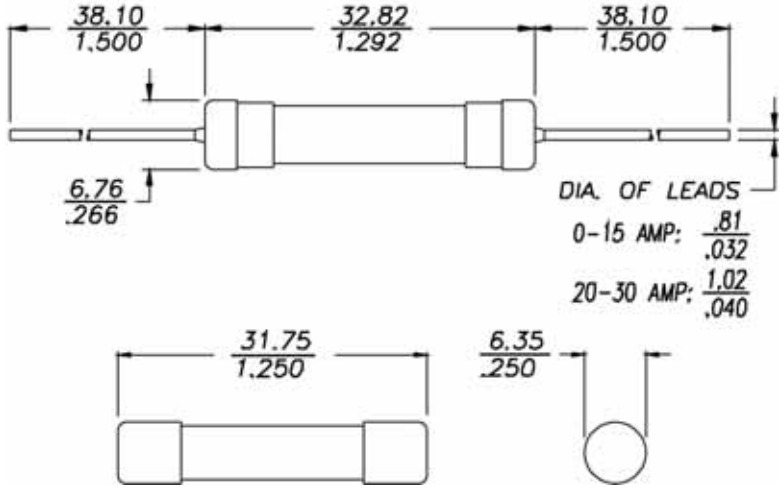
13-012-034

Non-RoHS Part Number	RoHS Part Number	AC Voltage Rating	SPECIFICATIONS AC Interrupting Rating (amps) 250	125	32	Typical DC Cold Resistance* (Ω)	Typical Melting I²t† AC	Typical Voltage Drop‡
AGC-1/16	AGC-1/16-R	250	35	10,000	—	4.500	0.00773	0.67
AGC-1/8	AGC-1/8-R	250	35	10,000	—	12.565	0.000787	6.00
AGC-¼	AGC-¼-R	250	35	10,000	—	6.800	0.00131	4.67
AGC-3/8	AGC-3/8-R	250	35	10,000	—	4.900	0.00637	4.12
AGC-½	AGC-½-R	250	35	10,000	—	3.360	0.00435	4.51
AGC-¼	AGC-¼-R	250	35	10,000	—	2.300	0.0148	0.89
AGC-3/8	AGC-3/8-R	250	35	10,000	—	1.670	0.0208	2.88
AGC-⅜	AGC-⅜-R	250	35	10,000	—	1.203	0.0321	4.59
AGC-½	AGC-½-R	250	35	10,000	—	0.615	0.269	0.59
AGC-¾	AGC-¾-R	250	35	10,000	—	0.312	0.815	0.37
AGC-1	AGC-1-R	250	35	10,000	—	0.190	1.615	0.31
AGC-1-¼	AGC-1-¼-R	250	100	10,000	—	0.145	0.018	0.35
AGC-1-½	AGC-1-½-R	250	100	10,000	—	0.115	0.0149	0.27
AGC-2	AGC-2-R	250	100	10,000	—	0.078	0.00509	0.28
AGC-2-¼	AGC-2-¼-R	250	100	10,000	—	0.067	0.00588	0.26
AGC-2-½	AGC-2-½-R	250	100	10,000	—	0.057	0.00879	0.31
AGC-3	AGC-3-R	250	100	10,000	—	0.045	0.0167	0.25
AGC-4	AGC-4-R	250	200	10,000	—	0.030	0.0305	0.22
AGC-5	AGC-5-R	250	200	10,000	—	0.024	0.045	0.23
AGC-6	AGC-6-R	250	200	10,000	—	0.020	0.071	0.23
AGC-7	AGC-7-R	250	200	10,000	—	0.017	0.105	0.23
AGC-7-½	AGC-7-½-R	250	200	10,000	—	0.0146	—	—
AGC-8	AGC-8-R	250	200	10,000	—	0.014	0.152	0.19
AGC-9	AGC-9-R	250	200	10,000	—	0.012	0.21	0.18
AGC-10	AGC-10-R	250	200	10,000	—	0.008	0.492	0.20
AGC-12	AGC-12-R	32	—	—	1000	0.0070	—	—
AGC-14	AGC-14-R	32	—	—	1000	0.0062	—	—
AGC-15	AGC-15-R	32	—	—	1000	0.006	0.566	0.14
AGC-20	AGC-20-R	32	—	—	1000	0.004	1.438	0.12
AGC-25	AGC-25-R	32	—	—	1000	0.003	2.109	0.11
AGC-30	AGC-30-R	32	—	—	1000	0.002	3.807	0.12
AGC-35	AGC-35-R	32	—	—	70	0.0014	—	—
AGC-40	AGC-40-R	32	—	—	80	0.0019	—	—

* DC Cold Resistance (Measured at ≤10% of rated current)
† Typical Melting I²t (A²Sec) (I²t was measured at listed interrupting rating and rated voltage.)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C ambient temperature at rated current)

Dimensions (mm/in)

Drawing Not to Scale



Agency Information

- UL Listed Card: AGC 1/500-10
- UL Recognition Card: AGC 11-45
- CSA Component Acceptance Card (Class No. 1422 30)
- CSA Certification Card (Class No. 1422 01)

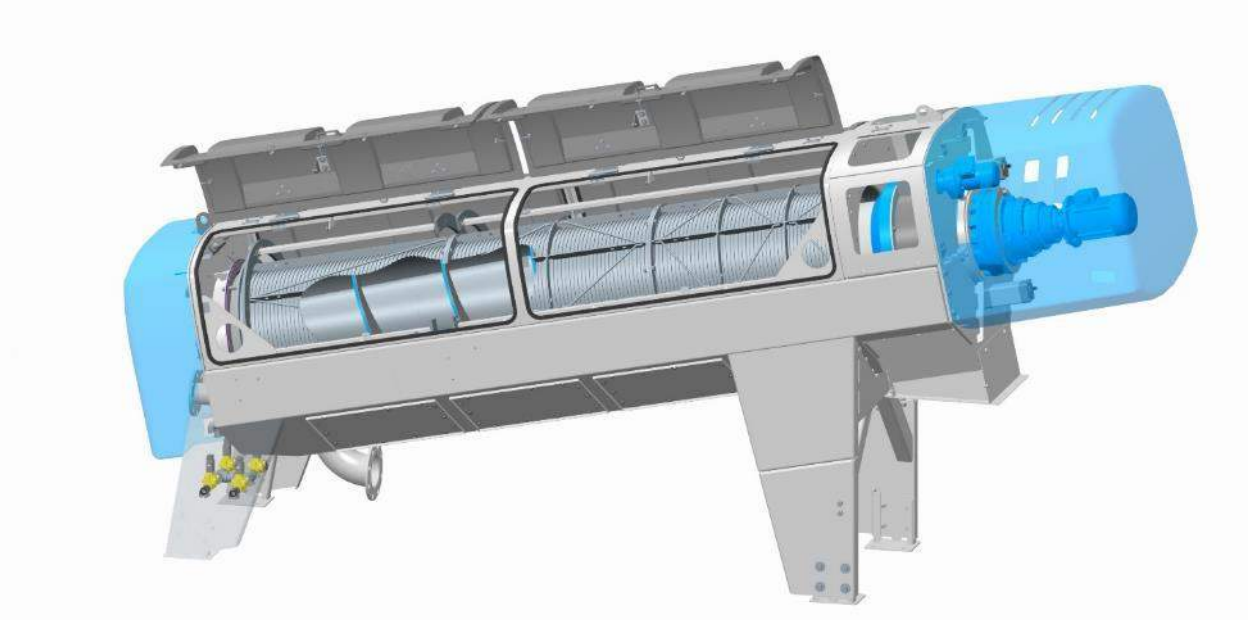
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Rev: 0	Device Tag: SPARE	
Date: 02-16-2026		
Manuf.: . PNo: Bussman: AGC-1	Job Number: HBR10366	Page # 1/1
By: AJ		

Operation Manual

HUBER Screw Press Q-PRESS®

620.2
800.2



HUBER SE
Industriepark Erasbach A1

92334 Berching

Original Operating Manual
Version 01/25



NOTICE

This manual is part of the plant and must be available for the operators any time.
The safety instructions must be observed.
In case of selling the plant, the manual must be included.
For a better overview this manual may contain photos/graphics of the machine without safety devices. Operation of the machine is only permitted when all prescribed safety devices as e.g. covers or railings are mounted.

Translation
For delivery in the EEA, the operating manual is to be translated into the language of the target country.
If inconsistencies occur in the text, refer to the original operating manual (German), or contact the manufacturer.

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1 Product specification

1.1 Intended use

The plant is designed for continuous dewatering of freely flowing conditioned suspensions (sewage sludge) by gravity, pressure and shear forces.
Fields of application: treatment of municipal and industrial sludge
Any other or additional use does not comply with the intended use. The manufacturer does not assume any liability for consequential damage caused by non-observance of these operating instructions. The operator bears the full risk.

The intended use also includes:

- Observance of the start-up, operation and maintenance conditions as set out in this operating manual.
- Due consideration of foreseeable misuse
- Operation by skilled workers only (who are familiar with the correct procedures and know the dangers)

⚠ WARNING

The machine is intended exclusively for the above specified use.
Any additional use or rebuilding of the equipment without prior written approval by the manufacturer does not comply with the intended use.
The manufacturer will not assume liability for consequential damage. The operator alone will bear the risk.
Do not start up the machine before there has been ensured that all safety devices are completely mounted and operable, and that the plant into which the machine may be incorporated complies with the rules.

1.2 EMC advice

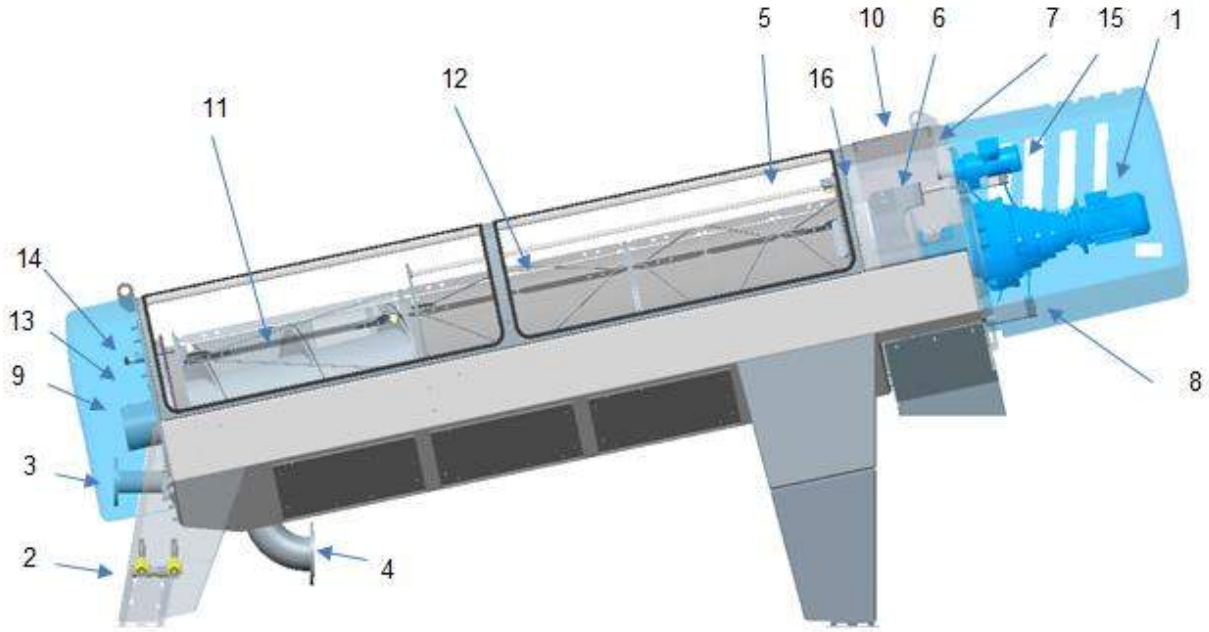
NOTICE

Advice for applying the EC rule EMV 2014/30/EU:
The plant is prepared for operation in industrial areas acc. to DIN EN 61000-6-4 (generic standards for transient emissions in industrial areas). Wiring and control technology have to meet additionally the requirements of DIN EN 61000-6-3 (transient emission in living areas) for operation in living areas, in business and commercial areas and in small companies.

1.3 Definition of terms for equipment components

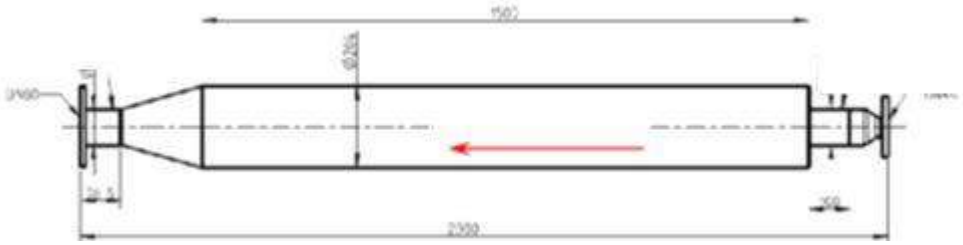
Definition of terms:

Partial section of a size 620.2 unit:

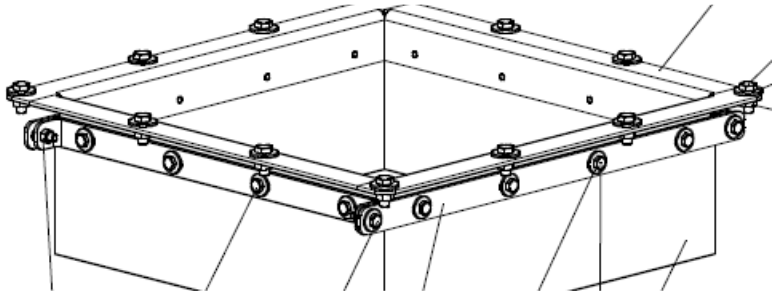


1	Screw drive	9	Screw bearing lubricator
2	Wash water connection to 4 solenoid valves	10	Sludge discharge inspection cover
3	Sludge inlet flange	11	Screw shaft
4	Filtrate outlet flange	12	Cylindrical screen drum
5	Spray nozzle bar / spray nozzles	13	Screening zone inspection cover
6	Pressure cone	14	Pressure sensor of sludge inlet chamber
7	Sludge discharge chamber	15	Drive of spray nozzle basket
8	Pneumatic cylinder with connections for compressed air	16	Proximity switch of spray nozzle basket

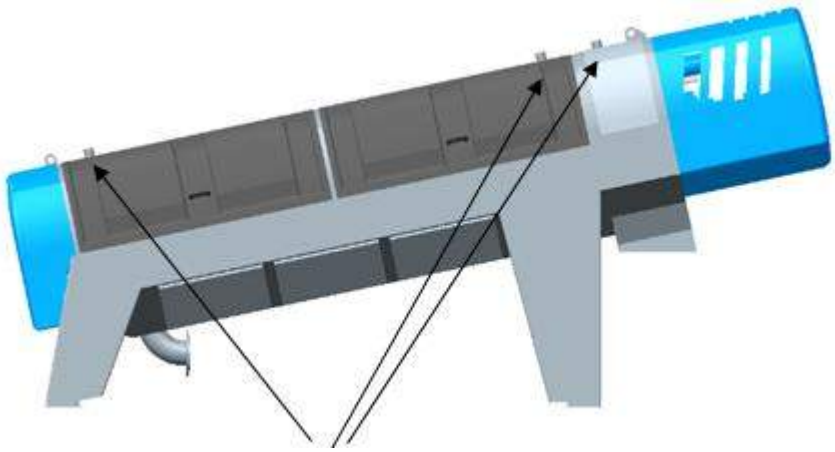
Optional equipment:



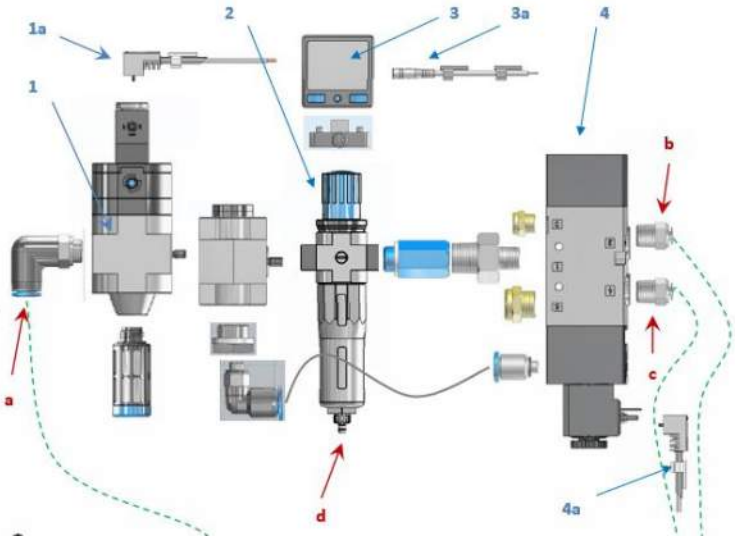
Tubular flocculation reactor for sludge conditioning, flow direction from right to left



Transfer chamber to downstream conveying system



Ventilation pipe sockets for the connection of an external ventilation plant



Pneumatic control unit for pressure cone control

1.4 Functional description

The dewatering machine is a screw press with a conical screw shaft and cylindrical sieve consisting of three treatment zones: inlet and drive zone, three-part thickening and dewatering zone, and press zone with pneumatic counter-pressure cone.

The screw press must be fed with flocculated sludge of sufficient stability. In the first section of the sieve the feed pump removes the free supernatant liquor quickly from the sludge via a large free screening surface and with low primary pressure. The pressure probe in the inlet protects the plant against excessive primary pressure and consequently excessive pollution of the filtrate liquor.

In the second section of the sieve the volume of material between the screw flights is reduced by the conical screw and the sludge pressed against the inner screen surface so that the sludge is dewatered, with a continuous reduction of filter cake thickness. The screen apertures are much smaller in this section of the sieve.

In the third section of the sieve the pneumatic counterpressure cone presses the residual water out of the sludge with a minimum filter cake thickness. Depending on the type and consistency of the sludge flocks the pressure applied on the sludge can be varied infinitely.

The dewatered sludge is pushed by the conveying screw past the pressure cone into the discharge chamber.

The sludge residence time in the screw press and thus the filtration time can be adjusted to individual requirements by adjusting the rotational speed of the screw shaft.

Scrapers fitted on the flights ensure permanent automatic sieve cleaning from inside. Intervallic cleaning of the sieves from outside is accomplished by means of a spray nozzle bar. On Q-PRESS® 440.2 units, the spray bar is stationary mounted whereas the screen basket is a rotating element. For the purpose of cleaning the feed into the screw press is temporarily stopped and the shaft starts to reverse. As the flexibly supported screen drum rotates passing by the spray nozzle bar, the screen surface is cleaned. In pressing mode sludge feeding starts again and the screw shaft rotates forwards. The screen basket rotates until arrested by ratchet pawls anchored in the casing. On Q-PRESS® 620.2 and 800.2 units, the dewatering process is not interrupted while the washing mode is active, i.e. the machine does not stop during a wash cycle. Four separately controllable spray nozzle segments permit screen basket washing zone by zone.

Notice

The cleaning unit is subject to the Pressure Equipment Directive 2014/68/EU, and the requirements of Article 4 paragraph 3 for "sound engineering practice" have been taken into account.
Safety is ensured when it is used under the foreseeable conditions specified in the Operating Manual.

2 EC Conformity Certificate, Certificate of Incorporation

The machine complies with the EC standards which prescribe the CE label. The EC Declaration of Conformity confirms that the operable machine fulfils all relevant safety and health requirements. The EC Declaration of Conformity is provided only if the HUBER plant is supplied as a ready-to-operate unit complete with the electrical switchboard and control panel, and if plant installation and commissioning are performed by HUBER SE.

The Declaration of Incorporation is required if the supplied incomplete machine is not operable independently, i.e. if the machine is to be incorporated in other machines for example to obtain an operable complete plant, or if the electrical switchboard and control panel is supplied by a third party. We herewith declare that the design of the incomplete machine as supplied complies with standards, EC directives and DIN EN standards, as far as applicable as delivery does not include the electrical switchboard and control panel. Any modification of the machine without our prior approval will invalidate this declaration. Start-up of the machine is prohibited until the complete plant is in conformity with the quoted directives.

The Declaration of Incorporation is attached in the appendix and additionally included in the table of contents.

3 Safety

3.1 General safety instructions

DANGER

„DANGER“ indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

„WARNING“ indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

„CAUTION“ indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

„NOTICE“ indicates a property damage message. Follow notices to avoid material damage!

This operating manual has to remain attached to the machine. It must be ensured that all personnel operating the machine have access to the operating manual at all times. In addition to these operating instructions, instructions in the sense of the labour protection law and ordinance regulating the use of tools have to be available.
The operating manual contains fundamental guidelines which must be observed during installation, operation and maintenance. For this reason, this operating manual must be read by the technicians responsible before assembly and commissioning. The operating manual must always be available in the immediate vicinity of the machine. In addition to the general safety guidelines listed in this section, the specific safety guidelines listed under the main points below must also be observed.

3.1.1 Due diligence of the operator

The system is designed and built according to a risk assessment, careful selection of harmonised mandatory standards and additional technical specifications. The plant complies with state-of-the-art technology and offers the maximum amount of safety.

However, this level of safety can only be achieved during operation if all of the required measures are taken. The operator of the machine is responsible for planning these measures and ensuring that they are implemented.

The operator must especially ensure that

- The equipment is only used as intended (see chapter Product Specification).
- The equipment is only operated when it is in working order and that the function of the safety mechanisms is checked regularly.
- Personal protective equipment for the operating, maintenance and repair personnel is available and used.
- These operating manual is always in a legible state and is available in its entirety in the immediate vicinity of the machine.

- Only sufficiently qualified and authorised personnel operates, maintains and repairs the machine.
- Such personnel receive regular briefing concerning all questions of safety and environmental protection and know these operating instructions, especially the safety instructions contained.
- All safety and warning notices on the machine are not removed and can be read at all times.

3.1.2 Description of safety symbols



⚠ WARNING

Occupational safety symbol
This symbol will accompany all safety instructions that are associated with risks to life and/or limb. Follow these instructions and proceed carefully! At the same time, follow all applicable laws, general safety and accident prevention regulations.



⚠ WARNING

Electric current warning
This symbol warns of electric current. Prior to performing any work, switch off the mains isolator and make sure that the system is off-circuit.
At the same time, follow all applicable laws, general safety and accident prevention regulations.



⚠ WARNING

Automatic machine start:
Be careful not to get caught when starting up, servicing or repairing the machine!

NOTICE

This symbol is found where special attention is required to ensure compliance with instructions concerning correct operating sequences to prevent damage to the machine or its function.

Instructions directly attached to the machine, e.g.
- Notice and warning signs
- Identification signs for liquid supply connections
- Rotational direction arrow

must be adhered to and fully legible at all times.
Damaged or illegible signs must be replaced immediately.

3.1.3 Qualification and training of personnel

Only well-trained and briefed persons who know these operating instructions and act according to these instructions are authorized to operate the machine. The individual areas of responsibility of operating staff must be defined clearly. The area of authority, responsibility and control of the personnel must be precisely regulated by the operator. The operator must further ensure that the personnel has fully understood these operating instructions.

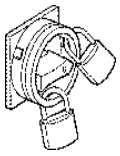
Personnel being trained must in the beginning work under the supervision of an experienced person. The completed successful training and briefing must be confirmed in writing.

Any electrical control and safety devices must generally be operated by instructed and authorized persons only.
Any person performing work on the machine must read these operating instructions and confirm by signature that the operating instructions have been understood.

3.1.4 Safety instructions for maintenance, inspection, installation

Maintenance work must only be carried out by qualified personnel.
Any inspection and installation work must be carried out by authorised and qualified personnel only. Work on electrical equipment must only be carried out by qualified electricians according to DIN VDE 1000-10.
Work on the plant may only be carried out when the plant is disconnected from the mains.

Enclosed rooms of wastewater treatment plants that must be entered for service and maintenance have to be aerated in a way that prevents a dangerous explosive atmosphere, lack of oxygen and presence of harmful concentrations of gas or vapour.



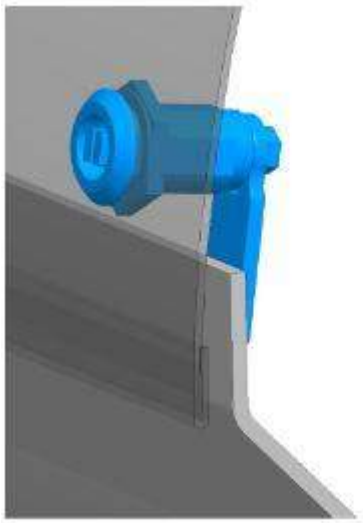
⚠ WARNING

Shutdown procedure: Switch off mains isolator and lock it.
Each person who is commissioned to perform maintenance work on the machine must have his own padlock. Starting the machine is only possible when all padlocks on the mains isolator have been removed.
Check if upstream and downstream equipment may cause a danger, switch off power supply for upstream and downstream equipment before performing maintenance or repair.
If the whole plant cannot be disconnected from the mains for operational reasons, individual machines must be disconnected by a skilled electrician in accordance with DIN VDE 1000-10 and secured against unintentional restart acc. to DIN EN 50110-1 VDE 0105-1.
As an option all machine drives can be supplied with a repair switch. For maintenance work the machine or area concerned can be switched off acc. to DIN VDE 0100-200. The repair switches must be switched off and locked as described above..

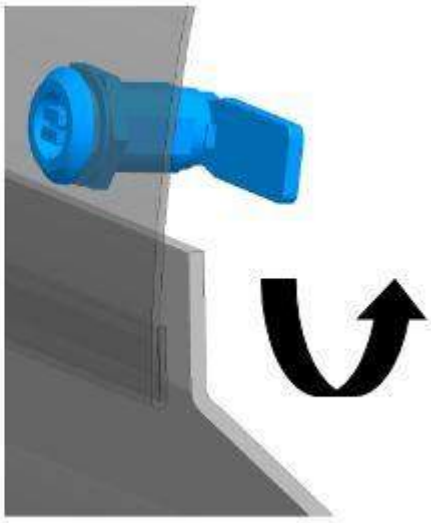
Opening the machine:
All inspection openings are secured with screw connections or turning locks to prevent they are opened by unauthorized persons.

⚠ CAUTION

Open the inspection covers only after shutdown of the machine or for visual inspection while the machine is running.
Never grip into the inside of the machine while the machine is running.



Turning locks closed



Turning locks open

Do not immediately re-start the machine, if the reason why it has stopped is unclear. Somebody could have stopped the machine in order to make a manual adjustment and may have forgotten to secure it against starting. The unexpected start could result in serious injury of personnel.

It is in your own interest to clean the machine prior to working on it to prevent the danger of infections.

⚠ CAUTION

Always protect yourself by means of waterproof protective gear, boots, gloves, and, if possible, also by face protection during cleaning of the machine - especially if a high pressure cleaner is being used – to avoid being hit by waste water, organic material, etc.
Re-attach all safety equipment, covers, grates completely to their original place and assure that they are properly and completely reattached.
Use only tools and means that are expressly intended for such work.
Before starting the machine check the closed position of the turning lock on safety equipment like covers, these locks keep the covers in safe position.



⚠ Caution

When working on the machine, always wear safety goggles with integrated side protection (in accordance to standard EN 166) and protective gloves.

Before starting the machine again, check the items mentioned in chapter Start-up.

3.1.5 Residual risk

The residual risk describes the risk of a system that remains after the implementation of planned risk containment measures and in spite of existing safety devices.

The following residual risks may appear:

- Automatic machine start
- Aerosols contaminated by viruses and bacteria caused by manual cleaning
- Reaching into the running machine

3.1.6 Unauthorised rebuilding and production of spare parts

Alterations or changes to the machine:

For safety reasons, it is not permitted to make unauthorized alterations or changes to the machine. This applies also to welding work on bearing components.

Any intended modifications, alterations or changes require the prior written consent of HUBER SE.

Use only original spare parts, original wearing parts and original accessories as these are especially designed for the machine. Components purchased from other sources give no guarantee that they have been designed and manufactured to suit the specific operating and safety requirements.

3.2 Machine identification

Any specifications made in these operating instructions apply to only the type of machine that is named on the title page.
The identification plate is attached to the screenings discharge and specifies the following.

- Name and address of supplier
- CE label
- Serial name and type, optionally serial number
- Year of manufacture

Always forward the machine type, year of manufacture and order number when inquiring or ordering spare parts to ensure perfect and prompt processing or your queries and orders.

3.3 Incorporated safety systems

The incorporated safety systems are subject to regular checkups (**t** = daily, **w** = weekly, **m** = monthly, **j** = yearly). The following methods are applied:
S = sight inspection, **F** = functional test, **M** = measuring.

These specifications refer to a 24 hour operation on 365 days a year.

Mains isolator
The mains isolator is located on the control panel and disconnects/connects the machine from/with the mains supply.

Padlock the mains isolator after switch-off prior to performing service or repair work.

Inspection	
Interval	**Method**
y	**F**

Emergency cutoff circuit
The machine is equipped with an emergency cutoff circuit. Whenever the emergency cutoff switch (option) is operated, the machine or complete plant including incorporated units will be set into a safe operating state.
The emergency cutoff switch can be released by pulling or turning to the right.

Inspection	
Interval	**Method**
m	**F**

Motor protection switch
The machine is equipped with an indirect current overload protection with a motor protection switch. The motor will be switched off, if the overload is too much. The thermal delayed overcurrent protective device must be selected that the drive unit will be switched off in time $t_{E.}$

Inspection	
Interval	**Method**
y	**F, M**

Motor temperature control (option)
The motor is equipped with a temperature sensor, which must be evaluated with an evaluation relay or a frequency converter. If the permissible temperature is exceeded, this must lead to the motor being switched off.

Inspection	
Interval	**Method**
y	**V, F, M**

Overpressure control
The machine is equipped with a feed pressure controller.
If the pressure exceeds maximum pressure of 500 mbar the complete plant included incorporated units must be set into a safe operating state. When the pressure has fallen below maximum pressure and the fault has been reset, the plant can be re-started.

Inspection	
Interval	**Method**
m	**F**

Pneumatic isolation / maintenance system
As an option the machine is equipped with a pneumatic maintenance mechanism.

The pneumatic pressure cone can be depressurized for the purpose of executing maintenance and inspection work.

Inspection	
Interval	**Method**
m	**F**

Wash cycle monitoring
The machine is equipped with a wash cycle monitoring mechanism. The end position of the spray basket is monitored by a proximity switch.

Inspection	
Interval	**Method**
m	**F, M**

Machine control
Internal machine control includes a 5-conductor feed system, 3 phase, with separate earth line with GREEN/YELLOW line coating.
Additionally earth the machine casing for potential equalization. Please check earthing connection on corrosion.

Inspection	
Interval	**Method**
y	**V, F, M**

Categories according to DIN EN ISO 13849-1
The following categories are installed in the plant:

Category	System performance	Component	Inspection interval
1	• A fault may cause the loss of safety function, • Some faults may stay unrecognized	Main switch, water shut-off device with protection against restart	1x per year or acc. to instructions of supplier of components
2	• A fault may cause the loss of safety function between the tests. • The loss of safety function is recognized by the test.	Emergency stop (emergency cut-off relais with push-button and cut-off protection)	1x per year or acc. to instructions of supplier of components



⚠ WARNING

Control panels can only be opened by using a special key. The special key may only be handed to an authorized person. Take care that doors of control panels are only opened by skilled staff for maintenance work and fault detection, otherwise the doors must stay locked!

NOTICE

These operating instructions are part of the machine and have to be available for the operating staff at any time.
The safety instructions contained must be observed.
It is strictly prohibited to override any safety instructions or change the mode of action of safety instructions.

3.4 Safety measures

It is the operator's responsibility to instruct his operating and servicing staff concerning:
- Protective devices on the machine,
- Control of observance of safety measures.

This copy of operating instructions has to be stored to be at hand when needed in the future. Observe the intervals for inspection and control measures! In these operating instructions, the work is described so that it can be understood
- by an instructed person (referring to chapter Operation and operation modes
- by skilled staff (referring to chapters Transport, Installation, Maintenance, Trouble Shooting and Repair).

The chapters Transport, Installation, Maintenance, Trouble Shooting and Repair are intended for skilled staff only. Any work described under these chapters must be performed by skilled staff only.

Instructed person
An instructed person is a person that has been instructed by a skilled person, and trained if necessary, about the assigned jobs and possible risks arising from improper performance and informed about necessary protective devices and protective measures.

Skilled persons
Skilled persons are persons that are able to evaluate assigned jobs and recognize possible risks, due to their professional skills, expertise and experience and knowledge of corresponding standards.
This definition follows EN 60204-1

3.5 Operator's duty of care

NOTICE

The valid national version of the framework directive 89/391/EWG and corresponding individual directives, especially 89/655/EWG concerning minimum requirements for safety and health protection of staff when using work equipment, are applicable in EEA countries and must be observed.
For Germany, the occupational safety directive of 2015 is applicable and must be observed.

The operator has to obtain the local operating license and observe the respective requirements. In addition, the operator has to observe the local laws concerning

- Safety of personnel (accident prevention regulations)
- Safety of work equipment (protective gear and maintenance)
- Product disposal (Waste Management Law)
- Material disposal (Waste Management Law)
- Cleaning (cleaning agent and disposal)
- Environmental compliance

Connections:
The operator has to ensure before start-up of the machine, if installation and start-up are performed by the operator himself, to comply with local standards (such as for electrical connection for instance).

NOTICE

Lighting
The operator has to provide sufficient and equal lighting in all areas of the plant. The recommended illumination level is 300 lux (value for maintenance; in Germany acc. to ASR).

3.6 Safety inspections

Safety inspections are carried out by the manufacturer in the factory.

1. Measurement of airborne noise

- according to appendix 1 of the EU Machinery Directive (1.74/f).

The machine noise level is below 70 dB(A).

2. Tested and verified in accordance with DIN EN 60204-1

- Check of electrical equipment for correspondence with the technical documentation (chapter 18.1)

- Function tests (chapter 18.1)
  Test functions of the electrical equipment, especially those which are related to safety and safety measures.

