

CALL FOR BIDS

Special School District No. 1
Official Publication No. **OP 26-2602**
Minneapolis Public Schools
Southwest High School: Material Pre-Purchase for a Pump House

Bids Due: 1:00 PM, local time Tuesday, September 23, 2025
Bid Opening: 1:00 PM, local time Tuesday, September 23, 2025

To furnish materials, equipment, and incidentals to complete a Pre-Purchase of a Pump House with Drawings and Specifications prepared by ATSR Planners, Architects and Engineers.

A complete set of Contract Documents will be available Tuesday, September 9, 2025.

Procurement of Documents is as follows: You may view and order documents for this project by going online to Quest CDN Website: Electronic downloads are available by visiting www.QuestCDN.com, for material pre-purchase #9865368. The cost for downloading a set of Contract Documents is \$22. Please contact QuestCDN.com at 952-233-1632 or info@Questcdn.com for assistance in free membership registration, download and working with this digital project information.

In the left column under "Plan rooms", select "Order from Plan Well".

When the next page opens, skip the username section and in the left column under "Public Plan room", select "Go".

Once in the plan room, you may find the project and click on the project number link to the left.

Once in the project, select "Download Complete Set", then "Instant Download".

After Registration, select "Download Now". You will be provided with a link to the files. Simply click it and save to your computer.

You must complete the checkout process, or you will not be notified when Addenda are issued.

Sealed bids will be received not later than 1:00 PM local time on Tuesday, September 23, 2025, and time stamped by the receptionist at 1st floor, Davis Center, 1250 W. Broadway Ave., Minneapolis, MN 55411, at the North security desk until **1:00 PM, local time on Tuesday, September 23, 2025**, at which time they will be publicly opened and read aloud in Conference Room N1-052. All bids received after that date and time will not be considered. The vendor assumes the risk of any delay in the receipt or handling of mail or other delivery by employees of the district. The vendor assumes all responsibility for having their bid at the Davis Center no later than the date and time specified above. Envelope must bear the name of the firm submitting the bid, the Official Publication Number, and the Official Publication Title.

Special School District No. 1 reserves the right to award this bid in part or in whole to a single supplier or to reject any or all bids if it is in the best interest of the School District to do so. Bids must be typewritten or handwritten and include handwritten signature in ink.

For more information, please contact MPS Procurement Department at rfx@mpls.k12.mn.us or 612-668-0465.
Special School District No. 1 is an Equal Opportunity School District.

DOCUMENT 00 21 13

INSTRUCTIONS TO BIDDERS

Armstrong, Torseth, Skold & Rydeen, Inc. (ATSR)

Architects and Engineers

ARCHITECT: Eric Anderson (763) 525-3270, eanderson@atsr.com

ENGINEER: Blayne Parkos (320) 761-3351, bparkos@atsr.com

8501 Golden Valley Road, Suite 300

Minneapolis, MN 55427-4414

Telephone Number: 763-545-3731

Fax Number: 763-525-3289

MPS Project Manager:

Jeff Helstrom 612-207-7859

Jeffrey.helstrom@mpls.k12.mn.us

To be considered, Bids shall be prepared in accordance with these Instructions to Bidders.

1.01 SUMMARY OF BIDDING

- A. **Base Bid:** A single lump sum Base Bid will be received for the total Scope of the Work for the Project. Include FOB shipping to point in costs of the base bid with delivery to project site.
- B. **Alternate Bids:** Prime Bidders are requested to submit a Bid for each Alternate Bid described in Section 01 23 00 of the Specifications and noted on the Bid Form, if any.
- C. **Break-Out Costs:** Awarded Contractor is required to submit an itemized list of break-out costs to be used by Owner for budgetary and funding purposes, break-Out costs to be provided in the Bid Form. Break out costs do not need to total the Base Bid, but provide a cost break out of the major components.

1.02 DEFINITIONS

- A. **Architect/Engineer:** The words "Architect" and "Engineer" are to be considered interchangeable throughout the Contract Documents and shall mean Armstrong, Torseth, Skold & Rydeen, Inc. (ATSR) and their consultants.
- B. **Bidding Documents:** Documents include the following:
 - 1. Bidding Requirements:
 - a. Advertisement For Bids Invitation to Bid
 - b. Instructions to Bidders
 - c. Information Available to Bidders:
 - 1. Equipment Quantities and Descriptions.
 - 2. Expected Submittals
 - d. Bid Form
 - 2. Addenda Issued During Bid Phase
 - 3. Specifications
- C. **Base Bid:** Amount stated on the Bid Form as the sum for which a Prime Bidder offers to perform the work described in the Bidding Documents, exclusive of adjustments for Alternate Bids.
- D. **Alternate Bid:** Amount stated on the Bid Form as the sum for which a Prime Bidder offers to perform a defined change in the Work that is described in the Bidding Documents which adds to or deducts from the Base Bid amount if the Alternate is accepted by the Owner.
- E. **Prime Bidder:** Person or entity who submits a Bid to the Owner and agrees to enter into a Contract with the Owner if the Bid is accepted by the Owner.

DOCUMENT 00 21 13

1.03 PROCUREMENT OF BIDDING DOCUMENTS

1. Procurement of Documents is as follows: You may view and order documents for this project by going online to Quest CDN Website: Electronic downloads are available by visiting www.QuestCDN.com. The cost for downloading a set of Contract Documents is \$22. Please contact QuestCDN.com at 952-233-1632 or info@Questcdn.com for assistance in free membership registration, download and working with this digital project information. In the left column under "Plan rooms", select "Order from Plan Well". When the next page opens, skip the username section and in the left column under "Public Plan room", select "Go". Once in the plan room, you may find the project and click on the project number link to the left. Once in the project, select "Download Complete Set", then "Instant Download". After Registration, select "Download Now". You will be provided with a link to the files. Simply click it and save to your computer.
2. **You must complete the checkout process, or you will not be notified when Addenda are issued.**
 - A. **Procurement of Addenda:**
 1. Copies of Addenda will be issued to Quest CDN. Any addenda will be posted no later than 72 hours prior to bid.

1.04 INTERPRETATIONS OR CORRECTION OF BIDDING DOCUMENTS DURING BIDDING PERIOD

- A. **Questions:** Submit questions concerning Bidding Documents and Project site existing conditions to Architect. Contact ATSR (Eric Anderson or Blayne Parkos)
- B. **Interpretations and Correction of Bidding Documents:** Replies to questions and correction of Bidding Documents will be issued in Addenda, which will become part of the Contract Documents.
- C. **Oral Clarification:** Architect and Owner will not be responsible for oral clarifications.
- D. **Bidding With Uncertainty:** Do not submit a Bid in uncertainty.

1.05 SUBSTITUTION OF PRODUCTS

- A. **General Requirements:**
 1. To obtain approval for use of products not specified, Bidders or product manufacturers shall submit written requests for substitution to Architect/Engineer not less than (5) days before bid date.
 2. Requests for substitution received after specified time will not be reviewed.
 3. Requests for substitution shall clearly describe the product for which approval is being requested and shall include data necessary to demonstrate acceptability of the product.
 4. If product is approved for substitution, Architect/Engineer will list the item as an approved substitute product in an Addendum.
- B. **Request Submittal Procedure:**
 1. Submit a request for product substitution using a separate Substitution Request Form for each proposed product.
 - a. Requests shall be submitted using "CSI Form 1.5C". For reference purposes, a copy of this Form is attached as an appendix.
 2. Requests for product substitution shall include Project name and location; Specification Section title, number, and specified product which substitution request is for; name, brand, catalog number, and manufacturer of proposed substitute product; and complete specifications, descriptive literature, and/or samples which are necessary to demonstrate superiority or equality of proposed product to product specified.
 3. If required information is not submitted, requested for substitution will not be reviewed.

DOCUMENT 00 21 13

- C. **Reply Requested:** If a written reply to results of a product substitution evaluation is desired by submitter, submit substitution request in duplicate and submit a self-addressed, stamped envelope.
- D. **Costs Resulting From Use of Approved Substitute Products:** Requests for product substitution shall inform Architect/Engineer of deviations from products specified. Include in submittal bid(s), costs which will result due to use of an approved substitute product.

1.06 BASIS OF BIDS

- A. **General Requirements:** Provide the following cost amounts on the Bid Form:
 - 1. Base Bid: Lump sum amount.

1.07 PREPARATION OF BIDS

- A. **Bid Form Format:** Submit Bids on Bidders' letterhead, in exact form and wording as copy of Bid Form included in this Project Manual.

1.08 SUBMISSION OF BIDS

- A. Sealed bids will be received not later than 1:00 PM local time on Tuesday, September 23, 2025, and time stamped by the receptionist at 1st floor, Davis Center, 1250 W. Broadway Ave., Minneapolis, MN 55411, at the North security desk until 1:00 PM, local time on Tuesday, September 23, 2025, at which time they will be publicly opened and read aloud in Conference Room N1-052. All bids received after that date and time will not be considered. The vendor assumes the risk of any delay in the receipt or handling of mail or other delivery by employees of the district. The vendor assumes all responsibility for having their bid at the Davis Center no later than the date and time specified above. Envelope must bear the name of the firm submitting the bid, the Official Publication Number, and the Official Publication Title.

1.09 OWNER'S RIGHTS

- A. **Disqualification of Bidders:** Owner reserves the right to disqualify a Bidder, before or after Bid opening, upon receiving evidence of collusion with intent to defraud or of other illegal practices by Bidder.
- B. **Rejection or Acceptance of Bids:** Owner reserves the right to reject a Bid which is in any way incomplete or irregular, the right to waive informalities or irregularities in a Bid received, and the right to accept a Bid which in the Owner's judgement is in the Owner's best interest.

1.10 MODIFICATION AND WITHDRAWAL OF BIDS

- A. **Modification of Bid:** Bids may not be modified after being submitted.
- B. **Withdrawal of Bid:** Submitted Bids may be withdrawn at any time before start of bid opening, but withdrawn Bids may not be resubmitted. Opened Bids may not be withdrawn for 30 60 days from date of bid opening.

1.11 OPENING OF BIDS

- A. **Procedures:** Bids will be opened as specified in Call For Bids.

1.12 AWARD OF CONTRACT

- A. **Basis of Award of Contract:** Owner will consider award of the Contract on the basis of the low Bid after considerations of the Base Bid amounts submitted, and acceptance or rejection of Alternate Bid amounts, submitted by Bidders.
 - 1. Owner reserves the right to accept or reject any and all Alternate Bids received and to do so in any order.

DOCUMENT 00 21 13

END OF DOCUMENT

OP 26-2602

Southwest High School: Pump House Scope Statement:

The Chilled Water Pump House is to service the building side chilled water distribution to the School, providing for 3 pumps, electrical panel, side stream filtration, air separator, expansion tank, valves and accessories as well as a heating source for the building, and insulated shell and proper support for all equipment that is compliant with MN HVAC codes, MN Energy code and Minneapolis Public Schools Specifications. All needed information for the system is included in the attachments, from pump selections, Valves, Air Control Filters, Heater, etc. and including the MPS specification sections that include the MPS requirements for those pieces.

See attached:

1. Pump House Bid Information

2. Supporting MPS Specifications for Pump House:

1. 23 00 00 – HEATING, VENTILATING, AND AIR-CONDITIONING
2. 23 01 00 – OPERATION AND MAINTENANCE OF HVAC SYSTEMS
3. 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
4. 23 05 19 – METERS AND GAUGES FOR HVAC PIPING
5. 23 05 23 – GENERAL-DUTY VALVES FOR HVAC PIPING
6. 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
7. 23 05 30 – HYDRONIC SYSTEM SPECIALTIES
8. 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
9. 23 05 55 – PENETRATION SEALANTS FOR HVAC SYSTEMS
10. 23 07 00 – HVAC INSULATION
11. 23 09 33 – VARIABLE FREQUENCY DRIVES
12. 23 21 23 – HYDRONIC PUMPS

3. Expected Submittals to Support MPS Specifications above for the Pump House:

1. Air Control Submittal
2. Check Valves Submittal
3. Chilled Water Pumps Submittal
4. Inertia Bases Submittal
5. Pump Accessories Submittal
6. Pump Flexible Connectors Submittal
7. Pump Flow Measuring Valve Submittal
8. Pump House Submittal

9. Pump Isolation Valve Submittal

10. Pump Side Stream Filter Submittal

11. Space Heater Submittal

MPS – SWHS Pump House Pre-Purchase Equipment Descriptions

01 PUMP HOUSE

- 1 Packaged Pumping Enclosure by ProPak Solutions, including the following: -
 (3) e1510 end-suction pumps with 6" drops to each pump including suction diffusers, isolation valves, flexible connectors, venturi flow meter, and check valves. Each pump includes wall-mount ABB ACH580 VFD's with integral disconnect wired to the motor. Pumps will be installed on vibration inertia base which will be filled with non-shrink grout and blocked for shipping. Removal of blocks and setting of springs at final level is by installer. - 8" piping headers including vertical offsets for connection points as shown on the detail. - Air management system including air separator and expansion tank. Includes makeup water piping including 3-valve bypass and pressure reducing valve. - Side-stream filter and associated piping and isolation valves. - All piping 2-1/2" and larger to be sch 40 black steel pipe with weld fittings and 150# flanges. Piping 2" and smaller to be Type L copper pipe and fittings. All piping to be insulated with fiberglass insulation with PVC fittings. Tanks shall be insulated. - All piping will be supported using spring isolators. - Pumps shall have pressure gauges piped to a shared Trumpet Valve. Appropriate temperature gauges to be provided. Piping must be designed with appropriate air purges and drains. Above components piped and mounted within a mechanical enclosure consisting of a structural steel base, tube steel frame, and 3" insulated panels. Enclosure will include lifting lugs with an approximate dimension of 18' x 12' x 10'. Enclosure shall include (1) double door, (1) electric heater, (1) exhaust fan, and (2) louvers. - Enclosure will be installed by others on spring-isolated roof rails. Roof rails provided/installed by others. - Single-point electrical connection, 460/3/60, includes power distribution to each pump and transformer for lights, fan, unit heater, and convenience receptacles. Power wiring to each component will be factory-completed. - Does not include any controls. Installer will be responsible for installing communication wiring to each VFD, and any control sensors within the piping. Complete Revit files to be provided to engineer and owner. **Fabrication of enclosure and all hydronic components must be completed by Union Labor Shop.** Exclusions: - Installation or supervision - Control devices or wiring

- 1 Tag:
 FREIGHT Wt: 0 lbs ea.
 Tag: Freight

02 AIR CONTROL

- 1 B&G RL-8F TANGENTIAL AIR SEPARATOR LESS STRAINER; 125# WP; 8" FLG;
1900 GPM MAX Wt: 400 lbs ea.
Tag: AS-1
- 1 B&G #107A AIR VALVE 3/4" NPTF Wt: 10 lbs ea.
Tag: AS-1 accy
- 1 B&G B-600 ASME BLADDER TANK; 158GAL; 125# WP; 30" DIA X 65"OAL; 2"
NPTF Wt: 360 lbs ea.
Tag: ET-1
- 1 B&G #97 AIR VENT Wt: 2 lbs ea.
Tag: ET-1 accy

03 CHILLED WATER PUMPS

- 3 B&G Base Mounted Pump Series e-1510, Model e-1510, 4 GC, SS, 40 HP, 1800
RPM, 324T Frame, with 12.375" Impeller, STD-
Buna/Carbon/Ceramic/SS/Bronze Seal, , BG Choice, ODP, NEMA Premium
w/Shaft Grounding Rings, Inverter Duty, 230/460/3/60 Motor, 515 gpm, 140 ft
Wt: 1,084 lbs ea.