4 Handling and transporting

Observe the following points to avoid damage to the machine or persons when handling the equipment:

- Only qualified persons are permitted to perform transport work, observing the safety instructions.
- Lifting and righting of the equipment must be done only by the lifting eyes provided.
- Use only the lifting devices specified hereunder to transport the machine.
- Empty the machine prior to transporting it.
- Read also the chapter General Safety Instructions.

NOTICE

Do not step on the plastic covers and do not put weight on them by lashing straps.

4.1 Dimensions and weight

Several plant sizes are available. The plant dimensions are specified in the project-specific installation drawing. The weight of the plant depends on its size. The weights are specified in the installation drawing. The weight is also specified on the nameplate.

The machine is transported with the machine feet dismounted.





4.2 Approved equipment and accessories for transportation

⚠ CAUTION

Have transport and unloading done by experienced experts only.

⚠ WARNING

Approval of lifting devices for mass to be moved
Assure yourself that the lifting devices have the required load bearing capacity by means of the capacity specifications on the lifting devices and the weight specifications of the loads to be moved.

Transport the plant on site with the greatest possible care and observe the following instructions: If the plant was already operated before, then remove all connected supply lines from the machine prior to moving the machine.



⚠ WARNING

Transport by forklift is forbidden, never insert the fork under the machine!



⚠ WARNING

Pay attention to always keeping the plant in an upright position!
Hook the shackles, load hooks, etc. into the lifting eyes on the upper side of the plant. The attachment points are market with the label in the margin. The lifting equipment cables must be freely suspended and must not be attached beyond 45° from the vertical line. The machine must be suspended horizontally during unloading.

If you notice any damage which has occurred during transportation, note this on the consignment note and inform the carrier and the manufacturer immediately!

NOTICE

Make sure the delivery is complete by carefully checking all received materials against the bill of delivery.

4.3 Machine storage

The machine and components can be stored as supplied. The ambient temperature should be between a minimum of +5°C and a maximum of +40°C. Avoid high temperature fluctuations.

If outdoor storage cannot be avoided, the motors, electrical components and cardboard packaging must be protected against direct exposure to the weather (moisture, direct sunlight, dirt/dust), e.g. by using a breathable cover.

When selecting the storage location, please ensure that there is no risk of damage, e.g. from construction vehicles or negligent work in the vicinity of the machine. Avoid soiling from cement, mortar, concrete and paint splashes. Protect the machine from sparks from angle grinders and other tools to prevent corrosion.

Stable storage must be ensured to prevent the machine from tipping over. The storage location must be vibration-free.

Never store organic solvents at the machine's storage location. Avoid ambient air containing hydrogen sulphide and chloride.

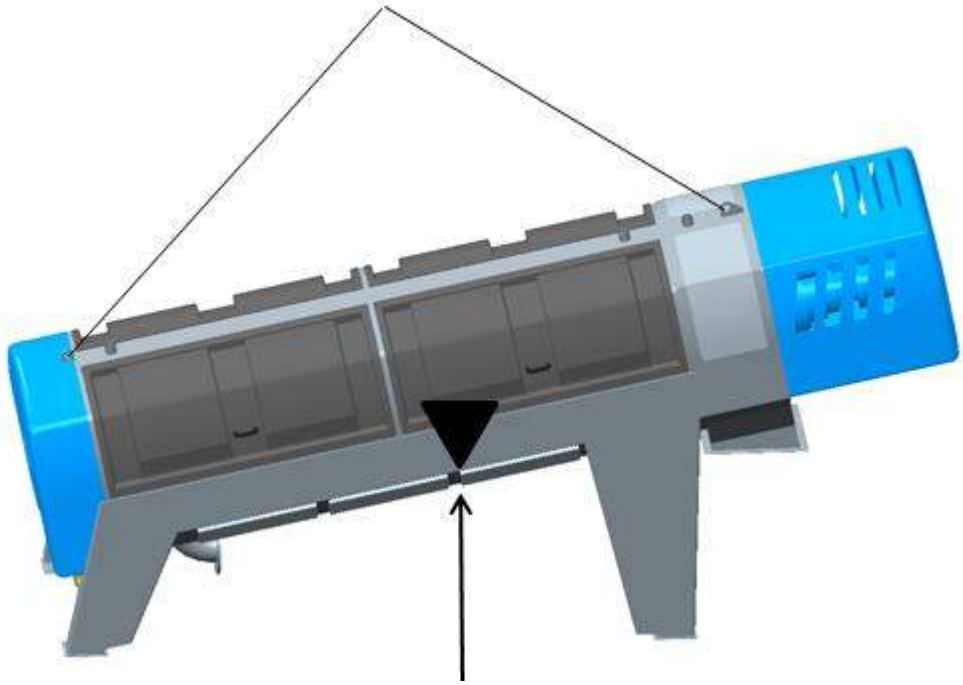
Observe the storage instructions for equipment attached to or supplied with the machine.

4.4 Lifting by crane

Size 620.2

- Mount appropriate load-carrying equipment to the 2 outer lifting eyes at the top of the machine. (See below photo.)

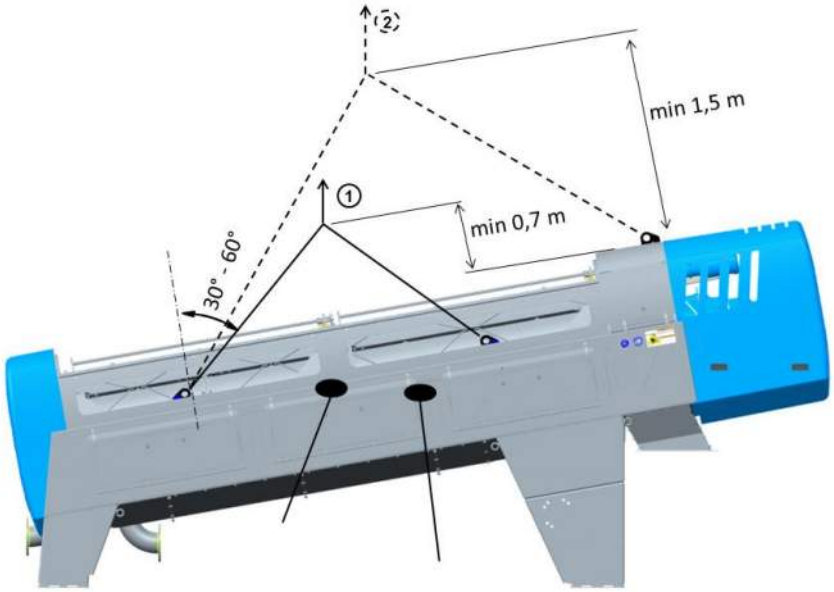
Make sure the load-carrying equipment is suitable to bear the machine weight. The machine weight is specified in the dimension drawing.
Please note that the tractive forces increase if the rope guide is not vertical.



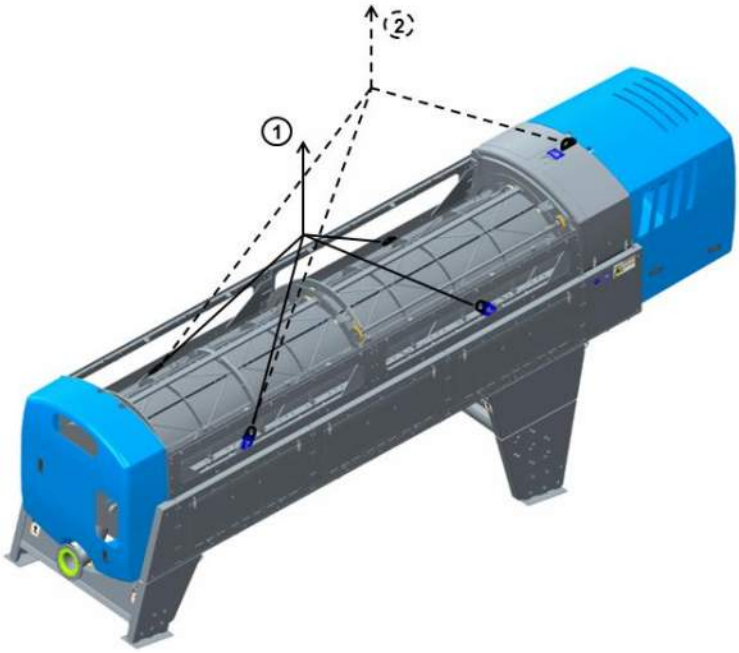
Size 800.2

- Remove the upper covers from the machine.
- Mount appropriate load-carrying equipment to the 4 inner lifting eyes on the base frame inside the machine (see below figure.) Alternatively the machine can be lifted on 2 inner and one outer lifting eye on the discharge housing (figure version 2).

Make sure the lifting devices do not exert any pressure load on the machine casing, covers or internals.
Make sure the load-carrying equipment is suitable to bear the machine weight. The machine weight is specified in the dimension drawing.
Please note that the tractive forces increase at the maximum permissible rope angles.



centre of gravity filled / empty



The machine feet on the discharge end may have been dismounted for transport.

Carefully lift the machine and balance it.



⚠ WARNING

The maximum working load of the lifting device must be above the weight of the single machine components.
Observe the stability of the lifting device.

⚠ CAUTION

Wear safety shoes with steel caps to prevent injuries.



⚠ WARNING

Always stand clear off a suspended load!

5 Installation

Observe the following safety instructions when installing the machine to avoid critical injuries, damage to the machine and other damage.

- Only qualified persons are permitted to perform installation work, observing the safety instructions.
- Check the machine for transport damage prior to starting with any installation work.
- Make sure that only authorized persons have access to the working area and that installation work does not endanger any other persons.
- When laying machine connections, make sure that no one can trip over laid cables, hoses, pipelines, etc.
- Observe the prescribed bending radii when laying cables/hoses/pipelines.
- Observe the instructions for operating media, lubricants, auxiliary material used.
- Read also the chapter General Safety Instructions.

5.1 Acceptable environmental conditions for installation

NOTICE

Strictly observe the requirements specified below prior to installing and starting up the plant. The manufacturer does not assume any liability for damage caused by non-observance of these requirements.

The plant is designed for installation in a building. The manufacturer assumes no liability for any damage resulting from outdoor installation and inadequate protection against bad weather (frost, storm, snow, ice, etc.).

The minimum protection grade of the electrical consuming devices of the Q-PRESS® is IP 55.

Foundation

The foundation must be designed to bear the machine weight and must allow for horizontal machine mounting and installation. This point must especially be observed when erecting bearing steel constructions. (See attached installation plan and dimension scheme.)

NOTICE

In the case of a concrete foundation the concrete should be at least class C20/25 to ensure safe anchorage of the machine.

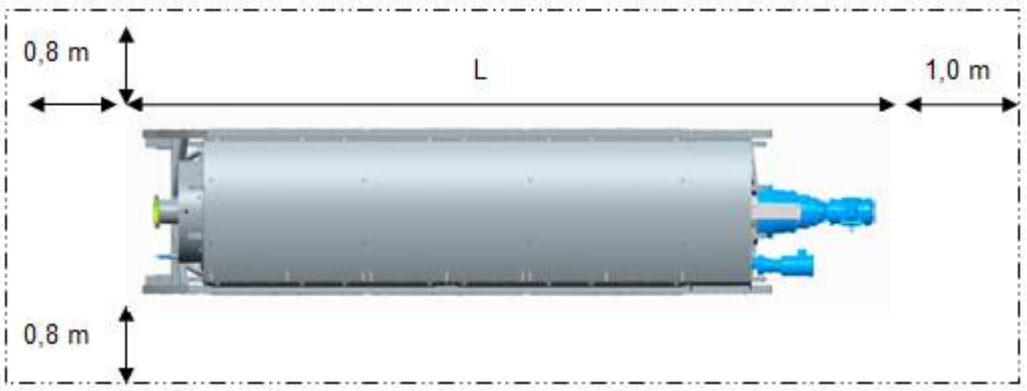
Clean the installation place prior to starting with any installation work. In addition, use a water level to check that the surface of the installation place is level.

Drainage of the operation room

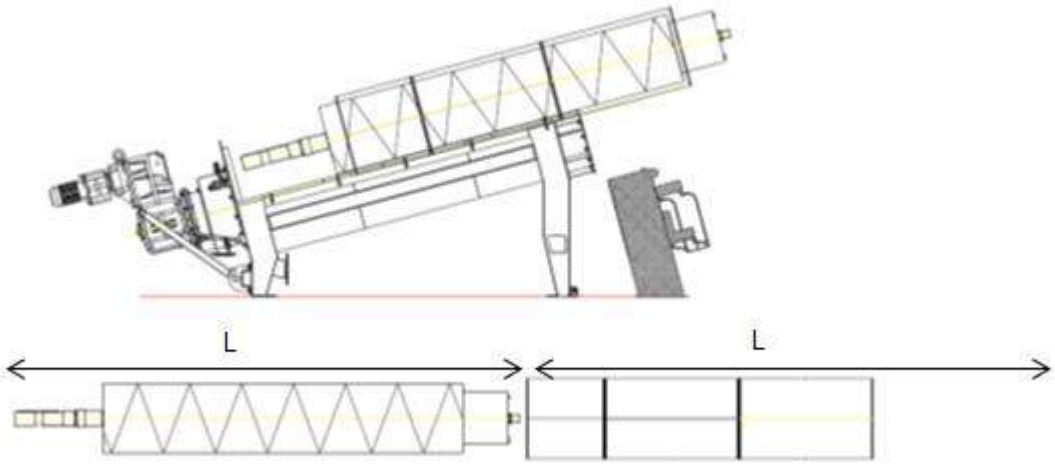
Floor drainage is generally required to remove cleaning water.

Space requirements

Recommended minimum space for **operation/inspection/maintenance**:



Additional space for **maintenance** is required for machines with screen baskets that cannot be divided:
If the screen basket is not dividable, an additional space of approximately two times the machine length must be available outside the machine casing for separating the screw shaft from the screen basket.



If the scraper on the screw flights needs to be replaced, the screw shaft must be lifted out with the screen basket. Therefore, either sufficient free space must be available in longitudinal machine direction or a crane runway that provides the possibility to bring the machine into a position with sufficient space for scraper replacement.

Lightning protection concept:
The plant must be integrated into the complete concept of the treatment plant for observing the Lightning Protection Standard DIN EN 62305-3.
The state of the art of a functioning overall concept for wastewater treatment plants is particularly described in the supplement 2.

Lighting

The lighting system must be designed to ensure at any time riskless and safe working on any machine parts.

NOTICE

Lighting
The operator has to provide sufficient and equal lighting in all areas of the plant. The recommended illumination level is 300 lux (value for maintenance; in Germany acc. to ASR).

Supply connections

Wash water:
The wash water supply system must be designed to ensure that it supplies at any time the amount of wash water required by the spray nozzle bar for screen basket cleaning. (See Technical Data.) The required connections are specified in the Technical Data.

Minimum required wash water pressure:	5 bar
Maximum permissible wash water pressure:	8 bar

Water quality:

Maximum permissible particle size:	0.3 mm
Maximum permissible particle concentration:	200 ppm

To avoid sedimentation on the filter cloth, the wash water should have an as low as possible chloride and iron oxide content and a pH in excess of 6.5.

If fresh water is used, it is necessary to provide a return flow inhibitor complying with EN 1717 to prevent return flow of wastewater into the potable water network.

NOTICE

Depressurize the wash water supply line prior to executing any maintenance work.
A shutoff valve must therefore be installed in the wash water line.

The connection of the wash water line to the screw press should consist of a flexible rubber fabric hose to facilitate the connection to the machine and reduce shock pressures when the valve closes.

Compressed air:
The compressed air supply system must be designed to ensure that it supplies the pneumatic pressure cone of the screw press at any time with the required amount of wash water. The required connections are specified in the Technical Data. Pneumatic lines must be laid in protective tubes to avoid damage.

The working pressure of the pneumatic pressure cone is manually adjustable via an optional control unit.
Working pressure: 0.5 – 6 bar
The input pressure into the control unit must be 6 – 10 bar.

Minimum compressed air quality: according to DIN ISO 8573 class 4:
Maximum residual moisture: 37 g/m³ (1 bar, 25°C)
Maximum residual dust: 8 mg/Nm³
Maximum residual oil content: 5 mg/Nm³

NOTICE

Depressurize the compressed air lines prior to executing any maintenance work.
A suitable means to achieve this is a maintenance unit with arrestable pressure reducer.

Technical ventilation:
The optional ventilation connections of the screw press are provided to connect a customer supplied exhaust air plant.

Ventilation of machine interior and sludge discharge housing

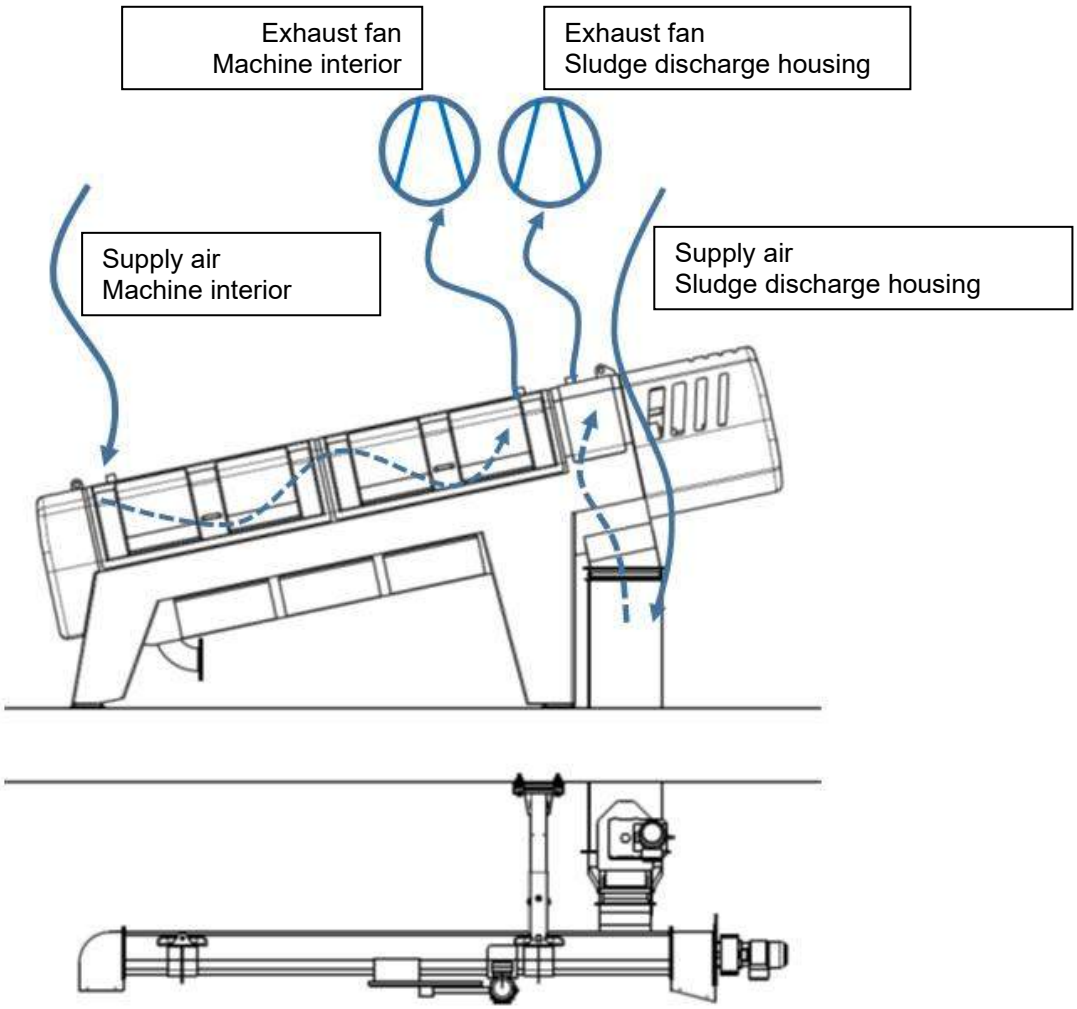
- avoids an explosive atmosphere
- reduces odour nuisance
- reduces corrosion in the machine interior.

Recommendation:
The air volume flow should permit approx. 20 air changes of the machine volume per hour.

Size	Machine volume	Volume of sludge discharge housing (plus discharge shafts, conveyor screws…
Q 620.2	3,5 m³	0,5 m³
Q 800.2	8,0 m³	1,0 m³

There is no gas exchange between machine and sludge discharge housing resp. possible following transport devices for pressed sludge. In case of explosion zoning both areas must be looked at separately.

Avoid contamination by loaded atmosphere e.g. through the filtrate discharge pipes of the screw press.



Product connections

Details on the machine connections are provided in the dimension sheet.

Product connections:

- Sludge inlet flange
- Filtrate outlet pipe connection
- Sludge discharge chamber
- Connection for wash water
- Connections for compressed air

Electrical connections

The electrical power supply must comply with the circuit and wiring diagrams. (See appendix.)

Electrical consumers on the screw press:
- Screw shaft drive motor
- Drive motor of the spray basket
- Solenoid valves on wash water connection
- Pressure sensors of sludge inlet chamber
- Proximity switch
- Pressure switch of pressure supply unit (option)

Potential adjustment

If mechanical and electrical plant installation is not executed by HUBER SE but by a third party, the operator shall be responsible to provide a connection for potential adjustment on the plant.

5.2 Installation

- Clean the installation place with a broom.
- Use a water level or levelling device to check the planeness of the machine foundations.

The height offset of the machine foundations must not exceed 2 mm.

- Mark the machine fixing points according to the axial dimensions specified in the installation drawing.
- Transport the plant to its intended installation place as described above under Handling and Transporting.
- Mount the machine feet to the machine casing.
- Check that the fixing points are in accordance with the machine feet.

Observe the installation instructions for the supplied fixing material.

- Drill the holes for the fixing material.

NOTICE

Blow the holes for the stainless steel plugs under pressure after drilling (using bellows, air pump, etc.) to ensure a professional durable adhesive joint.

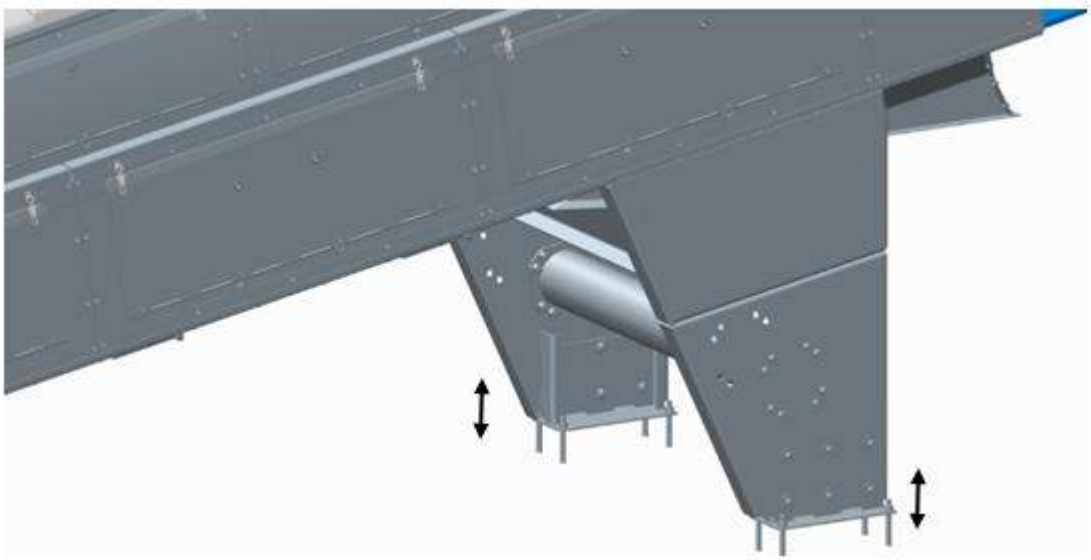
Use grease for all unlockable screws, thus providing a durable mobility of thread.

NOTICE

Use only the supplied mounting material for installation of the machine!

Alignment of screw press size 620.2 / 800.2 units

The screw press must be aligned to ensure that the height offset between the machine feet does not exceed +- 2 mm.
The machines have 4 height-adjustable feet.



NOTICE

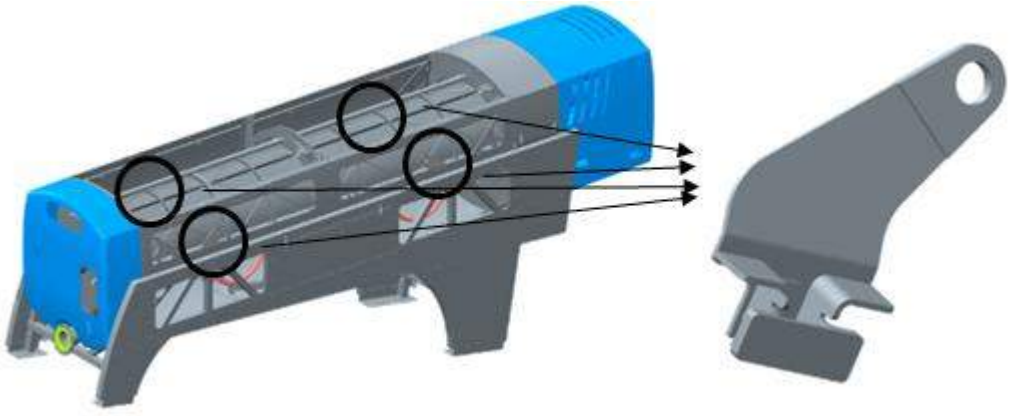
Do not remove the load-carrying equipment before all fixing screws of the four feet have been screwed tightly with the machine and the machine foundation.
Secure the bottom plates by welding them to the machine feet.

NOTICE

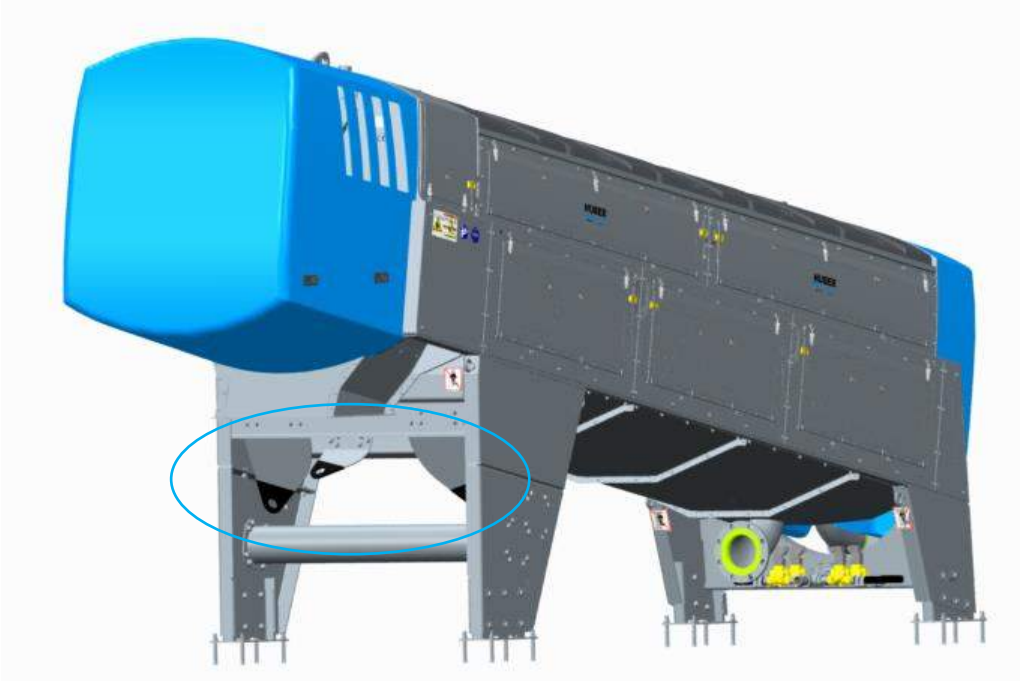
The machine must not be screwed in place and operated before it has been aligned on the machine foundations!

Additional preparatory work on the size 800.2 screw press

Remove the four lifting eyes from the machine.



Fix the 4 lifting eyes at the park positions provided between the support legs at the discharge side.



⚠ WARNING

Use the lifting eyes only with the provided number of screws at the provided positions on the machine.
Check the lifting eyes and screws according to the enclosed inspection sheet before reuse.

Mount the machine covers.

5.3 Customer-supplied connections

NOTICE

Ensure the tension-free installation of all connections.

Establish the following mechanical connections:

- Removal of dewatered sludge



Use a flexible transition piece between the sludge discharge of the screw press and the conveying unit.

⚠ WARNING

In case of open access to the discharge area, protect the machine against unintended start-up and secure the danger zone prior to starting the machine or executing maintenance on (or dismantling) a downstream machine. The requirements of DIN EN 13857 (“Safe distances to prevent danger zones being reached by the upper limbs”) must be observed.

- Sludge inlet



NOTICE

The sludge line to the screw press should run horizontal or ascending.

Sloping lines bear the risk of gas accumulation or unfavourable pressure conditions.

- Polymer injection and mixing unit



Observe the operating instructions for the injection and mixing unit.

Provide for a sample taking pipe socket between the thin sludge pump and injection and mixing appliance to allow for sampling of unflocculated sludge.

- Filtrate outlet

The filtrate runs off without pressure through the filtrate outlet of the screw press.
The filtrate line must be laid with an inclination.
Provide for a sampling cock in the submerged area of the filtrate drain line to facilitate filtrate sampling.

- Wash water supply line



The wash water connection should be flexible.

- (Optional) exhaust air extraction, if required
- Air lines between pneumatic cylinders and pneumatic control unit

NOTICE

Check that no tools or mounting materials has been left inside the pipelines.
Otherwise, the plant may suffer damages.

General information for electrical installation:
Installation must be carried out in accordance with these instructions if electrical installation is not part of the supply contract with HUBER SE.
If the customer assembles the machine, the manufacturer assumes no liability for damage which may occur as a result of improper assembly.

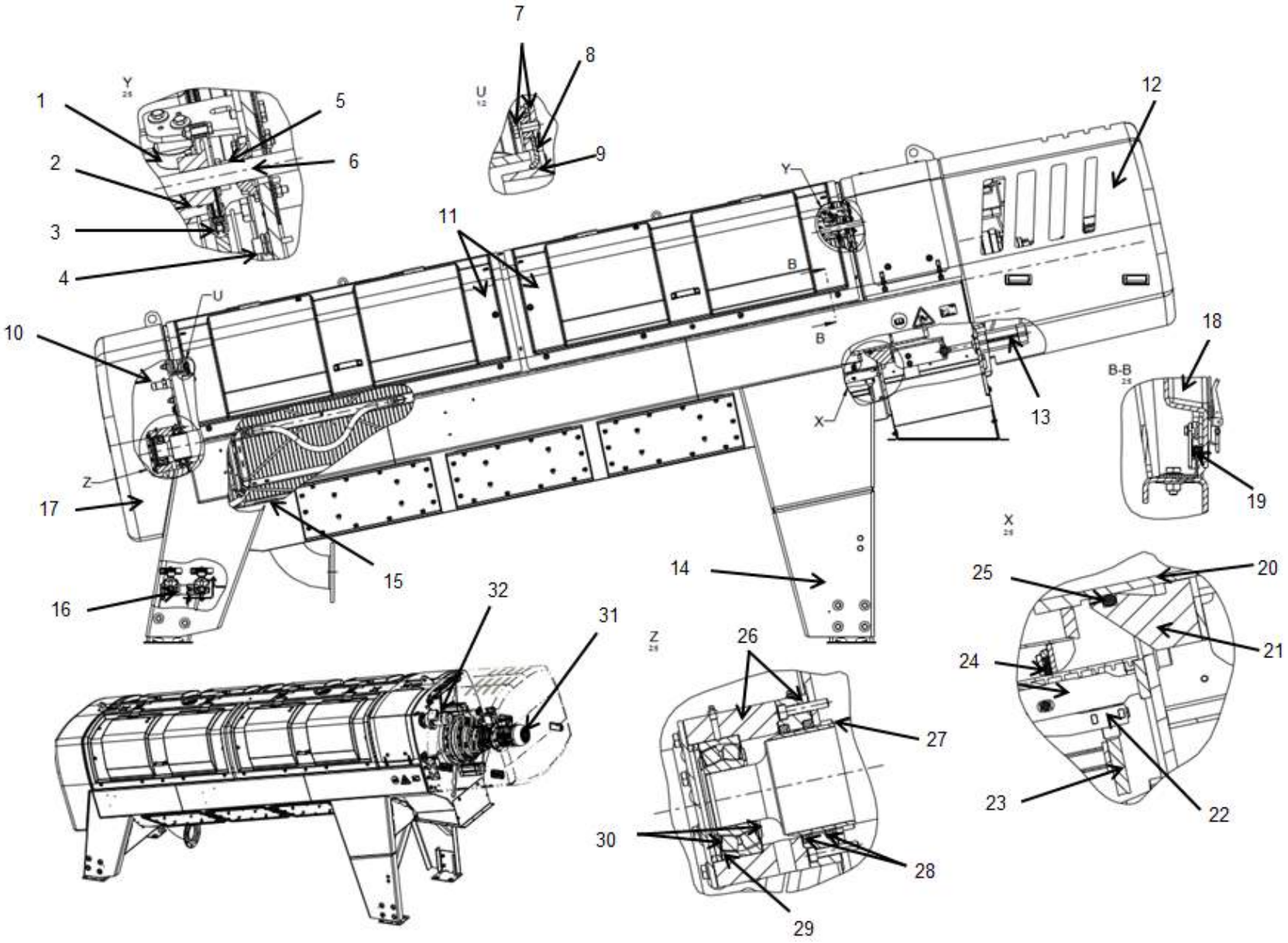
Wiring:



⚠ WARNING

Make sure that power supply is isolated!
Take appropriate measures to ensure that this is the case!
Have the electrical connection work executed only by an electric specialist only or by sufficiently instructed staff under the supervision of an electric specialist.

- When laying all supply lines, make sure that they do not become a trip hazard for operating staff.
- Have laying of the electric connections executed by a specialist only. (See connecting/wiring diagram.)
- Prepare earth connection to the plant prior to beginning any other work, and earth the gear motor and solenoid valves (optional). The degree of protection of the terminal boxes and cable glands must match that of the safety area in which the machine is installed. Fix the control panel (option) with bolts in its intended position.
- Fix the adjacent control box (option) with dowels next to / onto the machine.
- Prepare all cables between the plant, control panel and adjacent control box and connect the plant to the power supply according to the specifications in the wiring diagram. The wiring diagram and cable list are attached in the appendix, if the electrical switchboard and control panel is part of the HUBER supply contract.