Tag: CWP-4,5,6

04 PUMP ACCESSORIES

- 3 B&G GF-3 SUCTION DIFFUSER PLUS, 6" FLG X 5" FLG Wt: 105 lbs ea.
Tag: CWP-4,5,6 accy1
- 3 4 PORT CONNECTORS FOR TV-4 TRUMPET VALVE (8 CONNECTORS) Wt: 1 lbs
ea.
Tag: CWP-4,5,6 accy2

05 INERTIA BASES

- 3 VibroAcoustics Concrete Inertia Bases: 8"CIB72"X24" c/w(4)FS-SA, (2) FS-SA-
700 and (2) FS-SA-800 Isolators. Wt: 201 lbs ea.
Tag:
- 3 VibroAcoustics Concrete Inertia Bases: 8"CIB72"X24" c/w(4)FS-SA, (2) FS-SA-
700 and (2) FS-SA-800 Isolators. Wt: 201 lbs ea.
Tag:

06 FLEXIBLE CONNECTORS

- 3 MODEL VFR0406 4" x 6" INCREASING FLEXIBLE CONNECTOR. 150# FLAT FACE FLANGED CONCENTRIC INCREASER X 150# FLAT FACE FLANGE S/S HOSE & BRAID, CARBON STEEL FITTINGS, STAINLESS STEEL VANE 16.25" OAL Wt: 35 lbs ea.
Tag: CWP-4,5,6 DISCHARGE
- 3 METRAFLEX MMCC 6" DIA X 11" OAL STAINLESS FLEX CONNECTOR FLG/FLG Wt: 28 lbs ea.
Tag: CWP-4,5,6 SUCTION

07 FLOW MEASURING VALVE

- 3 HCI MS Metering Station Fixed Orifice, 6" Flanged Connections, Class 150, MS-JFF-H. 15.0" OAL Wt: 59 lbs ea.
Tag:

08 CHECK VALVES

- 3 METRAFLEX 6" VFD CHECK VALVE 125# GLOBE STYLE SILENT CHECK VALVE W/ SS TRIM. P/N CVOSSVFD906 Wt: 81 lbs ea.
Tag: CWP-4,5,6

09 PUMP ISOLATION VALVES

- 6 METRAFLEX 6" BUTTERFLY VALVES DESIGN CONDITIONS – 200 PSI, EPDM SEAT - 40°F TO 250°F, DINC DISC LUG STYLE Wt: 28 lbs ea.
Tag: P-1,2,3 SUCTION AND DISCHARGE

10 SIDE STREAM FILTER

- 1 Quantrol QFP4X2-304, Multi-Round Housing, 60 GPM, 4 Cartridges. - In/Out Size: 2" MNPT, Max Pressure: 150 psi, Max GPM (Pleated cartridge): 60 GPM, Cartridges: (4) 20" length, Style of Cartridge: DOE, 222/Flat or 222/Fin Wt: 30 lbs ea.
Tag:

11 SPACE HEATER

- 1 STIEBEL ELTRON CNS Plus Wall Mounted Convection Heater. Model CNS 150-1 Plus. 120V/1ph, 12.5 AMP Power (15AMP Breaker Min) 1500Watt, 5118btuh. P/N 201996 Wt: 1 lbs ea.
Tag:

12 VARIABLE FREQUENCY DRIVES

- 3 ABB #ACH580-PDR-052A-4+J429; 40 HP/460V/52A; VFD/Disc/VFD fuses/UL-1/5% DC reactor/Bluetooth. VFD must have 5% DC Reactor. Wt: 70 lbs ea.
Tag: CWP-4,5,6

13 STARTUP

- 1 VFD'S: One trip onsite certified startup assistance, 2 year parts and labor warranty. Installer and end user maintenance technician to be present at time of startup for training and to assist. We request a 2 week notice to schedule startup for M-F 8am-5pm. Pumps: One trip for onsite certified startup. Installer and end user maintenance technician to be present at time of startup for training. We request a two week notice to schedule Monday - Friday 8:00 - 5:00. Wt: lbs ea.
Tag:

Supporting MPS Specifications for Pump

House:

1. 23 00 00 – HEATING, VENTILATING, AND AIR-CONDITIONING
2. 23 01 00 – OPERATION AND MAINTENANCE OF HVAC SYSTEMS
3. 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
4. 23 05 19 – METERS AND GAUGES FOR HVAC PIPING
5. 23 05 23 – GENERAL-DUTY VALVES FOR HVAC PIPING
6. 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
7. 23 05 30 – HYDRONIC SYSTEM SPECIALTIES
8. 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
9. 23 05 55 – PENETRATION SEALANTS FOR HVAC SYSTEMS
10. 23 07 00 – HVAC INSULATION
11. 23 09 33 – VARIABLE FREQUENCY DRIVES
12. 23 21 23 – HYDRONIC PUMPS

SECTION 230000
HEATING, VENTILATING, AND AIR-CONDITIONING

PART 1 - GENERAL

1.01 CONDITIONS

- A. General:
1. Each Contractor involved in the mechanical work of any Section of Division 23 for this Project shall be governed by this Section 23 00 00, Heating, Ventilating, and Air-Conditioning (HVAC) - General Requirements, in its entirety.
 2. General Conditions, Supplementary General Conditions, and Division 1 General Requirements apply to Division 23.
 3. Design and installation of mechanical equipment shall at a minimum provide service access in accordance with Minnesota mechanical code requirements. Roof mounted HVAC equipment shall comply with Chapter 3 line 306.5.
 4. For natural gas connected equipment, refer to Specification Section 22 63 00 Gas Systems for requirements.

1.02 SUMMARY OF WORK

- A. Section Includes:
1. The work to be accomplished under this Specification and the accompanying Drawings includes furnishing all labor, materials, equipment, and services necessary for the proper completion of all mechanical work.
 2. The omission of express reference to any parts or services necessary for, or reasonably incidental to, a complete installation shall not be construed as releasing the Contractor from furnishing such parts or services.
 3. In general, the work consists of:
 - a. Chilled water system
 - b. Ventilation/Exhaust Systems
 - c. Miscellaneous Mechanical Work
 - d. Commissioning of Specified Systems
 - e. Building Control Systems
 4. Job Progress: Contractor shall provide sufficient workers and materials to keep pace with the construction schedule. Contractor shall place orders for equipment such that job progress is not slowed due to late delivery and shall confirm delivery dates with suppliers.
 5. Coordination: Contractor shall coordinate trades to install systems in the space provided within the structure. Where required, Contractor shall remove and reinstall existing work to allow for a congruous installation. Install systems and materials for ease of maintenance. Equipment arrangements shall provide at least the minimum clearances as recommended by equipment manufacturer to facilitate proper maintenance and servicing of system. Care should be taken upon installation of new equipment to not render existing equipment inaccessible for maintenance and repair.
 - a. Deviations in minimum clearance requirements shall be permitted only upon prior written authorization from Architect/Engineer and Owner.
 - b. Testing and balancing shall be scheduled after Mechanical Contractor has given written documentation to Test and Balance Contractor that systems are fully operational and building controls and graphics are complete. Mechanical Contractor shall send a copy of documentation to Engineer.

- c. Commissioning shall be scheduled after Mechanical Contractor has given written documentation to Commissioning Authority that systems are fully operational and building controls and graphics are complete. Mechanical Contractor shall send a copy of documentation to Engineer.
 - 1) Punch lists generated by Commissioning Authority will not be inspected by Commissioning Authority for completion until Commissioning Authority has received written documentation indicating that all punch list items have been completed. Closeout and final payments will not be authorized until all punch list items, generated by Commissioning Authority and Engineer, have been completed to Engineer's satisfaction.

1.03 SITE INSPECTION

- A. General Requirements:
 - 1. Before submitting a proposal for work outlined in this Specification and accompanying Drawings, Bidders shall examine the site and check as to the means of making connections to services and shall become familiar with all existing conditions and limitations. No extras will be allowed because of Contractor's misunderstanding as to amount of work involved or lack of knowledge of any site conditions that may affect the work. Any apparent variance of the Plans or Specifications from the existing conditions at the site shall be called to the Engineer's attention during the Bid period so clarification can be made by Addenda.
 - 2. The existence of any wires, conduits, pipes, ducts, or other facilities are shown in a general way only. It shall be the Contractor's responsibility to visit the site and make exact determination of the existence of any such facilities prior to the submission of Bid. It is understood that the Contractor will be responsible for making the exact determination of the location and condition of such facilities.

1.04 FEES, PERMITS, AND INSPECTIONS

- A. General Requirements: All required fees, permits, and inspections shall be obtained and/or arranged for by the Contractor under the section of the Specifications for which they are required.
- B. Regular Inspections: Regular inspections shall be arranged by the Contractor as required by any and all regulations. All charges for inspections by regulating agencies of installations or review of Plans and Specifications shall be paid by the Contractor.
- C. Certificate of Final Inspection: Under each applicable section of the Specifications, the Contractor shall, upon completion of the work under that section, furnish a Certificate of Final Inspection to the Engineer from the inspection department having jurisdiction.

1.05 CODES AND STANDARDS

- A. General Requirements: All materials and workmanship shall comply with all applicable codes, specifications, ordinances, laws, regulations, industry standards, and utility company regulations.
- B. Variations: In case of difference between building codes, specifications, state laws, local ordinances, industry standards, and utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, and utility company regulations, the Contractor shall bear all costs arising in correcting the deficiencies.
- D. Energy Code Compliance: All projects shall select an energy code compliance path as described in the Scope and Application sections of the Minnesota Energy Code (most current edition). All design and construction disciplines must follow the same compliance path. The Minnesota Energy Code compliance path must be specified in the Construction Documents.

1.06 DRAWINGS USE AND INTERPRETATION

A. General Requirements:

1. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment, unless indicated otherwise by dimensions or Detail Drawings. For exact locations of building elements, refer to dimensioned Architectural/Structural Drawings; however, field measurements take precedence over Dimensioned Drawings. The installation of all systems and equipment is subject to clarification as indicated in Division 1 - General Requirements.
2. Piping and Ductwork Plans are intended to show size, capacity, approximate location, direction, and general relationship of one work phase to another, but not the exact detail or arrangement.
 - a. Generally, layout pipelines requiring drainage first, followed by large pipe mains, ductwork and electrical conduit. Follow this procedure for an orderly installation but not to establish precedence of one trade over another.
3. Equipment outlines shown on Detail Drawings or dimensions indicated anywhere on the Drawings are limiting dimensions. Equipment exceeding approximate dimensions indicated by equipment outlines on Detail Drawings and any equipment or arrangements that reduce indicated clearances or exceed specific equipment dimensions may not be used.
4. The Contractor, before roughing in any facilities or installing any equipment, shall consult all Drawings (including General, Landscape, Structural, Mechanical, Electrical, Kitchen or Laboratory Layout) and shall be informed of materials, finishes, locations of ceilings, structural members, pipes, ducts, recessed lighting fixtures, conduits, and other components which may affect the installation. The Contractor, in installing equipment, shall leave adequate room for the installation of equipment by other Contractors where space is limited. Consideration has been given to such conditions of limited space in the preparation of the Drawings and the locations and dimensions of equipment have been selected accordingly. The Contractor shall be cautioned that in certain instances, space may be limited to the extent that there may be only one arrangement of equipment or facilities that will allow installation of same.
5. Discrepancies discovered before or after work has started, shall be brought to the Engineer's attention immediately and the Engineer reserves the right to require minor changes in the work of any Contractor to eliminate such discrepancies with no change in Contract Sum.
 - a. The Plans and Specifications are complementary and what is called for in either one shall be as binding as if called for in both.
 - b. Where a disagreement exists between the Plans and Specifications, the item or arrangement of better quality, greater quantity, or higher cost, shall be included in the Bid.
6. Definitions
 - a. Provide: Under this Contract, Contractor shall furnish and install item or items specified. Contractor shall perform all labor and furnish all materials and equipment necessary to that specified item or system will be complete and operational in every respect.
 - b. Furnish: Under this Contract, Contractor shall deliver to the site item(s) specified, as well as additional specialized materials and/or accessories necessary for the use and operation of item or items specified.
 - c. Install: Under this Contract, Contractor shall set in position, connect (including sub-assemblies furnished), and adjust for use. Contractor shall furnish miscellaneous specialty items such as hangers, valves, unions, piping, sheet metal, etc., as obviously necessary for a complete and operating installation.

1.07 SYMBOLS AND ABBREVIATIONS

- A. General Requirements: Refer to symbols and abbreviations on Drawings. Other symbols are in common usage, but if uncertainty exists regarding any plan symbols or abbreviations, it shall be brought to the Engineer's attention for clarification by Addenda.
 - 1. Where the phrase "Provide" occurs, "provide" shall be construed to mean the same as "furnish and install".

1.08 CUTTING AND PATCHING

- A. General Requirements: Each trade shall perform all cutting and patching necessary in order to perform the work unless such work has been delegated to the General Contractor. However, special permission shall be obtained from the Engineer before cutting structural members or finished material. All patching shall be performed in such manner as to leave no visible trace and to return the part affected to the condition of undisturbed work. Patching work shall be performed by persons experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted. Pipe penetration through new or existing floors and walls, regardless of type of construction, should be done by rotary drill, wet or dry method. Use of hand, electric, or pneumatic impact tool is not acceptable. Contractor to contain water and dust to avoid damage to adjacent finishes, furniture and equipment.
 - 1. This Contractor is responsible for patching all holes and openings left in existing floors, walls, ceilings, and roofs where mechanical equipment, such as pipe, ductwork, and other components, have been removed unless noted otherwise on Drawings. Patching shall be performed by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
- B. Exterior: Pavements, sidewalks, roads, and curbs shall be cut, patched, repaired, and replaced as required to permit the installation of the work of each trade. Such cutting, patching, repairing, and replacing shall be the responsibility of, and paid for by, the trade requiring the work.
- C. Costs: Each trade shall bear the expense of all cutting, patching, repairing, or replacing of the work of other trades required due to that trade's fault, error, or tardiness, or because of any damage done by that trade.
- D. Prior to any floor cutting, scan the area where the cutting will occur to coordinate with any items buried in the concrete floor or within the saw cutting diameter.

1.09 HOLES THROUGH MASONRY AND CONCRETE

- A. General Requirements: Each trade shall provide all holes and openings required for that trade's work unless such holes and openings are shown to be provided on the Architectural or Structural Drawings. Pay particular attention to openings required in pre-cast, pre-stressed, or post-tensioned slabs. Each trade shall be responsible for locating chases and openings required for work in the General Construction of the building.
 - 1. Holes made in the field shall be core drilled large enough to allow all pipe insulation to continue uninterrupted. Holes in floors or exterior walls above grade shall include a steel pipe sleeve, schedule 40 or better, grouted watertight.
 - a. The above method shall be employed whenever holes are made on-site, including holes required by change orders or because of omissions made inadvertently by the trade.

2. Pipe openings in exterior walls below grade between earth areas and interior spaces shall include a steel pipe sleeve and a mechanical seal.
 - a. At locations where piping penetrates the foundation wall, a mechanical pipe to wall penetration seal shall be provided. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between pipe and wall opening. The seal shall be constructed so as to provide electrical isolation between the pipe and wall.
3. Each trade shall be responsible for providing and disposing of water used in the core drilling operation. Such work shall be scheduled and other trades coordinated so that damage will not result from the use of water.
4. Each trade shall be responsible for grouting air-tight any openings adjacent to the trade's work to seal against the passage of air, smoke vapors or sound as indicated in Section 23 05 55.

1.10 SLEEVES

- A. General Requirements: Install pipe sleeves, schedule 40 or better, at any masonry type partitions and exterior wall penetrations, both above and below grade. Sleeves through walls to be no longer than thickness of the wall. Floor sleeves to extend a minimum of 3/4 inch above finish floor in general areas. No less than 4 inches above floor in Mechanical Equipment/Boiler Rooms. Install sheet metal sleeves at stud type interior partitions and ceilings other than suspended. Install steel pipe sleeves at any masonry type partition and exterior wall penetrations, both above and below grade. Cast iron pipe sleeves are not acceptable.
 1. Refer to Section 23 05 55, Penetration Sealants for HVAC Systems.
- B. Kitchen Walls: Piping through walls shall be caulked between sleeves and piping to make it water-proof. Plastic sleeves shall not be used.

1.11 PAINTING

- A. General Requirements:
 1. Refer to appropriate section of Division 23 for painting requirements.
 2. Refer to the General Construction Specifications for painting and report any discrepancies to Architect/Engineer for clarification by Addenda.
- B. Pre-Painted Equipment: Pre-painted equipment delivered to the job-site prime-painted or finish-painted shall be touched up as necessary or as directed. When available, spray cans of the paint shall be obtained from equipment manufacturer.
- C. Mechanical Systems Painting in Unfinished Rooms (Mechanical Rooms, Boilers Rooms, Chiller Rooms, and Other Equipment Rooms): Exposed supporting iron and steel work, bare pipe, fittings, hangers, and supports shall be wire brushed, washed with mineral spirits to remove dirt and grease, and painted with (1) coat of metal primer followed by (2) finish coats of battleship gray paint.

1.12 CONTINUITY OF SERVICES

- A. General Requirements: The building will be in use during these operations, and each trade shall schedule their work and carry it out in such a manner as to least inconvenience the occupants due to interruption of mechanical services. Interruptions shall be confined to the smallest area possible at any one time and all interruptions shall be approved by Owner. Temporary connections shall be made if required to provide continuity of service.
 1. After service has been restored following an interruption, each trade shall inspect all areas affected by the interruptions and be responsible for returning all services to the same operating condition which existed prior to the interruption.

2. Where relocations of existing equipment, and piping systems and materials is necessary in areas providing uninterruptible services, schedule the work for minimal down time during a slack period, if possible. Assign an adequate crew to accomplish the job in least possible time. Prefabricate and install interconnecting portions of these systems prior to shut-down for final connections.
 - a. Locate existing piping and make connection where required or where shown on the Drawings. Do not cut into existing services without verifying with Owner that the pipe involved is the desired service.
 - b. Maintain all existing services and equipment unless otherwise shown on Drawings.
 - c. Perform work that interrupts any service (this includes cutting into existing lines for new connections) at times (usually night) to cause the least interference to the normal operation of the building. Anticipate scheduling work at periods which will result in additional construction cost, such as nights and weekends, and include cost in the proposal.
 - d. Inform the building engineering staff in advance of any shut-off that will occur and give an estimate of duration. Only after the engineering staff is fully informed and has agreed to the schedule of shut-offs, can the work then proceed accordingly.
- B. Connections: Contractor shall field verify and inspect existing buildings for connections to existing systems, equipment, and materials designated, on Drawings or in Specifications, to be used.
 1. Existing piping and ductwork that is disconnected and abandoned shall be removed. All capping of piping and duct shall be done at the main.
 2. Requests for additional compensation will not be considered when such occurrence is the result of existing conditions.
- C. Verification of Conditions:
 1. On-Site Review: Contractor shall visit site to become thoroughly acquainted with existing conditions of site and services.
 2. Existing Active Services: When encountered in Work, Contractor shall protect, brace or support pneumatic tubing, existing active ductwork, or other services, where required, for proper execution of Work.
 - a. If existing active services not indicated on Drawings are encountered, Contractor shall relocate and brace these services at no additional cost to Owner.
 3. Inactive Services: If encountered in Work, Contractor, as appropriate, shall cap or plug inactive pipes, ducts, and temperature control wiring at no additional cost to Owner.
 4. Responsibility: Liability for repairs or replacement of damaged or defective materials, including, but not limited to, property damage resulting from negligence or other causes, shall be the Contractor's sole responsibility until work has been accepted by Architect/ Engineer and Owner.
- D. If project entails multiple summer construction, Contractor shall not install the glycol solution in the heating or cooling system until all revisions are finished. During the interim, Contractor shall drain the chilled water system in its entirety, including cooling coils, when chilled water system is placed off-line for the season.

1.13 USE OF FACILITY

- A. General Requirements: The normal use of the facility shall not be disturbed, except within the immediate construction area. All walks, driveways, and entrances shall be kept clear and free of all Contractor's equipment, material, and debris at all times.

1.14 PREFABRICATION

- A. General Requirements: If a Contractor elects to prefabricate piping and ductwork, Contractor is still obligated to abide by all requirements for cooperation with other trades. Contractor shall not assume that materials will be installed first and other trades must follow.

1. If changes are made by the Architect/Engineer reasonably in advance of anticipated installation, the Owner shall not be penalized with added cost because materials were prefabricated in advance.

1.15 CLEAN-UP

- A. General Requirements: Each trade shall periodically clear away all debris, surplus materials, and other rubbish resulting from the trade's work or operations, leaving the job and the equipment furnished under any or all contracts in a clean condition.
 1. Remove from the building and site, scrap material, temporary building, packaging material, miscellaneous debris, and dirt on a regular schedule, or as required, and in accordance with Architect/Engineer's direction, to maintain building in a reasonably clean, workable condition during construction.
 - a. Cutting oil and steel shavings shall be caught in a suitable container to ensure final finish material in building will not be marred or damaged.
 - b. Upon completion of work and before final inspection, Contractor shall remove plaster, paint, rust, stickers, and shipping tags from installed equipment.
 - c. Clean foreign matter from installed equipment and remove dirt and debris, in connection with work, from building.
 - d. Chases and shafts shall be clean of debris and accessible.

1.16 TESTS

- A. General Requirements: Each trade shall test the equipment provided and/or installed under this Specification and shall demonstrate its proper operation to the Owner's operating engineer and trade shops.
 1. No equipment shall be tested or operated for any purpose until it has been fully prepared, lubricated, and properly connected and made ready for normal operation. Any damage to equipment occasioned by improper or ill-timed operation or testing shall be made good at the Contractor's own expense, before final inspection and acceptance.
 2. Refer to section on Testing, Adjusting, and Balancing.
- B. Heating System:
 1. System Guarantee: Contractor shall guarantee that the installation shall operate with complete noiseless circulation of heating media through piping system, radiation, and equipment.
 2. Defects: Contractor shall be responsible for defects which develop in the systems caused by faulty workmanship, material or equipment and shall replace any such faulty workmanship, material or equipment during a period of one year from date of final acceptance. Acceptance of the work shall not waive the guarantee.
 3. Tests: In the presence of the Architect/Engineer, or a duly authorized representative, the heating system shall be tested at 1 1/2 times the Normal Operating Pressure, but not less than 100 psi hydrostatic pressure, and proved drip-tight for a period of not less than (4) hours. Tests shall be complete before piping is connected to equipment or covered.
 - a. Apply tests to all piping and equipment, which are a part of these systems, including tanks, pumps, and valves, except for those items that could be damaged because of excessive pressures.
- C. Cooling System:
 1. System Guarantee: Contractor shall guarantee that the installation shall operate with complete noiseless circulation of cooling media through piping system and equipment.
 2. Defects: Contractor shall be responsible for defects which develop in the systems caused by faulty workmanship, material or equipment and shall replace any such faulty workmanship, material or equipment during a period of one year from date of final acceptance. Acceptance of the work shall not waive the guarantee.
 3. Tests: In the presence of the Architect/Engineer, or a duly authorized representative, the cooling system shall be tested at 1 1/2 times the Normal Operating Pressure, but not less

than 100 psi hydrostatic pressure, and proved drip-tight for a period of not less than (4) hours. Tests shall be complete before piping is connected to equipment or covered.

- a. Apply tests to all piping and equipment, which are a part of these systems, including tanks, pumps, and valves, except for those items that could be damaged because of excessive pressures.

D. Ventilation System:

1. Contractor shall guarantee complete uniform circulation of air through ventilated spaces without objectionable noise. Contractor shall assume responsibility for and replace any faulty workmanship, material or equipment during a period of one year from date of final acceptance.

E. Temperature Control System:

1. Contractor shall be responsible for defects which develop in any part of the system caused by faulty workmanship, material or equipment and shall replace any such faulty workmanship, material or equipment during a period of one year from date of Substantial Completion.
 - a. Instruments shall be calibrated to sense, activate, and display information specified.
 - b. Acceptance of the work shall not waive this guarantee.

1.17 SUBMITTALS

- A. Substitutions: Written requests for substitutes of material and equipment must be submitted through a bidding contractor and received by the Engineer no later than ten (10) calendar days prior to bid opening. Requests shall be accompanied by detailed information of the proposed material or equipment. Acceptable substitutes will be included in an Addendum to the Contract Documents which will be issued before bids are due. Acceptance of substitutes in no way relieves the Contractor of his responsibility to provide materials and equipment which adhere to the intent of the specifications and drawings, and the minimum quality set forth therein. For additional requirements refer to Division 1.
- B. General Requirements: Refer to Section 01 33 00 for submission requirements.
- C. Operating Characteristics: Submittals shall list actual proposed capacities of equipment submitted. Contractor shall indicate actual operating characteristics of proposed equipment at specified design conditions in the submittal.
- D. Review: Review of Shop Drawings and other submittals will be general in nature and shall not be considered:
 1. As permitting any departure from Contract requirements.
 2. As relieving Contractor of responsibility for errors, including details, quantities, dimensions, and materials.
 3. Contractor is responsible for reviewing all information in Shop Drawings related to the mechanical systems. Information includes, but is not limited to, size, dimensions, electrical power requirements, horsepower, CFM, GPM, BTU, sound, system operating steam and/or gas pressure, pressure drops (water and air), and tonnage.
 4. Contractor shall highlight all differences between that which is being submitted and that which was specified.
- E. Samples: Provide samples of material or equipment proposed to be furnished, if requested. Samples shall become the property of the Architect/Engineer and will be returned only when accompanied by a written request to do so.
- F. Record Drawings: See requirements as indicated in Section 01 77 00.
 1. Record Drawings shall be provided in a hard copy and an electronic copy (PDF format).
- G. Compatibility of Equipment: Contractor shall have full responsibility of component parts of the mechanical system to ensure that new equipment, integrated with existing equipment and systems, will perform and operate in accordance with requirements of the Specifications without excessive or unusual service or maintenance requirements.

1. Should damage be sustained to existing fixtures, materials or equipment to be reused, relocated or to remain, the same shall be replaced with new material or equipment of equal or better quality as the Architect/Engineer directs.

2. It shall be the Contractor's responsibility to determine that changes in physical dimensions, access for maintenance, service line connections, structural supports, and vibration devices for substitute (Owner approved equal) equipment are acceptable in the space provided for equipment and that performance characteristics are at least equal to base specification for equipment utilized from the substitutes (Owner approved equals) listed.
 3. Increased costs to provide additions or revisions required by acceptable manufactures not used as basis of design and substitute (Owner approved equal) manufactures shall be the sole responsibility of this Contractor. Examples of additions or revision shall be as follows, but is not inclusive of all items:
 - a. Electrical Service Connections Revisions
 - b. Additional Equipment
 - c. Wall and Room Layout Revisions
 - d. Structural Support Revisions
 - e. Screen Wall Revisions
 - f. HVAC Connection Revisions
- H. Critical Mechanical Equipment Submittals: The Contractor shall submit the following mechanical equipment Shop Drawings within 15 days of award of Contract.
1. Chillers
 2. Desiccant Dehumidification Units
 3. Energy Recovery Units
 4. Air Handlers
 5. VAV Boxes
 6. HVAC Pumps
 7. Diffusers
 8. Fan Coils
 9. Valve and Damper Schedules with Cut Sheets
 10. Fire Stop
 11. Fire Smoke Dampers
 12. Fire Dampers
 13. Fans
 14. Balance Valves
 15. Duct Assemblies which are exposed to outdoor conditions
 16. Side stream filters
 17. Chemical feeders
 18. Expansion tanks
- I. Submittal Review
1. Engineer/Architect will review each submittal a maximum of two times as part of the project. If submittal is rejected twice, Contractor will be responsible for all costs associated with the Engineer/Architects time and effort spent on reviewing subsequent submittals. Compensation will be in the form of a deduct Change Order. Estimate of the Engineer/Architect's cost will be provided upon Contractors request.

1.18 ENERGY REBATE SCHEME

- A. General Requirements: It is the intention to apply for energy rebates on [motors, chillers, variable speed drives. Mechanical Contractor shall secure on behalf of the Owner the maximum rebate. This shall include all submittals to the power company including substantiation where required and making all necessary arrangements on behalf of the Owner.