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B-B
X
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B

1 Roller with journal bearings, running axle
2 Chain wheel
3 Roller chain
4 Proximity switch
5 Flange bearing
6 Drive shaft of the spray nozzle basket
7 Sealing fixation
8 Sealing
9 Clamping ring on screen basket
10 Pressure probe
11 Cover
12 Discharge-end cover
13 Pneumatic cylinder
14 Protective conductor connection point
15 Pressure hose
16 Solenoid valve
17 Inlet-end cover
18 Cover
19 Sealing profile
20 Screw shaft
21 Pressure cone
22 Roller with journal bearings, running axle
23 Running surface of spray nozzle basket
24 Screw flight with scraper lip, screening element
25 Round cord
26 Retainer for the grooved ring and bearing
27 Bushing
28 Grooved ring
29 Self-aligning roller bearing
30 Nilos rings
31 Planetary gear motor
32 Gear motor

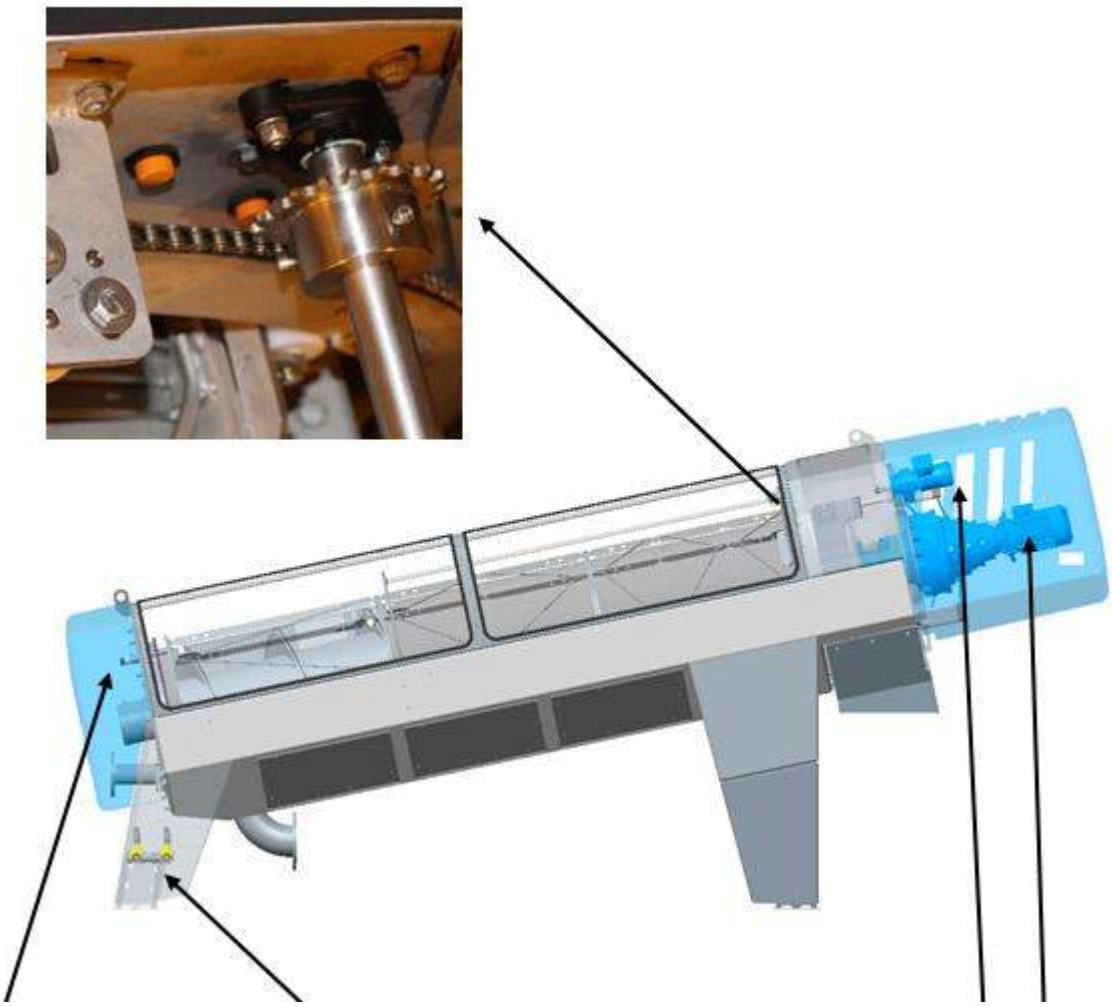
The following items are to be earthed with a potential equalisation conductor 6 mm²: 16, 31, 32

Protective conductor terminal: (M8 x min. 20 mm)
The conductor terminal as connection to the main potential equalisation acc. to DIN EN 60204-1 (VDE 0113-1) is shown by the conductor marking grounding EN 61310 D 20, see pictogram aside. Observe local protective measures as per local standards (DIN, VDE, EN, EeEx-Atex 100a).



Electrical consumers on the screw press:

Proximity switch



Pressure switch Solenoid valves Drive motors

Check the running direction of the motors prior to initial start-up and prior to any re-start (e.g. after a change of voltage supply)!

NOTICE

Running direction checks must be limited to only few seconds. The missing "lubricating" effect of sludge/water may lead to loud nose and/or wear of pumps or the screw press.

Safety guideline for the use of frequency converters

⚠ CAUTION

This plant uses electrical equipment, e.g. frequency converters. Due to operating conditions and in the event of a fault direct currents and high-frequency alternating currents may occur which cannot be handled by customary residual current circuit breakers type A or AC so that no sufficient operator and plant protection can be guaranteed any more. We recommend the use of an AC/DC sensitive residual current circuit breaker type B.

NOTICE

The drive motor of the machine may be designed as a permanently-energised synchronous motor. Permanently-energised synchronous motors must only be operated on suitable frequency converters.

5.4 Check-up of connections

Check all electrical connections with a rotation direction test.

NOTICE

Check only for few seconds if the rotation direction is correct.
Longer dry running may cause damage.

Check all safety devices by means of a functional test.

⚠ Caution

When operating feed pumps in hand operation, the pressure monitoring of the screw press must also be activated in manual mode.

⚠ CAUTION

Risk of injury! For functional checks with the control voltage switched on, the selector switch (mains isolator) must be switched on. Never put your hands into the machine interior, reactor or thick sludge trough!

NOTICE

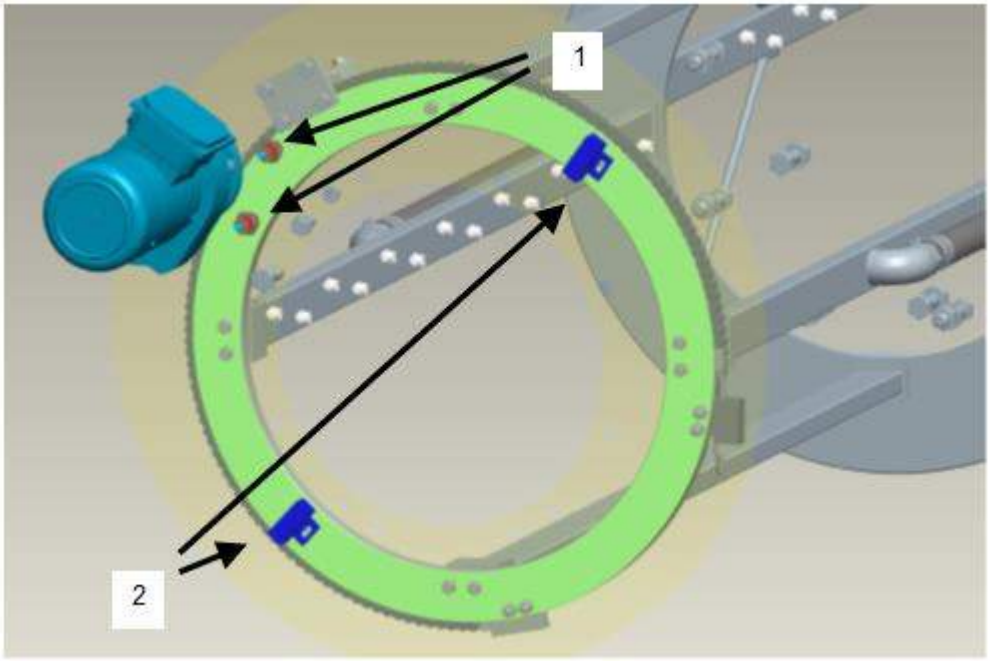
Wet the screen basket of the screw press with water before carrying out the functional test to prevent excessive noise or wear during dry running.

Check all mechanical connections for

- leakage when charged with water or compressed air.
- vibrations.

NOTICE

Check the spray nozzle basket position before starting with plant start-up.
None of the two proximity switches below the spray nozzle basket drive must be positioned in end position (directly on the cam switch of the spray nozzle basket.



- 1: Proximity switch in the machine casing
- 2: Cam switches on the spray nozzle basket

6 Start-up

Personnel

Have initial plant start-up executed by a start-up engineer of HUBER SE or specially trained external personnel. On that occasion your own operating staff must be instructed how to handle the equipment.

Prerequisites

- The equipment must have been installed exactly as specified in the operating instructions.
- All mechanical and electrical installations must have been executed properly.
- Setting parameters of probes and electrical drives must be recorded according to the electrical control system description.

NOTICE

Note especially the parameters for a limitation of the motor load and the inlet pressure.

- The wash water supply to the machine must be sufficient.
- Peripheral plant equipment that is required for the function and operation of the dewatering process, such as coagulant agent conditioning unit, pumps, probes, measuring devices, indicators, platforms, etc., must be fully operable.
- It is recommended to commission test engineers of flocculant suppliers with the pre-selection of suitable coagulant agents.

NOTICE

Strictly observe the supplied operating instructions. The manufacturer does not assume any liability for consequential damage caused by non-observance of these operating instructions. The operator bears the full risk.

Carefully fill in the start-up report and have it signed by the start-up engineer and responsible operator. Keep the report in safe custody together with the operating instructions and send one copy to HUBER SE.

6.1 Instructions for start-up

Suitable coagulant agents should be selected by means of flocculation tests prior to start-up of the screw press. The screw press normally requires flocks of a very high shearing stability.

Due to the long sludge residence time inside the press, modifications of the screw press settings, e.g. screw speed, cone pressure or flocculant dose, may become effective later than one to two hours.

The optimal screw press adjustment is always a compromise between throughput, dewatering results, filtrate quality, coagulant agent consumption and wear.

6.2 Screw press start-up

6.2.1 Preparatory work

- Prepare a suitable polymer solution.
- Make sure sufficient mixing takes place in the intermediate sludge storage tank.
- Calculate the polymer dose required for the requested sludge throughput on the basis of the polymer tests.
- Wait until the ripening time stated by the flocculant supplier has expired.

6.2.2 Starting the screw press

- Drive the pressure cone completely back (open).
- Start the screw press with approx. 50 Hz.
- Start the polymer dosing pump.
- Start the sludge feed pump.
- Inspect the sludge structure at the discharge.

The discharged sludge should be thickened, i.e. not contain visible free water any more. The flock structure should be visible.
If free water can still be seen, the polymer dose may be too high, so that the screening surface becomes clogged with polymer. The free water may be milky turbid.
If no flocks can be seen, the flocculant is unsuitable, the dose too low or the polymer mix-in energy unfavourable.

6.2.3 Rough adjustment of the screw press

- Reduce the screw speed until clear water escapes on top of the first part of the sieve. In this way the inlet area is impounded and a small preliminary pressure built up.
- Drive the pressure cone with a low pressure against the escaping sludge.
- Make sure the power consumption of the motor remains within the permissible range.

Due to the counter pressure from the pressure cone the screw press becomes filled with sludge and the dewatering process starts. Along the second and third part of the screen some solids are pressed through the screen surface.

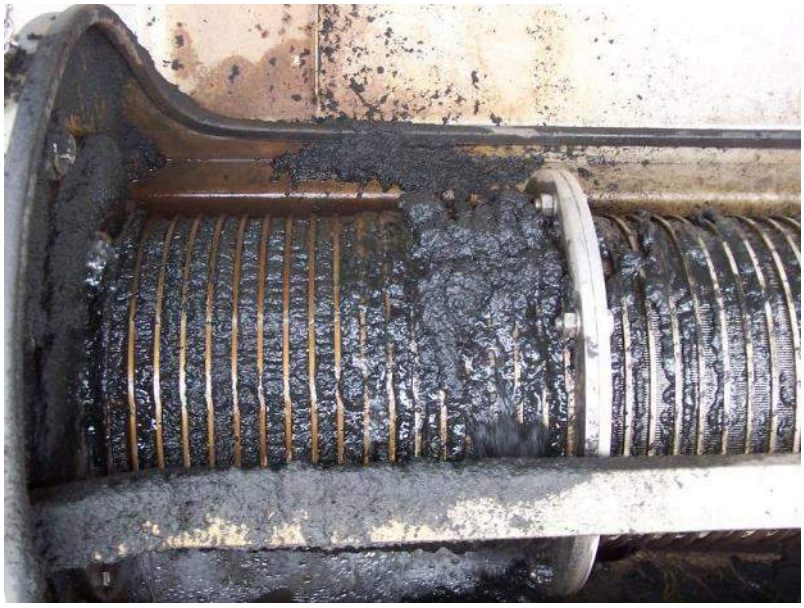
- Change the polymer settings if filtrate quality is insufficient.

6.2.4 Optimisation of settings

- Increase the cone pressure until the requested dewatering result is achieved, or filtrate quality becomes insufficient respectively.
- Too high a cone pressure may impair dewatering results and filtrate quality.

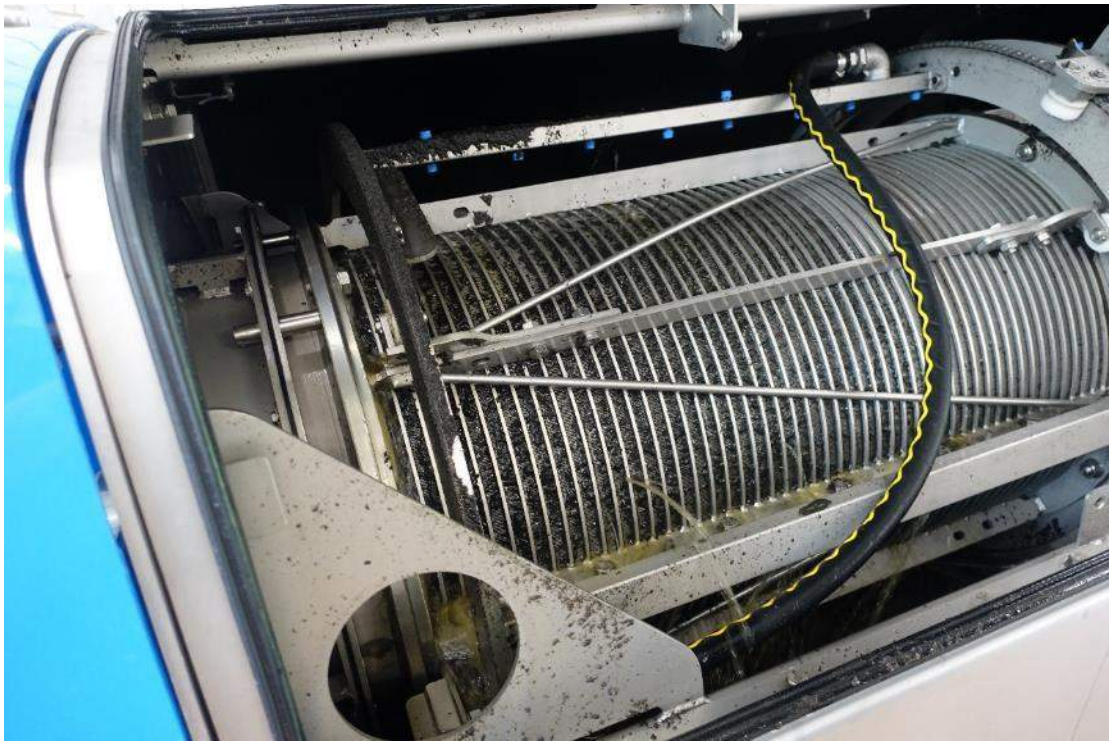


- Massive sludge deposition on the second and third screen sections, as shown in the photo above, are a sign for insufficient flocculation or a too high cone pressure.
- Deposition on the first part of the sieve (inlet area), as shown in the photo below, is a sign for insufficient screw speed or wrong polymer settings. As a result, the pressure in the inlet screen becomes too high which causes entrainment of solids into the filtrate. Read the pressure in the inlet from the pressure probe. Program the pressure at which too many solids are forced through the sieve as the limit pressure. As a safety function the plant will at this pressure switch off the feed pumps in automatic mode in the future.
- Observe the attached operating instructions for the pressure switch.
- Typical settings and limit values can be found in the separate electrical control description.





- Make sure the motor torque output lies below the nominal motor torque.
- The settings are optimal when clear water is pressed out of the screen basket in the inlet area, the middle and third part of the screen are completely filled with sludge with only few solids escaping, and sludge is discharged evenly around the pressure cone. (See below.)





- Since every washing cycle means water entry into the sludge, screen washing should be activated as infrequently as possible. Screen washing must be activated if the screen has become clogged from the outside and no filtrate can escape any more.

NOTICE

Check the motor torque of the screw drive motor whenever you have modified any settings. If the torque exceeds the nominal motor torque, this may lead to motor stoppage, screw blocking or even damage to the drive or screen.

7 Operation

7.1 Safety instructions

Operate the machine only when it is in a safe and functionable condition.

If any malfunction (incl. operating behaviour) occurs, report this immediately to the responsible authority. If required, the machine must immediately be shut down and locked! Have the causes of troubles eliminated immediately!

Prior to switching on the machine, always make sure no one can be endangered when the machine is operating.

7.2 Operation mode

The basic plant functions are automatic and do not require any manual operation.

The plant is controlled exclusively via the automatic system inside the central control panel. The complete plant is switched on and off there.

Manually adjust the plant settings (polymer settings, screw speed, inlet pressure, cone pressure, wash cycle settings, etc.) to the sludge quality.

⚠ CAUTION
In order to switch off the complete plant, it needs to be switched off at the control panel.

8 Trouble shooting and repair

8.1 Mechanical-technical and mechanical operational faults

Fault	Possible cause / Repair
Fault indication on all drives of the sludge treatment unit	
Motor fault Motor protection switch has tripped.	Remove any mechanical blockage. Check motor power consumption. Switch off mains isolator. Check the drive. Determine the cause and repair if required. Switch on motor protection switch and operate reset key. Check that there are no solid objects in the pump feed lines.
Phase breakdown	Check fuses in control panel. Check preceding fuses.
PLC (CPU) failure	Observe battery replacement intervals.
Sludge treatment does not start although no fault is indicated.	
External power supply is interrupted.	Make sure external power supply is OK.
Mains isolator is in OFF position.	Switch ON mains isolator.
Pre-selected operation: SEMI-AUTO mode	Set preselected operation mode to AUTO mode.
Emergency stop button activated	Release emergency stop button Operate reset button
Control fuse has melted.	Find the cause and replace the fuse.
Sludge feed pump does not deliver although no fault is indicated.	
Pre-selected operation: SEMI-AUTO mode	Set preselected operation mode to AUTO mode.
Air in pump housing	Shortly lift and then re-lower the switched-on feed pump on the lifting device.
Back valve is blocked.	Clean the back valve.
Intake pipe is blocked. A solid object blocks the inlet.	Clean the intake pipe. Remove the object.
Frequency converter overload	Check fault signal on frequency converter. SEPI Check the fuse. Check/change calibration
MAX pressure in the machine inlet	Wait for delay time.
The delivery flow of the sludge feed pump is too small or there is no flow at all.	
Check delivery flow control.	Frequency converter (see manufacturer's instructions) Check servo motor limit switch and adjust if required.
Check delivery flow indicator.	Re-calibrate flow indicator if required.
Worn rotor/stator assembly	Replace the rotor/stator.

Symptom	Possible cause / Repair
Coagulant agent dosing pump does not start or stops.	
Pre-selected operation: SEMI-AUTO mode	Set preselected operation mode to AUTO mode.
MIN or dry run probe in coagulant agent conditioning plant responds.	Check that coagulant agent conditioning plant is filled with sufficient medium.
Dry run protection has tripped.	Check if there is medium on the pump's suction side. Activate reset button and evaluation device.
Overpressure protection has tripped.	Find the cause. Clean the valve and back valve if required and wash the pipeline. Clean the coagulant agent dilution unit and pipeline. Activate the reset button and evaluation device.
Coagulant agent deposits in the casing or dosing line or a solid object block the inlet.	Clean and/or remove the object.
Frequency converter overload	Check fault signal on frequency converter.Check the fuse. Check/change calibration
The delivery flow of the coagulant agent dosing pump is too small or there is no flow at all.	
Check delivery flow control.	Frequency converter (see manufacturer's instructions) Adjust servo motor limit switch.
Check delivery flow indicator.	Re-calibrate flow indicator if required.
Worn rotor/stator system	Replace system according to manufacturer's instructions.
Coagulant agent deposits in the casing or dosing line or a solid object block the inlet.	Clean and/or remove the object.
Coagulant agent deposits in the coagulant agent dilution unit or dosing line or a solid object block the inlet.	Clean coagulant agent dilution unit, in particular the mixing unit and dosing line, and/or remove the object.
Shaft packing of coagulant agent dosing pump is untight.	
Shaft packing drips.	Check its seat. Re-adjust, if required. See manufacturer's instructions.
Slide ring sealing drips.	Replace slide ring sealing. (See manufacturer's instructions.)
Sludge dewatering machine does not start although no fault is indicated.	
Pre-selected operation: SEMI-AUTO mode	Set preselected operation mode to AUTO mode.
Frequency converter overload	Check fault signal on frequency converter.Check the fuse. Check/change calibration

8.2 Process-technical operational faults

Symptom	Possible cause / Repair
Flock production is disturbed (instable) – Coagulant agent overdosing and/or underdosing	
Only water is “conditioned”.	Check that coagulant agent concentrate tank is filled with sufficient medium. Dosing point / 3-way valve on coagulant agent conditioning plant is blocked. Clean it.
The dose delivered by the coagulant agent dosing pump is too high/small.	Check magnetic inductive flow meter. Check dose and flow rate and correct it. Clean coagulant agent injection nozzles of injection and mixing unit. Check adjustment of the back valve of the injection and mixing unit and correct it.
Incorrect secondary dilution of coagulant agent.	Check secondary dilution and correct flow rate.
Thin sludge concentration changed	Check concentration and correct flow rate.
Thin sludge amount is too high/small.	Check magnetic inductive flow meter. Check dose and flow rate and correct it.
Incorrect coagulant agent concentration in the conditioning plant	Water and/or coagulant agent concentrate inlet is disturbed. Re-adjust. Clean coagulant agent disperser. Check and clean filling level probes. Check if stirrers of coagulant agent conditioning plant work properly. Clean them if required. Check if coagulant agent concentrate line is clogged and clean it. Measure content of coagulant agent concentrate pump in litres. Check impulse/pause dosing times. Clean coagulant agent concentrate dosing screw and measure content in litres again. Remove deposits in the intermediate storage tank for powdery coagulant agent concentrate. Check heating. Check durability and effective substance of coagulant agent.
Coagulant agent not suitable for the sludge (summer-winter operation)	Test coagulant agents and select a suitable product.
Coagulant agent conditioning plant does not start, or stops, although no fault is indicated.	
Dry run of coagulant agent conditioning plant	Fill the plant with water and coagulant agent.
Pre-selected operation: SEMI-AUTO mode	Set preselected operation mode to AUTO mode.
Chemicals tank is empty (dry run protection).	Fill the intermediate chemicals storage tank.
Water supply is disturbed. Reduced flow. The float element falls below the magnetic contact.	Ensure supply of process water; or water pressure is too low. Clean the sieve. Install a pressure reducer.

Symptom	**Possible cause / Repair**
The coagulant agent concentrate dosing process stops.	Process water supply is disturbed or water pressure too low.
MIN or dry run probe in preparation tank responds.	No conditioning of coagulant agent has taken place – plant EMPTY Reduce extraction rate and/or prepare new coagulant agent. Plant is set to AUTO operation while in SEMI-AUTO mode. (Change operation mode.)
Inlet pressure in screw press too high	
Sieve clogging	Check polymer settings.
Screw speed too low	Adjust screw speed.
Sieve apertures are blocked.	Clean the sieve / use a high pressure cleaner.
Scraper lip wear	Replace the scraper lip.
Varying solids load	Adjust solids-specific polymer doses.
Filtrate load too high	
Screw speed too low	Adjust screw speed.
Varying solids load	Adjust solids-specific polymer doses.
Cone pressure too high	Adjust cone pressure.
Unfavourable polymer dose	Check polymer settings.
Insufficient dewatering results	
Unfavourable polymer dose	Check polymer settings.
Unfavourable cone pressure.	Check cone pressure.
Screw speed too high.	Adjust screw speed.
Sieve clogging/blocking	Adjust washing cycles. / Clean the sieve.
Insufficient sieve washing	
No wash water pressure.	Check/clean the wash water pump. Clean the pump suction side. Clean the wash water intermediate storage tank.
No water jet.	Clean/replace the nozzles. Clean the wash water intermediate storage tank.
Solenoid valve does not switch.	Clean solenoid valve / servo boring.
Spray nozzle basket does not rotate any more.	Proximity switch / overtravel of end positions Manually turn back the spray nozzle basket and adjust the proximity switch. Make sure both sprockets are working at a time!
Screw shaft overload (material jamming)	Reverse the screw shaft briefly, activate washing and discharge the soggy press cake with a high screw speed and with the pressure cone open.

8.3 Fault repair

8.3.1 Motor overload – removing sludge blockage

A fault message and machine standstill due to motor overload is typically caused by a blockage with jammed incompressible sludge.

The typical causes of jamming:
- inhomogeneous sludge feed
- high mineral content in the sludge feed
- polymer overdosing
- short cleaning time of the screw press after stopping automatic operation
- low, slow speed controller settings of the screw press
- high, slow torque controller settings of the screw press

must be corrected before removing the blockage or restarting the machine.

To remove the blockage, the machine must be cleared in manual mode according to the following procedure. Observe the safety instructions in chapter 9 *Maintenance and repair.*

1. Activate manual mode.
2. Retract and release the pneumatic press cone.
3. Start the wash water supply, open the wash water solenoid valves
   Removing the last three wash water nozzles on the discharge side beforehand accelerates the rinsing and re-dilution process.
4. Rotate the spray nozzle basket several times between the end positions.
5. Open the inspection cover on the inlet side (see picture below).
6. Reverse the screw shaft at 50% speed for a maximum of 2 minutes.
   Any possible clogging in the inlet area can be visually recognised through the open inspection opening and must be avoided.
7. Open the wash water supply again and rotate the spray nozzle basket several times between the end positions over a period of approx. 10 minutes to dilute the jammed sludge.
8. Start the screw shaft in the pressing direction at 10% speed. The diluted sludge should now be discharged as the motor load decreases. After approx. 30 minutes, stop manual operation, insert the wash water nozzles, activate the pneumatics and start the machine in automatic mode.
9. Once the blockage has been successfully cleared, close the inspection cover on the inlet side, insert the spray water nozzles and start the machine in automatic mode.



Inlet-side inspection cover

NOTICE

Repeatedly starting the screw shaft when clogged without first reversing and re-diluting can lead to mechanical damage to the screw press

9 Maintenance, repairs and cleaning

⚠ CAUTION

Enclosed rooms of wastewater treatment plants that must be entered for service and maintenance have to be aerated in a way that prevents a dangerous explosive atmosphere, lack of oxygen and presence of harmful concentrations of gas or vapour.

⚠ CAUTION

The chapter maintenance and repair is intended for skilled staff only.
Any maintenance or repair work must be performed by skilled staff only.
Skilled staff has to be equipped with personal protective gear (such as gloves, etc.).

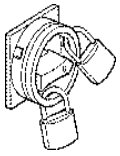
Qualified technician
A person that is able to evaluate assigned jobs and recognize possible risks, due to his/her professional skills, expertise and experience and knowledge of corresponding standards.
(Definition adapted from EN 60204-1.)

In order to prevent faults during operation, the machine must be cleaned and maintained at regular intervals.



⚠ CAUTION

When cleaning the machine always protect yourself with waterproof protective clothing, boots, gloves, and also with a face mask (if available and especially when using a high-pressure cleaner, in order to avoid coming into contact with wastewater, faeces, etc.)



⚠ WARNING

Shutdown procedure: Switch off the mains isolator and lock it.
All persons responsible for carrying out maintenance work on the machine must have their own padlock. The machine can only be restarted when all padlocks have been removed from the mains isolator.
Interrupt the water and compressed air supply. Secure the shut-off devices against re-opening. Depressurize the plant.

In order to prevent injuries and damage to the machine, it is important to observe the following points when carrying out maintenance on the machine:

- First cordon off a large space around the area in which maintenance work is to be carried out.
- Switch off all voltage sources and ensure that they cannot unintentionally be switched back on.
- Depressurize the pneumatic and water lines.
- Secure the shut-off devices against re-opening.
- Never use any other than the specified operating media.
- Only use spare parts which are listed in our spare parts lists.
- Also refer to the chapter *General Safety Instructions.*

The above maintenance measures add to the prolongation of the machine life. Furthermore, they improve machine availability and performance.

9.1 Inspection intervals

NOTICE

Check the potential equalisation regularly, as described in chapter 3.3, Incorporated safety systems!

Prior to starting with any inspection work, clean the respective equipment parts.

⚠ CAUTION

Never use a high pressure unit to clean electrical plant equipment!

Risk of injury! Always wear protective goggles when cleaning the machine with a water jet. Never direct the jet towards a person standing nearby!



⚠ WARNING

Automatic machine start:

Risk of injury! For visual inspections with the control voltage switched on, the maintenance switch (main switch) must be switched on.

Never put your hands into the machine interior, reactor or thick sludge trough! Risk of injury! If you want to carry out function tests that require access to the machine interior, you must shut down the plant before.

9.1.1 Weekly visual inspection

Visual inspection of the complete machine is required once a week. Visual inspection is also required whenever process settings have been changed or processes been adapted.

Check in particular the following:

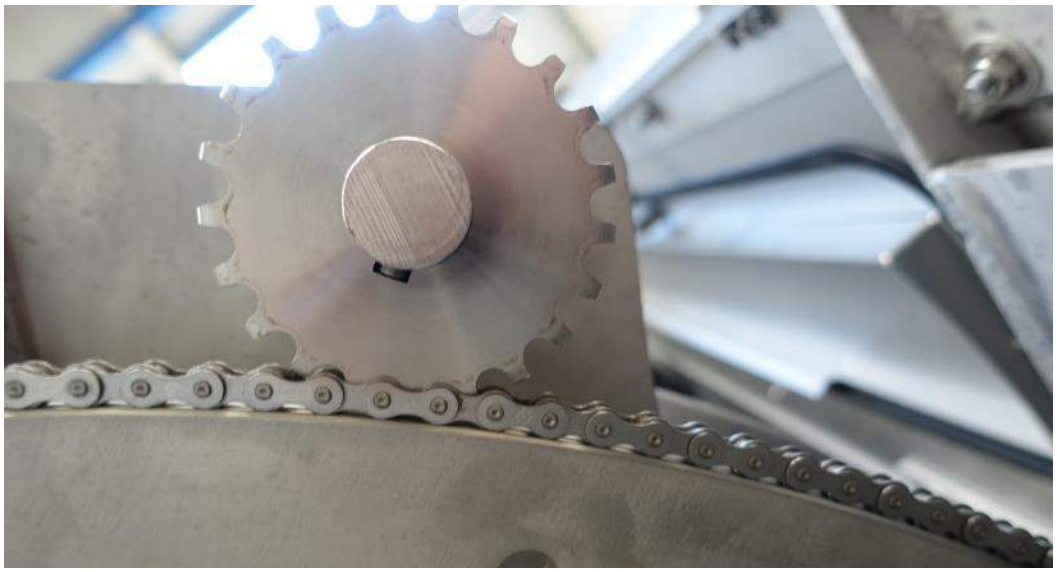
- Screen basket cleanness
- Function of the spray nozzle basket
- Filtrate chamber cleanness
- Functional test of cleaning nozzles
- Inspection of electric cables
- Inspection of connections

9.1.1.1 Screen basket

Check the screen basket once a week for cleanness (visual inspection).

9.1.1.2 Function of the spray nozzle basket

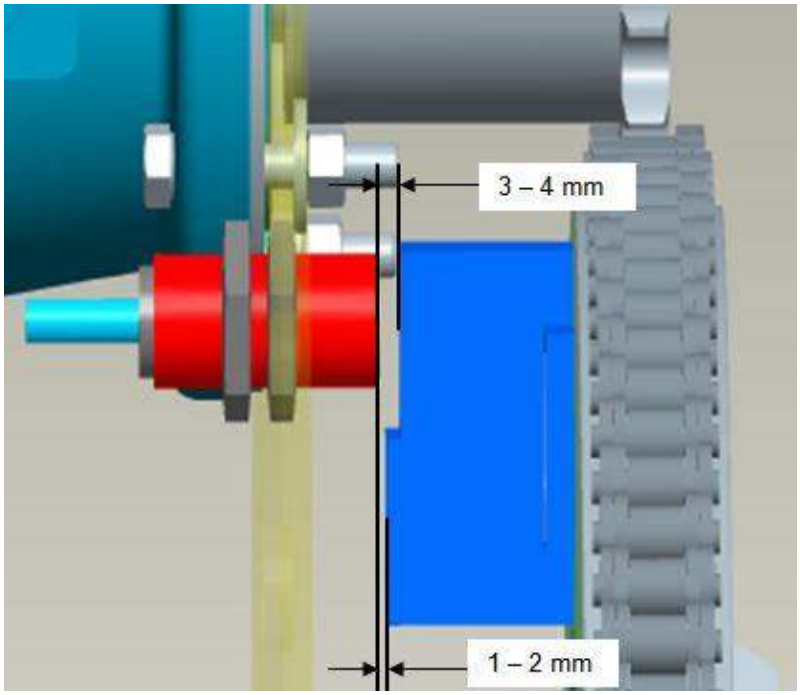
The screen basket must run without play. Worn rollers must be replaced.
The drive pinion must engage into the drive chain deeply in the middle.