1.19 REFERENCES

- A. Air Conditioning and Refrigeration Institute (ARI):
 1. ARI 435-78, Application of Central Station Air Handling Units
- B. American National Standard Institute (ANSI):

1. ANSI B31.1, Pressure Piping - Power Piping
- C. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE)
- D. American Society of Mechanical Engineers (ASME):
 1. Boiler and Pressure Vessel Code: Section IX, Welding and Brazing Qualifications
- E. American Society for Testing and Materials (ASTM):
 1. ASTM R84, Surface Burning Characteristics of Building Materials
- F. Air Moving and Conditioning Association (AMCA):
 1. AMCA 410-72, Recommended Safety Practices for Air Moving Devices
- G. Manufacturer's Standardization Society (MSS of the Valve and Fittings Industry, Inc.):
 1. MSS SP-58-1975, Pipe Hangers and Supports Materials, Design, and Manufacture
 2. MSS SP-69-1976, Pipe Hangers and Supports Selection and Application
- H. National Electrical Manufacturers Association (NEMA)
- I. National Fire Protection Association (NFPA):
 1. NFPA 90A, Air Conditioning and Ventilation Systems
 2. NFPA 101, Life Safety Code
- J. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- K. Steel Tank Institute (STI)
- L. Underwriters' Laboratories (UL)

1.20 DESIGN INTENT

- A. Design Criteria:
 - a. 88 Degrees F DB / 72 Degrees F WB
 - b. -15 Degrees F DB
 - c. 78 Degrees F DB / 50 Percent RH
 - d. 75 Degrees F DB / 50 Percent RH
 - e. 72 Degrees F DB
 - f. 72 Degrees F DB
 - g. 7 AM to 4 PM, Monday through Friday, With Frequently Scheduled After Hours Usage
- B. Mechanical System Overview: A new chilled water plant will service the building for all cooling, removing existing DX cooling units and coils. scope also include replacing various air handlers throughout the building and controls updates.
- C. Mechanical Load Calculations:
 1. Heating and cooling loads shall be calculated as described in Minnesota Energy Code Section C403.1.1 (Or Most Current Edition).
 2. Outside air quantities shall be calculated as described in Minnesota Mechanical Code (Most Current Edition).
 3. Occupancies shall be based on the default occupancies as described in the Minnesota Mechanical Code (Most Current Edition).
- D. Mechanical System Description:
 1. New building will be heated and cooled by indoor air handling units or perimeter radiation.
 2. Cooling (if applicable) source shall be from central air cooled rotary chiller, centrifugals/cooling towers, and screw compressors, or condensing units and rooftop units.
 3. Heating source shall be from (2) hot water boilers or steam or condensing.
 4. Air handling units are designed to supply 55 degrees F air during the cooling months and 60 degrees during the heating months.
 5. VAV boxes with reheat will provide the necessary air quantities with discharge temperature modulated by the reheat coils.

6. Control system shall be direct digital control or in retrofit cases pneumatic. Computer, keyboard, Monitor, and printer are located in the maintenance office and at the District Communications Office (DCC) for controlling and monitoring the system, including alarm reporting. Re-programming of local controllers can be done from the central system located in the DCC.
- E. Description of Systems:
1. Heating System: Existing Boiler Plants
 2. Chilled Water System: New Air Cooled Chiller Plant
 3. Ventilation: Air Handling System will provide required ventilation.
 4. Energy Conservation Systems: Energy recovery within AHUs and ERUs, VFDs, Controls.
 5. Controls and Building Management System: Updated DDC Controls.
 6. Special Systems: Pool Dehumidification System
 7. Balancing: TAB to be completed by CX agent TAB contractor.
- F. Special Construction Procedures:
1. Use of Mechanical Systems During Construction:
 - a. Ventilation systems shall not be used until the building is dust-free.
 - b. Heating systems shall not be used until the building is enclosed.
 - c. All equipment used during construction shall be thoroughly cleaned, filters replaced, and rechecked.
 - d. All warranties shall start after the building has been accepted by the Owner.
- G. Description of Commissioning Process: Refer to commissioning spec.
- H. Operation Considerations:

1.21 QUALITY ASSURANCE

- A. Qualifications: Where equipment is specified by manufacturer, brand name or catalog number, this shall establish the standard of quality and style of the product to be provided under the Contract.
1. Where (2) or more units of the same kind of equipment are required, they shall be products of a single manufacturer. Mixing and matching of various manufacturers like or similar components shall not be permitted.
- B. Material and Workmanship:
1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt, and weather.
 2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturer's recommendations, instructions and current SMACNA standards.
 3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.
 4. Exposed duct system installations shall be protected from dents, scratches, and duct sealant should be applied inside of the duct.
- C. Regulatory Requirements:
1. State Building Code (Most Current Edition)
 2. State Mechanical Code (Most Current Edition)
 3. State Fuel Gas Code (Most Current Edition)
 4. State Energy Code (Most Current Edition)
 5. National Electric Code (Most Current Edition)
 6. Local Codes and Ordinances (Most Current Edition)

1.22 WARRANTY

- A. General Requirements: Equipment furnished under this Contract shall have a 1-year warranty on parts and labor beginning at the date of Substantial Completion, unless a longer period is

specified in the Equipment Specification Section. Or special warranty conditions will existing in specified section of equipment.

1.23 START-UP AND OPERATING REQUIREMENTS

- A. General Requirements: Provide unit start-up by factory trained and authorized personnel for all central HVAC and heating and cooling equipment.
 - 1. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, until building is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

1.24 DEMOLITION DESCRIPTION OF WORK

- A. General Requirements: Demolition work includes all labor, material, equipment, and services necessary and incidental to complete all the demolition and removal of mechanical work as shown on the Drawings or as required.
 - 1. The Drawings do not necessarily indicate all conditions, details, or work required. Mechanical Contractor shall examine the building to determine the actual conditions and extent of the work. Any details not clear to the Contractor shall be referred to the Architect/Engineer for clarification prior to bidding.
 - 2. Mechanical Contractor shall be responsible for demolition and removal of all existing superfluous mechanical systems. No mechanical systems scheduled for demolition may be abandoned in place, but rather shall be removed and disposed off of site, unless specifically noted on the Drawings. Use of Owner's dumpsters for the disposition of any type of construction debris is not allowed.
 - 3. Where removal of existing suspended ceilings to remain is required to be removed to provide access for work to be performed above the ceiling, removal and replacement of the ceiling shall be by construction trade requiring access.
- B. Hazardous Materials: Removal of Existing Building Materials Containing Asbestos and Lead: Refer to Sections 00 31 26.23 Asbestos-Containing Materials and Section 00 31 26.26 Lead-Containing Materials.

PART 2 NOT USED

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Connection to Equipment Specified: Provide material and labor required to connect to the mechanical system of fixtures and equipment having mechanical connections and which are specified in other Sections or Divisions of the Specifications or furnished by Owner.
 - 1. Provide piping supply connections with shut-off valves.
 - 2. Ductwork connections to equipment, diffusers, and appurtenances shall not be made with flexible ductwork unless a flexible connection is indicated.
- B. Floor, Wall, and Ceiling Plates: Where uncovered exposed pipes pass through floors, walls or ceilings in finished rooms and inside casework, fit with approved type chrome plated metal plate.
 - 1. Plastic escutcheon plates shall not be permitted.
- C. Filtration: Provide (3) sets of filters; (1) for during construction, (1) set prior to final balancing, and (1) set delivered boxed to Owner at Substantial Completion.
 - 1. At time of Substantial Completion, and prior to turning equipment over to Owner, Contractor shall deliver a complete set of unused, clean filters to the Owner for each unit supplying filtered air to the building.

- D. Mechanical Equipment Mock-Up Requirements: Mechanical Contractor shall assist and supervise the completion of a mock-up of each piece of mechanical equipment for which there is a detail in the Mechanical Construction Documents. Provide mock-up for fire stop material as indicated in Section 23 05 55.
1. Mock-ups when approved may remain as part of the final installation. The Contractor shall coordinate, with the Mechanical Engineer, the installation of the mechanical equipment as a standard of quality that is expected.
 2. Before any additional installation work is started in other areas of the building, the Owner and the Architect/Engineer shall approve the mock-up. The Contractor shall obtain approval of each mock-up. Provide a 3-day notice to the Mechanical Engineer to schedule approval of the mock-up.
- E. Lubrication: After systems and equipment have been installed and just prior to building acceptance, properly lubricate motors and equipment installed for this project in accordance with the manufacturer's recommendations.
- F. Protection: Storage of equipment on construction site shall be covered with polyurethane film, or other method approved by Architect/Engineer, and be kept in a clean, dry, new condition through installation.

3.02 DEMOLITION GENERAL REQUIREMENTS

- A. General Requirements: The demolition work shall be a phased operation and shall comply with the construction sequence schedule. Coordinate with Building Engineer and School Principal.
1. Mechanical Contractor shall include all temporary connections necessary to permit the Owner to occupy areas of the building during the various construction phases.
 2. Mechanical Contractor shall be responsible for coordinating the mechanical installations to prevent disruption to the Owner and to minimize the down-time. The Architect's and Owner's approval shall be sought prior to all cut-off of services.
 3. Mechanical Contractor shall remove existing work shown, specified or necessary for completion of work. Owner shall have the option of retaining any or all items of material removed under this Contract. Items or materials not retained by Owner shall become the property of the Contractor and shall be removed from the premises.
 4. Mechanical Contractor shall verify the extent of the remodeling work and any details not clear to Contractor shall be referred to the Architect/Engineer for clarification prior to commencing demolition work.
 5. Revised installation within the remodeled areas shall be concealed unless noted otherwise. All surface work shall be verified with the Architect.

3.03 MECHANICAL LIST OF CONSTRUCTION CLOSEOUT DOCUMENTS

- A. General Requirements: Contractor and Subcontractors should proceed immediately to fully complete the work as listed in Appendix 'A' at the end of this Section. Contractor responsible shall initial and date the "Contractor Completed" column after each item as it is completed and forward a copy of the fully completed punch list to the Mechanical Engineer for final approval.

APPENDIX A

Section	Document Description	Contractor Date Comp./By	Architect Approved
23 00 00	Heating record drawings, including underground piping.	_____/____	_____
23 00 00	Ventilation record drawings.	_____/____	_____
23 00 00	Submit energy rebates on premium efficiency motors.	_____/____	_____
23 00 00	Submit energy rebates on variable speed pumping.	_____/____	_____
23 00 00	Submit energy rebates on boilers.	_____/____	_____
23 00 00	Submit energy rebates on chillers.	_____/____	_____
23 00 00	Submit energy rebates on variable speed drives for fans.	_____/____	_____
23 00 00	Provide documentation that new filters for all air handling units have been installed at time of substantial completion.	_____/____	_____
23 00 00	Document that hydrostatic pressure test has been completed on the heating water system.	_____/____	_____
23 00 00	Document that hydrostatic pressure test has been completed on the chilled water system.	_____/____	_____
23 01 00	Heating operation and maintenance manuals.	_____/____	_____
23 01 00	Ventilation operation and maintenance manuals.	_____/____	_____
23 01 00	Maintenance and lubrication schedule (heating).	_____/____	_____
23 01 00	Maintenance and lubrication schedule (ventilation).	_____/____	_____
23 01 00	Filter maintenance schedule.	_____/____	_____
23 05 23	Valve tag schedule (heating & cooling).	_____/____	_____
23 05 23	Provide a typewritten list identifying all numbered valves and submit with operation and maintenance manual.	_____/____	_____
23 05 30	Provide Owner with 4 pressure gauge adapters with 1/8 inch outside diameter probe and four 5 inch stem pocket testing thermometers for use on Pressure - Temperature Test Stations.	_____/____	_____
23 05 93	Document that a Pre-Test and Balance meeting was held with the Engineer.	_____/____	_____
23 05 93	Provide test and balance data for the hydronic systems.	_____/____	_____
23 05 93	Provide test and balance data for the	_____/____	_____

	ventilation systems.		
23 09 00	Energy Management and Temperature Control operation and maintenance manuals.	/	
23 09 00	Document that the Owner has received training on the Energy Management and Temperature Control.	/	
23 09 00	Document acceptance test of the Energy Management and Temperature Control.	/	
23 09 00	Document verification and calibration of the Energy Management and Temperature Control.	/	
23 09 00	Document that each air handling unit will shutdown from the duct smoke detectors as specified.	/	
23 21 23	Document that the disposable fine mesh strainer has been removed after pump start-up for each suction diffuser.	/	
23 21 23	Document that a qualified millwright has checked and aligned each pump prior to start-up.	/	
23 25 00	Document that heating water system piping has been pre-cleaned as indicated.	/	
23 25 00	Document that a new strainer screen was installed prior to filling heating system for operation and after pre-operational system cleanout.	/	
23 25 00	Document that chilled water system piping has been pre-cleaned as indicated.	/	
23 25 00	Document that a new strainer screen was installed prior to filling chilled water system for operation and after pre-operational system cleanout.	/	
23 25 00	Document test of glycol water systems before system is turned over to Owner.	/	
23 25 00	Document test of glycol water systems prior to end of first year of operation and replenish as required.	/	
23 25 00	Document that one year supply of recommended chemicals for prevention of scale, corrosion, and microbiological growth in the condenser water system was provided to the Owner.	/	
23 33 00	Document all fire dampers, smoke dampers, and ceiling dampers have been operated, prior to the occupancy of a building, to determine that they function in	/	

	accordance with NFPA.		
--	-----------------------	--	--

23 34 00	Document that gravity backdraft dampers in roof curbs for power roof ventilators are adjusted to assure operation when opening.	_____ / _____	_____
23 37 00	Document that gravity backdraft dampers in roof hoods are adjusted to assure operation when opening.	_____ / _____	_____
23 64 16	Document chiller control system training (minimum of 40 hours).	_____ / _____	_____
23 64 26	Document that the Owner has been provided a start-up service and training by an authorized factory trained representative for the rotary screw water chiller(s).	_____ / _____	_____
23 64 26	Document shut down of rotary screw water chiller(s) at end of first cooling season.	_____ / _____	_____
23 64 26	Document start-up of rotary screw water chiller(s) at beginning of second year.	_____ / _____	_____
23 64 26	Document rotary screw water chiller control system training (minimum of 40 hours).	_____ / _____	_____
23 72 13	Document that the Owner has been provided start-up service and training by an authorized factory trained representative for the energy recovery unit.	_____ / _____	_____
23 72 13	Provide documentation that new filters for the energy recovery units have been installed at time of substantial completion.	_____ / _____	_____
23 72 19	Document that the Owner has been provided start-up service and training by an authorized factory trained representative for the air-to-air crossflow energy recovery unit.	_____ / _____	_____
23 72 19	Provide documentation that new filters for air-to-air crossflow energy recovery units have been installed at time of substantial completion.	_____ / _____	_____
23 73 13	Document that the modular air handling unit(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____
23 73 13	Provide documentation that new filters for all modular air handling units have been installed at time of substantial completion.	_____ / _____	_____
23 73 23	Document that the custom air handling unit(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____

23 73 23	Provide documentation that new filters for all custom air handling units have been installed at time of substantial completion.	_____ / _____	_____
23 74 13	Document that the rooftop air handling unit(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____
23 74 13	Provide documentation that new filters for all rooftop air handling units have been installed at time of substantial completion.	_____ / _____	_____
23 75 13	Document that the custom rooftop air handling unit(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____
23 75 13	Provide documentation that new filters for all custom rooftop air handling units have been installed at time of substantial completion.	_____ / _____	_____
23 81 26	Document that the spot cooler(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____
23 82 19	Document that the fan coil unit(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____
23 82 19	Provide documentation that new filters for the fan coil units have been installed at time of substantial completion.	_____ / _____	_____
23 84 19	Document that the pool dehumidification air handling unit(s) have been installed and are operating per the manufacturer's recommendations.	_____ / _____	_____
23 84 19	Provide documentation that new filters for all pool dehumidification air handling units have been installed at time of substantial completion.	_____ / _____	_____