The spray nozzle basket must change its rotary direction when reaching the respective end positions.

NOTICE

To ensure that the spray nozzle basket performs perfectly, the distance between the cam switches and the according proximity switch must be 2 mm (minimum) to 6 mm (maximum).



The distance between the proximity switch and the cam switch can be adjusted on the thread on the proximity switch.

9.1.1.3 Filtrate chamber

Check once a week that the filtrate chamber is clean (visual inspection).

9.1.1.4 Spray nozzles

- Check the nozzles by examining the jet pattern. Screw out and clean the nozzles that are clogged.

9.1.1.5 Electric cables

- Check all cables for damage.
- Have all damaged cables replaced by a specialist.

9.1.1.6 Connections

- Check that all connections of the machine are tight (leak-proof) and undamaged (pneumatic hoses, etc.).

9.1.2 Monthly functional test

Monthly execute the following maintenance work:

- Check the sieve apertures.
- Check the feed end oil seal.
- Check the pressure cone system.

Check the pressure sensor during operation, without dismounting:
Check if the display shows 0 mbar at empty machine or tank.
Clean any dirt from the filter cover and deposits from the process membrane if the deviation is bigger than 2% of the measurement range.

9.1.2.1 Inspection of sieve apertures

- After the washing mode, check the sieve apertures for organic or mineral sediments.

Mineral deposits caused by wash water with a high lime or iron content or organic deposits caused by sludges that contain grease for example may blind the screen apertures and reduce filtration efficiency. (See below.)







Useful is regular washing with warm water, using additives or screen basket cleaning with acid-containing agents.

⚠ CAUTION

Wear lye-resistant clothes and gloves, sealed goggles and respiratory protection to protect yourself while carrying out chemical purification! Pay attention that the working area is sufficiently ventilated. If you get in contact with hazardous substances, immediately take off your clothes and wash the affected skin with water.

Observe also separate safety instructions (safety data sheets) of the chemicals suppliers.

NOTICE

In order not to impair the durability of the construction materials of the machine, observe the instructions for use provided by the suppliers of the chemicals.

The following recommendations for the use of cleaners apply additionally:

- **Empty contaminated machine parts before chemical cleaning, clean them with clear water and let them dry.**
- **Use only chemical cleansers with a corrosion inhibitor.**
- **Dilute high-concentration acids or lyes to a concentration of 12% maximum.**
- **Let the cleaner react for 20 minutes maximum.**
- **Wash the cleaner off thoroughly after expiry of the reaction time.**

9.1.2.2 Feed-end oil seal

The oil seal can be inspected through a leakage opening below the grease nipples at the feed end. If sludge escapes at the point marked below, either the grease filling of the seal chamber is insufficient or the seal is defective.



9.1.2.3 Checking the pressure cone system

- Remove deposits from the shaft surface in the cone area.
- Remove deposits from the pushing rods of the pneumatic cylinder.
- Check the pneumatic cylinders at the pushing rods and exterior air connections.
- Drain the water collected in the pneumatic lines.



9.1.3 Yearly functional test

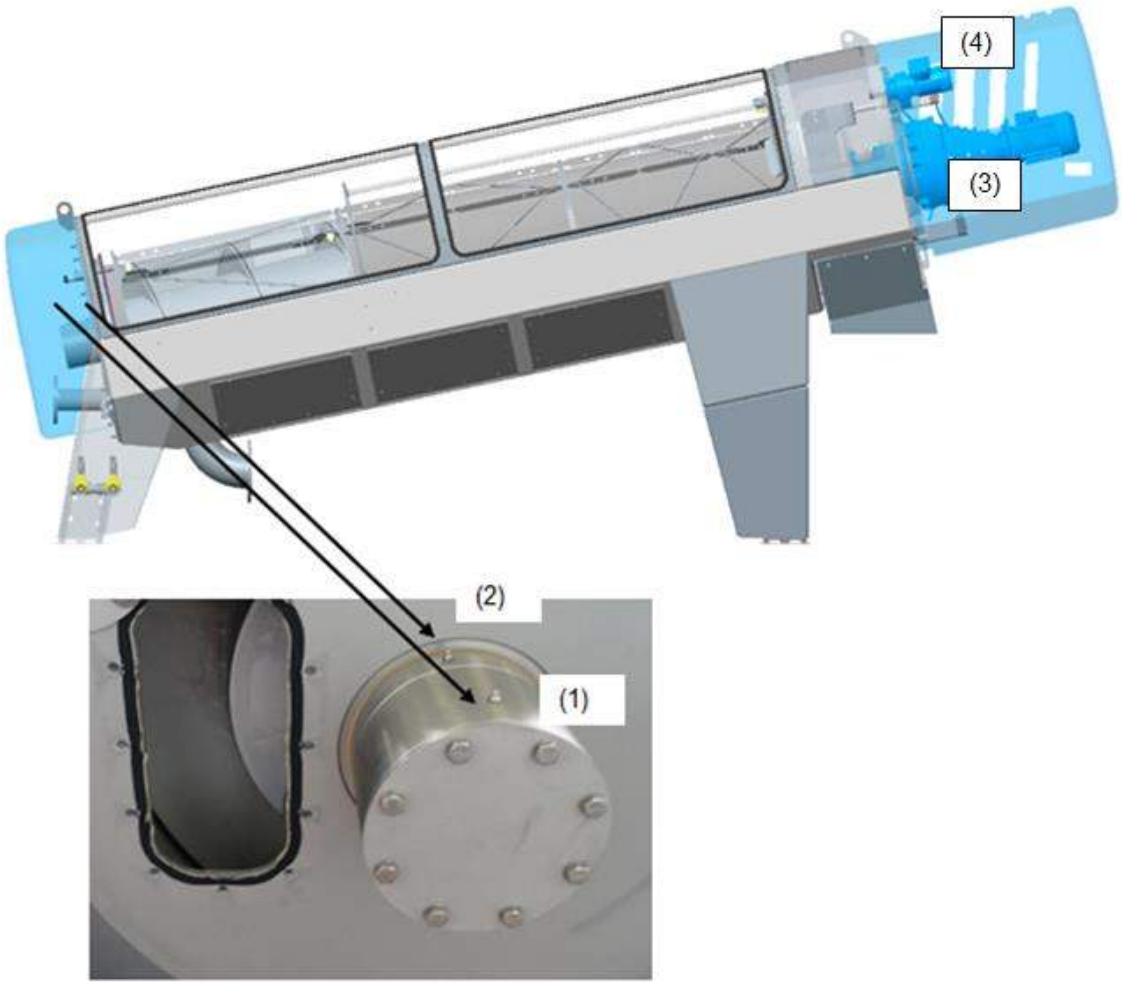
Yearly maintenance (shutdown machine, dissassemble)
Cleaning of pressure sensor:
Clean the process membrane with a soft sheet and suitable cleaners.
Overpressure or touching the membrane with hard metallic objects may damage the measurement electronics.

9.2 Maintenance

9.2.1 Lubrication

Lubrication point	Interval	(Proposed) lubricant
Feed-end screw shaft bearing (1)	monthly or every 500 operating hours 5 g lubricant	Plantogel ECO 2 S
Feed-end oil seal (2)	monthly or every 500 operating hours 1 g lubricant (620) 2 g lubricant (800)	Plantogel ECO 2 S

Lubricant specification according to DIN 51502: KPE 2 K-30
Lubricant specification according to DIN 51519: ISO-VG 100



If the bearing or oil seal is to be replaced, the new bearing or new sealing must be filled 100% with lubricant.

NOTICE

Grease the bearing points while the screw shaft is rotating to ensure the complete lubrication of the bearings.

9.2.2 Oil change

Observe the attached operating instructions for the gear motor.

⚠ CAUTION

When working on the gear motor, provide a suitable work platform, which complies with the general safety and accident prevention regulations.

Lubrication point	Interval	(Proposed) lubricant
screw shaft gear (3)	first time after 500 operating hours, then every 8000 operating hours resp. yearly	Fuchs Renolin PG 320
Spray basket gear (4)	every 10 000 operating hours resp. after 2 years latest	Fuchs Renolin CLP 220

9.3 Repair

It may be necessary to dismount the machine or parts of the machine to do maintenance and repair work.

⚠ WARNING

Consider that some machine components may swing back and forth when they are lifted.

Use separate lifting devices to secure machine components which are installed inclined (e.g. the screw drive) against pendular movement.

NOTICE

Do not step on the plastic covers and do not put weight on them by lashing straps.

These auxiliary means and special tools facilitate maintenance work:

- Mounting rail above the machine's longitudinal axis
- Moveable portal crane or fork lift
- Torque wrench up to 800 Nm

The heaviest individual machine parts and their weight:

Size	Screw shaft	Screen baskets	Screw drive
Q 620.2	400 kg	420 kg 210 kg half-shell	280 kg
Q 800.2	650 kg	720 kg 360 kg half-shell	400 kg

Size 620.2 machines **without** dividable screen basket

- Pull-in device for screw shaft
- Chain hoists, lifting power >= 1.5 t
- Bearing blocks, load-bearing capacity >= 1.5 t

Weight of the heaviest assembly group to be handled: 1.8 t

This assembly group consists of the screen basket, screw shaft, discharge chamber with motors and pressure cone, and the spray nozzle basket.

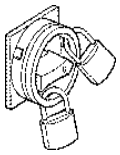
⚠ CAUTION

Observe the safety instructions under chapter Handling and transporting.
Risk of injury! Always wear protective goggles when cleaning the machine with a water jet. Never direct the jet towards a person standing nearby!

For durable and reproducible positioning of plant components some connections are secured with at least 2 adjust pins (connections of the screen baskets, inlet/outlet chambers, screw shaft bearing).

NOTICE

Pay attention to the drill holes for the adjust pins when you adjust and align the components during assembly.
Use new adjust pins to secure the connections.



⚠ WARNING

Shutdown procedure: Switch off the mains isolator and lock it.
All persons responsible for carrying out maintenance work on the machine must have their own padlock. The machine can only be restarted when all padlocks have been removed from the mains isolator.
Check if hazards arise from upstream or downstream equipment. Switch off the power supply of upstream and downstream machines before carrying out maintenance or repair work.
If, for operational reasons, it is not possible to disconnect the entire plant the responsible electrician, who must be qualified according to DIN VDE 1000-10, has to disconnect the individual machines and make sure according to DIN EN 50110-1 VDE 0105-1 they cannot be restarted unintentionally.
As an option, all drives and machines can be equipped with a repair switch which allows to switch off the respective machines/areas prior to carrying out repair work, according to DIN VDE 0100-200. The repair switches must be switched off and locked as described above.

9.3.1 Replacing the rollers of the spray nozzle basket

If the spray nozzle basket shows a radial play on the screen basket or the drive pinion does not perfectly engage into the drive chain any more, the rollers of the spray nozzle basket must be replaced.

- Completely deplete the machine.
- Shut down the machine.
- Remove the machine covers.
- Clean the machine interior and the drive elements of the spray nozzle basket using a high-pressure unit.
- Temporarily close the filtrate outlet with paper to avid that screws or tools get lost.
- Remove the pinions of the spray nozzle basket from the machine.
- Remove the hose lines from the spray nozzle basket.
- Turn the spray nozzle basket in the machine into a position where the flange plates of the spray nozzle basket can be accessed.
- Secure the upper and bottom half shells of the spray nozzle basket on the screen basket or on the machine frame so it cannot move.
- Loosen the flange plates of the spray nozzle basket paying attention to the markings on the elements for later reassembly.



- Lower the bottom half of the spray nozzle basket into the filtrate chamber of the machine.
- Lift the upper half of the spray nozzle basket out of the machine.
- Replace the axial and radial rollers including the axle bolts and pins.





- When reassembling the equipment, pay attention to the markings on the individual elements.

- After completed reassembly, check the concentric alignment towards the screen basket. Check also that the drive pinions engage perfectly and that the cam switches have the correct distance to the proximity switches.

9.3.2 Replacing the scraper on the screw shaft

Replace the scraper if the dewatering efficiency decreases significantly, or if the feeding pressure or the rotary speed of the screw increases despite otherwise unchanged sludge properties and settings for the flocculant.

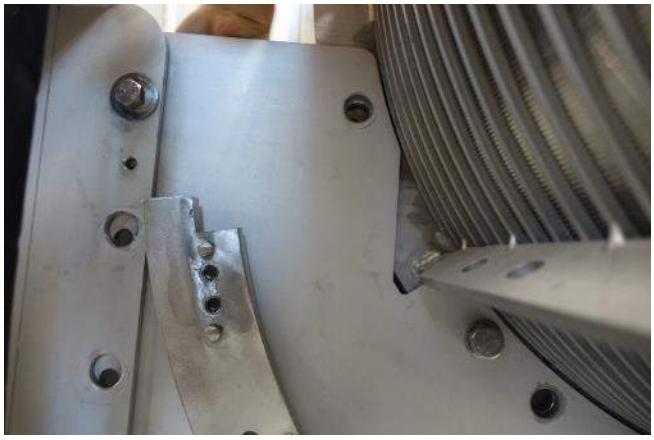
How to proceed with machines with a splittable screen basket:

- Divide the spray nozzle basket as described above.
- Loosen the radial grooved pins on the half shells of the screen basket.
- Loosen the axial grooved pins on both ends of the upper half shell of the screen basket.





- Loosen the through-bolts on the holder of the screen basket support at the inlet end of the machine. The clamping ring at the inlet side can now me pushed some centimetres into the inlet chamber. The upper half of the screen basket now has axial play inside the machine casing.





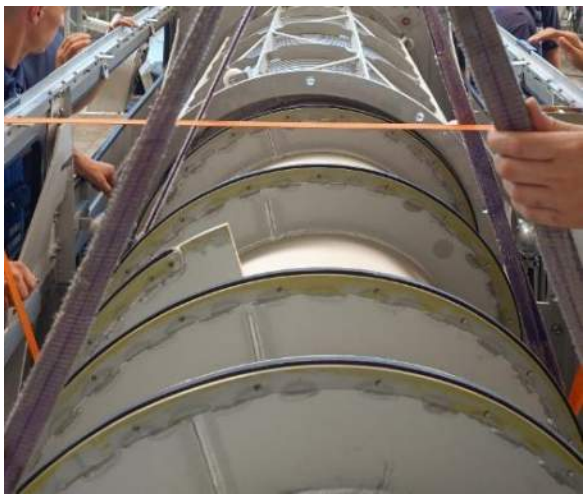
- Temporarily fix the pushed back clamping ring in the inlet chamber.



- Lift the upper half of the spray nozzle basket out of the machine casing.



- Loosen now the exposed headless screws that fix the scraper.



- Give the screw shaft a half turn.

⚠ WARNING

The machine must be in maintenance mode when turning the screw shaft (see Electrical Control Description).

- only tip operation (no intervention into the machine possible at the same time)
- significantly reduced rotary speed
- only forward moving
- time-limited

⚠ WARNING

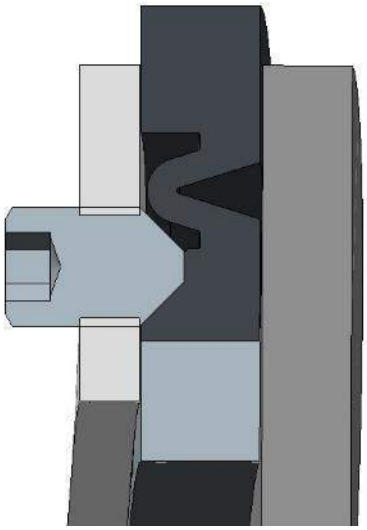


Automatic machine start:
Risk of injury! For visual inspections with the control voltage switched on, the maintenance switch (main switch) must be switched on.

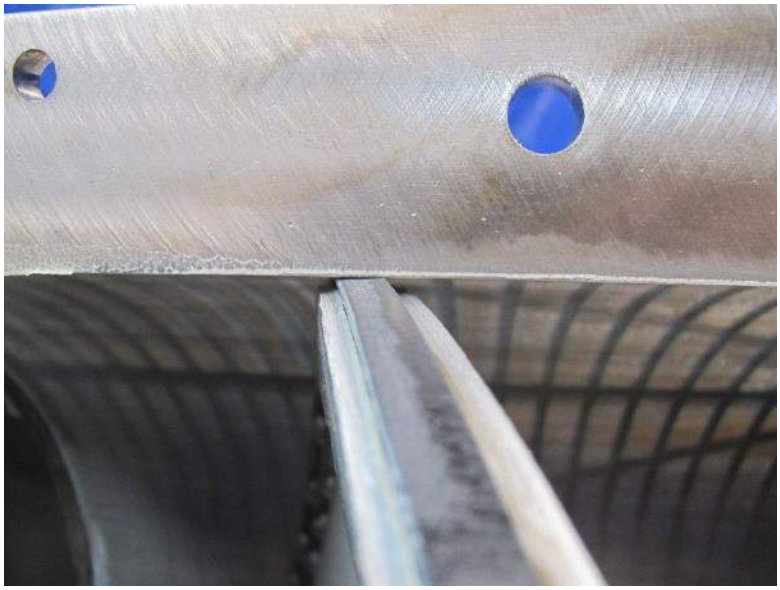
Never put your hands into the machine interior, reactor or thick sludge trough! Risk of injury! If you want to carry out function tests that require access to the machine interior, you must shut down the plant before.

- Loosen the other headless screws that fix the scraper.
- Pull the worn scraper out of its frame.
- Thoroughly clean the frame.
- Insert a new scraper lip into the frame beginning on the discharge end.
- Push the ends of the scraper into the pockets of the frame.





- Fix the scraper with threaded pins on the first half, exposed turn. The screwed-in threaded pins should be flush with the metal frame.
- Bevel the scraper with a knife on the first 3 cm to make it flush with the upper edge of the screw flight and thus allow the scraper to easily slide into the bottom half of the screen basket when the screw shaft is turned.
- Lubricate the scraper with flocculant or soft soap.



- Give the screw shaft a half turn and fix the scraper with screws.
- Continue this way to replace the scraper over the whole screw shaft.
- Cut off the projecting length. Bevel the last 3 cam with a knife to make it flush with the upper edge of the shaft.
- Reassemble the machine proceeding in reverse order.
- Use new grooved pins when pinning the individual components.
- Prior to restarting the machine, check that the drive pinions of the spray nozzle basket engage correctly and that the distance between the cam switches and the proximity switches is correct.

How to proceed with machines with a non-dividable screen basket:

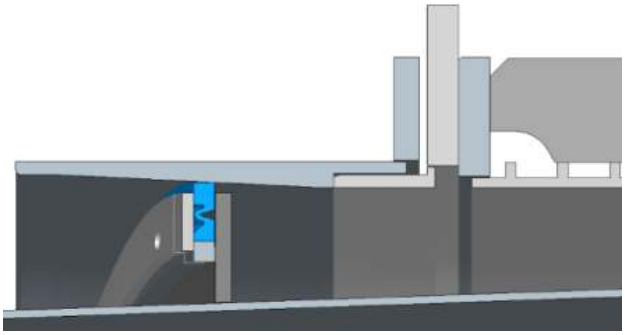
- Completely deplete the machine.
- Shut down the machine.
- Remove the machine covers.
- Clean the machine interior and the drive elements of the spray nozzle basket using a high-pressure unit.
- Temporarily close the filtrate outlet with paper to avid that screws or tools get lost.
- Remove the electrical connections of the motors and the pneumatic hoses from the pressure cone.
- If any, loosen the connections to the press sludge conveying unit.
- Remove the wash water hoses from the spray nozzle basket.
- Remove the discharge casing from the machine frame.
- Remove the radial screen basket holders from the machine frame.

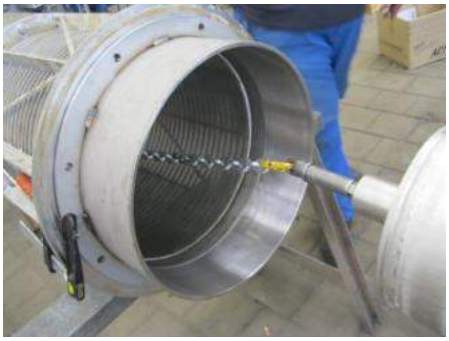


- Attach the end of the screen basket on the inlet side and the discharge casing to the lifting device.
- Slowly pull out of the machine the screen basket along with the washing system and the discharge casing with the motors and the pressure cone. Pull in axial direction until the shaft journal can be seen.
- Lift the complete assembly group upwards oust of the machine casing.
- Place the assembly group onto bearing blocks beside the machine.



- Loosen the screws that connect the gearing and screw shaft.
- Pull the screw shaft out of the screen basket at the inlet end.
- Replace the scraper on the screw shaft as described above.
- Separate the drive shaft of the spray nozzle basket from the drive journal.
- Separate the discharge chamber from the screen basket.
- Lubricate the scraper and screen basket.
- Attach the screw shaft at the inlet end to the conical clamping ring on the screen basket.
- Pull the screw shaft out of the screen basket at the inlet end.





- Pay attention that the scraper does not get jammed but slides easily into the screen basket.

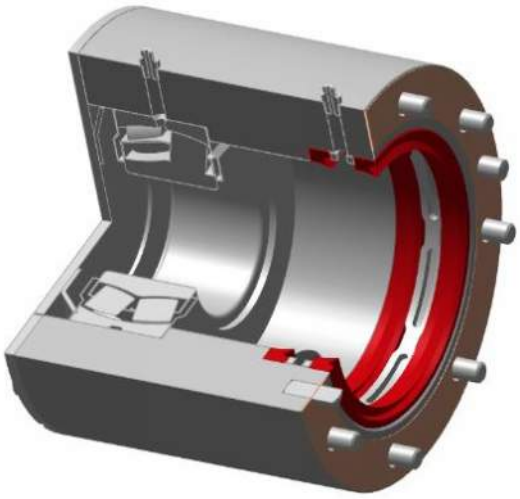


- Replace the sealing ring in the pressure cone.
- Replace the rollers of the spray nozzle basket, if necessary.
- Reassemble the machine proceeding in reverse order.
- Use new grooved pins when pinning the individual components.
- Pay attention that the tightening torques are correct when fixing the screw shaft to the output flange of the gearing.
  620.2: 510 Nm (M20 A2-70)
  800.2: 780 Nm (M30 A2-70)
- Prior to restarting the machine, check that both drive pinions of the spray nozzle basket engage correctly and evenly and that the distance between the cam switches and the proximity switches is correct.

9.3.3. Replacing the feed end shaft sealing/bearing

Replace the shaft sealing if sludge exits from the leakage borehole under the grease nipple. The bearing holder and the sealing support are screwed together. The sealing support is screwed and pinned to the inlet chamber.





- Loosen the bearing cover, bearing bush and sealing support, one after the other.
- Replace the shaft sleeve.
- Replace the shaft sealing rings and, if necessary, the shaft bearing.
- Before reassembly, completely fill the shaft bearing and the sealing gap with grease.
- Re-mount the components proceeding in reverse order.
- Lubricate the bearing and the shaft sealing only while the screw shaft is rotating. Pay attention to apply the correct amount of lubricant and lubricate in the required intervals.

9.4 Spares, wear parts

a) Wear parts

Our guarantee does not include wearing parts that are subject to natural wear during opera-tion. Wearing parts are defined as parts that show increased wear due to their function – such as the rotating plant parts, shaft seal and gearbox seals, scrapers, packing strips, etc. – the degree of wear depending on operational conditions, running hours and plant maintenance.

These are the main wear parts of the plant:

1. Scraper brushes on the screw flights
2. Shaft sealing with shaft sleeve
3. Shaft bearing
4. Rollers of the spray nozzle basket (620.2, 800.2)
5. Rollers of the spray nozzle basket (620.2, 800.2)
6. Nozzles of the spray nozzle basket
7. Hoses of the spray nozzle basket
8. Pneumatic cylinder

If the plant is fed with abrasive material (as frequently contained especially in industrial sludges), the life of the cleaning brushes may significantly be reduced. Components subject to emery wear are excluded from warranty.

b) Spare parts
For other spare parts such as gear motor, solenoid valve, lubricator, etc. see appendix.

Please provide the following details when ordering spare parts:
Type of machine
Size
Order number = machine number
Year of manufacture
Operating voltage of the electrical part
Order number from the spare part list (see appendix)
Required number of units
Delivery address

10 Shutdown

In order to avoid injury, damage to machinery and environmental damage when decommissioning the machine, the following safety guidelines must always be observed:

- The machine must only be decommissioned by authorised, qualified personnel.
- Please contact the manufacturer if you have questions concerning the disposal of the machine.
- Take care of environmentally sound disposal of operating media, lubricants and auxiliary material (e.g. gearbox oil): Observe the regulations for eco-friendly waste disposal!
- The machine must only be lifted at the points specified for the purpose.
- Only the lifting equipment and accessories listed here must be used for lifting the machine and parts of the machine.

⚠ WARNING

Use the lifting eyes only with the provided number of screws at the provided positions on the machine.
Check the lifting eyes and screws according to the enclosed inspection sheet before reuse.

- Also refer to the chapter *Transportation*.
- Also refer to the chapter *General Safety Instructions.*

10.1 Temporary shutdown

- Make sure there are no sludge residues left in the tanks and sludge dewatering machine after cleaning which might lead to biogas production.
- Empty the coagulant agent concentrate and dosing line (suction and pressure lines).
- Completely evacuate the coagulant agent conditioning plant.
- Flush all dosing pumps and deplete them.
- Empty the feed reactor.
- Empty the thick sludge trough.
- Clean coagulant agent injection nozzles of injection and mixing unit.
- Completely evacuate the sludge thickening machine and manually remove sludge residues. Make sure the filter surfaces are completely clean.
- Clean the nozzles of the filter cleaning system.
- Empty the coagulant agent concentrate pump.
- Frost-protect the pipelines and prevent deposits.
- Check control panel battery of the PLC (E-Prom).
- Completely evacuate the coagulant agent conditioning tank.
- Lubricate all bearings and sealings.

10.2 Final decommissioning / disposal

Qualified staff only is authorized to perform electrical and mechanical shutdowns.
Prior to a final shutdown, follow the instructions for a temporary shutdown and the following additional instructions:

Completely empty the coagulant agent conditioning plant and coagulant agent concentrate tank. Clean the coagulant agent conditioning plant with appropriate agents. Return/dispose unused chemicals to the supplier.

11 Additional information

Do you have any further questions or requests? We will be happy to assist you.

Our company address:

HUBER SE
Industriepark Erasbach A1
92334 Berching
Germany

Phone: +49-8462-201-0
Fax: +49-8462-201-810
E-mail info@huber.de

You can contact our central customer service by:

Phone: +49-8462-201-455
Fax: +49-8462-201-459
E-mail service@huber.de

We will help you to quickly find the right technical expert to answer your questions.

You can also visit us online at:

You can also find up-to-date information on our service division there.

Our range of services includes **preventive maintenance, maintenance, and rapid repairs.** Our service hotline is available **24 hours a day, 7 days a week.**

Our service department will provide you with the customer-oriented and reliable service that our customers have come to expect. Our qualified employees and skilled management offer you assistance with:

- **Installation and commissioning**
- **Advice, information and training of operating personnel**
- **Maintenance at regular intervals**
- **System optimisation**
- **Maintenance of product performance**
- **Repairs and standard spare parts within 48 hours**

This comprehensive range of services ensures that your system can be operated safely and reliably. This is an important aspect for municipalities and industry. The support provided by our service department means that you can more effectively carry out the task of maintaining the functionality of your system.

INTECHNICA CERT GmbH

CERTIFICATE

ISO 14001:2015

for

HUBER SE

at the site

92334 Berching, Industriepark Erasbach A1

The DAU-accredited environmental verifier hereby certifies that the named organization has implemented an Environmental Management System.

Scope: Development, production and sales of machine equipment and plants for water/waste water and sludge treatment for municipalities and industries as well as products for the drinking and waste water sector

With an audit it has been assessed that the requirements of ISO 14001:2015 are fulfilled.

Nürnberg, 21 May 2024

The follow-up certificate No. UG0247-2024 is valid until 29 May 2027.

Dipl.-Phys. Reinhard Mirz
Environmental Verifier
DE-V-0260

Dr. Reiner Beer
Environmental Verifier Organization
DE-V-0279

Certificate

Standard **ISO 9001:2015**

Certificate Registr. No. **01 100 1700023**

Certificate Holder: **Huber SE**
Industriepark Erasbach A1
92334 Berching
Germany

Scope: Development, manufacture and sales of machine equipment and plant for water, wastewater, sludge for municipalities and industries as well as products for the drinking- and wastewater sector

Proof has been furnished by means of an audit that the requirements of ISO 9001:2015 are met.

Validity: The certificate is valid from 2023-08-13 until 2026-08-12.
First certification 2017

2023-07-10

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

www.tuv.com

DAkkS Deutsche Akkreditierungsstelle D-ZM-16031-01-00

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HUBER TECHNOLOGY
WASTE WATER Solutions

Certificate
Pickling Plant HUBER SE

We confirm with this certificate that

- All HUBER SE stainless steel products are acid treated in a pickling bath and passivated in the fully automatic pickling plant installed in the Hans Huber SE factory.
- The pickling tank size is 12m x 3m x 3m to ensure the treatment of even big equipment parts. Later welding work at the time of machine assembly can be avoided.
- The pickling process consists of preliminary washing, pickling and secondary washing. The plant is operated fully automatically.
- The pickling plant is operated as a circulation system and equipped with a state-of-the-art wastewater treatment plant. The corresponding threshold values are met considerably.

Only these measures ensure the material retains its excellent properties and remains corrosion-resistant according to its material quality.

The pickling process is annually inspected by an external environmental verifier. The pickling process is further monitored continuously by the operator himself, additionally by external maintenance specialists and the local authorities.

Nürnberg, May 17th 2016

Dipl.-Phys. R. Mirz
Environmental Verifier DE-V-0260

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Sitz der Gesellschaft / Headquarters: Berching · AG Nürnberg / Register of companies: HRB 25558
Vorstand / Board: Georg Huber (Vorsitzender / CEO), Dr.-Ing. Oliver Rong (stellvertretender Vorsitzender / Vice CEO), Dr.-Ing. Johann Grienberger, Rainer Köhler
Aufsichtsratsvorsitzender / Chairman of the Supervisory Board: Karl-Josef Huber
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TECHNICAL MEMORANDUM

Surface Treatment of Stainless Steel

Currently Huber Technology processes up to >5000 metric tons of stainless steel per year. All finished products made of stainless steel have to undergo an appropriate surface treatment: pickling and passivation of the surface. In order to guarantee a constant and consistent treatment, pickling and passivation have to take place in a pickling bath using the full immersion method. The actual pickling process takes place in a pickling pool with a volume of 160 m^3. This pool volume is necessary in order to pickle even the largest items with the bath method. In the pickling bath processing-related material changes and alterations (caused by edging, welding, or caused by the contact with other materials) are reversed.

Especially ferritic inclusions, chromium-carbide formations and changes in the crystalline surface structures are eliminated. Thus, later occurring types of corrosion that are associated with stainless steel, in particular inter-crystalline corrosion, grain border corrosion and contact corrosion are avoided.

The pickling solution consists of nitric acid and hydrofluoric acid. The nitric acid serves for the oxidation of undesired materials and inclusions, while the hydrofluoric acid has the purpose of keeping the developing oxides in solution. The content of the etching bath gets constantly circulated while being kept at a constant temperature of 20 - 30° C through a heat exchanger. The bath is continuously kept free of mechanical pollution by the action of a filter. The pickling bath is always kept closed. It is opened only for loading and unloading. Before the cover is removed waste air is sucked off through slots on the side. The waste air is first cleaned by passing it through filters before it is released into the atmosphere. Thus, the formation of foul smelling odors is prevented.

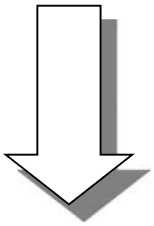
In a section next to the pickling plant, the pickled stainless steel items are passivated and cleaned off acid residues using spray- and steam pressure installations. The flushing water is collected in a collection pool. Later, it is centrally removed from there. First the flushing water is neutralized with calcium hydroxide. The addition of the neutralization agent takes places in portions while the pH of the flushing solution is continuously monitored. Once neutralized, the flushing water is passed through a heavy metal separator where heavy metals are secreted through the action of four consecutive inclined treatment groups that have flocculation compounds (polyacrylamid, polyacrylate) added to them. The heavy metals are removed and drained in a chamber filter press. The filter cake is disposed of in a hazardous waste facility. Finally, the cleaned waste water can be taken from the neutralization plant. Once again, the pH of the water is measured automatically and is recorded.

Additional samples that are examined for their pH-values and heavy metal contents are taken discontinuously from the effluent stream. In this manner, a supplementary running control is guaranteed. The bottom and the side walls of the entire pickling- and passivation bath are coated with shock-resistant and acid-proof plastic so as to avoid that water from the bath sprays outside. Only with this plant it is possible to achieve a professional, necessary surface treatment of stainless steel. And it is possible that the surface treatment of Huber stainless steel products which have their use in the environmental protection field, can take place in an ecologically-sound manner.

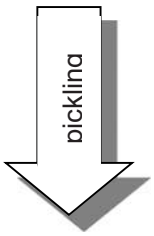
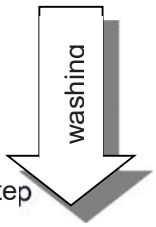
Learn more about Huber's experience with stainless steel at link at . . .
www.huber-technology.com/about-huber/our-manufacturing-quality.html

Time flow of a pickling process

PRIMARY CLEANING



PICKLING PROCESS

		Duration[1)]
FIRST step 	- Filling the acid into the pickling tank	1 hour
	- Pickling	2.5 hours (2-4 hours)
	- Pump off into the acid tanks	1 hour
SECOND step 	- Filling the pickling tank with wash water	1 hour
	- Washing	0.2 hours (0-1.25 hours)
	- Pump off into the wash water tanks	1 hour

SECONDARY CLEANING

[1)] The pickling and washing times are variable and depend on the other parameters.

Correct handling of stainless steel products

HUBER stainless steel products are carefully manufactured under precisely the right conditions for the material. The final pickling bath treatment and subsequent passivation ensures that each product receives the best possible protection against corrosion. It is however essential that this protection is not damaged by improper delivery, storage, handling in transit or on site.

What impairs corrosion protection?

Stainless steel must not come into contact with salt solutions (sodium chloride)!

- Avoid contact with de-icing salt during winter transport (provide covers).
- Avoid contact with sea or brackish water.
- Avoid drying of salty liquids (wash off).

Stainless steel must not come into contact with other metals. Do not ...

- store with other metals (storage platforms, scaffolding, tools).
- fix stainless steel with fixings of dissimilar materials (galvanised nuts, brackets).
- attach stainless steel products with other metals directly (pipelines).

Stainless steel must not be treated improperly. Do not ...

- clean stainless steel with carbon steel brushes.
- expose stainless steel to red-hot cutting fountains (from angle grinders).
- use grinding discs containing iron.
- carry out thermal or mechanical treatment without subsequent pickling and passivation.

Do's on site

Avoid 'cold welding', caused by fixing stainless steel of the same grade. Do ...

- use screws made of V2A and nuts made of V4A material.
- use suitable lubricants.
- separate stainless steel from other materials electrolytically through the use of synthetic gaskets, washers and sleeves.

Connections should be preferably bolted. If on-site welding cannot be avoided, it should be carried out correctly. Do ...

- use the correct welding supplements.
- use only TIG welding with filler rod for one-sided butt welding.
- use MIG or electric arc welding only for two-sided butt welding.
- always pickle the surface with a suitable compound after welding.
- allow passivation by flushing the surface with salt-free water after pickling.

When setting in concrete. Do ...

- use stainless steel wall ducts.
- allow for different rates of thermal expansion.
- treat the surface carefully.
- use only suitable cleaning materials and always flush afterwards.
- use a protective covering when burying stainless steel in ground containing iron.

Properly treated stainless steel does not require any further corrosion protection.
However, if the surface must be painted for aesthetic reasons, do use a suitable primer.

Only with your cooperation, to ensure correct delivery, storage, handling in transit or on site and installation, can we guarantee you the best from our stainless steel products. In doing so, you will also promise the operator maintenance and trouble-free operation for years.

Important information for the long-lasting use of stainless steel

Chloride content of the wastewater:

- Maximum for V2A (304, 304L) 100 mg/l *
- Maximum for V4A (316L, 316Ti) 400 mg/l *
- Maximum for V4A (316L, 316Ti) 250 mg/l **

* no hydrogen sulphide in the area of the stainless steel
** with a maximum hydrogen sulphide content of 6 ppm

Chloride content in service/potable water

- Maximum V2A (304, 304L) 100 mg/l
- Maximum V4A (316L, 316Ti) 250 mg/l

pH value of the wastewater / service water

V2A (304, 304L) V4A (316L, 316Ti) > 6.5

Iron content in service water:

V2A (304, 304L) V4A (316L, 316Ti) ≤ 0.50 mg/l

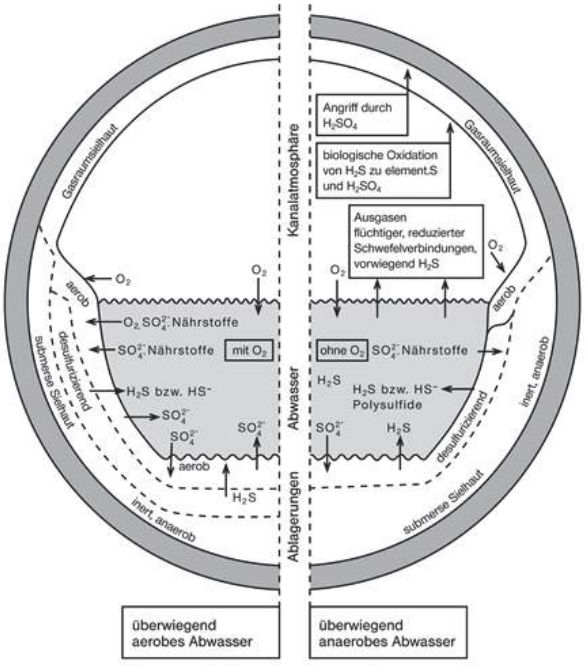
Hydrogen sulphide concentration:

in the area of the stainless steel construction (machine)

V2A (304, 304L) not permitted
V4A (316L, 316Ti) ≤ 6 ppm

In the presence of hydrogen sulphide, continuous active air suction from the machine with an air exchange rate of approx. 20 times is generally recommended. Furthermore, cleaning nozzles are recommended for closed tanks.

Hydrogen sulphide generation



Under anoxic or anaerobic conditions in the sewer (e.g. long flow times), sulphate reduction takes place already in the upper layers of slime and settled solids. The generated sulphides can diffuse unhindered into the wastewater. There, depending on the pH value of the wastewater, a balance is established between the hydrogen sulphide and the hydrosulphide ions. The lower the pH of the wastewater, the greater the proportion of hydrogen sulphide in the total sulphide and the greater the H_2S potential that can be released to the sewer atmosphere, in pump sumps or in the inlet to the machines and, in addition to corrosion, can also lead to odour problems and endanger life.

Image from: Leaflet DWA-M 168 "Corrosion of wastewater systems - wastewater pipes", June 2010

Warranty

Sandpoint, ID

HUBER warrants that the equipment and components furnished will be free from defects in workmanship and materials and perform the general process function intended, solely under the conditions defined by HUBER for a period of (a) twelve (12) months from completion of installation, start-up or owner acceptance of the equipment assuming the equipment is accepted by the owner within 6 months of delivery or (b) eighteen (18) months from the date of delivery to Purchaser, whichever date comes first. HUBER will replace, modify or repair, at its sole option, any such defective component or equipment at no charge provided that HUBER is notified promptly in writing of any claimed defect. If requested by HUBER, any such defective part or component shall be returned to HUBER, freight prepaid. HUBER will provide on-site Field Service when reasonably assured of payment therefore if this warranty does not apply or when such service is required in its judgments. This warranty does not apply to any defect or malfunction arising out of failure to store, install, operate or maintain the equipment in accordance with instructions by HUBER. Warranty shall be voided for any misuse of equipment; operation under conditions other than those defined by HUBER in its operation and maintenance (O&M) manuals for said equipment, or gross operator negligence. Any unauthorized modification or alteration of the equipment or repair or replacement of components may void this warranty, at the sole option of HUBER. For any billable repairs completed outside of the initial warranty period, a sixty (60) day guarantee on work performed and parts supplied will apply.

HUBER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, WITH REGARD TO THE DESIGN, SALE, MERCHANTABILITY OR FITNESS
OF THE GOODS FOR A PARTICULAR PURPOSE OR USE EXCEPT AS EXPRESSLY SET FORTH IN HUBER'S TERMS AND CONDITIONS.
HUBER IS NOT SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR WARRANTY,
TORT CLAIMS INCLUDING NEGLIGENCE, GROSS NEGLIGENCE AND STRICT LIABILITY, OR ANY OTHER THEORIES OF LAW. HUBER IS
UNDER NO EVENT LIABLE FOR ANY SPECIFIC, INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGES, EXPENSE, INJURY, DISMEMBERMENT, OR DEATH OF ANY KIND WHATSOEVER.

NUMBER OF DAYS AND TRIPS FOR START-UP

Sandpoint, ID

HUBER Q-Press 620.2

Huber will provide two (2) trips, for a total of eight (8) on-site day(s).
This trip is to inspect the final installation, supervise initial start-up and operation and to train operating personnel in the proper operation and maintenance of the system.

Per Stantec, start-up services to be contracted via contractor

LIST OF SPARE PARTS SUPPLIED
BY HUBER WITH EQUIPMENT

Sandpoint, ID
HUBER Q-Press 620.2

Spare Parts:

-One (1) set of wipers with mounting material
-One (1) bearing sealing set
-One (1) solenoid valve
-Ten (10) nozzles for cleaning system

Additional spare parts and service are available through:

HUBER Technology, Inc.
1009 Airlie Parkway
Denver NC 28037
Tel: (704) 949-1004
Fax: (704) 896-2830
E-Mail: parts@hhusa.net or service@hhusa.net

LONG TERM STORAGE PROCEDURE

Sandpoint, ID
HUBER Q-Press 620.2

Mechanical Equipment Storage:

When selecting a location for storage

- Take care that the components cannot be damaged due to vehicles or careless working.
- The components may not become dirty due to splashes of concrete or mortar
- There should be no spark fountains from angle grinders, etc
- Exposed electrical components of the equipment (sensors and motors) must be covered with a waterproof bag, but do not wrap
- The equipment may not be stored externally near the coast.
- The storage location must be vibration free.
- Do not store organic solvents at the location of storage.
- Avoid ultraviolet radiation as well as ambient air containing ozone, hydrogen sulfide and chloride.
- If equipment is stored for longer than 6 months, the gearbox oil should be drained and refilled with new oil.
- Please contact Huber on the project specific external storage strategy for approval.

Control Panel Storage:

When selecting a location for storage

- Take care that the components cannot be damaged due to vehicles or careless working.
- The components may not become dirty due to splashes of concrete or mortar.
- There are no spark fountains from angle grinders etc.
- The control panel must be stored internally in a climate controlled environment within a non-classified environment. Do not expose to rain
- The storage temperature shall not drop below 23°F and shall not exceed 120°F
- Specific external storage strategies are allowed upon prior written permission by Huber. In these cases, please provide detailed storage plan, in writing, so t hat a component by component evaluation can be completed for the control system.

Pre-Startup Checklist

The following points must be completed and verified by the customer or contractor prior to the travel of the HUBER representative. Failure to submit this form or to have these items completed can result in additional charges for new travel arrangements or time and material used on site. The requested date for startup should be indicated below.

Please submit the completed form and pictures to Sebastian.Seiber@hhusa.net and Christian.Reyer@hhusa.net

- *Please note that once startup services are scheduled, this time is reserved exclusively for that service(s). Cancellation and/or rescheduling prior to the scheduled dates are subject to airline change fee(s) plus the differences in the cost for the new airline ticket(s) and any additional expenses that may occur (including hotel cancellation fees and airline agent fees).*
- In the event of on-site delays which are beyond HUBER's control, including proper installation, training and start-up, additional charges will be invoiced ($155/hour, plus expenses).

Site Name: _____ **Contact:** _____

Site Address: _____

Contact Phone Number(s): _____ **Email:** _____

IT IS REQUIRED TO HAVE THE FOLLOWING ITEMS COMPLETED PRIOR TO STARTUP

Type of equipment

ITEM	INITIALS
Headworks Equipment (Screens, etc.) *"Influent is required"*	
Grit Equipment (Grit Washer, etc.) *"Seeding Sand is required and should be provided by others"*	
Sludge Equipment (Sludge Thickening, etc.) *"Sludge is required"*	

Training

ITEM	INITIALS
1. Required personnel will be available for training during the startup	

Mechanical

ITEM	INITIALS
1. Verify field dimensions against project drawings	
2. Equipment mounted at correct angle/level	
3. Supports/Feet anchored securely	
4. Discharge for effluent and solids connected	
5. Access to all maintenance areas/valves	

Plumbing

ITEM	INITIALS
1. All connections tightened and sealed if necessary **(Include photos of all water connections)**	
2. Water supply with local valve (pressure and flow rate according to specifications)	
3. Wash down water available (plant or potable)	
4. Plumbing for effluent and solids connected	
5. Overflow drains clear and down-grade	
6. Ancillary piping installed (reject water, etc.)	

Electrical

ITEM	INITIALS
1. Main feed with local disconnect	
2. Size of service sufficient for ratings	
3. Connections to control panel **(Include photos of field wiring in cabinet)**	
4. Preliminary check of control panel	
5. Verify wiring from cabinet to equipment	
6. House current available	
7. Were entries in the top of the panel made	YES NO
8. Are site specific IP-Addresses required	YES NO

If entries in the top of the panel were made, please ensure that all debris was removed from the inside of the panel.

If site specific IP-Addresses are required, please provide the information below.

IP-Address: _____

Subnet: _____

Gateway: _____

SAFETY

Item	Comments
Contact person – especially and mainly for on-site – Name and contact number	
Site required PPE (hard hat, safety vest, etc.)	
Specific site requirements (parking, food / vending, tobacco / vape / smokeless policy, etc.)	
Onsite SME for mechanical, electrical, plumbing, etc. – name and contact number	
Access – security, how get in, what need for entry	

Job hours on site to work – for early morning or afternoon work	
Locations of restrooms for our service techs	
Evacuation, Take cover or Active shooter notification – what sounds like and where to go	
Lighting – inside / outside for work to be performed? Available for early morning or evening work?	
AED location	
Emergency contacts including alternate 911 number- name and contact number	
Weather – have anything in place / available for hot, wet, or cold weather (shelter, tent, fans, AC or heat location, etc.)	
Fall Protection (Required / Available: Ladders, Lifts (elevated work platforms), Scaffolding, harnesses, etc.)	
Site Signage marking hazards (Confined spaces, head bump objects, chemical storage	
Confined space attendee and rescue plan available	
Power shut off and power up or site electrical contact (name and contact number)	
Electrical – Panel properly grounded, other power LOTO, etc.	

Requested date for Startup: _____

By signing below, I certify that the above information is true and accurate for the startup of the HUBER equipment.

Date	Printed Name	Signature

Additional paid startup trips are available if required. Please contact us for an additional estimate for extended or additional trips.

HUBER Technology, Inc.
1009 Airlie Parkway, Denver, NC 28037
(704) 949-1010 - Fax (704) 949-1020 - huber@hhusa.net
www.huber-technology.com
A member of the HUBER Group

PURCHASE ORDER

CITY OF SANDPOINT
1123 LAKE STREET
SANDPOINT, ID 83864

DATE	P.O. No.
10/27/2025	**26-1678**

SUPPLIER:

VENDOR: 004959

HUBER TECHNOLOGY INC
1009 AIRLIE PKWY
DENVER, NC 28037-7705
PH: (704) 949-1010

SHIP TO:

WASTEWATER TREATMENT PLANT

723 S. ELLA
SANDPOINT, ID 83864
PHONE: (208) 255-2657
EMAIL: CHUGHES@SANDPOINTIDAHO.GOV

Description: HUBER SCREW PRESS Q-PRESS 620.2

Internal Use Only: DETAILS ON WHAT ALL IS INCLUDED IN THE $1,110,000.00 PRICE CAN BE FOUND PAGE 4 OF THE ATTACHED BUDGET PROPOSAL - HF

Item No.	QTY	Unit	Description	Unit Price	Amount
HUBER SCREW PRESS Q-PRESS 620.2	1.00	Units	HUBER SCREW PRESS Q-PRESS 620.2 31-3257-7730-0000-32721036	1,110,000.00 1,110,000.00	

Total: $1,110,000.

~~Subject to the Terms and Conditions Set By the City of Sandpoint~~
~~1. Acceptance of this order includes acceptance of all terms, prices, delivery instructions, specifications and conditions.~~
2. Purchases may not exceed the total amount of this order without prior approval.
3. Invoices and Packages must bear the Purchase Order Number above.
4. All Purchases are subject to a Net 30 payment term.
Visit www.sandpointidaho.gov for More Details

The Terms and Conditions applicable to this Purchase Order are Huber's Standard Terms and Conditions which are attached hereto and incorporated herein by reference. Huber will proceed with its obligations as specified in this Purchase Order in reliance upon Purchaser's acceptance of and agreement with Huber's Standard Terms and Conditions.

Jeremy Grimm (Oct 29, 2025 13:09:49 MDT)

Authorized Signature

Date Printed: 10/28/2025

No: 25-034
Date: September 3, 2025

RESOLUTION
OF THE CITY COUNCIL
CITY OF SANDPOINT

TITLE: DECLARING HUBER TECHNOLOGY, INC., THE SOLE SOURCE PROVIDER OF THE Q-PRESS SCREW PRESS FOR WASTEWATER TREATMENT PLANT

WHEREAS: The City's Wastewater Treatment Plant (WWTP) solids-handling building currently contains two aging belt presses used for dewatering biosolids, which are at the end of their useful life, showing significant rusting, and identified by the Idaho Department of Environmental Quality (DEQ) as a permit violation;

WHEREAS: To maintain regulatory compliance and ensure reliable operations, replacing the belt presses with two screw presses was identified and budgeted as a bridge improvement project in advance of the full WWTP reconstruction, with the goal of replacing these presses now to protect operations and the added benefit of eventual use of this equipment in the new facility once it is constructed;

WHEREAS: After evaluating alternatives and conducting a pilot test, Stantec Consulting Services, the City's consultant, recommends sole source pre-procurement of two Huber Technology Q-Press screw presses, models 440.2 or 620.2;

WHEREAS: Idaho Code § 67-2808 authorizes sole source procurement when there is only one vendor reasonably available or when competitive solicitation is impractical;

WHEREAS: The solids-handling building imposes dimensional and weight constraints that limit available equipment options, where the existing roof hatches and structural capacity can accommodate the Huber units, while many competing products are too large or too heavy to install without costly structural modifications or construction of a new building;

WHEREAS: In addition, the City requested pilot testing from multiple manufacturers, with only Huber Technology conducting a pilot test at the Sandpoint WWTP, where their Q-Press successfully demonstrated reliable performance in dewatering the plant's sludge and no other manufacturer providing proof of equivalent effectiveness;

WHEREAS: Schedule reliability is also a critical concern, where the belt presses are at high risk of failure and waiting for a competitive procurement would extend the timeline and potentially leave the City without a functioning dewatering system; and

WHEREAS: Pre-procurement of the Huber presses will allow design and submittal processes to move forward immediately, preventing costly delays and ensuring the WWTP can continue to operate without interruption, with the use of known equipment also allowing the design team to finalize electrical, HVAC, and piping requirements accurately, reducing redesign costs and change orders during construction.

NOW, THEREFORE, BE IT RESOLVED THAT: Pursuant to Idaho Code § 67-2808, the City Council of the City of Sandpoint hereby declares Huber Technology, Inc., the sole source vendor for purposes of procuring two Q-Press screw presses, models 440.2 or 620.2, and related equipment for the City's Wastewater Treatment Plant.

BE IT FURTHER RESOLVED THAT: City staff is directed to provide for publication of this sole source expenditure declaration in the legal publications section of the Bonner County Daily Bee, the City's newspaper of record, at least 14 calendar days prior to the award of any contract to, or purchase of this equipment from, Huber Technology, Inc.

BE IT FURTHER RESOLVED THAT: Provided no challenges are received, the Mayor is hereby authorized to approve a Purchase Order to Huber Technology, Inc., in an amount not to exceed $1,500,000.

Jeremy Grimm, Mayor

ATTEST:

Melissa Ward, City Clerk

PO26-1678 HUBER TECHNOLOGY SCREW PRESS001

Final Audit Report 2025-10-29

Created:	2025-10-28
By:	Heather Faircloth (hfaircloth@sandpointidaho.gov)
Status:	Signed
Transaction ID:	CBJCHBCAABAAnJlYhcl9Tk4LmUqt4lPfSVz_gRTmntYN

"PO26-1678 HUBER TECHNOLOGY SCREW PRESS001" History

Document created by Heather Faircloth (hfaircloth@sandpointidaho.gov)
2025-10-28 - 7:10:47 PM GMT

Document emailed to Jeremy Grimm (jgrimm@sandpointidaho.gov) for signature
2025-10-28 - 7:10:53 PM GMT

Email viewed by Jeremy Grimm (jgrimm@sandpointidaho.gov)
2025-10-29 - 7:09:38 PM GMT

Document e-signed by Jeremy Grimm (jgrimm@sandpointidaho.gov)
Signature Date: 2025-10-29 - 7:09:49 PM GMT - Time Source: server

Agreement completed.
2025-10-29 - 7:09:49 PM GMT

HUBER TECHNOLOGY
WASTE WATER Solutions

HUBER TECHNOLOGY, INC. STANDARD TERMS AND CONDITIONS OF SALE

1. **ENTIRE AGREEMENT/ORDERS.**
Unless otherwise noted in Exhibit A of the Proposal, this Proposal is dependent and expressly conditioned upon Purchaser's acceptance of the attached HUBER Technology, Inc. (hereinafter "HUBER") Standard Terms and Conditions of Sale dated 11/25/2025.

This agreement (the "Agreement") is between HUBER Technology, Inc., ("HUBER") and Purchaser. No order for HUBER's goods or services shall be binding upon HUBER until acknowledged in writing by HUBER. Such written acknowledgement and these Standard Terms and Conditions of Sale (the "Terms and Conditions") constitute the entire agreement between HUBER and Purchaser. Any purchase order, offer or counter-offer made by Purchaser before or after HUBER's written acknowledgement is rejected and all documents exchanged prior to HUBER's written acknowledgement are merely preliminary negotiations and not part of any agreement between the parties. For example, orders submitted on Purchaser's own purchase order forms modifying, adding to, contrary to, or inconsistent with these Terms and Conditions are expressly rejected and of no force or effect and acceptance is expressly made conditional upon assent to these terms. In no event will HUBER be deemed to have in any way changed, enlarged or modified its liabilities or obligations as fixed by these Terms and Conditions including, without limitation, situations in which HUBER satisfies an order submitted on Purchaser's own purchase order form. No other terms or conditions or modification of these terms shall be binding upon HUBER unless specifically accepted in writing by an Officer of HUBER. Merely signing a purchase order or other document as a condition of payment shall not be deemed a specific acceptance of terms therein by HUBER.

Purchaser shall have been deemed to agree to these Terms and Conditions upon the earlier of acceptance of HUBER's quotation, acceptance of delivery of the goods or services or the issuance of a purchase order to HUBER.

2. **Scope of Supply/Work and Ancillary Equipment**
This Proposal includes only those items specifically mentioned in the equipment descriptions. Any items which may be necessary for the operation of the equipment, but are not specifically mentioned HUBER's Scope of Supply, such as motors, drives, controls, supports, piping, or otherwise, are to be supplied via additional quotation separate from this offering.

HUBER will use HUBER products or HUBER standards and colors whenever possible unless specifically called out in the quotation.

Any deviations from the HUBER standard mechanical and electrical specifications must be discussed with HUBER and agreed upon in writing. If HUBER mechanical and electrical specifications are changed, performance of HUBER equipment may be affected. If Purchaser fails to provide intake materials consistent with those in the specifications and Proposal, performance of HUBER's equipment cannot be guaranteed. HUBER reserves the right to charge additional costs to the equipment price for any non-standard mechanical and electrical components required by the Purchaser and not explicitly stated in HUBER's scope of supply in the form of a Change Order and as stated below under Article 9 Submittals.

Control Panel design (if a part of the manufacturers scope of work) is based on the specification provided and is inclusive to meet the requirements of a vendor-designed panel, whereas the components and the factory testing of the panel will meet the manufacturer's requirements for function and warranty. Additional requirements or sections of the specification to meet local authority requirements or control panel designs unrelated to the equipment section, including special labeling, testing, or integration, have not been included.
Factory testing documents will be based on HUBER (or their designated vendors') typical testing forms, modified to match the scope of the equipment outlined in this quote. If specific custom testing forms are required, example documents will need to be provided and evaluated to determine if there will be an impact to project cost.

If customer elects to supply control panel(s) for HUBER equipment, HUBER will supply the following information with their submittal: Site specific standard HUBER equipment PID for equipment being delivered, detailed control strategy for HUBER supplied equipment, setpoint names, typical ranges, and initial values, submittal comments outlining any concerns with HUBER equipment requirements as it pertains to project plans and specifications. No additional information other than these items will be shared/reviewed by HUBER during the submittal stage.

3. **Exclusions Includes:**
   - Financing
   - Cranes and/or lifting devices
   - Unloading and/or storage of equipment on job site
   - Foundation design and engineering (HUBER will only furnish equipment drawings and data)
   - Utilities for erection, installation and operation
   - Gauges and instrumentation not specifically described in HUBER scope of supply
   - Rental of Vacuum Trucks, pumping trucks or any other methods for cleaning and removing sludge, water, waste or the like
   - Validation and/or testing of third party or ancillary systems such as polymer dosing, fans, air balancing and the like.
   - Interconnecting wiring, conduit, piping, tubing, valves, fittings, etc. between the equipment and other equipment and/or control devices and control panel.
   - Tools, oil, grease, grease gun, dumpster(s), or bin(s).
   - All other items not specifically described in HUBER scope of supply
   - Witnessed factory testing, and site testing and commissioning are not included unless otherwise noted. In addition, custom forms, submittals, and programming, are not included. These items are available as needed and HUBER can provide pricing for these items upon request.
   - Customer travel expenses associated with witnessed factory testing (if applicable).
   - If outlined explicitly in the OEM process equipment specification(s), control system spare parts *will* be included. Any spare parts will be specifically limited to those items named in OEM equipment specifications. Spare I&C components listed in referenced specification sections are specifically NOT included, as these items are assumed to be provided by the Contractor and/or Systems Integrator. If asked to supply these items after a Purchase Order has been issued, HUBER can offer these items via change order.
   - Control panel seismic analysis, loop diagrams, harmonic studies, electrical site studies, PLC logic diagrams, flow charts, project specific P&ID's, ISA data sheets, point-to-point wiring diagrams, etc. unless specifically stated otherwise.

- Software *licenses* for the PLC/HMI program are not included unless stated otherwise. These items are available for additional price adder upon request.

4. **Abrasion or Corrosive Materials**

All of HUBER's machines, control panels, and systems are manufactured from 304L or 316L grade stainless steel. Purchaser expressly acknowledges that HUBER has no control over the environment or materials where the HUBER equipment will be installed. The environment or materials the equipment may be exposed to may be abrasive or corrosive. This Proposal makes no representation or warranties concerning the service life of the equipment against such structural abrasion or corrosion. The concentration of chloride and hydrogen sulfide (H_2S) in the equipment operating environment shall be kept below the following values:

- Maximum Chloride for V2A (304, 304L)* 100mg/L
- Maximum Chloride for V4A (316L, 316Ti)* 400mg/L
- Maximum Chloride for V4A (316L, 316Ti)** 250mg/L
- pH Value of the Wastewater/Washwater >6.5
- Iron Content in Washwater <0.50mg/L

* NO hydrogen sulfide present in the area of the stainless steel

** Maximum hydrogen sulfide content of 6 ppm present in the area of the stainless steel Control panels are to be located in an environment free from hydrogen sulfide, and tin plated copper wiring is recommended for all customer field wiring installations.

Upon specific request and HUBER approval, machines may be made from Duplex grade stainless steel at an additional price for extremely harsh operating environments.

5. **PRICES.**

Prices are in U.S. Dollars unless noted otherwise. Until acceptance of a purchase order is acknowledged in writing by HUBER, all prices are subject to change. Written quotations expire thirty (30) calendar days from the date of quotation unless specified otherwise. After expiration of validity HUBER reserves the right to adjust pricing to take into account any increases in material costs such as steel, stainless steel finished products, stainless steel coil, etc. The determination to increase pricing due to increased material costs is within HUBER's sole discretion. Due to the **current volatility of raw materials and shipping** HUBER cannot guarantee to hold prices beyond the validity date. HUBER therefore reserves the right to adjust our pricing at time of order. Verbal quotations are non-binding on HUBER. Quoted prices do not include sales, excise, municipal, state or any other government taxes. All taxes and other governmental charges upon the production, manufacture, distribution, sale or use of goods or services to the extent required or not forbidden by law to be collected by HUBER from Purchaser, shall be paid by Purchaser to HUBER unless Purchaser furnishes HUBER with exemption certificates acceptable to the relevant taxing authorities. Price does not include installation or building modifications. Typographical and/or clerical errors made by HUBER are subject to correction.

If Purchaser causes or requests delays in manufacture or shipment beyond six (6) months from acceptance of Purchase Order, HUBER shall have the right to increase price based on any actual escalation in labor, material, overhead, and component costs. HUBER also reserves the right to charge Purchaser for any direct costs, reasonable storage costs caused by such delays and a finance charge of 1.5% of the Contract value per month.

Equipment prices broken out on the HUBER proposal for convenience are only valid when packaged together.

6. TERMS OF PAYMENT.

Invoices are net thirty (30) days from the date of invoice, unless specified otherwise and approved in writing by HUBER. In the event that the purchase order between Purchaser and HUBER requires partial payments to be made by Purchaser, Purchaser shall pay those required amounts in a timely manner or HUBER will be permitted to suspend, without penalty or liability of any kind, delivery of future goods and services to the Purchaser and terminate any agreement between the parties, even though partial payment for such undelivered goods or services may have already been received by HUBER. At any time prior to or after the commencement of delivery or work pursuant to the Agreement, HUBER may request that Purchaser provide reasonable documentation demonstrating that Purchaser has the ability to perform all payment obligations specified herein.

Progress payments are as follows:

- 20% upon delivery of submittals (net 30 days)
- 75% upon delivery of equipment (net 30 days)
- 5 % upon startup of equipment (net 30 days)

Past due accounts will bear interest at the rate of 1.5% per month of the invoiced amount. All invoices are payable in U.S. dollars, unless specified otherwise and approved by HUBER in writing. Acceptance of bank drafts, checks or other form of payment shall be subject to immediate collection of the full face amount thereof. HUBER may, at its discretion, impose a transaction fee on payments processed via wire transfer or by Letter of Credit.

HUBER reserves the right at any time to suspend credit or to change credit terms provided herein when in its sole opinion the financial condition of Purchaser so warrants. In such case, in addition to any other remedies provided herein or by law, HUBER may request cash payment or satisfactory security from Purchaser prior to shipment of goods.

In the event of nonpayment of an invoice when due, and without prejudice to other lawful remedies, HUBER shall have the right, without penalty or liability of any kind, to suspend further work or the delivery of future goods under this Agreement and terminate this Agreement or any other agreement with Purchaser until such invoice is paid in full; provided, however, that if such invoice remains unpaid for more than five (5) days after written demand by HUBER, HUBER may terminate this Agreement without penalty and recover all damages as a result of Purchaser's Breach.

7. RETAINAGE.

There shall be no retainage under this Agreement.

8. TAXES AND OTHER CHARGES.

The prices for Goods and/or Services do not include any sales, use or other taxes or charges payable to state or local authorities. In addition to HUBER's invoice price or quote price, Purchaser is also responsible for payment of any use-tax, sales tax, excise tax, VAT tax, duty, custom, inspection or testing fee, and/or any other fee, tax, or charge imposed by governmental or non-governmental

authority arising from the Goods and/or Services provided by HUBER. Purchaser is responsible for and bears the risk of establishment of a valid exemption from any fee, tax, or charge. In the event HUBER is required to pay any of the fees, taxes, or charges listed in this paragraph, Purchaser herewith agrees to immediately reimburse HUBER for this cost, or in lieu of such payment by HUBER, Purchaser agrees to timely provide an exemption certificate or other comparable document to the entity or authority imposing said fee, tax and/or charge. In the event that any tariffs, taxes, or import duties are imposed between the goods purchased to the time of shipment, the cost of these charges will be passed on to the Purchaser. If the Purchaser does not accept the additional costs or if the Purchaser is unable to fulfill these payment obligations, HUBER reserves the right to cancel the order and issue a refund on invoices paid up to the time of cancellation, after deducting any related direct cost that HUBER has incurred to the date of cancellation. Purchaser further agrees to waive any and all claims regarding the reasonableness of such payment and will be liable to HUBER for reasonable attorneys' fees and/or court costs incurred by HUBER as a result of Purchaser's failure to pay the charges listed in this paragraph.

Purchase Orders

All Purchase Orders are to be faxed or mailed to:

HUBER Technology, Inc.
1009 Airlie Parkway
Denver, NC 28037
Phone: (704) 949-1010
Fax: (704) 949-1020

All Purchase Orders are subject to acceptance by HUBER and acceptance of HUBER's Standard Terms and Conditions.

9. **Submittals**

HUBER will provide documentation to the Purchaser per the following schedule:

- An electronic copy of the Submittals will be provided via HUBER Share four (4) to six (6) weeks after acceptance of a written purchase order and receipt of all technical information
- For projects exceeding $1 million in total value, involving five (5) or more major equipment components, or requiring fulfillment under multiple purchase orders, the standard submittal delivery timeline shall be a minimum of six (6) to eight (8) weeks from the date of receipt of a complete and executed purchase order, inclusive of all required technical, commercial, and project-specific information. Submittals may be delivered in staged packages, grouped by system or purchase order structure, at the discretion of the Supplier to support efficient and timely project execution.
- Operation & Maintenance (O&M) manuals will be provided electronically via HUBER Share prior to equipment startup.
- Printed hard copies of the submittals and/or O&M manuals are available at an additional cost.
- Custom submittal or O&M formats outside of the HUBER Standard are available for an additional cost.
- HUBER's standard submittal documents, programming (as applicable), testing procedure, and O&M documentation have included for all equipment, and any controls which are included in the HUBER Scope of Supply.

CHANGES TO DELIVERY DATE MAY RESULT IF THESE ITEMS ARE NOT ADDRESSED (If applicable).

- All necessary information including, but not limited to, up-to-date layouts, technical specifications, prints and pertinent specifications. These must be in AutoCAD DWG, DXF, IGES or STEP format and be supplied within 1 Week (5 business days) of P.O. receipt, or equipment prices and delivery may be impacted. A more specific date will be set upon the Seller's acknowledgment of the Buyer's order, and is subject to Seller's timely receipt of all conformed drawings, specification, and other information necessary for the design, manufacture, and factory witness test of the machine or product, if applicable. Seller shall not be liable to the buyer for any loss or damage direct or consequential due to any delay in delivery.
- Submittals. After receipt of the d submittal(s), they must be approved as is, or changes noted, and signed by the buyer. The buyer must return the signed approval submittal(s) to HUBER Technology within 4 weeks (20 business days) of receipt. HUBER Technology will exercise its knowledge and experience by performing an internal design review, bypassing a customer review process. This requirement may be required if the delivery date is to be achieved. Any changes in the process after purchase order is issued may result in a later delivery date, change order, or an addendum to the proposal. All changes must appear in writing using HUBER Technology C.O. (Change Order) form and signed by a representative of both HUBER Technology and the buyer before any changes can be made.
- Timing:
    - Project schedule is based upon the following: Customer approval or changes noted on Approval Submittal within 4 weeks (20 business days) of Submittal receipt.
    - In cases where changes or comments are noted, HUBER to supply resubmittal within 4 weeks (20 business days) of receipt of comments. Customer approval or changes noted on Approval Submittal within 2 weeks (10 business days) of Submittal receipt.
    - Any delays in the above approvals can impact overall project timing. HUBER Technology reserves the right to adjust project schedule based on customer delays to these milestones. Please note, each day late can result in up to a 2 day delay to project delivery. [Example: Submittal comments received 9 weeks after receipt (5 weeks (25 work days) past the due date) can result in up to a 10 week (50 work day) shift to the delivery schedule.]
    - Delays in customer milestones exceeding 6 weeks are subject to re-quote. NOTE: Changes or comments not captured in the scope may require a change order and can impact project schedule and cost. If submittals are not finally approved within 6 months of initial submission, this order is subject to change order for increase cost if necessary.
    - Any delay in the above-referenced process that is not solely due to the Seller's omissions and errors shall not be a basis for delay damages. Seller expressly reserves the right to increase costs and charge for costs relating to any delays not solely attributable for the Seller in the submittal process.
    - It is the responsibility of the purchaser to ensure timely approval of submittals in accordance with these terms. By accepting this purchase order, the purchaser agrees to accept delivery of the goods within 18 months from the execution date of the purchase order. Failure to accept delivery within this timeframe may result in the order being subject to a change order, which may include revised pricing and/or cancellation of the order at the discretion of the seller.