END OF SECTION

**SECTION 230100
OPERATION AND MAINTENANCE OF HVAC SYSTEMS**

PART 1 - GENERAL

1.01 OPERATION AND MAINTENANCE MANUALS

- A. General Requirements: Section is in addition to the Division 1 O&M Manual requirements.
- B. Binders: Contractor shall prepare 3-ring binders. Each binder shall contain material and equipment data sheets, installation details, instructions, and schematics of actual equipment and operations directions supplied by the manufacturer for each item of equipment. Final acceptance of the work will be withheld until such data has been presented complete to the Engineer for transmission to the Owner. The manual shall be available for instruction of operations and maintenance of equipment and systems.
- C. Number: The number of manuals shall be as stated in the Special Conditions, with a minimum of (3).
- D. Submittal: Operations and Maintenance (O&M) Manuals shall be submitted in paper and electronic formats. Contractor shall complete and submit (3) copies of each O&M Manual section (main tab) within 30 days of the respective submittal acceptance. These will be reviewed for compliance and acceptability by the Architect/Engineer and Commissioning Authority.
 - 1. Electronic format shall be provided on CD in format acceptable to the Owner.
 - 2. Electronic files shall be saved as PDF's.
- E. Format: 60 days prior to the original scheduled Substantial Completion date, the Contractor shall compile the individual O&M Manual sections and submit copies to Architect/Engineer. The Contractor shall compile O&M Manuals for every piece of equipment and building operating system according to the following requirements:
 - 1. 8 1/2-inch by 11-inch loose leaf binders. Each binder shall be clearly labeled on the spine. Use as many as required. Do not overload binders. Use dividers with permanently marked tabs of card stock separating each section and subsection. Tab labels must be easily readable and not handwritten.
 - 2. Each binder shall be composed of:
 - a. Title Page
 - b. Table of Contents
 - c. Main Tab for each Specifications Section
 - d. Sub-Tab for each Piece of Major Equipment (or group, if small or numerous)
 - 3. Each sub-tab shall be similar to the main tab for the Specification Section, but of a different color. Inside each equipment sub-tab shall be the following sections, in the given order, divided by a double-weight colored sheet labeled with the title of the section.
 - a. Contractor: Record the name, address, and telephone number of the manufacturer and installing contractor, and the 24-hour number for emergency service for all equipment in this sub-tab, identified by equipment.
 - b. Submittal and Product Data: This section shall include all approved submittal data, cut sheets, and appropriate Shop Drawings. If a submittal was not required for approval, include descriptive product data.
 - c. Operation and Maintenance Instructions: Written manufacturer's data with the model and features of this installation clearly marked and edited to omit reference to products or data not applicable to this installation. This section shall include data on the following:
 - 1) Installation, Start-Up, and Break-In Instructions and Reports
 - 2) Starting, Normal Shutdown, Emergency Shutdown, Manual Operations, Seasonal Changeover, and Normal Operating Procedures and Data; including any special limitations
 - 3) O&M and Installation Instructions; shipped with the unit

- 4) Preventive Maintenance and Service Procedures and Schedules
 - 5) Troubleshooting Procedures
 - 6) Parts List; edited to omit reference to items that do not apply to this installation
 - 7) List of Any Special Tools; required to service or maintain the equipment
 - 8) Performance Data, Ratings, and Curves; including at least (5) part load points (20, 40, 60, 80, 100 percent load) for the expected range of operating conditions (50-degree F to 55-degree F supply air temperature and minus 20-degree F to 95-degree F outdoor air temperature)
 - 9) Warranty; which clearly lists conditions to be maintained to keep warranty in effect and conditions that would affect the validity of the warranty
 - 10) Any Service Contracts Issued
 - 11) Maintenance and Lubrication Schedule (Refer to Appendix B at end of the Section for Blank Form); shall include each motor, function, control location, fuse location, type of lubricant, and rate of lubrication in accordance with manufacturer
 - 12) Filter Maintenance Schedule (Refer to Appendix C at end of the Section for Blank Form); shall include filter size and quantity for each unit, located by room number
- d. Control Drawings: Include the Control Drawings for the piece of equipment and its components, including the sequence of operation. This section will be electronically provided by the Controls Subcontractor for integration by the responsible subcontractor.
 - e. Specifications: This section is comprised of the component or system specification section copied and inserted, including all Addenda.
 - f. System Description: This section shall include the individual equipment portion of the overall system design documentation narrative. It will contain simplified professionally drawn single line system diagrams on 8 1/2-inch by 11-inch or 11-inch by 17-inch sheets, showing all controls, connections, and interfaces.
 - g. Preventive Maintenance Instructions: This section shall include condensed, typewritten excerpts from the manufacturer's written instructions for weekly, monthly, quarterly, and annual maintenance. This summary shall be prepared by the responsible contractor with help from the equipment supplier. It shall be prepared for all installed equipment. This section should include checklists for each task required.
 - h. Supplemental Data: When manufacturer's standard printed data is not available or the information necessary for a proper understanding and O&M of equipment or systems is missing, supplemental data shall be developed by the responsible contractor for the equipment. This data shall be written text and simple schematic drawings.
 - i. Include a warranty letter in the O&M Manual, to include the starting date(s) of warranty period(s) (including delayed start warranties and extended warranties) and duration of warranty periods. Warranty date should correspond to Substantial Completion date established by the Contract Documents.

1.02 INSTRUCTION OF OPERATING PERSONNEL

A. Instructors:

1. Each trade shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction in the care, adjustment, and operation and maintenance of all parts of the equipment to the Owner's permanent employees who are to have charge of the equipment.
2. Each instructor shall be thoroughly familiar with all parts of the installation on which they are to give instructions and shall be trained in operating theory as well as in practical operation and maintenance work. Factory trained instructors shall be employed wherever they are available. Instruction shall be given during regular workweek and at a time just

prior to the time the equipment is accepted and turned over to the Owner for regular operation.

- B. Format: The Contractor or Contractor's Representative shall provide a minimum of 4 day(s) instruction period for Owner's permanent employees on the mechanical equipment excluding temperature control system. Training for the temperature control system is indicated in Section 23 09 00, Building Management System.
1. Instruction shall take the form of classroom sessions to introduce the HVAC operation, maintenance, and management personnel to the manuals, drawings, and other documents and aids available to operate and maintain the HVAC equipment and systems.
 2. Instruction shall provide sufficient information to allow Owner's personnel to understand and operate all equipment and components.
 3. Contractor shall coordinate and assist Owner to allow for videotaping of on-site training if Owner chooses to do so.
 4. Visual aids, such as slides and video shall be used during training and made part of the user's permanent files to be used for reference, refresher, and retraining. Provide electronic DVD of training for Owner's use.
 5. Refer to Appendix A at the end of this Section for training agenda format.
- C. Training:
1. All training is to be scheduled 14 days in advance. All scheduling will be coordinated through individual Trades Shops.
 2. At the time of the request, a written training agenda will be submitted, with the request to schedule, to individual Trades Shops. This allows the District to have the appropriate personnel involved. Contractor is to prepare an attendance verification form (refer to Appendix D at the end of this Section) to be signed by all participants. Architect in conjunction with Owner's staff will provide specified training requirements to Contractors at the Pre-Construction Meeting.
 3. Substantial Completion certificate will not be issued until all training is satisfactorily completed.
 4. Training shall be more than a general review of equipment. The goal is to completely prepare personnel for system operation and maintenance.
 5. All summer/winter change-over methods shall be provided in written form as related to the specific project. This shall be provided at the training session. Until this process is completed, the Contractor shall be responsible for all change-over and winter protection of the equipment.
 6. The Contractor shall provide a certificate indicating the date(s) the training was given, the hours of training, a list of the documentation given to the Owner, the names of individuals (including company name and telephone number) providing the training, the names of Owner's personnel receiving the training, and a list of the equipment/systems the training was provided for. This certification shall be signed and dated by a representative of the Owner. A copy of all the certifications shall be given to the Owner and the Architect/Engineer prior to the closeout of the project.

PART 2 NOT USED

PART 3 NOT USED

(REFER TO FOLLOWING PAGES FOR APPENDICES)

APPENDIX A

TYPICAL HVAC TRAINING AGENDA

- A. Opening Remarks
- B. Introduction
- C. Description of HVAC Systems
 - 1. Air Side
 - a. Cooling
 - b. Heating
 - c. Ventilation
 - d. Life Safety
 - 2. Wet Side
 - a. Cooling
 - b. Heating
- D. Description of Equipment and Systems (Individual Suppliers will discuss their equipment)
 - 1. Wet Side
 - a. Chiller (or Refrigeration Equipment)
 - 1) Accessory Equipment
 - 2) Electrical
 - 3) Control
 - 4) Refrigerant Piping
 - b. Chilled Water
 - 1) Pumps
 - 2) Exchangers
 - 3) Piping
 - 4) Controls
 - 5) Water Treatment
 - 6) Electrical
 - 7) Control
 - 8) Chilled water Side Stream filter system operation
 - c. Boilers (Steam Generators)
 - 1) Water Make-Up
 - 2) Water Treatment
 - 3) Piping
 - 4) Controls
 - 5) Safety Accessories
 - 6) Electrical
 - 7) Insulation
 - 8) Hot water Side Stream filter system operation
 - 2. Air Side
 - a. Air Handling Units (Fans)
 - 1) Fans
 - 2) Coils
 - 3) Humidifiers
 - 4) Controls
 - 5) Electrical
 - 6) Isolation
 - 7) Insulation

- b. Terminal Boxes
 - 1) Fans
 - 2) Coils
 - 3) Controls
 - c. Duct System
 - 1) Type(s)
 - 2) Pressure(s)
 - d. Filter System
 - 3. Controls
 - a. Type System
 - b. Purpose
- E. Walk-Through of Building
- F. Start-Up Procedures
 - 1. Seasonal Considerations
 - 2. Check List
 - 3. Emergency Procedures
- G. Operation Procedure
 - 1. Occupancy Considerations
 - 2. Seasonal Considerations (Changeover)
 - 3. Manual/Automatic
 - 4. Emergency
- H. Shut Down
 - 1. Check List
 - 2. Normal
 - 3. Emergency
- I. Maintenance (list major equipment systems)
 - 1. Routine
 - 2. Periodic
 - 3. Service
 - 4. Lubrication
 - 5. Overhaul
 - 6. Factory
- J. Warranties
 - 1. What they cover
 - 2. How to use them
- K. Spare Parts
- L. Tools
 - 1. Normal tools, supplies and equipment
 - 2. Special tools
- M. Hands-on operation of HVAC equipment and systems in conjunction with HVAC preliminary commissioning.

APPENDIX B

[illegible]

APPENDIX C

[illegible]

APPENDIX D

TRAINING DOCUMENTATION

This form documents that the Owner's representative has received training by the Contractor.

Description of Training Received:

END OF SECTION

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Types of work, normally recognized as electrical, but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Mechanical Contractor shall furnish and install all electric motors for equipment included in Contract unless specifically noted otherwise. It shall be the responsibility of each Contractor and supplier to check any notations made in Motor, Appliance, and Equipment Schedule on Drawings.
 - 2. Unless specifically noted otherwise, all motor starters, control devices, and wiring of motors and controls will be by the Electrical Contractor. Any exception to the preceding will be described under that part of this Specification that is directly affected.
 - 3. Mechanical Contractor shall verify the ratings and characteristics of all electrical equipment that they furnish to ensure that the equipment will be compatible with the services provided and equipment furnished by other contractors. Refer to Motor and Equipment Schedules on the Electrical Drawings.
 - 4. Any electrical wiring, which is included in the mechanical work, shall comply with the standards set forth in the Specifications for Electrical Work (Section 26).
 - 5. If the Contractor has any doubt as to whether any item of electrical equipment or wiring is to be included in this Contract, Contractor shall either assume that it is to be included or obtain clarification from the Engineer prior to bidding.
 - 6. Refer to Division 23 controls sections for control system wiring.
 - 7. Refer to other Division 23 sections for specific individual mechanical equipment electrical requirements.
 - 8. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.

1.02 QUALITY ASSURANCE

- A. Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections. Meet applicable requirements of Division 26 sections for electrical work of this Section that is not otherwise specified.
- B. Standards: For electrical equipment and products, in accordance with applicable NEMA Standards, and refer to NEMA Standards for definitions of terminology herein. Meet requirements of National Electrical Code (NFPA 70) for workmanship and installation requirements.

PART 2 - PRODUCTS

2.01 MOTORS

- A. General Requirements: The electric motors furnished with all equipment shall meet the requirements of this Specification. If a conflict exists between provisions of this Section and provisions of other sections detailing the driven equipment, the provisions of this Section shall govern. Motors must comply with NEMA MG 1 unless otherwise indicated. Severe-duty motors must comply with IEEE 841.
- B. Motor Characteristics: Must meet or exceed the Motor Efficiencies as listed in the Minnesota Energy Code (Most current edition)

2.02 FABRICATION

- A. General Requirements: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives, arranged for lubrication and similar running maintenance without removal of guards.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General Requirements: Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 horsepower and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
 - 1. Deliver starters and wiring devices which have not been factory installed on equipment unit to electrical installer for installation.

END OF SECTION

SECTION 230519
METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories necessary to furnish and install meters and gauges applicable to chilled water, steam, radiator coolant water, and heating hot water piping systems.

1.02 SUBMITTALS

- A. Shop Drawings: Submit a portfolio showing piping specialties for approval by Architect/Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers for Thermometers and Gauges: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or Owner approved equal:
 - 1. Trerice (Basis of Design)

2.02 PIPING SPECIALTIES

- A. Thermometers: Thermometers shall be blue reading, non-mercury type with range suitable for intended service.
 - 1. Thermometers shall be 9-inch scale case, industrial type, with vari-angle feature and brass separable socket. Provide extension neck as required on insulated pipe.
 - a. Conform to the following range:
 - 1) Hot Water: 30 degrees F to 240 degrees F with 2 degree F scale divisions (0 degrees C to 115 degrees C with 1 degree C scale divisions).
 - 2) Chilled Water: 30 degrees F to 120 degrees F with 2 degree F scale divisions (0 degrees C to 50 degrees C with 1 degree C scale divisions).
 - 2. Remote reading dial thermometers shall be 4 1/2-inch dial size, cast aluminum back flanged case, bronze spiral armored capillary, with separable socket connection.
 - a. Conform to the following range:
 - 1) Hot Water: 30 degrees F to 240 degrees F with 2 degree F scale divisions (0 degrees C to 115 degrees C with 1 degree C scale divisions).
 - 2) Chilled Water: 30 degrees F to 120 degrees F with 2 degree F scale divisions (0 degrees C to 50 degrees C with 1 degree C scale divisions).
- B. Gauges: Gauges shall be 4 1/2-inch dial size, cast aluminum back flanged case, complete with "T" handle gauge cock. Provide coil siphon on steam line gauges. Provide ray snubbers downstream of gauge cock in pulled circulating lines at each gauge. Label gauge behind glass on face of dial indicating unit of measurement, including P.S.I.G. and feet of head.
 - 1. Conform to the following range:
 - a. 0 to 100 psi
 - b. 0 to 200 psi
- C. Pressure - Temperature Test Stations: Provide specific pipe wells in lieu of "Pete's Plug" as noted in specification for Pressure - Temperature Test Stations and in locations indicated on Drawings.
- D. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1, with ASME B1.20.1 pipe threads.