10. Project Management

HUBER will assigned a Project Manager for the duration of the contract. Project Management services are included in this package and are as follows:

- Main point of contact for communication, for submittals, and shall make adjustments at their discretion.
- Provision of a complete critical path project schedule for HUBER equipment
- Coordination with HUBER manufacturing on materials procurement and fabrication to and with HUBER shipping/logistics to ensure HUBER commitments are maintained.
- No contractual warranty or indemnity relating to any service performed by Project Manager is extended to HUBER, nor are any Project Managers authorized to bind HUBER with any oral representations or statements in conflict with this Agreement.

11. PURCHASER CANCELLATION

If at any time prior to delivery of equipment, the Purchaser terminates this Agreement and/or refuses delivery, HUBER shall be entitled to receive all costs incurred during the design and manufacturing of the equipment, all costs and expenses incurred in disposing of the equipment, all costs resulting from the cancellation of any agreements with relevant suppliers and all anticipated overhead and profit on the equipment outlined in the Agreement.

12. DELIVERY & INSTALLATION.

HUBER shall not be liable for any damage as a result of any non-delivery or delay, including, without limitation, an act of God; act of Purchaser; act of HUBER; embargo; other government act, regulation or request; fire; accident; strike; war; boycott; slowdown; riot; or delay in transportation or inability to obtain necessary labor, materials, or manufacturing facilities. HUBER will use its best efforts to meet promised delivery dates, but under no circumstances shall HUBER be liable for any direct, or indirect, consequential, incidental, liquidated or other damages for delay in delivery or installation, where applicable.

Purchaser will notify HUBER within thirty (30) days after order acceptance of the scheduled delivery date. If Purchaser does not notify, a delivery date of six (6) months, unless otherwise specified by HUBER, after notice to proceed and/or approval of submittals is agreed. For any delays by Purchaser after commencement of manufacturing, a finance charge of 1.5 % per month of the contract value will be assessed to Purchaser.

HUBER reserves the right to substitute suitable alternative materials and components where necessary.

Where the services are to be performed on Purchaser's premises, Purchaser agrees to provide HUBER on a timely basis with such access, machine downtime, utilities and equipment as HUBER shall reasonably require in order to perform the services in accordance with the Agreement. If Purchaser fails to perform its obligations or shall fail to perform them in a timely manner, Purchaser acknowledges and agrees that HUBER shall be entitled to delay performance of the services, without penalty or liability of any kind, until such time as Purchaser has complied in all respects with its obligations and to increase the price for the services to reflect any increased cost to Huber caused by Purchaser's failure to perform or late performance.

If delivery is delayed or deferred by Purchaser beyond the scheduled date, payment shall be due in full when HUBER is prepared to ship the goods or perform the services. The goods may thereafter, at HUBER's option, be stored at the risk and expense of Purchaser. If HUBER undertakes storage of the equipment, the Purchaser shall pay an additional $3.00 per sq-ft (palletized and crated size) and an additional weekly value for each week storage continues as outlined below:

Total P.O. Value	Value added storage fees
≤$50,000	$175
$50,001-$100,000	$340
$100,001-$250,000	$625
$250,001-$500,000	$1,350
$500,001-$1,000,000	$2,700
>$1,000,000	Calculated per project

All amounts outlined above for storage shall be billed to the Purchaser at the time it is willing and able to accept delivery of the equipment. The storage fee shall be due upon receipt of the HUBER invoice and is a condition precedent to delivery of the equipment.

HUBER may at certain times provide goods or services to Purchaser prior to the issuance, delivery and acceptance of a corresponding purchase order. In such cases, these Terms and Conditions shall apply to such transactions and Purchaser shall be deemed to have accepted such Terms and Conditions upon HUBER's delivery of goods or performance of services.

13. GOODS ACCEPTANCE.

It is HUBER's intent to deliver complete orders in good condition to the final destination dictated by the Purchaser. All equipment and components delivered to the receiving location must be duly inspected upon receipt. Any visible damages must be noted on way-bill and followed up with a full inspection within a period of seven (7) days from delivery date. If a written report is not submitted to HUBER within this period it is assumed that the equipment was received in good condition, meets the specifications of the purchase order, constitutes unqualified acceptance by the Purchaser, and Purchaser waives any rights to rejection or remediation of delivered equipment.

14. FIELD SERVICE.

"Field Service" refers to the services of a Huber factory-trained representative at the site of end-use for installation inspection, start-up, observation and operator training. "Field Service" refers also to any subsequent investigations of warranty issues, operational difficulties, Purchaser complaints, or requests for post-warranty service. Purchaser acknowledges that HUBER Field Service representatives shall make all arrangements necessary with labor unions for their presence on the site. No contractual warranty or indemnity relating to Field Service is extended by HUBER, nor are its Field Service representatives authorized to bind HUBER with any oral representations or statements in conflict with or addition to the governing contract terms or any manual or instructions provided by HUBER. This paragraph shall apply to any and all initial and subsequent Field Service provided by HUBER relating to the Goods sold to the Purchaser. Any field service work performed at site after expiration of the initial warranty period is warranted for sixty (60) days after the work has been completed.

An authorized HUBER Service Technician will be scheduled to provide start-up and commission assistance. To meet demand, HUBER may, at its sole discretion, source from an available international network of authorized technicians. HUBER is able to quote additional installation, start-up supervision, and training, which is not specifically included in the scope of supply, at the Purchaser's written request. For such additional services Purchaser shall pay the current per daily rate, per diem, and expenses, for eight (8) hours per day.

- At the request of the Purchaser, overtime service will be provided at a rate of 1.5 times the regular rate for weekdays, and 2.0 times the regular rate for weekends and/or holidays.
- "Expenses" are defined as the costs of travel from HUBER's location to the point of installation and return; together with accommodation and living expenses during the start-up period of field service. HUBER will make all reasonable efforts to provide a HUBER Representative located within North America. However, some circumstances will require travel from Europe.
- Charges for all time involved will be invoiced. The full net invoice is payable within thirty (30) days of receipt by Purchaser.
- In the event of on-site delays which are beyond HUBER's control, including proper installation, training and start-up, additional charges will be invoiced the current hourly rate, plus expenses).
- Please note that once startup services are scheduled, this time is reserved exclusively for that service(s). Cancellation and/or rescheduling prior to the scheduled dates are subject to airline change fee(s) plus the differences in the cost for the new airline ticket(s) and any additional expenses that may occur (including hotel cancellation fees and airline agent fees).

HUBER requires clients to maintain at least one employee or site representative onsite whenever a HUBER representative may be required to work. This includes the commencement of work after normal business operation hours. It is the responsibility of site employee and or site representative to maintain all regulated safety standards and requirements for the project site. If a site representative or site employee is unable to remain on site after hours, HUBER Representatives will stop all work at that time to return when a site representative or employee is available to be on site. Furthermore, if a HUBER Representative encounters an unsafe work environment that HUBER Representative is required to stop all work and report the unsafe items to the site representative and stand by until these items are deemed safe for work to continue. As the schedule for work commencement is set prior to the start of work any travel changes and or additional hours needed to complete the approved scope due to delay or stoppage of work caused by actions or lack of action from the site representative of will require a change order and will be billed accordingly.

15. SHIPMENT/RISK OF LOSS.

Freight is delivered with duty paid (D.D.P.) to Job site. HUBER will use commercially reasonable efforts to meet delivery dates stated in advance of actual shipment of goods or performance of services, but in no event shall such quoted delivery dates be deemed to represent fixed or guaranteed delivery dates. Under no circumstances will HUBER be liable for any direct, or indirect, consequential, incidental, liquidated or other damages for delay in delivery. Risk of loss or damage shall be upon Seller until the materials of equipment are physically delivered to Purchaser at the Project or other authorized destination.

HUBER will make commercially reasonable efforts to maintain the following schedule:

- Equipment delivery 22-30 weeks after approved submittals and notice to proceed.
- Operation & Maintenance (O&M) manuals will be provided electronically via HUBER Share prior to equipment startup. Printed hard copies of the O&M manuals are available at an additional cost.
- For any delays in delivery which are beyond HUBER's responsibility, a finance charge of 1.5% of the contract value per month and all direct Costs incurred as a result of the delay will be due and payable to HUBER upon request/invoice. Under no circumstances, shall HUBER be liable for any direct, or indirect, consequential, incidental, liquidated, or other damages for delay in delivery.

Method and route of shipment will be at the discretion of HUBER unless specified otherwise by Purchaser and agreed by HUBER, and any additional expense of the method or route of shipment specified by Purchaser shall be borne by Purchaser. Claims for shortage or other quantity errors must be made in writing to HUBER within seven (7) days after receipt of shipment. Failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Purchaser.

HUBER, in its sole discretion, may accommodate Purchaser requests for delivery of goods in installments if such requests are confirmed in writing by HUBER. Such installment deliveries, when separately invoiced, shall be paid for when due per invoice without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Purchaser of its obligations to accept remaining deliveries.

16. GOVERNMENT STANDARDS.

HUBER applies quality standards in our manufactured equipment that are designed to meet and comply with federal government occupational safety, noise, sanitation and health standards. The Purchaser is solely responsible for compliance of the equipment and its operation with any state or local laws, codes, ordinances, or regulations, unless otherwise specified by HUBER in its proposal.

17. LIMITED WARRANTY.

HUBER warrants that the equipment and components furnished will be free from defects in workmanship and materials and perform the general process function intended, solely under the conditions defined by HUBER for a period of (a) twelve (12) months from completion of installation and start-up assuming the equipment has completed start-up within 6 months of delivery or (b) eighteen (18) months from the date of delivery to Purchaser, whichever date comes first. HUBER will replace, modify or repair, at its sole option, any such defective component or equipment at no charge provided that HUBER is notified promptly in writing of any claimed defect. If requested by HUBER, any such defective part or component shall be returned to HUBER, freight prepaid. HUBER will provide on-site Field Service when reasonably assured of payment therefore if this warranty does not apply or when such service is required in its judgments. This warranty does not apply to any defect or malfunction arising out of failure to store, install, operate or maintain the equipment in accordance with instructions by HUBER. Warranty shall be voided for any misuse of equipment; operation under conditions other than those defined by HUBER in its operation and maintenance (O&M) manuals for said equipment, or operator negligence. Any unauthorized modification or alteration of the equipment or repair or replacement of components may void this warranty, at the sole option of HUBER. For any billable repairs completed outside of the initial warranty period, a sixty (60) day guarantee on work performed and parts supplied will apply.

HUBER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, WITH REGARD TO THE DESIGN, SALE, MERCHANTABILITY OR FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE OR USE EXCEPT AS EXPRESSLY SET FORTH IN HUBER'S TERMS AND CONDITIONS. HUBER IS NOT SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR WARRANTY, TORT CLAIMS INCLUDING NEGLIGENCE, GROSS NEGLIGENCE AND STRICT LIABILITY, OR ANY OTHER THEORIES OF LAW. HUBER IS UNDER NO EVENT LIABLE FOR ANY SPECIFIC, LIQUIDATED, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER.

18. EXCLUSIVE REMEDIES.

Purchaser acknowledges that its sole and exclusive remedies for breach of the Limited Warranty shall be replacement or repair by HUBER of any defective part or component, and payment of the reasonable out of pocket costs incurred in connection with replacement or repair if such costs are approved in advance by HUBER, or a refund pursuant to the Paragraph 19 herein..

19. LIMITATION OF LIABILITY/INDEMNITY.

HUBER's liability on any claim other than Limited Warranty claim as outlined in Paragraph 18, including but not limited to any loss or damage arising out of any transactions under this Agreement or from the performance or breach thereof or connected with any goods or services supplied hereunder, or the sale, resale, operation or use of goods, whether based on agreement, tort (including negligence) or other grounds, shall not exceed 10% of the purchase price of such goods or services or part thereof involved in the claim. This limitation of liability and remedies reflects a deliberate and bargained-for allocation of risks between HUBER and Purchaser and constitutes the basis of the parties' bargain, without which HUBER would not have agreed to the price or terms of this transaction. **EXCEPT FOR A CLAIM UNDER THE LIMITED WARRANTY DURING THE WARRANTY PERIOD RELATED TO REPLACEMENT, IN NO EVENT SHALL SELLER'S AGGREGATE LIABILITY ARISING OUT OF OR RELATED TO THIS AGREEMENT, WHETHER ARISING OUT OF OR RELATED TO BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, EXCEED 10% OF THE PURCHASE PRICE.**

HUBER SHALL NOT IN ANY EVENT BE LIABLE WHETHER AS A RESULT OF BREACH OF AGREEMENT, WARRANTY, TORT (INCLUDING NEGLIGENCE) OR OTHER GROUNDS FOR INCIDENTAL, INDIRECT, DIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF GOODS OR ASSOCIATED PRODUCTS, BUSINESS INTERRUPTION, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES OR SERVICES, DOWNTIME COSTS, OR CLAIMS OF PURCHASERS OF PURCHASER FOR SUCH DAMAGE. In addition, if HUBER furnishes Purchaser with advice or other assistance regarding any goods or services supplied hereunder, or any system or equipment in which any such goods may be installed, and which is not required pursuant to this transaction, the furnishing of the advice or assistance will not subject HUBER to any liability, whether based on agreement, warranty, tort (including negligence) or other grounds.

In the event Purchaser modifies HUBER goods or incorporates HUBER goods into another product or component part, Purchaser agrees to hold harmless and indemnify Huber from any and all claims, liabilities, losses, costs and expenses (including reasonable attorneys' fees) involving personal injury or property damage. Purchaser also agrees to hold harmless and indemnify HUBER from any patent or other intellectual property claims related to (i) any HUBER goods made in accordance with

Purchaser's designs or specifications; or (ii) the use of any drawings provided to HUBER by Purchaser for use in the manufacture, production or assembly of such goods to the fullest extent of the law.

20. TITLE.

Notwithstanding delivery, installation or start-up, title to all equipment furnished shall remain solely with HUBER until the full purchase price is paid by Purchaser. Until such time, HUBER may enter the premises where such equipment is then located and repossess and remove such equipment by any lawful means as this is the property of HUBER Technology. Purchaser agrees to do all acts deemed necessary or desirable or requested by HUBER to maintain HUBER's rights in, and title to such equipment.

21. WAIVER.

The failure of Huber to insist in any one or more instances, upon the performance of any of the Terms and Conditions as set forth herein or the failure of HUBER to exercise any of its rights hereunder shall not be construed as a waiver or relinquishment of any such terms, conditions or rights and shall not effect HUBER's right to insist on strict performance and compliance with regard to any future performance of these Terms and Conditions.

22. CHOICE OF LAW.

This Contract shall be exclusively governed by the laws of the State of North Carolina, without regard to its conflict of law provisions. HUBER and Purchaser further consent to the exclusive personal jurisdiction of any applicable court, in the county of Lincoln, North Carolina for any legal action or proceeding brought to enforce, construe or interpret these Terms and Conditions. Venue is proper only in the North Carolina Superior Court of Lincoln County. Each party hereto irrevocably submits to the jurisdiction of each court in each such action or proceeding.

23. DISPUTE RESOLUTION/ATTORNEYS' FEES.

Any controversy or claim arising out of or relating to this Contract or its breach shall be settled by arbitration conducted in Denver, North Carolina in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association and North Carolina law and judgment on the award rendered by the arbitrator(s) may be entered in any court of competent jurisdiction. The arbitrator shall award attorneys' fees, costs, witness costs, expert witness fees, arbitrator compensation, arbitrator fees, exhibit fees, travel costs and other amounts deemed reasonable to the prevailing party as defined by North Carolina law.

24. ASSIGNMENT, WAIVER, ENTIRE AGREEMENT, SEVERABILITY.

Neither party shall assign or delegate any of its rights or obligations under this Agreement without the prior written consent of the other party, which such consent shall not be unreasonably withheld, except that either party may assign or delegate its rights or obligations hereunder to an Affiliate without the other party's consent. As used herein, the term "Affiliate" shall mean any entity that directly or indirectly through one or more intermediaries, controls or is controlled by, or is under common control with the entity specified. Huber may terminate this Agreement upon written notice to Purchaser without any further liability to Purchaser if there is a change of control of Purchaser. The Agreement constitutes the entire agreement between the parties with respect to its subject matter, and supersedes all prior oral or written representations or agreements by the parties with respect to the subject matter of this Agreement. Neither the Agreement nor any of its provisions may be modified, amended or waived, whether orally, through the parties' course of

performance, course of dealing or course of conduct, or manifested in any other way, unless in writing and signed by an authorized officer of Huber. It is the express intention of the parties that such requirement for written modifications, amendments or waivers be strictly enforced notwithstanding judicial precedent or statutory provisions to the contrary. Any provision found invalid or unenforceable will not affect the validity or enforceability of any other provision and the invalid provision may be judicially modified to the extent enforceable.

Project Name: Sandpoint, ID

Purchase Order Number/Job Number (if applicable): PO26-1678

Customer Billing Address:	Shipping Address:
Customer (Legal Business Name): City of Sandpoint	Name of Site: Wastewater Treatment Plant
Street: 1123 Lake Street	Street: 723 S. Ella
City, State, Zip: Sandpoint, ID 83864	City, State, Zip: Sandpoint, ID 83864

Tax Exemption (Please circle one): Yes | No
If yes, please provide tax exemption certificate.

Customer Contact information:

- Name: Deven Hull
- Email Address: dhull@sandpointidaho.gov
- Phone Number: (208) 255-1568

City of Sandpoint, ID	HUBER Technology, Inc.
Jeremy Grimm (Dec 8, 2025 11:39:00 PST) Accepted By (Signature)	Signature
Jeremy Grimm Print Name	Henk-Jan van Ettekoven Print Name
Mayor Title	President & CEO Title
12/08/2025 Date	12/9/2025 Date

HUBER Technology, Inc |1009 Airlie Parkway | Denver, NC 28037
Tel: (704) 949-1010 | Fax: (704) 949-1020 | huber@hhusa.net | www.huber-technology.com
A member of the HUBER Group

PO26-1678 HUBER TECHNOLOGY SCREW PRESS_with Terms

Final Audit Report 2025-12-08

Created:	2025-12-08
By:	Heather Faircloth (hfaircloth@sandpointidaho.gov)
Status:	Signed
Transaction ID:	CBJCHBCAABAABS1J2gdwtgzq34bk7wMAq3N9ruxcg4gS

"PO26-1678 HUBER TECHNOLOGY SCREW PRESS_with Terms" History

Document created by Heather Faircloth (hfaircloth@sandpointidaho.gov)
2025-12-08 - 7:25:12 PM GMT

Document emailed to Jeremy Grimm (jgrimm@sandpointidaho.gov) for signature
2025-12-08 - 7:25:21 PM GMT

Email viewed by Jeremy Grimm (jgrimm@sandpointidaho.gov)
2025-12-08 - 7:36:53 PM GMT

Document e-signed by Jeremy Grimm (jgrimm@sandpointidaho.gov)
Signature Date: 2025-12-08 - 7:39:00 PM GMT - Time Source: server

Agreement completed.
2025-12-08 - 7:39:00 PM GMT

Billing Address
SANDPOINT, ID
1123 Lake Street
Sandpoint, ID 83864
UNITED STATES

Delivery Address
Sandpoint, ID WWTP
723 S. Ella
Sandpoint, ID 83864
UNITED STATES

Invoice

Invoice No.:	II10009579
Invoice Date:	4/23/26
Customer No.:	130128

Order No.:	73013257	Date printed:	4/23/26
Project:	Sandpoint, ID WWTP_Screw Press	Contact:	Nick Kolsch
Your Reference:	26-1678	Phone:	+1-704-990-2498
		Email:	Nick.Kolsch@hhusa.net

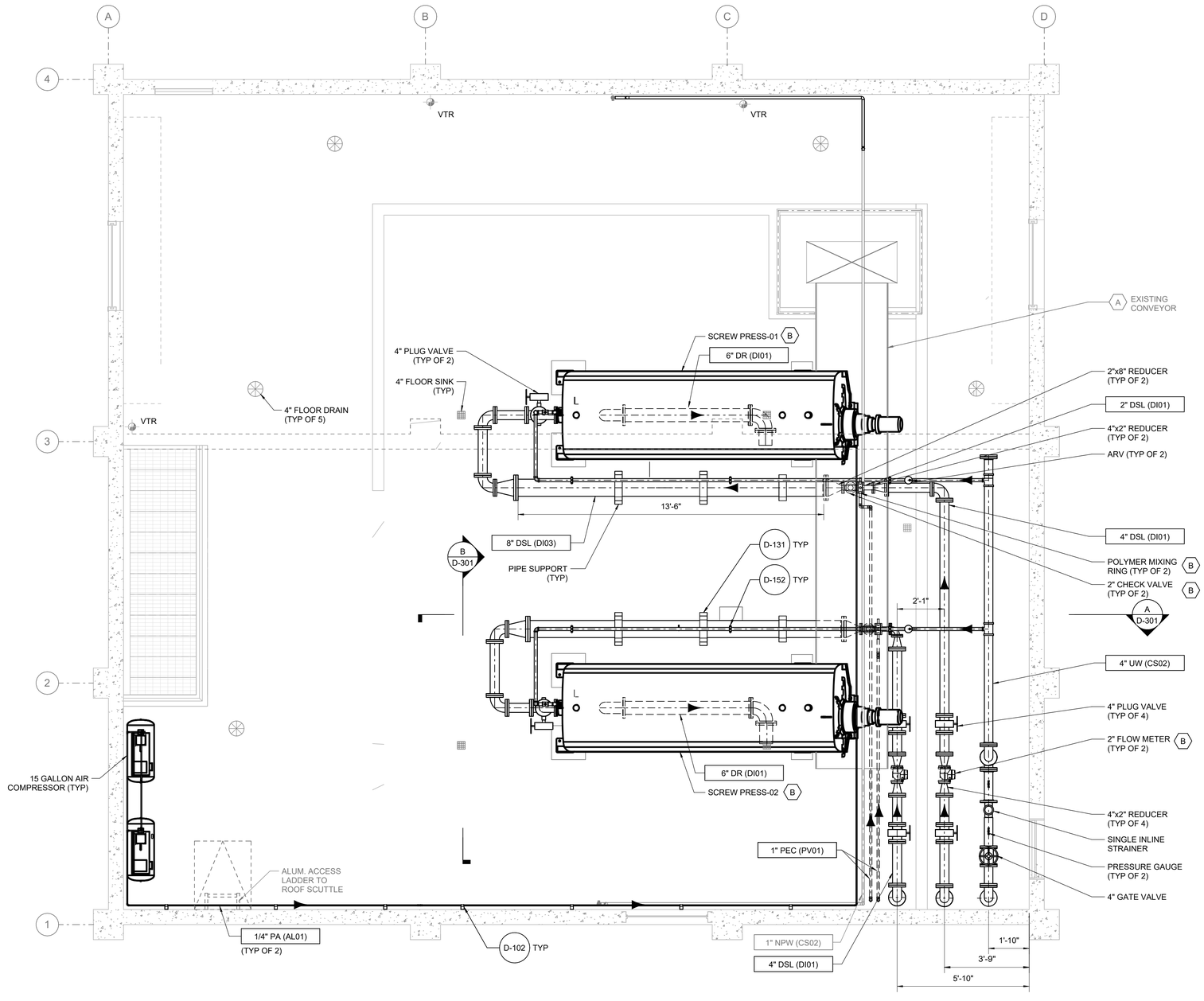
Pos	Quantity	Unit	Description	Price USD	Total USD Tax (%)
	1.00	pcs	Invoice 20% Of PO For Approved Submittals ($1,110,000 x 20% = $222,000)	222,000.00	222,000.00 0%
			Total net **USD**		**222,000.00**
			Sales Tax **USD**		**0.00**
			Total gross **USD**		**222,000.00**

Terms of payment: 30 days net
Pay Due: 5/23/26

SHEET KEYNOTE

A. CONTRACTOR TO LEAVE THE CONVEYOR BELT AS IS OR PROVIDE ALTERNATIVE METHOD OF SLUDGE CONVEYANCE TO MAINTAIN OPERATIONS.

B. THE SCREW PRESS UNITS, POLYMER MIXING RINGS. CHECK VALVES, AND SLUDGE FLOWMETERS ARE OWNER FURNISHED EQUIPMENT



UPPER FLOOR-PLAN

SCALE: 3/8" = 1'-0"

Stantec
601 SW 2nd Ave # 1400
Portland, Oregon 97204
Tel +1.503.226.7377
www.stantec.com

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Consultant

No.	Revision	By	Appd	YYYY.MM.DD

No.	Issued	By	Appd	YYYY.MM.DD
C	IFC	DP	NS	2026.01.23
B	90% DESIGN REVIEW	DP	NS	2025.11.21
A	30% DESIGN REVIEW	DP	NS	2025.07.14

Permit/Seal

PRELIMINARY NOT FOR CONSTRUCTION

Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 3/8" = 1'-0"

GD	PD		2025.07.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

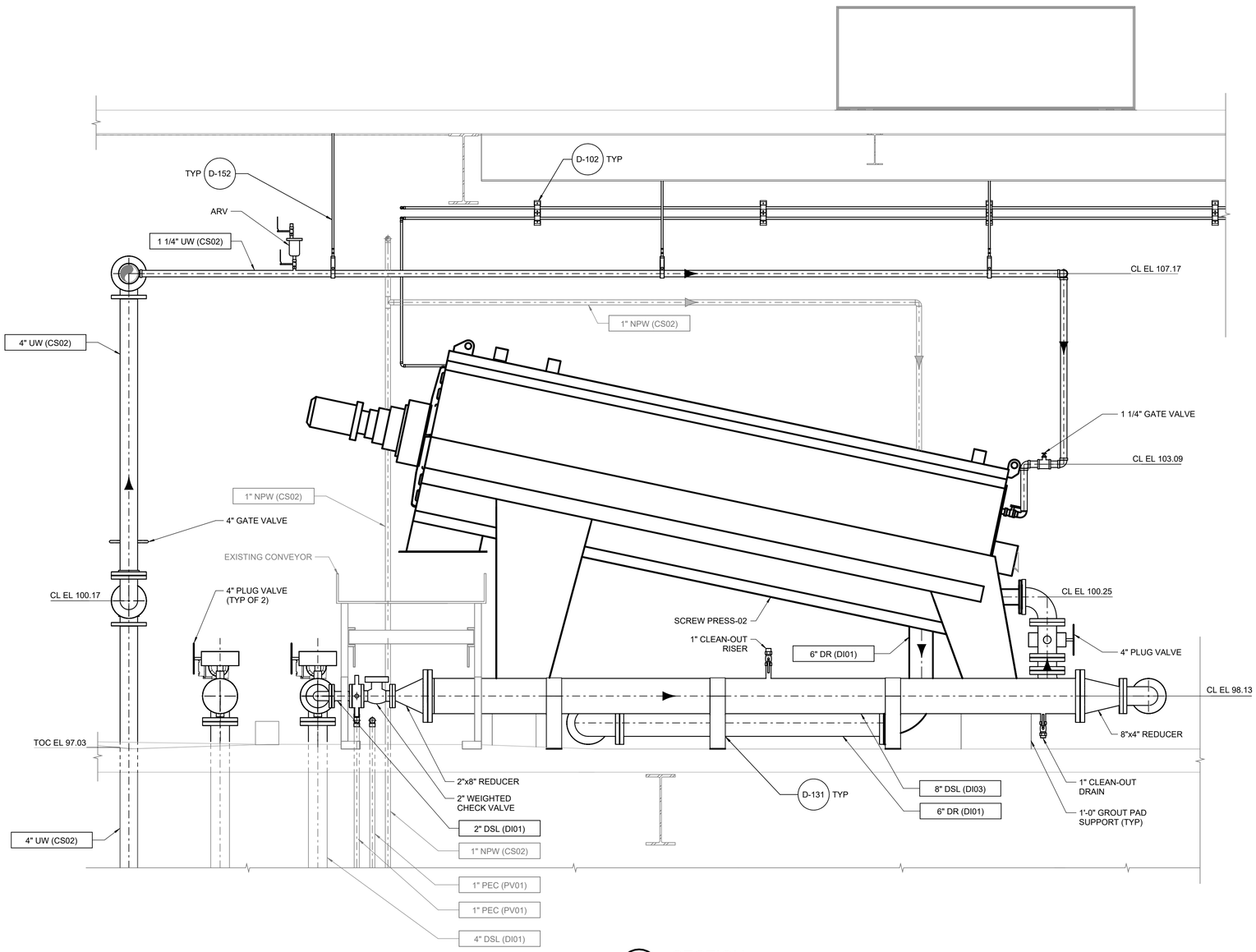
Title
SCREW PRESS PLAN

Revision:

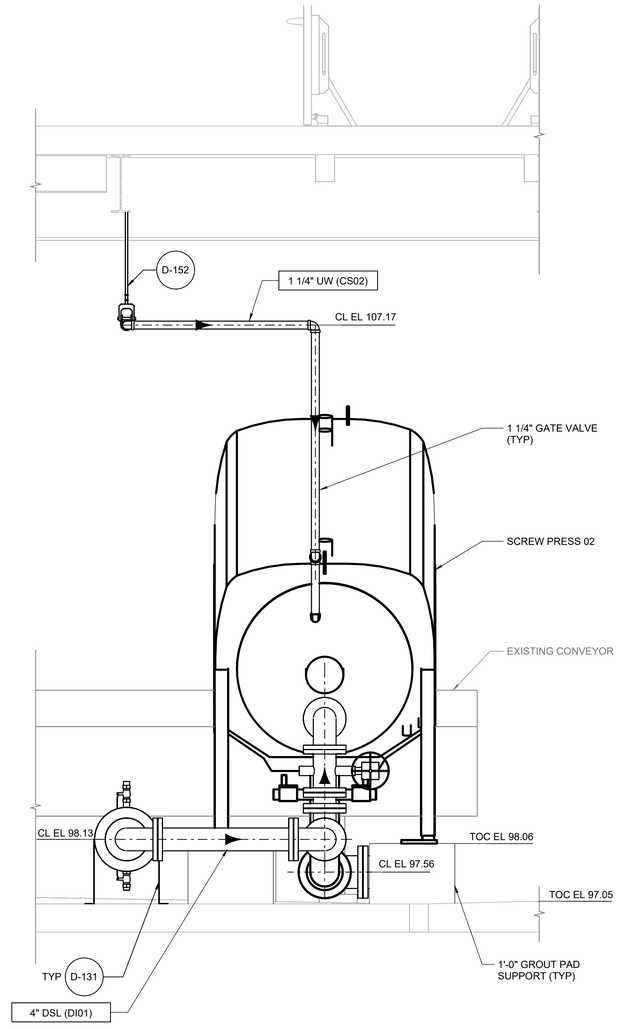
Drawing No.
D-101A

4/27/2026 6:44:23 PM

ORIGINAL SHEET - ANSI D



A D-101 SECTION
SCALE: 3/4" = 1'-0"



B D-101 SECTION
SCALE: 3/4" = 1'-0"

Stantec
607 SW 2nd Ave # 400
Portland, Oregon 97204
Tel: +1.503.226.7377
www.stantec.com

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Consultant

No.	By	Appd	YYYY.MM.DD	Revision
C	DP	NS	2024.01.23	IFC
B	DP	NS	2023.11.21	90% DESIGN REVIEW
A	DP	NS	2023.07.14	30% DESIGN REVIEW

Issued

Permit/Seal

PRELIMINARY NOT FOR CONSTRUCTION

Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.:2002003233

File Name: N/A

Scale: 3/4" = 1'-0"

GD	PD	2025.07.14
Dwn.	Dsgn.	Chkd. YYYY.MM.DD

Title
SCREW PRESS SECTIONS

Revision:

Drawing No.
D-301A

4/27/2026 6:44:24 PM

ORIGINAL SHEET - ANSI D

WWTP Screw Press Upgrade
BID No. 26-3257-2 - ADDENDUM NO. 1

City of Sandpoint
1123 Lake Street
Sandpoint, Idaho 83864

Date: May 28, 2026

BID Number and Title:	26-3257-2 – Addendum No. 1
BID Submission Deadline:	**Tuesday, June 9, 2026, no later than 2:30:00 p.m. local time**
Pages:	Addendum No. 1 (4 Pages) Cover Page (1 Page) Bid Bond (2 Pages) Appendix A Drawing D-101A (1 Page) Drawing D-301A (1 Page)

Acknowledge receipt of this Addendum by inserting its number and date on the Bid Form. Failure to do so may subject bidder to disqualification. This Addendum forms a part of the Contract Documents. It modifies the Contract Documents as follows:

PROJECT MANUAL COVER PAGE

Delete the Cover Page in its entirety and replace with the attached.

PART 1 – ADVERTISEMENT FOR BID

Revise the first paragraph of the Advertisement for Bids to read:

Sealed bids will be received by the City Clerk, City of Sandpoint, at City Hall, 1123 Lake Street in Sandpoint, Idaho 83864, until 2:30:00 p.m. local time on Tuesday, June 9, 2026 for Bid No. 26-3257-2 WWTP Screw Press Upgrade.