7. Internal Threads: 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
12. Heat-Transfer Medium: Mixture of graphite and glycerin.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Thermometers: Install vertically in an upright position and tilt so as to be easily read from floor level. Install at boiler inlets and outlets, chiller inlets and outlets (locate visible outside of the chiller enclosure/cottonwood screen), heat exchanger inlets and outlets, heating and chilled water coils inlets and outlets, and as indicated on Drawings.
- B. Thermowells: Install thermowells with socket extending to center of pipe and in vertical position in piping tees. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes. Install thermowells with extension on insulated piping. Fill thermowells with heat-transfer medium. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- C. Pressure Gauges: Install in piping Tee with pressure cock located on pipe at the most readable position. Locate at pumps, pressure reducing valves, any other equipment with pressure differentials which also includes heating and chilled water coils, and as indicated on Drawings.
 1. Mount gauges for convenient reading of operator standing on floor.
 2. For chillers, locate visible outside of the chiller enclosure/cottonwood screen and provide one pressure gauge on inlet and one pressure gauge on outlet.

END OF SECTION

**SECTION 230523
GENERAL-DUTY VALVES FOR HVAC PIPING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories necessary to furnish and install valves indicated on Drawings and specified.

1.02 SUBMITTALS

- A. Shop Drawings: Contractor shall submit a Shop Drawing portfolio showing valves, cocks, and faucets to be used and a schedule of equipment and areas to be served for approval by Architect/Engineer.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. State Building Code (Most Current Edition)
 - 2. State Mechanical Code (Most Current Edition)
 - 3. Local Codes and Ordinances (Most Current Edition)
 - 4. Local Authority having jurisdiction

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS

- A. Acceptable Manufacturers for Gate Valves (Steam Header Only): Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or Owner approved equal:
 - 1. Manufacturers
 - a. Stockham (Basis of Design)
 - b. Crane
 - c. Milwaukee
 - d. Nibco
 - e. Powell
 - 2. Description
 - a. Class 150, RS Bronze Gate Valves: Standard: MSS SP-80, Type 2.
 - 1) CWP Rating: 300 psig.
 - 2) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 3) Ends: Threaded.
 - 4) Stem: Bronze.
 - 5) Disc: Solid wedge; bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron, or bronze.
 - b. Class 250, OS&Y, Iron Gate Valves: Standard: MSS SP-70, Type I.
 - 1) NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - 2) NPS 14 to NPS 24, CWP Rating: 300 psig.
 - 3) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 4) Ends: Flanged.
 - 5) Trim: Bronze.
 - 6) Disc: Solid wedge.
 - 7) Packing and Gasket: Asbestos free.
- B. Acceptable Manufacturers for Check Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or Owner approved equal:
 - 1. Manufacturers
 - a. Stockham (Basis of Design)
 - b. Crane

- c. Milwaukee
- d. Nibco
- e. Powell
- 2. Description
 - a. Class 125, Lift Check Valves with Bronze Disc:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: 200 psig.
 - 3) Body Design: Vertical flow.
 - 4) Body Material: ASTM B 61 or ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
 - b. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1) Standard: MSS SP-80, Type 3.
 - 2) CWP Rating: 200 psig.
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
 - c. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1) Standard: MSS SP-80, Type 3.
 - 2) CWP Rating: 300 psig.
 - 3) Body Design: Horizontal flow.
 - 4) Body Material: ASTM B 62, bronze.
 - 5) Ends: Threaded.
 - 6) Disc: Bronze.
 - d. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1) Standard: MSS SP-71, Type I.
 - 2) NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - 3) NPS 14 to NPS 24, CWP Rating: 150 psig.
 - 4) Body Design: Clear or full waterway.
 - 5) Body Material: ASTM A 126, gray iron with bolted bonnet.
 - 6) Ends: Flanged.
 - 7) Trim: Bronze.
 - 8) Gasket: Asbestos free.
 - e. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - 1) CWP Rating: 300 psig.
 - 2) Body Material: ASTM A 536, ductile iron.
 - 3) Seal: EPDM.
 - 4) Disc: Spring-operated, ductile iron or stainless steel.
- C. Acceptable Manufacturers for Non-Slam Check Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or Owner approved equal:
 - 1. Manufacturers
 - a. Stockham (Basis of Design)
 - b. Crane
 - c. Milwaukee
 - d. Nibco
 - e. Powell
 - 2. Description
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.

- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze.
- D. Acceptable Manufacturers for Angle Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or Owner approved equal:
- 1. Manufacturers
 - a. Stockham (Basis of Design)
 - b. Crane
 - c. Milwaukee
 - d. Nibco
 - e. Powell
 - 2. Description
 - a. Class 150, Bronze Angle Valves with Bronze Disc:
 - 1) Standard: MSS SP-80, Type 1.
 - 2) CWP Rating: 300 psig.
 - 3) Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - 4) Ends: Threaded.
 - 5) Stem and Disc: Bronze.
 - 6) Packing: Asbestos free.
 - 7) Handwheel: Malleable iron or bronze.
- E. Acceptable Manufacturers for Full Port Ball Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or Owner approved equal:
- 1. Manufacturers
 - a. Apollo (Basis of Design)
 - b. Milwaukee
 - c. Nibco
 - d. Powell
 - e. Stockham
 - f. Watts
 - 2. Description
 - a. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1) Standard: MSS SP-110.
 - 2) SWP Rating: 150 psig.
 - 3) CWP Rating: 600 psig.
 - 4) Body Design: Two piece.
 - 5) Body Material: Bronze.
 - 6) Ends: Threaded.
 - 7) Seats: PTFE or TFE.
 - 8) Stem: Stainless steel.
 - 9) Ball: Stainless steel, vented.
 - 10) Port: Full.
 - b. Class 125, Iron Ball Valves:
 - 1) Standard: MSS SP-72.
 - 2) CWP Rating: 200 psig.
 - 3) Body Design: Split body.
 - 4) Body Material: ASTM A 126, gray iron.
 - 5) Ends: Flanged.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Stainless steel.
 - 8) Ball: Stainless steel.
 - 9) Port: Full.

- F. Drain Valves and Air Vents: Apollo Series 70-100-HC with hose thread, bronze cap and chain, 600-pound W.O.G., threaded.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General Requirements: Furnish and install gate, full port ball, and check valves where indicated on Drawings and where necessary for proper control of piping and equipment. Valves shall be same size as pipe in which installed, unless otherwise specified or shown on Drawings.
 - 1. Gate (steam header only) and full port ball valves shall be used where shut-off valves are to be fully open or closed.
 - 2. Full port ball shall be used where flow is to be throttled.
 - 3. All branch piping from hot and chilled water mains shall have shut-off valve at the branch take-off.
 - 4. If the main piping is not in the same room as the equipment the branch supplies, the branch piping from hot and chilled water mains to equipment shall have shut-off valve at the branch take-off in addition to individual shut-off valves at equipment.
 - 5. Valves on chromium plated piping shall be polished brass finish chromium plated. Compression stops shall be heavy pattern with stuffing box.
 - 6. Individual components must be provided, valve trains are unacceptable.
 - 7. Valves shall be of one manufacturer when possible and shall have name or trademark cast or stamped on valve.
 - a. Valves shall have packing gland nut, packing, and back seating design.
- B. Drain Valves and Air Vents: Locate where shown on Drawings, at each horizontal or vertical check valve, at pumps between the check valve and shut-off valve and at all low points in system. Install in accessible location for easy draining and venting of heating and chilled water system. Weld-in nipples are not acceptable; contractor must install Weldolet.
- C. Accessibility/Operation:
 - 1. Valves shall be installed to be easily accessible for operation, visual inspection, and preventive maintenance.
 - 2. Unless otherwise noted, valves shall be installed with valve stem in vertical position above piping, except chain-operated valves.
 - 3. Valves with stem above 8 feet from floor in boiler or equipment rooms shall have chain wheel operator and chain with chain guard.
 - 4. For valves located above hard or inaccessible ceilings, provide an access panel. Refer to Section 23 05 54.
- D. Valve Tags:
 - 1. Refer to Section 23 05 53, Identification for HVAC Piping and Equipment, for tagging requirements and valve tag schedule requirements.

END OF SECTION

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories to furnish and install supports, anchors, and seals for equipment, materials, and related work specified elsewhere.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers for Guides: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are:
 - 1. Metraflex (Basis of Design)
 - 2. Flexicraft
 - 3. Flexonic
 - 4. Flex-weld/KEFLEX
 - 5. Hyspan
- B. Acceptable Manufacturers for Manufactured Roof Supports: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are:
 - 1. Haydon H-Block Standard (Basis of Design)
 - 2. Eaton Dura-Blok
 - 3. C-Port C Series

2.02 DUCTWORK INSERTS AND HANGERS

- A. General: Support ductwork by concrete inserts in concrete construction, "C" clamps for beams and bar joists, or toggle bolts on prefabricated reinforced hollow concrete slabs. When ductwork is hung from beams or joist, the attachment shall be made to the top of the beam or joist. When cable type duct hanging products are selected, the base product is to be Gripple brand or Owner approved equal. The following criteria are to accompany any use of a cable hanging system:
 - 1. No hanging of fan powered or gas fired HVAC equipment by means of a cable hanging system, hanging of duct and diffusers only.
 - 2. When cable hanging systems are used the installing contractor shall have available on site the complete installation guide for review upon request.
 - 3. When a cable hanging system is used no mixing and matching of various manufacturers' products and use of all related hardware will be required. Use of the recommended cable is required, no mix and match.
 - 4. Minimum weight rating of 100lbs. for individual hangers, regardless of application. Due to the rating reduction when cable is other than vertical.
 - 5. No use of cable hanging systems where service access required staff to cross over or be on top of duct. Most all cable hanging systems do not allow walking or standing on duct installations hung by cable hanging systems.
 - 6. MPS restricts the use of cable hanging systems outdoors, no use outdoors without prior written approval by Owner.
 - 7. No use of cable hanging toggle type devices on rectangular duct installations.
 - 8. No use of magnetic pad type hanging devices for duct hanging.
 - 9. No painting of cable fastener device, installing contractor is responsible for protection of installed product.
 - 10. All installations shall follow cable hanging systems weight calculations chart recommendations to include the rating when cable hanging system is other than vertical installation.
- B. Support:

1. Provide bridging between structural members, as required, to provide adequate support locations for hangers.
2. Ductwork shall not be supported from metal roof decking.
3. Ductwork, piping or conduits shall not be supported from non-structural members, cross bridging, etc.

2.03 SPECIAL APPLICATIONS

- A. Tunnels and Crawl Spaces: Materials for inserts, rods and hangers in tunnels and crawl spaces shall be of non-ferrous material. Unistrut steel products shall have prime bonderized finish coating. Contractor shall field coat any raw cut edges on steel products with a prime bonderized finish coating.

2.04 PIPING INSERTS AND HANGERS

- A. General Requirements: Hangers and anchors for piping shall be attached to the building construction. Piping shall not be supported from another pipe.
- B. Hanger Supports and Inserts: Piping suspended from the building construction above shall be hung from concrete inserts in concrete construction, toggle bolts, and rod coupling on prefabricated, reinforced hollow concrete slabs, I-beam clamps or hanger rod, steel washer plate, and (2) nuts on bar joist construction. On other types of building construction, a field approved type clamp or bracket shall be used. When piping is hung from beams or joist, the attachment shall be made to the top of the beam or joist.
- C. Hangers, Clamps, and Collars: Piping shall be suspended from inserts, clamps or brackets by means of clevis type or roller type hanger and solid steel rods. Support vertical cast iron and steel pipes at each floor by heavy wrought steel riser clamps or collars. Support vertical copper pipes at each floor by riser clamps with asphalt felt lining under couplings placed in vertical copper piping. Support piping 4 inches and larger for hot water heating systems by single pipe roller assemblies with adjustable socket.
- D. Piping: Horizontal piping shall be supported at intervals close enough to keep it in alignment and to prevent sagging.

PIPING SUPPORT SPACING			
PIPE DIAMETER	ROD HANGERS	MAXIMUM HORIZONTAL SPACING	MAXIMUM VERTICAL SPACING
COPPER OR COPPER-ALLOY PIPE 1-1/4 INCH AND SMALLER	3/8 INCH ROD	6 FEET	10 FEET
COPPER OR COPPER-ALLOY PIPE 1-1/2 INCH AND LARGER	3/8 INCH ROD	10 FEET	10 FEET
COPPER OR COPPER-ALLOY TUBING 1-1/4 INCH AND SMALLER	3/8 INCH ROD	6 FEET	10 FEET
COPPER OR COPPER-ALLOY TUBING 1-1/2 INCH AND LARGER	3/8 INCH ROD	10 FEET	10 FEET
CPVC PIPE OR TUBING, 1 INCH AND SMALLER	3/8 INCH ROD	32 INCHES	10 FEET **
CPVC PIPE OR TUBING, 1-1/4 INCH AND LARGER	3/8 INCH ROD	32 INCHES	10 FEET **

POLYPROPYLENE PIPE	3/8 INCH ROD ON SMALL PIPE, 1/2" ROD ON LARGE PIPE	6 FEET - 8 FEET REFER TO MANUFACTURER DATA	10 FEET **
POLYVINYLDENE FLUORIDE PIPE	3/8 INCH ROD	32 INCHES	10 FEET **
PVC PIPE	3/8 INCH ROD	32 INCHES	10 FEET **
STEEL PIPE, SCHEDULE 40, 1 INCH AND SMALLER	3/8 INCH ROD	6 FEET	15 FEET
STEEL PIPE, SCHEDULE 40, 1-1/4 INCH TO 2 INCH	3/8 INCH ROD	10 FEET	15 FEET
STEEL PIPE, SCHEDULE 40, 2-1/2 INCH TO 3 INCH	1/2 INCH ROD	12 FEET	15 FEET
STEEL PIPE, SCHEDULE 40, 4 TO 6 INCH	5/8 INCH ROD	12 FEET	15 FEET
STEEL PIPE, SCHEDULE 40, 8 INCH AND LARGER	7/8 INCH ROD	12 FEET	15 FEET
STEEL TUBING	3/8 INCH ROD	8 FEET	10 FEET
EXPOSED VERTICAL PLASTIC PIPING	3/8 INCH ROD	C	4 FEET
* WHERE 10 FOOT LENGTHS OF CAST-IRON PIPE ARE USED, TEN FOOT INTERVALS BETWEEN SUPPORTS ARE ACCEPTABLE. ** PROVIDE MID-STORY GUIDE.			

- E. Piping: Vertical piping shall be secured at intervals close enough to keep it in alignment.
1. Copper Tubing
 2. Threaded Steel Pipe at Each Story

2.05 ANCHORS AND GUIDES

- A. Anchor Fabrication: Construct anchors using I-beams, channel iron, tees, or angles or a combination thereof.
1. Tee iron shall be welded to side, top or bottom of pipe. Angle iron diagonal bracing shall be welded or bolted to tee iron and wall or ceiling. Anchors shall be welded or double clamped to pipe.
 2. Where a group of pipes are to be anchored, but cannot be secured as above, the pipes shall be anchored to an assembly constructed of I-beams, channels or both, which shall be anchored to the building structure.
- B. Guides: Guides shall be fabricated from carbon steel. Housing shall be of 2-piece design, connecting upper and lower housing with 2-bolt or by welding, after spider and pipe have been set in lower half of housing. Lower housing shall have (2) legs for support running the full length of housing. Two piece spider clamp shall be fastened around pipe (or pipe with insulation) with (2) bolts forming (6) legs which guide pipe inside housing. Legs may be on bottom, side or top of unit for bolting to floor or top of beam, wall or underside of structure.
1. Insulation inside the spider clamp shall be hydrous calcium silicate with vapor barrier from entering and exiting pipe continuing through the clamp.
 2. Unit shall be furnished with a factory baked enamel finish.

2.06 MANUFACTURED ROOF SUPPORTS

- A. General Requirements: Roof supports shall be made from ultra-violet resistant rubber and have an integral steel channel to accept pipe guides.

PART 3 - EXECUTION

3.01 HANGER INSTALLATION

- A. Hanger Location: Locate hangers to properly support pipes and ducts; relieve strain on pipe, duct, and fittings; and allow for ample expansion and contraction. Piping smaller than 4-inch size shall be hung with individual ring hangers where space prevents use of other type hangers.
 - 1. Piping or ductwork shall not be hung from the roof deck.
 - 2. Insulation sheet metal shields shall be placed between insulation and pipe hangers at all hangers.
 - 3. Individual hangers to be adjustable swivel loop or standard weight clevis type, double nutted and washered on each hanger.
- B. Trapeze Hangers: Group of pipes at the same elevation and close together may be supported by a suitable Trapeze hanger suspended from the structure by use of strut channel and strut pipe straps at each strut.
- C. Plastic Piping Support: Support plastic piping from above inserts, clamps or brackets with Grinnell Figure 269 adjustable ring hanger on 32-inch centers.

3.02 BRACKETS, BRACES, AND SUPPORTS

- A. General Requirements: Furnish and install brackets, braces or reinforcing angles in partitions not sufficient in themselves to support piping or other wall hung equipment included in this Specification. Bolts shall extend through walls, finished on opposite side, or one wall of a pipe chase, and shall be not less than 3/8-inch brass bolts with 3-inch cut washer on opposite side of wall.
- B. Fasteners: Bolt head and washer shall be concealed under wall finish on finished walls. On hollow walls not finished on opposite sides, use toggle bolts. On solid walls, use 3/8-inch brass bolt extending 4 inches into wall secured with molten lead poured around bolt. Secure floor mounted wall closets with 5/16-inch brass bolt with chrome plated cap, nut, and washer.
- C. Support Racks: Support tunnel piping on Unistrut, Bee-Line or Owner approved equal, pipe racks assembled as indicated by details on Drawings. Unistrut steel products shall have prime bonderized finish coating. Contractor shall field coat any raw cut edges on steel products with a prime bonderized finish coating.
- D. Pipe Drop Supports: Brace exposed pipe drops to pumps and other equipment with angle iron framework to relieve strain on flexible connectors or equipment and anchor piping to eliminate movement.

3.03 INSTALLATION OF ANCHORS AND GUIDES

- A. Boiler Room: Provide adequate anchors and guides on heating piping in Mechanical Rooms and Boiler Room to prevent swaying of pipe.
- B. Anchors: Install anchors approximately centered in every 70-foot run, blind ends, changes in pipe direction, except when elbow is used to absorb expansion and at major branch connections.
 - 1. An expansion joint or loop or expansion elbow, but not more than one, with appropriate guides, shall be installed between each pair of anchors.
 - 2. If expansion loops are installed in same line with expansion joints, the section containing the loop shall be isolated from the section containing the joint by means of an anchor.
- C. Guides: Install (4) guides, (2) on each side, for each expansion loop or joint. On each side, install (1) pipe guide a maximum of (4) pipe diameters from expansion loop or joint and (1) pipe guide a maximum of 14 diameters from the first guide.
- D. Anchors and Guides in Radiation Covers: Provide anchors and guides in radiation covers where called for on Drawings and specified. Provide guides at each side of expansion joints.

3.04 INSTALLATION OF ROOF SUPPORTS FOR PIPING

- A. General Requirements: Furnish and install manufactured roof supports for piping that is being run on the roof. Use system that matches detailing on plans.
 - 1. Manufactured roof supports shall be installed in accordance with manufacturer's installation instructions.
 - 2. If Manufactured system does not comply with details, install per detail.

3.05 GENERAL NOTES

- A. General Notes:
 - 1. Beam clamps, universal type reversible with double rod hole, malleable iron casting with hardened cup point set screw and locknut.
 - 2. Hanger rod, nuts, and washers to be galvanized plated.
 - 3. Self-drilling concrete expansion type anchors shall be used.
 - 4. Hanger rods attached to structure through new or existing ceiling systems, regardless of type of construction, to be fitted with a white plastic rod escutcheon.
 - 5. Use of steel pipe to span bar joists for piping or equipment hangers is not acceptable. Use angle iron, channel iron, or strut.
 - 6. Band iron or wire not acceptable.
 - 7. Do not support one pipe from another.
 - 8. Pipe hangers attached to or through metal roof decking is not acceptable.
 - 9. Power activated attachments are not acceptable.
 - 10. Existing Trapeze or individual hanger fabricated of screwed pipe and fittings are to be removed and disposed of.
 - 11. Anchors for typical ductwork hangers shall be placed whenever practicable to anchors, bolts, or studs that are in shear in lieu of tension.

END OF SECTION

**SECTION 230530
HYDRONIC SYSTEM SPECIALTIES**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories necessary to furnish and install hydronic specialties in relation to hydronic supplied equipment specified in Section Aboveground Hydronic Piping.

1.02 SUBMITTALS

- A. Shop Drawings: Submit a portfolio showing hydronic system specialties to be used and a schedule of equipment to be served with related specialty types and sizes for approval by Architect/Engineer.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. State Building Code (Most Current Edition)
 - 2. State Energy Code (Most Current Edition)
 - 3. State Mechanical Code (Most Current Edition)
 - 4. Local Codes and Ordinances (Most Current Edition)
 - 5. Local Authority having jurisdiction

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers for Air Separators: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Bell & Gossett (Basis of Design)
 - 2. Armstrong
 - 3. SpiroTech
- B. Acceptable Manufacturers for Bladder Type Compression Tanks, furnished with pump house package: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Bell & Gossett (Basis of Design)
 - 2. Wessels
- C. Acceptable Manufacturers for Side Stream Filters, furnished with pump house package: Bag filters are not acceptable; cartridge filters only. Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Quantrol QFP 4X2-304/Quantrol QFP 5X2-304 (Basis of Design)
 - 2. Shelco 4FOS2/5FOS2
- D. Acceptable Manufacturers for Strainers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Crane No. 988-1/2 or Crane No. 989-1/2 (Basis of Design)
 - 2. Metraflex
 - 3. Mueller
 - 4. Nibco
 - 5. Apollo
- E. Acceptable Manufacturers for Flexible Pump Connectors: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Flexonics (Basis of Design)
 - 2. Mason Industries
 - 3. Metraflex

4. Minnesota Flexible
 5. ThermoTech
 6. Tri-State Packing
- F. Acceptable Manufacturers for Automatic Flow Control Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
1. Bell & Gossett Circuit Sentry (Basis of Design)
 2. Griswald
 3. Hays
 4. Tour Anderson
- G. Acceptable Manufacturers for Flow Measuring Stations: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
1. Bell & Gossett (Basis of Design)
 2. Gerand Engineering
 3. Hays
 4. Tour Anderson
- H. Acceptable Manufacturers for Balance Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
1. Bell & Gossett Circuit Sentry (Basis of Design)
 2. Gerand
 3. Hays
 4. Tour Anderson
- I. Acceptable Manufacturers for Non-Electric Thermostatic Radiator Valves: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
1. Danfoss
 2. Honeywell

2.02 PIPING SPECIALTIES

- A. Unions - Hydronic Piping: Flanged union connections shall be made with 150 psi weld neck flanges, with not less than 1/16-inch sheet gasket. Screwed unions shall be Crane No. 250-H, or Owner approved equal, bronze to steel seat, 2,000 psi. Couplings shall serve as unions and disconnect points.
- B. Strainers: Crane No. 988-1/2, Crane No. 989-1/2, or Engineer Owner approved equal, with stainless steel or monel mesh screen with reinforced ends and 2-inch pipe nipple and cap on discharge openings.
- C. Air Vents:
1. Manual: Use ball valves with chain and bronze cap. Apollo series 70-100-HC. COIN VENTS NOT ALLOWED.
 2. Automatic: Glycol compatible heavy-duty unit with built in air chamber, overflow connector for 1/4-inch outside diameter copper tubing.
 - a. Acceptable Manufacturers: B&G 7, 87, Sarco 13W, or Kunkle

2.03 AIR SEPARATORS

- A. Inline Type Air Separators:
1. Inline air separator shall have a side inlet connection, an equal size top outlet, and an equal size bottom connection. Bottom connection may be used as an inlet, outlet or drain connection. Air separator shall have a 3/4-inch NPT connection to facilitate its direct connection to a compression tank.
 - a. Air separator shall be designed for a maximum working pressure of 125 psi at 375 degrees F.
 - b. Air separator shall be painted with (1) coat of air dry enamel.

2. Air separator shall have a low velocity chamber with integral baffles and diffuser tube for proper air separation and elimination.

2.04 COMPRESSION (EXPANSION) TANKS

- A. Bladder Type Compression Tank:
 1. Provide a removable bladder type compression tank, for permanent separation of air and water, as specified in project documents.
 - a. Provide pressure relief valves for tanks 100 gallons or larger.
 - b. Tank to be base mounted on floor
 2. All wetted surfaces shall be of FDA approved materials for potable water applications.
 3. Bladder shall be of a heavy butyl material and shall be removable for inspection.
 4. Tank shall be designed, constructed, and stamped for a working pressure of 125 psig and an operating temperature of 240 degrees F.
 - a. Compression tank shall be painted with (1) coat of air dry enamel.
 5. Tank shall be furnished with the following:
 - a. Ring Stand as applicable
 - b. Air Section Drain Fitting and Fluid Section Drain Fitting with a means of tank separation from the system
 - c. System Connection
 - d. Charging Valve and Auxiliary Air Connection
 - e. Lifting Ring or Lug
 - f. Pressure equalizing loop- Provide an Anti-thermosiphon loop top to prevent gravity heating of tank, 12" drop.
 6. Tank labeling: Label tank with project calculated bladder tank air charge, not factory "precharge" as noted on the nameplate, and the calculated static water fill pressure of the system.

2.05 SIDE STREAM FILTER

- A. Filter Housing: Housing shall be minimum of 304 stainless steel.
 1. Internal components shall be rated to the temperature of the system to which they are filtering.
- B. Hinged Lid: If specified:
 1. Hinged lid shall be 304 stainless steel with clamps and washers.
 2. Lid to have swing bolt closure.
- C. Filter Media:
 1. Provide 2 sets each of 50 micron rated and 25 micron rated bleached cotton cartridges.
 2. Cartridges shall be rated for 200 degrees F operating temperature for hot water systems.
- D. Connections: Inlet and outlet connection shall be no smaller than 1" female threaded N.P.T. on opposite sides of housing.
 1. Housing shall have a 1/2-inch drain fitting at bottom of unit.
- E. Capacity: Units shall be sized to accept at least 10% of maximum GPM or flow of system it is attached to.
 1. Solids Collection Capacity: 25 Pounds
 2. Liquid Retention Capacity: 3.1 Gallons
- F. Pressure and Temperature Ratings:
 1. Maximum Working Pressure: 125 psi
 2. Maximum Operating Temperatures: 200 Degrees F
- G. Indicator Package: Provide with indicator package consisting of (1) inlet and outlet gauge rated to 0-60 psi., (1) gauge to show pressure drop. (Provide rigid piping as indicated on Drawing Detail Sheets.

2.06 CHEMICAL FEEDER

- A. MPS prefers to provide their own chemical feeders. Contractor shall provide connection points for chemical feeders. Refer to installation.

2.07 BUFFER TANK

- A. Quality Assurance: Buffer tanks shall be ASME Code constructed and stamped in accordance with Section VIII of the ASME Code B.
- B. Operating Pressure: Maximum 125 PSI operating pressure.
- C. Construction: Carbon steel tank with 2-inch expanded foam insulation and painted steel jacket.
- D. Piping Connections: Quantity of two flanged or NPT connections. Refer to equipment schedule for pipe connection sizes.
- E. Trim: Pressure relief valve.
- F. Warranty: Five years.

2.08 AUTOMATIC FLOW CONTROL VALVES (AFCV)

- A. General Requirements: Flow control valves shall be tamper proof, factory calibrated, automatic pressure compensating type. Each valve shall limit flow rates within a range of plus or minus 5 percent, regardless of system pressure fluctuations. Valve body material shall be suitable for the designed system piping requirements, with internal working parts of stainless steel construction. There shall be (2) body tapping's with P/T test ports for connection of flow measuring instrumentation. Provide valves with a metal tag, chain, and stamped for system identification. Automatic flow control valves shall be as indicated on Drawings.

2.09 FLOW MEASURING STATIONS

- A. General Requirements: Provide a venturi style water flow measurement device with stainless steel/carbon steel body at all branch piping and pumps. Standard rating of system shall be 250 psi and 250 degree F water.
 - 1. Contractor shall use a venturi type balance devices on piping 2" or larger and items which may vary in GPM volume. Some applications require a flow limiting valve or ball valve type isolation valves.
 - 2. All flow fittings shall be supplied with a permanently affixed tab listing size, model, rated GPM, and corresponding pressure drop.
 - 3. All flow devices shall have ports and/or quick connection for TAB readings.