PART 2 – INSTRUCTION TO BIDDERS
2010 ISPWC 00200 - INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS

ARTICLE 17 - EVALUATION OF BIDS AND AWARD OF CONTRACT

Delete paragraph 17.06 in its entirety and replace with the following:

17.06 The anticipated schedule for this project is as follows:
Bids Due – June 9, 2026
Anticipated Notice of Intent to Award – June 10, 2026
Anticipated City Council Approval – July 1, 2026
Anticipated Award Date and Notice to Proceed – July 8, 2026
Substantial Completion – May 7, 2027
Final Completion – May 21, 2027

PART 3 - BID BOND

Delete the Bid Bond in its entirety and replace with the attached.

PART 4A – SAMPLE AGREEMENT FORMS
2020 ISPWC 00520 – AGREEMENT BETWEEN OWNER AND CONTRACTOR

Delete Article 4.02.A in its entirety and replace with the following:

A. The Work will be substantially complete on or before May 7, 2027, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before May 21, 2027.

PART 4A – SAMPLE AGREEMENT FORMS
2020 ISPWC 00520 – AGREEMENT BETWEEN OWNER AND CONTRACTOR

Add the following paragraph immediately following paragraph 7.01.A.11:

12. Appendix A – Owner-Furnished Equipment Purchase Order and Supplier Proposal

---

SUMMARY OF WORK
01 10 00 1.06.A

Remove “The Contractor's attention is directed to the fact that during the period of January 1 through March 31, no interruption in the process can be accommodated, and the Contractor shall so schedule its construction operations that no interference with the operation of the plant will occur during this critical period.” *Replace with* “No significant outages shall be scheduled on Fridays without prior approval from the City”

SUMMARY OF WORK
01 10 00 1.06.B

Update to "Access to the site is limited to the hours of 7:00 am to 5:00 pm Monday through Friday unless otherwise requested by the Contractor and authorized by the City."

SUMMARY OF WORK
01 10 00 1.08.F

Replace "01 14 00 - Construction Constraints" with "01 14 00 - Construction Restraints"

CONSTRUCTION RESTRAINTS
01 14 00 1.08.B.1

Update to "The roof shall not be replaced during the winter months, starting from November 1 to March 31. The roof replacement shall be coordinated with the timing of the screw press upgrades. The HVAC improvements shall be completed prior to November 1 as well."

CONSTRUCTION RESTRAINTS
01 14 00 1.08.B.2

Replace "July 1, 2026" with "November 30, 2026".

DRAWINGS
D-101A SCREW PRESS PLAN

Clarification added for scope of owner supplied equipment. Updated sizing for owner supplied check valve and flow meters. Replace sheet D-101 with sheet D-101A attached.

DRAWINGS
D-301A SCREW PRESS SECTION

Clarification added for scope of owner supplied equipment. Updated sizing for owner supplied check valve and flow meters. Replace sheet D-301 with sheet D-301A.

APPENDIX A

Appendix A – Owner-Furnished Equipment Purchase Order and Supplier Proposal is hereby added to the Bidding Documents and shall be considered part of the Contract Documents.

Section 01 16 00 references the Purchase Order and Supplier Proposal to be included in Appendix A. These documents were not included in the original Bidding Documents and are now included as part of this Addendum.

The Owner has issued a purchase order to Huber Technology, Inc. for the Owner-Furnished Equipment identified in Appendix A. The Owner has made a prior payment equal to 20% of the purchase order amount for submittal review and related pre-assignment obligations. Upon assignment of the purchase order to the Contractor, the Contractor shall assume responsibility for the purchase order from the effective date of assignment forward, including coordination, remaining payments due to the supplier, delivery, storage, installation, integration, startup, testing, and completion of a fully functional system. The Owner shall remain responsible for amounts paid or obligations incurred prior to the effective date of assignment. Bidders shall include in their Bid the unpaid balance of the assigned purchase order, applicable taxes, and all Contractor costs necessary to receive, store, protect, install, integrate, test, and place the equipment into operation, unless otherwise specifically stated in the Contract Documents.

END OF ADDENDUM NO. 1

WWTP Screw Press Upgrade
BID No. 26-3257-2 - ADDENDUM NO. 2

City of Sandpoint
1123 Lake Street
Sandpoint, Idaho 83864

Date: June 2, 2026

BID Number and Title:	26-3257-2 – Addendum No. 2
BID Submission Deadline:	**Tuesday, June 9, 2026, no later than 2:30:00 p.m. local time**
Pages:	Addendum No. 2 (2 Pages) Specification Section 43 25 02 – Strainers (2 pages) Specification Section 43 30 62 – Slide / Stop Gates (5 pages) Drawing DD102 – Sludge Pump Replacement – Demo (1 page) Drawing D-102 – Sludge Pump Replacement – Plan View (1 page) Drawing D-103 – Overflow Channel Slide Gate (1 page) Appendix B - Owner-Procured Sludge Pump Brochure and Cut Sheets (9 pages) Reference Document – Existing Electrical Site Plan and General Notes, Sheet E-2, For Reference Only (1 page)

Acknowledge receipt of this Addendum by inserting its number and date on the Bid Form. Failure to do so may subject bidder to disqualification. This Addendum forms a part of the Contract Documents. It modifies the Contract Documents as follows:

CONSTRUCTION RESTRAINTS
01 14 00 1.08.B.1
Update to "The roof shall not be replaced during the winter months, starting from November 1 to March 31. The roof replacement shall be coordinated with the timing of the screw press upgrades. Owner-Procured Sludge Pumps shall be installed no later than three (3) months following Notice to Proceed. In addition, the full HVAC system must be installed prior to the screw press startup or November 30, 2026, whichever is earliest."

STRAINERS
43 25 02

Add Specification Section 43 25 02 Strainers, attached.

This specification is added for the in-line strainer shown in the existing plan set.

SLIDE / STOP GATES
43 30 62

Add Specification Section 43 30 62 Slide / Stop Gate, attached.

DRAWINGS
DD102 SLUDGE PUMP REPLACEMENT – DEMO
D-102 SLUDGE PUMP REPLACEMENT – PLAN VIEW
D-103 OVERFLOW CHANNEL SLIDE GATE

Add new drawings attached.

APPENDIX B - OWNER-PROCURED SLUDGE PUMPS

Owner-Procured Sludge Pump Brochure and Cut Sheets is included with this Addendum for reference and coordination of the Owner-Procured Sludge Pump installation.

REFERENCE DOCUMENT

Existing Electrical Site Plan and General Notes, Sheet E-2, is provided for informational purposes only.

END OF ADDENDUM NO. 2

SECTION 43 25 02 – STRAINERS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide pipe strainers, complete and operable, in accordance with the Contract Documents.

B. Strainers shall be of ample size, with perforations suitable for each individual service, and designed for easy cleaning and removal of the strainer basket.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with Section 01 33 00 - Contractor Submittals.

PART 2 -- PRODUCTS

2.1 STRAINERS (METAL BODY)

A. Equipment Requirements: Strainers shall be of the wye-pattern or basket type, with flush connections, cast iron or bronze bodies, and screwed ends for sizes 3-inches and smaller, and flanged ends for sizes greater than 3-inches. They shall be designed for not less than 250 psi working pressure in sizes 3-inches and smaller, and 125 psi working pressure in sizes over 3-inches. Strainers shall be of the same size as the entering pipe and the screens shall have a free area of not less than 3 times the cross-sectional area of the pipe.

B. Screens: Unless otherwise indicated or required by the service fluid, the screens shall be of type 316 stainless steel or monel construction, easily removable, with the following mesh or perforations:

Strainer Size	Size of Perforations
1/4- through 2-inches	20 mesh
2-1/2 through 5-inches	1/16-inch dia. or 3/64-inch
6- through 8-inches	1/8-inch dia
over 8-inches	3/16-inch dia

C. Manufacturers, or Equal

1. **Armstrong - Yoshitake, Inc.**
2. **Fisher Controls Company**
3. **G. A. Industries, Inc.**
4. **Mueller Steam Specialty**
5. **Watts Regulator Company**

2.2 STRAINERS (PLASTIC BODY)

A. Equipment Requirements: Strainers shall be of the Y-pattern type with removable screen, magnetic drain plug, cap, and EPDM or Viton O-ring seal, and PVC body with solvent welded (less than 2-inch nominal diameters) and flanged (2-inch nominal diameter or larger) ends, rated for the following pressures at 73 degrees F:

1/2- to 2-inches	150 psi
1/2- to 2-inches	90 psi
3- to 4-inches	60 psi

B. Screen: The screens shall be of PVC, with a free area of 6 times the cross-sectional area of the pipe and 1/16-inch perforations.

C. Manufacturers, or Equal

1. **ASAHI/AMERICA**

2. **Hayward Industrial Products, Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Unless otherwise indicated, strainers shall be provided ahead of any control valves, regulators, steam and condensate traps, and where indicated, and shall be preceded by shut-off valves.

B. Strainers shall be installed in accordance with the manufacturer's written instruction, in easily accessible locations for cleaning.

END OF SECTION

SECTION 43 30 62 – SLIDE / STOP GATES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall provide slide/stop gates, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 46 01 00 – Equipment, General, apply to this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

05 50 00	Metal Fabrications
09 96 00	Protective Coating

B. Reference Standards

American Water Works Association (AWWA)	
AWWA C513	Open-Channel, Fabricated-Metal Slide Gates
AWWA C561	Fabricated Stainless Steel Slide Gates
ASTM International (ASTM)	
ASTM A 276	Standard Specification for Stainless Steel Bars and Shapes
ASTM D 4020	Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
ASTM D 2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM B 584	Standard Specification for Copper Alloy Sand Castings for General Applications

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings

1. Submit the following:

a. drawings of gates, frames, slides, and actuators

b. design load calculations for deflection at the maximum expected head

c. calculations for the lifting force generated by 40 pounds effort on the handwheel or crank in order to operate the gate.

B. Technical Manuals

1. Submit complete technical manuals, including printed instructions for proper maintenance, lubrication, and complete parts list indicating the various parts by name, number, and exploded view where necessary.

2. A list of recommended spare parts for the OWNER to store at the facility shall be included.

1.04 QUALITY ASSURANCE

A. The leakage allowance for slide gates under the design seating and unseating heads shall conform with the AWWA Standards.

B. Factory Testing

1. Gates shall be factory-assembled and functionality-tested prior to delivery to the Site.

2. Test certificates shall be submitted.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Installation and Startup Assistance

1. Service and testing assistance by the manufacturer's engineering representative for each gate and valve shall be furnished by the CONTRACTOR during installation and startup.

B. Instruction of OWNER's Personnel

1. The CONTRACTOR shall arrange for the services of a factory service representative to instruct the OWNER's personnel in the operation and maintenance of the equipment.

1.06 SPECIAL WARRANTY REQUIREMENT

A. The CONTRACTOR shall furnish the manufacturer's written guarantee that the hydraulic gates comply with the indicated requirements.

B. The CONTRACTOR shall furnish the manufacturer's warranties as published in its literature.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Gates shall comply with the following Standards:

1. AWWA C513 (unless indicated otherwise) Open-Channel, Fabricated-Metal Slide Gates and Open-Channel, Fabricated-Metal Weir Gates

2. AWWA C561 Stainless Steel Slide Gates

B. Gates shall be new and of current manufacture, adequately braced in order to prevent warpage and bending under the intended use.

C. Gate actuators shall be sized, selected, and furnished by the gate manufacturer.

D. Gate actuators throughout the project shall be products of a single manufacturer.

E. Mounting Requirements

1. Where a gate is mounted in an opening between 2 sections of handrail, additional horizontal members shall be added to the gate frame to match the handrail, guardrail, and kickplate spacing of the adjacent railing.

2. Horizontal members shall be arranged such that the railing will not interfere with operation of the actuator.

2.02 STAINLESS STEEL SLIDE GATES

A. Construction

1. Unless otherwise indicated, materials of construction shall be in accordance with AWWA C561 suitable for the service.

2. Materials employed in the manufacture and installation of the hydraulic gates and operators shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended.

3. Materials used in the fabrication of the slide gates shall conform to the requirements of the standards designated for each material as indicated below:

Description	**Material Standards**
Stainless Steel Gates	
Slide	ASTM A 276, Type 316, or Type 316 L
Frame	ASTM A 276, Type 316, or Type 316 L
Stem and coupling	ASTM A 276, Type 316
Hardware	ASTM A 276, Type 316
Stem Cover	Aluminum pipe with slots and indicator
Guides and seats	UHMW Polyethylene, ASTM D 4020
Seals	“J” bulb Type, Neoprene, ASTM D 2000. Flat seals are not acceptable.

B. Lifting Devices

1. Provide lifting devices complete with stem, lifting nut, intermediate supports with steady bushings, stem cover, indicator, and gear reducer, hand wheel, crank, where indicated.

2. The lifting devices shall be weatherproof.

3. Pedestal Mounting

a. The lifting devices shall be mounted on pedestals constructed of cast iron or fabricated steel.

b. The pedestals shall have an ample base or bracket area to evenly distribute the load to the supporting concrete structure.

4. The centerline of the manual actuator shall be approximately 3 feet above the base for pedestal-mounted actuators, and approximately 4 feet above the floor for frame-mounted actuators.

5. Slide gate hoist heads shall be constructed of cast iron.

6. The operating nut shall be constructed of solid bronze, in accordance with ASTM B 584.

7. Operating thrust shall be taken on roller or ball bearings.

8. Parts shall be provided with an alternative lubrication system.

9. Handwheel Crank

   a. The unit shall be designed for a 40–pound maximum effort on the crank in order to operate the gate.

   b. Clockwise movement of the handwheel shall close the gate.

   c. The operating crank shall be easily removable in order to facilitate the use of a portable power operator.

C. Manufacturers, or Equal

1. Whipps Gates

2. Hydro Gate Corp.

3. Washington Aluminum Company, Inc. (WACO)

4. Waterman Gate Company

2.03 HARDWARE

A. Bolts and nuts shall comply with the requirements of Section 05 50 00 – Metal Fabrications.

2.04 PROTECTIVE COATING

A. Coat ferrous metal in accordance with the requirements of Section 09 96 00 – Protective Coating

2.05 TOOLS AND SPARE PARTS

A. Tools

1. Furnish special tools that are necessary for maintenance and repair of the gates.

2. Such tools shall be suitably stored in metal toolboxes and identified with the equipment number by means of stainless steel or solid plastic nametags attached to the box.

2.06

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Slide and shear gates shall be installed in strict accordance with the manufacturer's printed recommendations and the indicated requirements.

B. Operators shall be located as to avoid interference with handrails and structural members.

C. Gates with Wall Thimbles

1. Shortly before setting each gate, apply a 1/8-inch-thick layer of mastic grade polysulfide elastomeric sealant to the back of the gate frame.

2. After setting the gate, the nuts shall be turned down on the anchor bolts far enough only to make them snug and to cause the rubber sealant to begin to ooze out, but not far enough to produce any significant stress to the frame.

3. Excess sealant at the edges shall be removed.

4. The sealant shall be allowed to cure for at least 7 Days, after which the anchor bolt nuts shall be tightened to their final positions.

5. If gaskets are being used, they shall be installed over the studs in one piece or dovetailed and cemented with a liquid-type gasket material.

D. Damage to surface coatings incurred during shipment or installation shall be repaired.

END OF SECTION

Offer No.: 500346834/1
Your reference: Sandpoint, ID
Date: 13 January 2026

SEEPEX.
An Ingersoll Rand Business

Item: 20
Product group N
Standard Pump

CONVEYING CAPACITY
50 USGPM

PRESSURE
22 psi

SPEED
253 rpm



* typical image, design may differ

SEEPEX Smart Conveying Technology, SCT, enables full maintenance in place with no pipe-work needing to be removed. The two-part stator and "plug-in" rotor reduces maintenance times adjustable stator means the service life of the pumping elements is extended.

BN (SCT)

YOUR ADVANTAGES

• Fast maintenance, easy handling during assembly/dismantling

• Up to 200% longer rotor and stator service life thanks to the integrated retensioning device

• Reduction of maintenance times by 85%

• High productivity thanks to short maintenance downtimes and significantly reduced life-cycle costs

• Smart Seal Housing enables fast maintenance of the mechanical seals and thereby saves even more time during maintenance work (optionally available)

• Very easy to maintain: Work on the two-part Smart Stator can be carried out by just one individual

• Low space requirement for all servicing work, so no space allowance for stator dismantling is required.

• Environmentally friendly, as elastomer and steel components are disposed of separately

Offer No. 500346834/1/
Ambiente H2O - Idaho/Montana

SEEPEX.
An Ingersoll Rand Business

1/13/2026	**Item 20**
	pump to handle Unknown
qty.: 1	**Progressive cavity pump**
	BN 17-6LS / A1-J0-L8-F0-A

Application data

Conveyed product	Unknown
Flowability	flowable
Viscosity	low viscosity (< 500 cP/mPas)
Solids content	<= 2%
Size of solids	not specified
Density	unknown, 1 kg/dm³ assumed
Product temperature	32°F - 113°F
Product temperature (norm.)	113°F
pH value	5-9
Kind of operation	continuous
Operating hours	8 h/day
Location	indoor, dry atmosphere
Altitude of installation	up to 1000 m assumed
Surrounding temperature	normal (32-104 °F)

Performance data

	Capacity	**Pressure**	**Speed**
	50 USGPM	22 psi	253 rpm
Starting torque	70 lb.ft		
Req. operating power at pump shaft	1.6 HP		
Inlet pressure	flooded suction (up to 0,5bar)		

Tolerances according to SEEPEX standards.

Materials and executions

Installation	horizontal
Direction of rotation	counter clockwise (left)
Lantern - Design	with cover plates
Lantern - Material	EN-JL 1040 (gci-25)
Suction casing - Design	standard
Suction casing - Material	EN-JL 1040 (gci-25)
Pressure branch - Design	standard
Pressure branch - Material	EN-JL 1040 (gci-25)
Position of branch	position 1
Suction connection	NPS 4, drilled acc. to ASME B 16.5, Class 150, RF
Pressure connection	NPS 3, drilled acc. to ASME B 16.5, Class 150, RF
Joint - Design	pin joint with joint sleeve, grease filled
Joint - Material	standard, holding bands 1.4401
Joint - Universal joint sleeve: material	NBR - Perbunan
Coupling rod - Design	standard
Coupling rod - Material	1.4404 / AISI 316L
Rotor - Design	Smart Rotor-design
Rotor - Material	1.0503 (C45) / AISI 1045
Rotor - Coating	ductile chromium coating
Stator - Design	smart stator design
Stator - Material	NBR - Perbunan
Shaft sealing	packing
Design	standard
Casing - material	EN-JL 1040 (gci-25)
Packing ring - material	ramie, PTFE / silicone oil
Plug-in Shaft - Design	splash ring NBR and ductile coating
Plug-in Shaft - Material	1.4404 / AISI 316L
Bolting - Design	standard

Painting - Number of colors	single-colored standard
Painting - Painted components	complete combination
Painting - Color	Standard Enamel (SEEPEX Blue)
Painting - Surface protection	std. surface protection C2 (NDFT 95 µm)

Drive

Type	Gear motor
Make	Nord
Model	SK32FAL-112MP/4
Mounting type	Flange design
Mounting orientation	M1
Ratio (i)	6.74
Speed	257 rpm
	Norm
Speed	257 rpm
Frequency	60 Hz
Rated output	5 HP
Power factor	0.8
Rated speed	1730 rpm
Starting	direct on frequency inverter
Efficiency class	premium efficiency
Terminal box position acc. to supplier	1
Cable entry position acc. to supplier	I
Voltage	3x 230/460 V
Frequency	60Hz
Enclosure	IP55
Thermal class	F

The frequency inverter has to follow a linear U/f characteristic curve (constant torque).
It's essential to have a minimum overload capability of 150% for at least 3 seconds. (see technical data sheet)

Baseplate

Design	baseplate for block pump, design with side feet
Material	steel, painted
GPU Type Code	B-ST-LS

Packing

Type of packing	skid (US)
Type of transport	truck
Quantity of pumps per position	1 pump

Dry running protection device (TSE)

Design	standard design, complete - sensor sleeve fitted to the stator of the pump with integrated temperature sensor - connection head (IP55) - separate TSE control device suitable for mounting inside a control panel
Voltage	110-115 V / 50-60 Hz
Temperature coefficient	NTC
Material sensor sleeve	1.4404 / AISI 316L
Material connection head	aluminium

Please send your purchase order to incomingorders@seepex.net

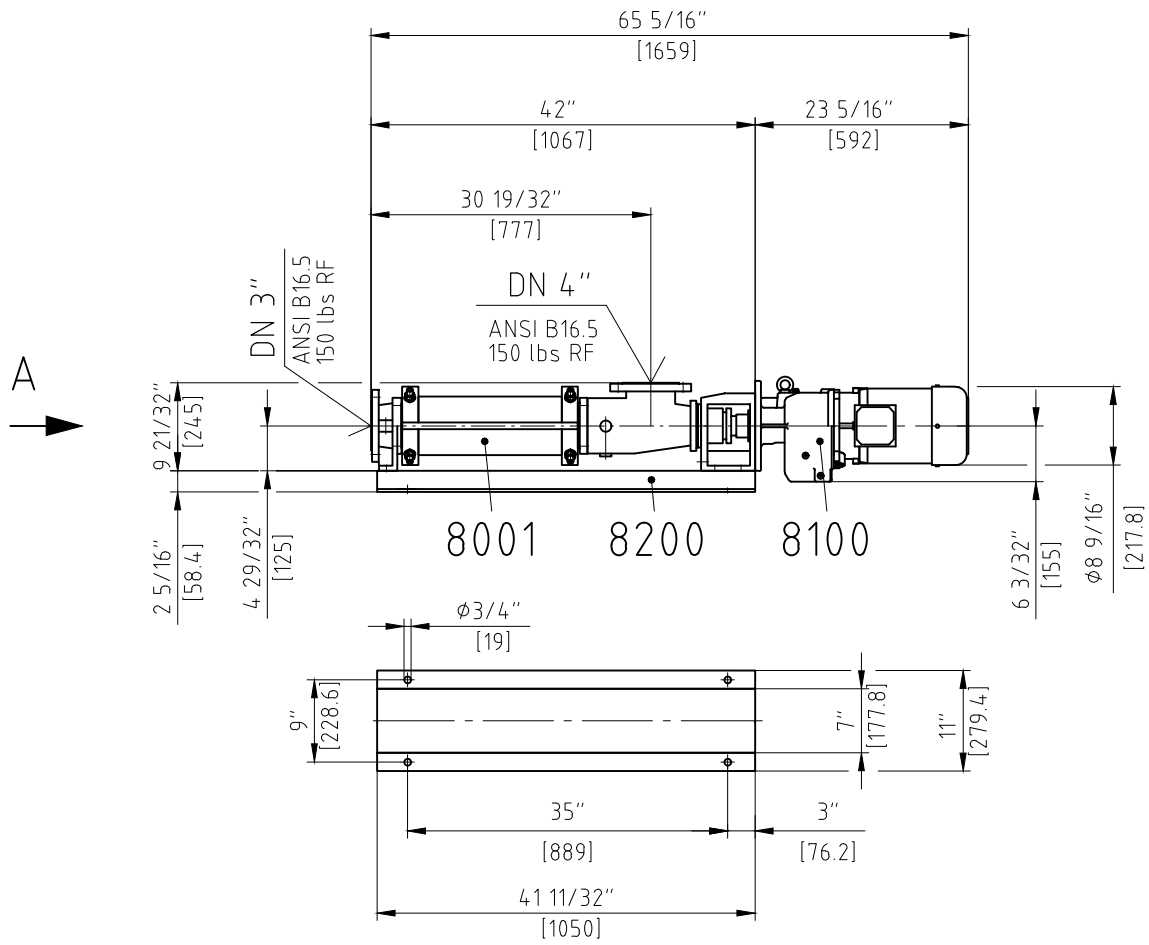
All drawings accompanying this offer is for REFERENCE ONLY, final drawings will be created upon receipt of order. If you need this drawing please request on PO.

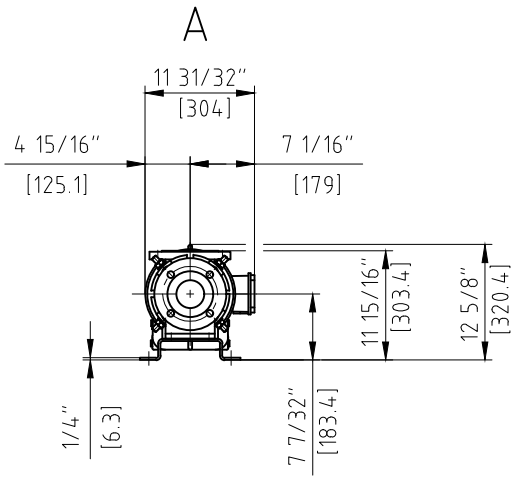
In order to process your order, we will require either a copy of the quote this order is based on, or the quote number.

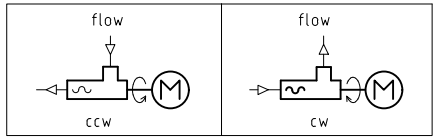
In order to process duplicate wet end orders, we will require the commission number of the pump being duplicated.

not binding drawing for offer

Copyright: This drawing is our property and patented for us according to the law of copyright and associated rights !







dimensions in [...] are in millimeter

Quant.	Denomination	Item	Material	Note	Weight / kg
1	baseplate	8200		Var.: 801-200/0100-C-100	21
1	drive: Nord SK32F-112MP	8100			54
1	pump: BN 17-6LS	8001			85

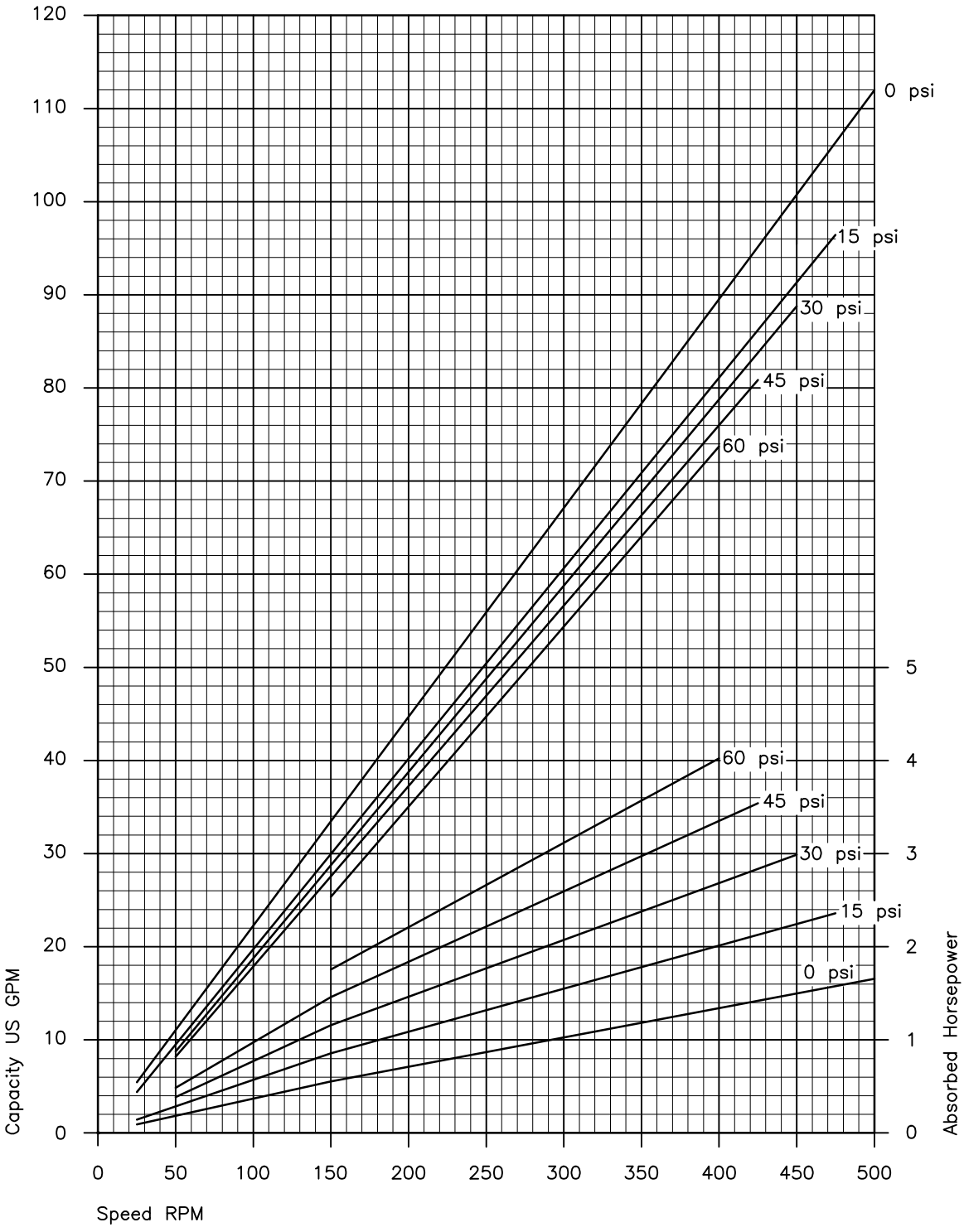
SEEPEX.
ALL THINGS FLOW

		Name	Day	Scale	Weight	Denomination
2016	Drawn	eba	23.06.	◎▱ 1:20	160 kg	dimensional drawing
	Checked	lsh	24.06.	EDP-No. 155041.dwg		Drawing-no. 262-C18/0170-S-719A4

General tolerances for dimensions without specified tolerances acc. to DIN ISO 2768-v

Characteristic Curves
Size
17–6LS

SEEPEX.
ALL THINGS FLOW

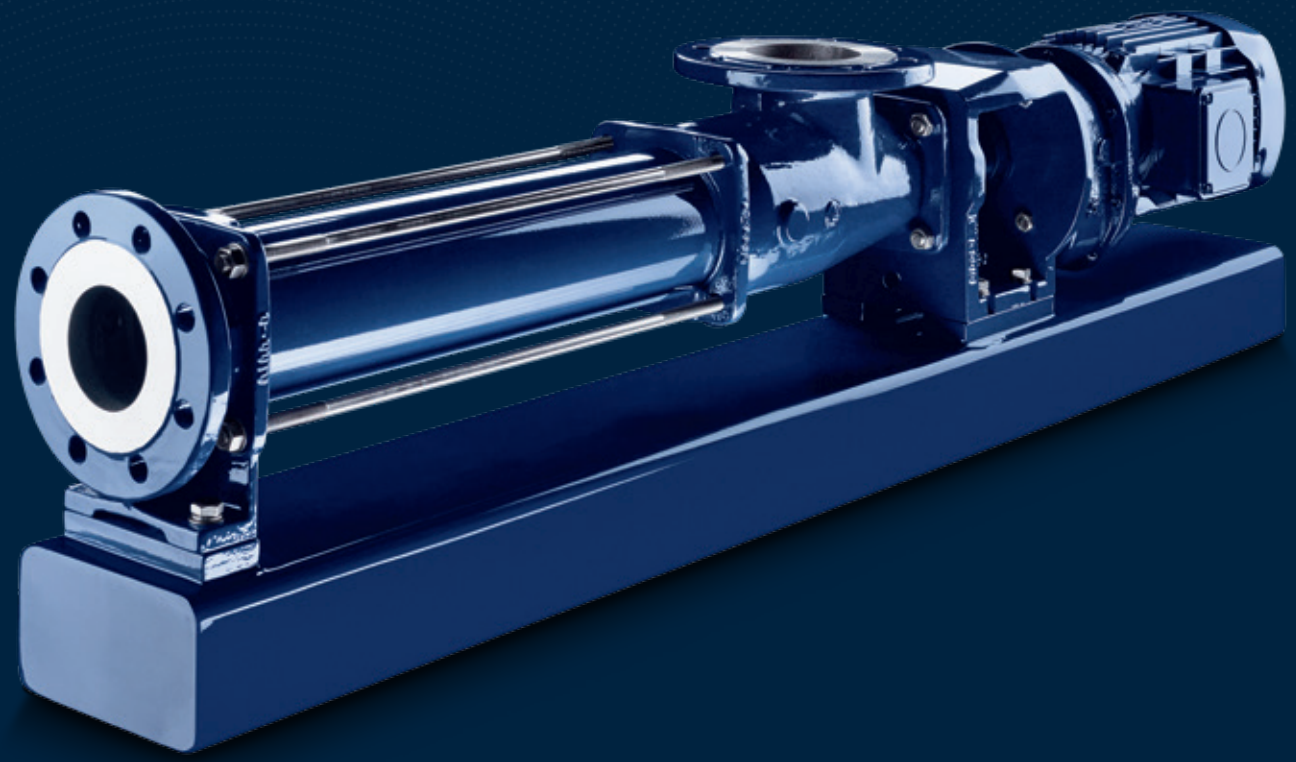


Values based upon water 68°F.

CHA.17–6LS_4, H 10.20us

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An Ingersoll Rand Business

THE BASIS
PRODUCT GROUP N



N

PRODUCT GROUP N

AN ESSENTIAL.

Product group N pumps are the model for the design of all SEEPEX progressive cavity pumps. They are used in all industries and convey thin to highly viscous liquids with or without solids. They are available with various rotor/stator geometries (conventional, 6L, Tricam and Equal Wall). These benefits and others ensure the pump's economical operation.

DRY RUNNING PROTECTION TSE; THERMOELECTRONIC SENSOR

Prevents the stator from being damaged by dry running. Optionally available.

ROTOR

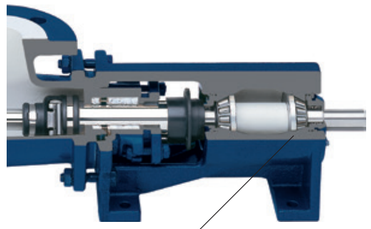
Wear and corrosion resistant materials. Hard coatings are also available.

PRESSURE BRANCH

Connection for pressure instruments. Flange connections in DIN or ANSI.

STATOR

The seal on both ends is molded as an integral part of the elastomer. Corrosion of the stator tube is prevented as the pumped liquid does not come in contact with the metal tube or the bonding adhesive. Available with an adjustable stator retensioning device.



DRIVE CASING

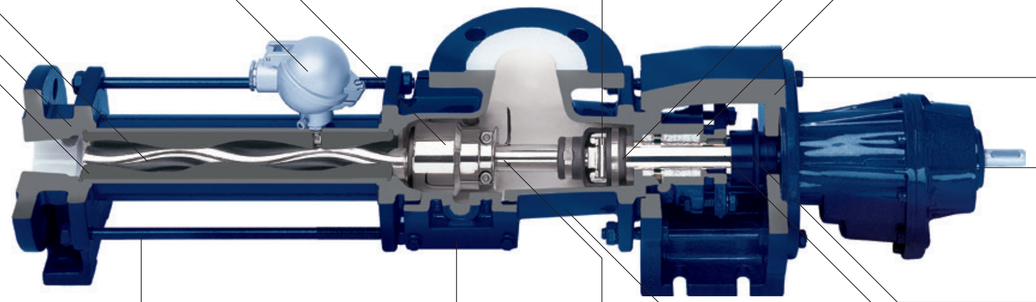
For NS range, drive shaft and bearings can be lubricated. Available with double bearing seals to prevent ingress of dust or moisture.

TIE BOLTS/SCREWS

Corrosion proof. Available in stainless steel.

UNIVERSAL JOINT SLEEVE PROTECTION

Made of stainless steel, protects the universal joint sleeve against mechanical damage from large or sharp solids. Optionally available.



INSPECTION PORTS

On both sides as an option.

UNIVERSAL JOINT

Consists of just five components. Power transmission through wear resistant, hardened and replaceable joint parts: easily repaired.

COUPLING ROD

For power transmission. Improved design, special designs with augers or paddles are available.

SUCTION CASING

With large cross section, drain plug and connections for pressure instruments. Designed for laminar flow conditions. Flange connections in DIN or ANSI can be rotated in 90° increments.

UNIVERSAL JOINT SLEEVE WITH HOLDING BANDS

Protects the grease-filled joints from penetration by the pumped liquid, even in case of maximum vacuum or pressure loading. The streamlined design reduces turbulence and NPSHr.

SHAFT SEALING

Gland packing with optional lantern ring. Balanced or unbalanced, component or cartridge, single or double mechanical seals from numerous suppliers are available. Quench and flushing systems are also available. Adheres to the DIN EN 12756 standards.

LANTERN

For connecting the pump and drive. To secure the assembly to the baseplate.

DRIVE

Gearmotors, variable speed drives or hydraulic motors from all major manufacturers can be directly flanged to the pump without additional couplings or guards.

PLUG-IN SHAFT CONNECTION

For easy dismantling of the pump and drive with quick replacement of the rotating parts and shaft seals. The plug-in shaft pin secures the shaft connection to the drive and the splash ring protects the bearings from contamination.

PLUG-IN SHAFT

Connects the drive shaft to the universal joint; with gland packing the plug-in shaft functions as a shaft sleeve. It is available with wear resistant hard coatings.

OVERVIEW OF RANGES

BN RANGE

The drive of BN range pumps is flange-mounted directly to the pump. This means that a separate pump bearing is not necessary and the pump is more compact and less expensive. The plug-in shaft connection between the drive and rotating unit simplifies the replacement of rotating wearing parts and the shaft sealing, thereby making the BN range very service-friendly.



NS/N RANGE

NS range pumps have drives not directly flange-mounted to the pump. Bare shaft designs can fit any drive the user desires including diesel engines or hydraulic motors. The drive casing can accommodate elastic couplings or belt pulleys and still has a service-friendly plug-in shaft connection. This connection simplifies the replacement of the rotating wearing parts and the shaft sealing.



APPLICATIONS

Product group N pumps form the basis of the modular concept that supports all SEEPEX progressive cavity pumps. They are ideal for applications in agriculture, ceramics, chemicals, biochemicals, construction, dyeing, paints, electroplating, environmental technology, fish processing, food, beverages, bakery dough and fillings, mining, inorganic minerals, oil and natural gas production, offshore technologies, cosmetics, petrochemicals, pharmaceuticals, pulp and paper, shipbuilding, sugar refining, water and wastewater treatment, textiles, glues, adhesives, mastics and sealers in the transportation and construction markets.

FEATURES

- Various rotor/stator geometries (conventional, 6L, Tricam and Equal Wall)
- Minimal pulsation, uniform and controlled flow. No pulsation dampeners or compensators are required.
- High self-priming capabilities even with a mixture of liquid and air/gas up to a 9 m (29.5 ft.) water column
- Can be mounted either horizontally or vertically, suction casing inlet can be rotated
- Large spherical entrance ports for improved solids handling
- Products with solids can be conveyed gently without damage
- Reversible rotation and fluid flow to improve the NPSHr and sealing
- Low shear rates

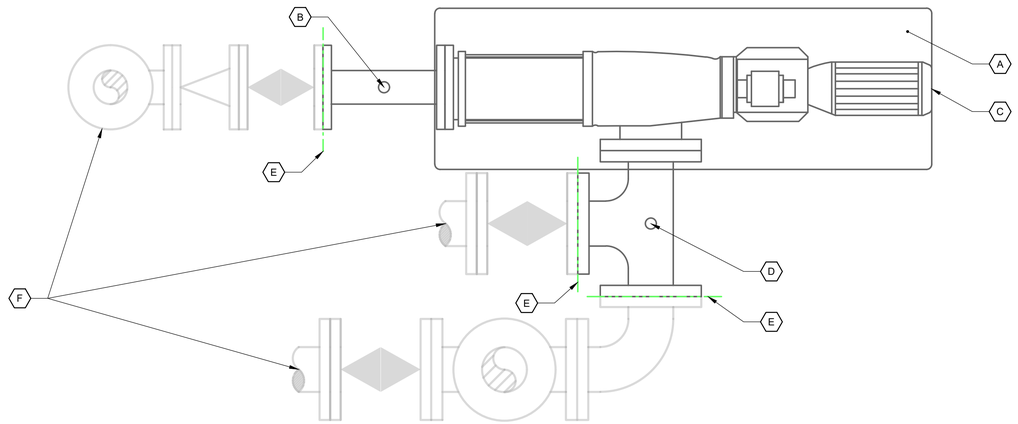
KEY FACTS

- Conveying capacity:
  30 l/h–500 m³/h (0.132–2,200 USGPM)
- Pressure:
  up to 96 bar (1400 psi)

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An Ingersoll Rand Business

SEEPEX GmbH
www.seepex.com

BR.N.EN_04.22



1 PLAN VIEW
NO SCALE

GENERAL SHEET NOTES

1. CONTRACTOR TO FIELD-FIT NEW PIPING & INSTRUMENTATION.
2. WHERE EXISTING PIPING IS TO BE REPLACED, CONTRACTOR TO MATCH EXISTING MATERIAL.
3. ALL FITTINGS TO BE FLANGED.
4. CONTRACTOR TO FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF PUMP AND BASEPLATE.

SHEET KEYNOTES

A. CONTRACTOR CAN REUSE EXISTING PUMP SUPPORT METAL BASE AND FIT AS NEEDED AND APPROVED BY ENGINEER. CONCRETE PAD TO REMAIN.

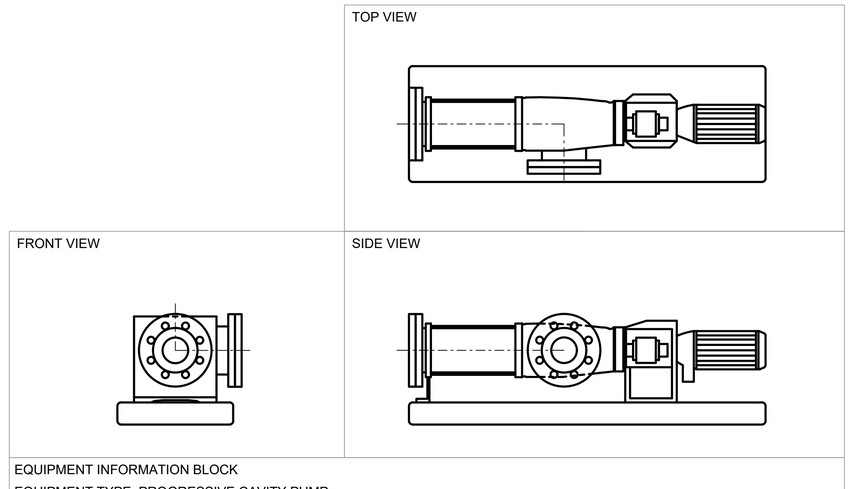
B. NEW PUMP HAS A 3" DISCHARGE. PRESSURE GAUGE AND SHUTOFF SWITCH TO BE REUSED ON NEW 3" TAPPED SPOOL.

C. PRE-PURCHASED PROGRESSIVE CAVITY PUMP TO BE INSTALLED. (2)

D. EXISTING 4"x4"x6" TEE TO BE REPLACED WITH 4"x4"x4" TEE. PRESSURE GAUGE AND SHUTOFF SWITCH TO BE REUSED ON NEW TAP.

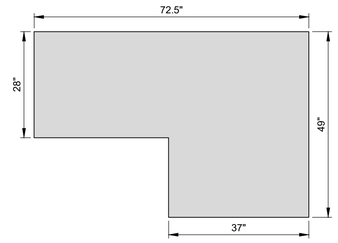
E. EXPECTED REPLACEMENT LIMITS.

F. TO EXISTING PIPING (NOT SHOWN FOR CLARITY).



EQUIPMENT INFORMATION BLOCK
EQUIPMENT TYPE: PROGRESSIVE CAVITY PUMP
MANUFACTURER: SEEPEX
MODEL #: BN 17-6LS
SIZE: 4" SUCTION & 3" DISCHARGE
DATE DRAWN: MAY 2026

2 PUMP DETAIL
NO SCALE



3 7" THICK CONCRETE PAD DETAIL
NO SCALE



4 PHOTO
NO SCALE

Stantec
Street Address
City, Province/State, Postal/Zip Code
Tel: +1.555.555.1234
www.stantec.com

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Consultant

No.	Revision	By	Appd	YYYY.MM.DD

No.	Issued	By	Appd	YYYY.MM.DD

Permit/Seal

PROFESSIONAL ENGINEER 12519 STATE OF IDAHO NICK SMITH

Client/Project
CITY OF SANDPOINT, ID
SCREW PRESS UPGRADE
SANDPOINT, ID

Project No.: 2002003233
File Name: ADD_2
Scale: NO SCALE

EJD	EJD		2026.05.28
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

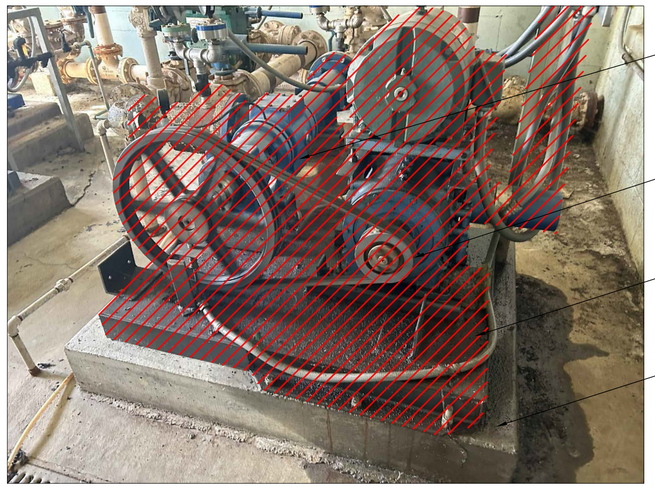
Title
SLUDGE PUMP REPLACEMENT - PLAN VIEW

Revision:

Drawing No.
D-102

C:\Autodesk\Accdocs\stantec.com\Proj\2002003233_sandpoint_misc_support\Project files\01_wip\09_process\sheet_files\d-102_2026.05.29 9:41:38 AM

ORIGINAL SHEET - ANSI D



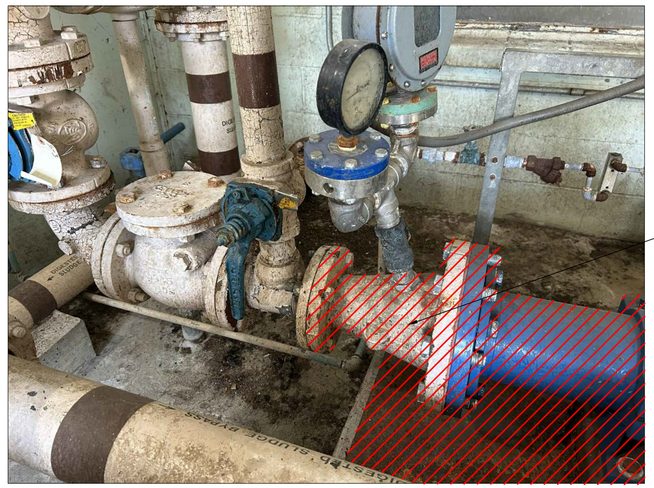
DEMO EXISTING SLUDGE PUMP

DEMO EXISTING MOTOR/BELT DRIVE

CONTRACTOR CAN CUSTOMIZE AND REUSE EXISTING 4" STEEL SUPPORT STRUCTURE AS APPROVED BY ENGINEER

EXISTING PAD TO REMAIN (3 / D-102) (4 / D-102)

1 PHOTO
NO SCALE



DEMO EXISTING REDUCER, PRESERVE INSTRUMENTATION FOR USE ON NEW PIPING

2 PHOTO
NO SCALE



EXISTING PRESSURE GAUGE AND SHUTOFF SWITCH TO REMAIN. SEE D-102 FOR ADDITIONAL INFORMATION

3 PHOTO
NO SCALE



DEMO EXISTING TEE

4 PHOTO
NO SCALE

GENERAL SHEET NOTES

1. SEE THE GENERAL NOTES AND SPECIFICATIONS FOR ADDITIONAL INFORMATION.

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Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD

Permit/Seal

PROFESSIONAL ENGINEER
12519
STATE OF IDAHO
NICK SMITH

Client/Project
CITY OF SANDPOINT, ID

SCREW PRESS UPGRADE

SANDPOINT, ID

Project No.: 2002003233
File Name: ADD_2

Scale:NO SCALE

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
EJD	EJD		2026.05.28

Title
SLUDGE PUMP
REPLACEMENT - DEMO

Revision:

Drawing No.
DD102

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ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. CONTRACTOR MAY NOT IMPACT WATER QUALITY OF FLOW FROM CHLORINE CONTACT CHAMBER TO EFFLUENT OUTFALL.
2. CHANNEL DIMENSIONS ARE SHOWN. CONTRACTOR TO FIELD VERIFY DIMENSIONS.



CHANNEL FROM DETENTION TANK AND OVERFLOW PUMPS. TYPICALLY STAGNANT FLOW

GATE TO BE INSTALLED BETWEEN 2 AND 3 FEET FROM CHANNEL CONFLUENCE

INSTALLATION OF COFFERDAM OR OTHER ISOLATION OF CHANNEL TO ALLOW DEWATERING OF THE OVERFLOW CHANNEL FOR INSTALLATION OF GATE PER MANUFACTURER RECOMMENDATIONS AND TO AVOID CONTAMINATION OF OUTFALL CHANNEL

FLOW FROM CHLORINE CONTACT CHAMBER TO OUTFALL (ACTIVE FLOW)

1 PHOTO
NO SCALE

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Consultant

No.	Revision	By	Appd	YYYY.MM.DD

No.	Issued	By	Appd	YYYY.MM.DD

Permit/Seal

PROFESSIONAL ENGINEER
Nick Smith
12519
STATE OF IDAHO
NICK SMITH

Client/Project
CITY OF SANDPOINT, ID
SCREW PRESS UPGRADE
SANDPOINT, ID

Project No.: 2002003233
File Name: ADD_2
Scale: NO SCALE

EJD	JJK		2026.05.28
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

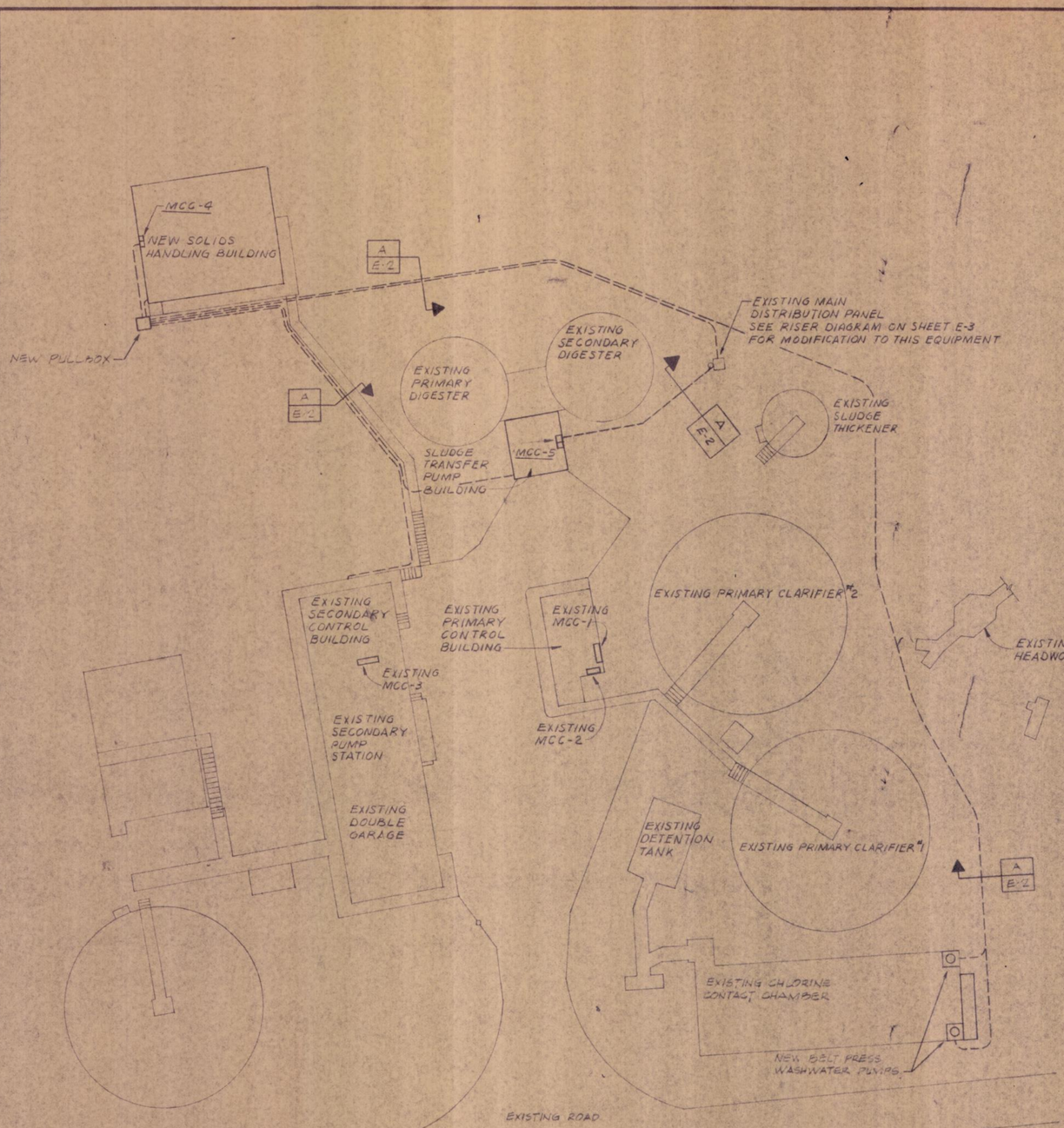
Title
OVERFLOW CHANNEL
SLIDE GATE

Revision:

Drawing No.
D-103

c:\outofdate\c\accdocs\stantec.com\ut\tmp\2002003233_sandpoint_mec_support\project files\01_eap\09_process\sheet_files\add_2
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ORIGINAL SHEET - ANSI D



ELECTRICAL SITE PLAN
SCALE 1"=20'-0"

GENERAL ELECTRICAL NOTES:

THE CONTRACTOR SHALL VERIFY EXACT LOCATIONS OF TERMINAL BOXES AND CONDUIT ENTRANCES OF ALL EQUIPMENT AGAINST SHOP DRAWINGS BEFORE STUBBING UP CONDUITS.

CONNECTION BETWEEN RIGID CONDUIT AND MOTOR TERMINAL BO. SHALL BE LIQUID TIGHT, FLEXIBLE CONDUIT.

EXPOSED FLEXIBLE CONNECTIONS SHALL BE FLEXIBLE LIQUID TIGHT CONDUIT WITH APPROVED GROUNDIN TYPE FITTINGS AND SHALL NOT EXCEED 30 INCHES IN LENGTH FOR 2-INCH SIZE AND LARGER, MAXIMUM OF 18 INCHES IN LENGTH FOR SIZES 1½ INCHES AND SMALLER.

MOTOR CONTROL CENTERS AND ALL FREE-STANDING PANELS SHALL BE SET ON CONCRETE PADS WITH LEVELING CHANNELS EMBEDDED INTO PAD AS SHOWN UNLESS OTHERWISE INDICATED.

ALL LIGHT SWITCHES AND DUPLEX RECEPTACLES SHALL BE MOUNTED UP 48 INCHES ABOVE FINISHED FLOOR SURFACE UNLESS OTHERWISE INDICATED.

THE CONTRACTOR SHALL SUBMIT COMPLETE ELECTRICAL SHOP DRAWINGS, BOUND IN 3-RING NOTEBOOK FORM WITHIN 30 CALENDAR DAYS AFTER AWARD OF CONTRACT.

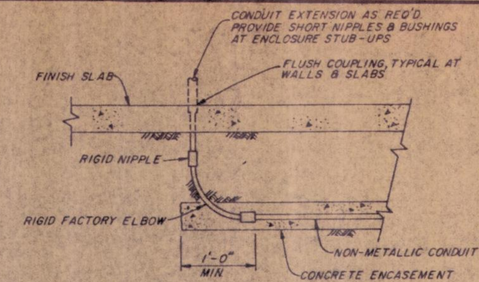
CONDUIT STUB-UPS SHALL NOT BE MORE THAN 6 INCHES FROM CENTER-LINES OF TERMINAL BOXES.

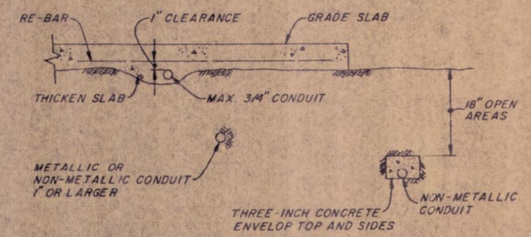
CONDUITS TERMINATING AT MOTOR CONTROL CENTERS, CONTROL CABINETS, ETC., SHALL BE EQUIPPED WITH A GROUNDING BUSHING "OZ" TYPE GB.

IN CASE OF INTERFERENCE BETWEEN ELECTRICAL EQUIPMENT SHOWN ON THE DRAWINGS AND OTHER EQUIPMENT, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN WRITING AND THE ENGINEER SHALL REVIEW THE PROPOSED CHANGES BEFORE THEY ARE MADE.

ALL OUTDOOR DEVICES SHALL BE WEATHERPROOF AND SLEET-PROOF.

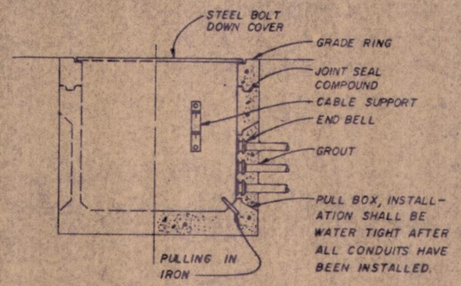
AT CONTRACTOR'S OPTION; LIGHTING CIRCUITS MAY BE COMBINED UTILIZING A COMMON NEUTRAL, RECEPTACLE CIRCUITS MAY BE COMBINED UTILIZING A COMMON NEUTRAL FOR RESPECTIVE HOME RUNS.



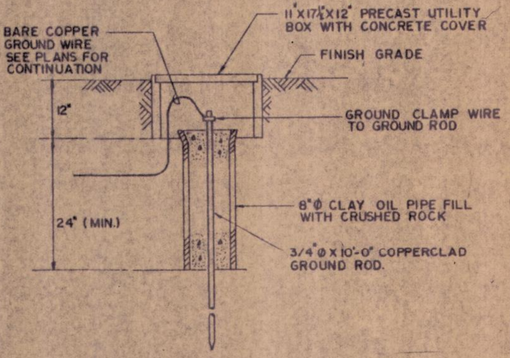


NOTE:
SEE SPECIFICATION FOR CORROSION PROTECTION REQUIREMENTS FOR METALLIC CONDUIT

RACEWAY PLACEMENT



PULLBOX
TYPICAL FOR MANHOLE



GROUND ROD & WELL

REV	DATE	BY	DESCRIPTION

SCALE: NOTED

DESIGNED
DRAWN
CHECKED

SUBMITTED
PROJECT ENGINEER — R.C.E. NO. — DATE
RECOMMENDED
JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. — R.C.E. NO. — DATE

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
1301 VISTA AVENUE, BOISE, IDAHO 83705

APPROVED — DATE
APPROVED — DATE

CITY OF SANDPOINT
SOLIDS HANDLING FACILITIES
ELECTRICAL SITE PLAN AND GENERAL NOTES

SHEET E-2 OF SHEETS

JOB NO. FILE CC 10-81

WWTP Screw Press Upgrade
BID No. 26-3257-2 - ADDENDUM NO. 3

City of Sandpoint
1123 Lake Street
Sandpoint, Idaho 83864

Date: June 5, 2026

BID Number and Title:	26-3257-2 – Addendum No. 3
BID Submission Deadline:	**Thursday, June 11, 2026, no later than 2:30:00 p.m. local time**
Pages:	Addendum No. 3 (2 Pages) Cover Page (1 Page) Bid Bond (2 Pages)

Acknowledge receipt of this Addendum by inserting its number and date on the Bid Form. Failure to do so may subject bidder to disqualification. This Addendum forms a part of the Contract Documents. It modifies the Contract Documents as follows:

PROJECT MANUAL COVER PAGE

Delete the Cover Page in its entirety and replace with the attached.

PART 1 – ADVERTISEMENT FOR BIDS

Revise the first paragraph of the Advertisement for Bids to read:

Sealed bids will be received by the City Clerk, City of Sandpoint, at City Hall, 1123 Lake Street in Sandpoint, Idaho 83864, until 2:30:00 p.m. local time on Thursday, June 11, 2026 for Bid No. 26-3257-2 WWTP Screw Press Upgrade.

PART 2 – INSTRUCTIONS TO BIDDERS
2010 ISPWC 00200 - INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS
ARTICLE 17 - EVALUATION OF BIDS AND AWARD OF CONTRACT

Delete paragraph 17.06 in its entirety and replace with the following:

17.06 The anticipated schedule for this project is as follows:
Bids Due – June 11, 2026
Anticipated Notice of Intent to Award – June 12, 2026
Anticipated City Council Approval – July 1, 2026
Anticipated Award Date and Notice to Proceed – July 8, 2026
Substantial Completion – May 7, 2027
Final Completion – May 21, 2027

PART 3 - BID BOND

Delete the Bid Bond in its entirety and replace with the attached.

PART 8 – DRAWINGS
D-103

Add the following clarification note to Drawing D-103: "Slide gate shall be sized to provide isolation of the full channel width and height as shown, as much as practical. Contractor shall coordinate final gate dimensions with the gate manufacturer in accordance with Specification Section 43 30 62."

END OF ADDENDUM NO. 3

PART 3

BID PACKAGE

THIS PAGE WAS INTENTIONALLY LEFT BLANK

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to:

City of Sandpoint
City Clerk
1123 Lake Street
Sandpoint, ID 83864

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security in the form of: cash, a certified check, cashier's check, or a Bid bond (on the form attached) issued by a surety meeting the requirements of the General Conditions.;

B. Bidder shall include in his Bid the name, or names and address, or addresses, and Idaho Public Works Contractor License Numbers of the Subcontractors who shall, in the event the Bidder secures the Contract, subcontract the plumbing, heating and air-conditioning work, and electrical work under the General Contract;

C. State of Idaho Public Works Contractor's License No.: ~~3371685~~ PWC-C-14034 A;

ARTICLE 3—BASIS OF BID—LUMP SUM BID

3.01 *Lump Sum Bids*

A. The Lump Sum Bid Price shall include all costs necessary to complete the Work, including but not limited to labor, materials, equipment, overhead, profit, permits, and all applicable federal, state, and local taxes, including taxes associated with Owner-furnished equipment.

B. Bidder will perform the following Work at the indicated price:

BID SCHEDULE A – BASE BID —LUMP SUM BID: $ 2,729,575.00

ARTICLE 4—TIME OF COMPLETION

4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

5.02 *Instructions to Bidders*

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date
1	5/20/26
2	6/2/26
3	6/8/26

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder's Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Bidder has carefully studied the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and

observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 6.02.A:

   a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.

   b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

   c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

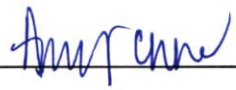
d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

BIDDER hereby submits this Bid as set forth above:

Bidder:

Apollo, Inc.

(typed or printed name of organization)

By: 

(individual's signature)

Name: Amy Jenne

(typed or printed)

Title: Vice President

(typed or printed)

Date: 06/02/2026

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: 

(individual's signature)

Name: Dan Sjule

(typed or printed)

Title: Senior Project Manager

(typed or printed)

Date: 06/02/2026

(typed or printed)

Address for giving notices:

1133 W. Columbia Drive

Kennewick, WA 99336

Bidder's Contact:

Name: Amy Jenne

(typed or printed)

Title: Vice President

(typed or printed)

Phone: 509-987-1417

Email: Amy.Jenne@apollo-gc.com

Address:

1133 W. Columbia Drive

Kennewick, WA 99336

Bidder's Contractor License No.: (if applicable) ~~3371685~~ PWC-C-14034-N

Naming of Subcontractors Form

Per Idaho Code, 67-2310, Bidder shall include in his or her Bid the names and address, and Idaho Public Works Contractor License Number of the Subcontractors who shall, in the event the Bidder secures the Contract, subcontract the plumbing, heating and air-conditioning work, and electrical work under the general Contract. Failure to name Subcontractors as required shall render any Bid submitted by the Bidder unresponsive and void.

Subcontractor Name and Address	Classification	License Number
Alden Plumbing LLC. 1392 W. Pine St. Walla Walla, WA 99362	Plumbing	066027
Sturm Heating & Air 1112 N. Nelson St. Spokane, WA 99202	HVAC	057231
McKinstry Electric 5005 3rd Ave. S. Seattle WA 98134	Electrical	PWC-C-15716

NOTES TO USER

1. This form must be included for all bids.

BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name: Apollo, Inc. Address *(principal place of business)*: 1133 W. Columbia Drive Kennewick, WA 98336-0617	Name: Western Surety Company Address *(principal place of business)*: 151 N. Franklin Street Chicago, IL 60606
Owner	**Bid**
Name: City of Sandpoint Address *(principal place of business)*: 1123 Lake Street Sandpoint, ID 83864	Project *(name and location)*: Bid No 26-3257-2 WWTP Screw Press Upgrade Bid Due Date: **June 11, 2026**

Bond

Penal Sum: Five Percent (5%) of the Total Bid Amount

Date of Bond: June 8, 2026

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

Bidder	Surety
Apollo, Inc. *(Full formal name of Bidder)*	Western Surety Company *(Full formal name of Surety) (corporate seal)*
By: Amy Jenne *(Signature)*	By: Kenneth J. Frick *(Signature) (Attach Power of Attorney)*
Name: Amy Jenne *(Printed or typed)*	Name: Kenneth J. Frick, ID Lic # 683264 *(Printed or typed)*
Title: VP	Title: Attorney-in-Fact
Attest: *(Signature)*	Attest: Nancy Salset *(Signature)*
Name: David Haight *(Printed or typed)*	Name: Nancy Salset *(Printed or typed)*
Title: Vice President	Title: Attorney-in-Fact

WESTERN SURETY COMPANY CORPORATE SEAL SOUTH DAKOTA

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
   3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
   3.2. All Bids are rejected by Owner, or
   3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Western Surety Company

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That WESTERN SURETY COMPANY, a South Dakota corporation, is a duly organized and existing corporation having its principal office in the City of Sioux Falls, and State of South Dakota, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Rod Lewis, Kenneth J Frick, Lorraine Hale, Nancy Salset, Individually

of Yakima, WA, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind it thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the corporation and all the acts of said Attorney, pursuant to the authority hereby given, are hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the Authorizing By-Laws and Resolutions printed at the bottom of this page, duly adopted, as indicated, by the shareholders of the corporation.

In Witness Whereof, WESTERN SURETY COMPANY has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 24th day of February, 2026.

WESTERN SURETY COMPANY

Larry Kasten, Vice President

State of South Dakota
County of Minnehaha } ss

On this 24th day of February, 2026, before me personally came Larry Kasten, to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is a Vice President of WESTERN SURETY COMPANY described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said corporation and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporation.

My commission expires
December 4, 2031

K. WALSH
NOTARY PUBLIC
SOUTH DAKOTA

K. Walsh, Notary Public

CERTIFICATE

I, Paula Kolsrud, Assistant Secretary of WESTERN SURETY COMPANY do hereby certify that the Power of Attorney hereinabove set forth is still in force, and further certify that the By-Laws and Resolutions of the corporation printed below this certificate are still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said corporation this 8th day of June, 2026.

WESTERN SURETY COMPANY

Paula Kolsrud, Assistant Secretary

Authorizing By-Laws and Resolutions

ADOPTED BY THE SHAREHOLDERS OF WESTERN SURETY COMPANY

This Power of Attorney is made and executed pursuant to and by authority of the following By-Law duly adopted by the shareholders of the Company.

Section 7. All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, and Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys in Fact or agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile.

This Power of Attorney is signed by Larry Kasten, Vice President, who has been authorized pursuant to the above Bylaw to execute power of attorneys on behalf of Western Surety Company.

This Power of Attorney may be signed by digital signature and sealed by a digital or otherwise electronic-formatted corporate seal under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 27th day of April, 2022:

"RESOLVED: That it is in the best interest of the Company to periodically ratify and confirm any corporate documents signed by digital signatures and to ratify and confirm the use of a digital or otherwise electronic-formatted corporate seal, each to be considered the act and deed of the Company."

Go to www.cnasurety.com > Owner / Obligee Services > Validate Bond Coverage, if you want to verify bond authenticity.