2.10 BALANCE DEVICES AT TERMINALS

- A. General Requirements: Provide a pressure independent auto flow type balance device rated for 250 PSI and 250 degrees. These balance valves shall be used at terminals with 2" and smaller piping. The general intent is to use pressure independent balance devices and pressure dependent control valves.
 - 1. MPS requires a pressure independent auto flow type balance device on pipe 2" and under.
 - 2. All pressure independent balance devices shall have a permanently affixed tag listing size, rated GPM, rated pressure drop and hydronic component served.
 - 3. On pipe sizes above 2" an Automatic Flow Control Valve (AFCV) shall be used. In a three way valve application a manual balance valve (B & G Circuit Setter or equal) will be required on the bypass piping.
 - 4. All devices shall have ports and quick connection for TAB readings.

2.11 FLEXIBLE PUMP CONNECTORS - BRAIDED HOSE

- A. General Requirements - Water Piping: Flexible stainless steel Type 304 or better hose and braided cover with carbon steel ends. 2 1/2-inch pipe size and smaller shall be male nipples. 3-inch pipe size and larger shall be 150-pound ASA flanges. Pipe sizes up to and including 1 1/2-inch pipe shall be 12 inches long, 3-inch pipe shall be 18 inches long, 6-inch pipe shall be 24 inches long, and 8-inch pipe and over shall be 36 inches long.

- B. General Requirements - Freon Piping: Flexible bronze braided hose with copper ends for Freon.

2.12 NON-ELECTRIC THERMOSTATIC RADIATOR VALVES

- A. General Requirements: Provide non-electric radiator control valves rated for 200 psig, 58 psig closing pressure, and with union connections.
- B. Control Elements: 50 degree F to 80 degree F range with either a direct mount thermostat or remote sensor thermostat based on design.
- C. Valve Bodies: Straight valve and nipple nickel plated brass bodies.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Location: Install compression tanks and air separators where shown on Drawings.
- B. Unions - Hydronic: Install unions or flanges in pipe connections to equipment and where shown on Drawings and Details. Couplings shall serve as unions and disconnect points. Install air separators with unions on inlet and outlet.
- C. Dissimilar Metals: Wherever connections are made between dissimilar metals, non-conducting dielectric couplings and dielectric nipples shall be used; dielectric unions not allowed. Brass adapters and valves are acceptable.
- D. Strainers: Install strainers where indicated on Drawings of same size as pipe in which it is installed.
 - 1. Install drain valve with threaded outlet and cap for blow-down.
- E. Air Vents for Bladder Compression Tank: Provide Bell & Gossett, Model 107A, high capacity air vent on air separator. Provide Bell & Gossett, Model 7, air vent on expansion tank.
- F. Installation: Install compression tanks with a tank fitting and drain valve with hose end connection.
 - 1. When more than one tank is used, tanks shall be parallel connected at top and bottom, and valved to allow isolation of one while operating the other(s).
 - 2. Bladder tanks to be installed with a pressure anti-thermosiphon equalizing loop.
- G. Side Stream Filter Installation and Monitoring:
 - 1. Install filters in locations indicated on Drawings. Provide ball valves on each side of filter for maintenance of system.
 - 2. Install 50 micron filter prior to start-up of hot water/glycol and cooling water/glycol systems.
 - 3. Daily monitor and record the pressure drop through the filter.
 - 4. When the pressure drop increases by 15 psi above the initial pressure drop, remove and clean the cartridge with fresh water and reinstall.
 - 5. When the rate of filtration requires cartridge cleaning no more frequently than once a week, remove the 50 micron cartridges and install a set of 25 micron cartridges. Run system as in No. 4 above and repeat as necessary.
 - 6. When 25 micron cartridges require cleaning no more frequently than once a week (15 psi increase), turn over the system and unused cartridges to Owner.
 - 7. Instruct the Owner on the use of the system. After the initial cleaning of the water/glycol systems, the valves to the filters will be closed and the filters will be used only when solution is added to the systems or at seasonal start-up.
- H. Chemical Feeder
 - 1. Provide 3/4" valved take-off for future MPS installed chemical feeder.
 - 2. Take-off shall be Weldolet, nipple, ball valve, with plug.
- I. Balancing Valves and/or Automatic Flow Control Valves: Install pressure independent automatic flow control valves where indicated on the Drawings, with the flow rates as indicated.

1. Venturi or calibrated ball valves may not be substituted where pressure independent auto valves are specified.
- J. Flexible Connectors: Install a flexible connector at each pump outlet. Exercise special care to provide pipe alignment such that no offset from pump to pipe will occur in flexible connector.
 1. For braided hose install horizontally, where possible, on the equipment side of shut-off valves.
- K. Air Vents: Provide and install vents where indicated on Drawings and where required in piping installation.
 1. Manual Air Vents: Install air vent valves at the high point wherever drops occur in the direction of water flow, at the top of all supply risers and at the high points of return risers on all hydronic supply and return mains. Install air vent valves and drains in accessible location.
 - a. The high side of heating elements on all hot water radiation, hydronic coils, cabinet unit heaters, etc. to be piped complete with a $\frac{3}{4}$ inch by 4-inch high air chamber with a reducer at the top from which a ball valve with garden hose adapter with chain and cap is attached. Apollo Series 70-100-HC.
 2. Automatic Air Vent: Install automatic air vents at the top of supply risers and at the high point of return risers of hydronic supply and return mains where indicated. Air vent valve to be preceded by an isolation shut off valve. Extend drain line to an accessible location.
- L. Non-Electric Thermostatic Radiator Valves: Install non-electric radiation valves where indicated.

3.02 EQUIPMENT SCHEDULES

- A. Refer to Drawings for schedules.

END OF SECTION

SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories to furnish and install vibration isolation equipment for equipment specified in this Contract.

1.02 SUBMITTALS

- A. Shop Drawings: Contractor shall submit a Shop Drawing portfolio showing vibration isolators to be used, a schedule indicating units served, and type and number of isolators per unit for approval by Architect/Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers for Vibration Isolation Equipment: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
1. Mason Industries, Inc (Basis of Design)
 2. Iso-Flex
 3. Kinetics
 4. Vibration Eliminator Company
 5. VMC Group

2.02 VIBRATION ISOLATION EQUIPMENT

- A. Schedule: The following schedule of vibration isolation equipment is specified for reference with the type desired for each piece of equipment being noted under the equipment section.
1. Type A: Mason Industries Type C housed spring mounts with neoprene non-skid pad on bottom, minimum static deflection 3/4-inch and 0.8 ratio spring diameter to compressed height.
 2. Type B: Mason Industries Type SLFH free spring mounts with leveling adjustment, base plate with bolt holes, and a 1-to-1 horizontal-vertical constant, minimum static deflection of 1 inch and as called for, and 0.8 ratio of spring diameter to compressed height.
 3. Type C: Mason Industries Type N Neoprene-in-shear mounts, non-skid surface top and bottom, minimum static deflection 0.4 inch.
 4. Type D: Mason Industries Type ND double deflection mounts, non-skid surface top and bottom, minimum static deflection 0.4 inch.
 5. Type E: Mason Industries Type DNHS combination spring and double deflection neoprene hangers, minimum deflection 1.4 inch.
 6. Type F: Mason Industries Type HD hanger, double deflection neoprene unit, minimum static deflection 0.4 inch.
 7. Type G: Mason Industries Type W neoprene pad, 5/16 inch thick, with 50 pounds per square inch maximum loading.
 8. Type H: Mason Industries Type NLD structural steel fan and motor base with integral motor slide rail, supported by a double deflection neoprene mount. Structure shall be rigid enough so as to prevent distortion on drive side and eliminate the requirement of vertical snubbers. Minimum static deflection 0.4 inch.
 9. Type I: Mason Industries Type SLF structural steel fan and motor base with integral motor slide rail, supported on Type SL bare springs with a 1-to-1 horizontal-vertical constant, structure shall be rigid enough to eliminate the use of any vertical snubbers and prevent drive distortion. Minimum static deflection 1 inch.
 10. Type J: Mason Industries Type SLR multiple spring mounts with leveling adjustment, snubbers, base plate with neoprene acoustical isolation pads and (4) bolt holes, hot-dip galvanized and minimum static deflection 3/4 inch, and 0.8 ratio spring diameter to compressed height.

11. Type K: Mason Industries Type 30 angularity spring hanger with neoprene seat, minimum deflection 0.8 inch.
- B. Pumps and Motor Bases:
 1. Units Above Grade: Mount pumps on floors above grade over 5 horsepower and provide with Mason Industries, Type K, bases constructed of 6-inch channels with 1/2-inch reinforcing rods welded in place 6 inches on center both ways, 1 1/2 inches above bottom with height saving brackets and Mason Industries Type SLF vibration isolators with 1 1/2-inch deflection anchored to floor and brackets. Pour frame solid with concrete and locate anchor bolts for pump in pour.
 2. Units on Grade: Mount pumps located on grade on thickened concrete floor slab, top 4 inches above floor with 1/2-inch rubber expansion joint material between floor and perimeter of pump concrete pad. Pump assembly base shall have 5/8-inch thick by 3-inch wide neoprene waffle pad at all points of contact between pump base and concrete.
- C. Floating Vibration Isolation Bases: Vibration isolator manufacturer shall furnish rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. Bases shall be not less than 6 inches in depth.
 1. Forms shall include minimum concrete reinforcement consisting of 1/2-inch bars or angles welded in place on 6-inch centers, running both ways in a layer 1 1/2 inches above the bottom.
 2. Forms shall be furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fall in concrete locations.
 - a. Bases shall be furnished with concrete poured into forms and cured on-site.
 3. Height saving brackets shall be employed in all mounting locations to maintain a 1-inch clearance below the base. Bases shall be equal to Mason Industries Type K or Owner approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Application: Meet requirements of manufacturer's instructions for installation and load application to vibration isolation materials and units.
 1. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points.
 2. Remove space blocks and similar devices intended for any temporary protection against overloading during installation.
 3. Anchor and attach units to structure and equipment as required for secure operation and to prevent displacement by normal forces.
 4. Adjust leveling devices as required to distribute loading uniformly onto isolators.
 5. Shim units where leveling devices cannot be used to distribute loading properly.
- B. Motor Isolation: Install vibration isolators for mechanical motor-driven equipment.
- C. Floating Vibration Isolation (Inertia) Bases: Install inertia bases of type and thickness, and isolators of type and static deflection as indicated.
 1. Set steel bases for 1-inch clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2-inch clearance.
 3. Adjust equipment level.
- D. Spring Isolators:
 1. Provide spring isolators on piping connected to isolated equipment as follows:
 - a. 3- to 4-Inch Diameter: First (3) points of support.
 - b. 5- to 8-Inch Diameter: First (4) points of support.
 - c. 10-Inch Diameter and Over: First (6) points of support.
 2. Static deflection of first point shall be twice deflection of isolated equipment.

END OF SECTION

**SECTION 230555
PENETRATION SEALANTS FOR HVAC SYSTEMS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories required to furnish and install through-penetration firestop systems at wall, floor and roof openings.
- B. Refer to Division 07 84 00 Fire Stopping

1.02 SUBMITTALS

- A. Instructions: Submit manufacturer's instructions for applying sealant.
- B. Certification:
 - 1. Submit manufacturer's certifications that materials meet or exceed specified requirements.
 - 2. Submit documentation of manufacturer's acceptance of applicator.
 - 3. Provide certification stating that sealant has been completed in full accordance with requirements to provide necessary fire-resistance ratings.
 - 4. Provide (3) copies of certified test reports of:
 - a. Fire test reports of sealant application to substrate materials shall be similar to project conditions.
 - b. Reports from reputable independent testing agencies of product proposed for use, indicating conformance with ASTM E814.

1.03 QUALITY ASSURANCE

- A. Qualifications: Applicator shall be acceptable to sealant manufacturer.
- B. Regulatory Requirements:
 - 1. State Building Code Division (Most Current Edition)
 - 2. State Mechanical Code (Most Current Edition)
 - 3. Local Codes and Ordinances (Most Current Edition)
 - 4. Local Authority having jurisdiction

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Bio-Fireshield, Inc.
 - 2. Carborundum Company
 - 3. Dow Corning Corporation
 - 4. General Electric Company, Silicone Products Division
 - 5. Metalines Industries
 - 6. Nelson Electric, a Unit of General Signal Corporation
 - 7. Rectorseal Corporation
 - 8. 3M Company
 - 9. Tremco, Inc.

2.02 MATERIALS

- A. Description: Penetration sealant shall be a single component ceramic fiber based putty fill, void or cavity material fire barrier caulk, putty strip, and sheet forms.
- B. Applications: Flame Spread/Smoke Contribution shall be 0/0 in accordance with ASTM E84. Underwriters' Laboratories rated material classified for use in Through-Penetration Firestop Systems shall be used for, but not limited to, the following:
 - 1. Metal Pipe: UL rated material classified for use in Through-Penetration Firestop System.
 - 2. Pneumatic Tubing; carborundum material is not acceptable in this application.

3. Glass Pipe / Plastic PVC / CPVC / Polypropylene; UL rated material for use in through-penetrations firestop system; carborundum material is NOT ACCEPTABLE in this application.
4. Ductwork: Vertical and horizontal ductwork passing through floors and fire rated walls shall have space between duct and sleeve filled with an approved, fire rated caulk.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 1. Confirm compatibility of surfaces to receive sealant materials. Verify that openings are sound, clean, dry, and ready to receive application of sealants. Verify that penetration elements are securely fixed and properly located, with a minimum of 1/2-inch space between penetrations and surfaces of openings. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

- A. General Requirements: Protect adjacent surfaces and equipment from damage. Clean contact surfaces of dirt, dust, grease, oil, loose material or other matter which may affect bond of sealant. Remove incompatible materials which affect bond by scraping, brushing, scrubbing, or sand blasting.

3.03 MOCK-UP

- A. General Requirements: Apply one seal on representative substrates on-site for each fire rating required at each type of wall, floor and roof construction. Confirm requirements of fire ratings.
 1. Application shall be in accordance with Project requirements as to thickness and density to achieve fire rating.
- B. Acceptance: Product and application shall be approved by governing authorities prior to continuing with the Work.
 1. Approved mock-up may remain as part of the completed Work.

3.04 APPLICATION

- A. General Requirements: Apply sealant in strict accordance with manufacturers' instructions. Apply sealant in sufficient thickness to achieve required rating. Pack material solidly around penetrations, and fill openings to a depth of 1 inch or in accordance with scheduled fire ratings. Sealing shall allow for expansion, contraction and mechanical vibration. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: Perform inspection to verify that work is in accordance with requirements. Correct unacceptable work and provide further inspection to verify that work meets requirements.

3.06 CLEANING

- A. General Requirements: Remove excess material, drippings, and debris. Remove sealant from materials and surfaces not specifically required to be sealed.

3.07 PROTECTION

- A. General Requirements: Protect applied sealant from damage.

END OF SECTION

SECTION 230700 HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment and accessories for the installation of thermal and acoustical insulation for heating, and air conditioning piping and ductwork in strict accordance with insulation section of the Specifications and applicable Drawings.
 - 1. For chilled water systems, insulate piping and fittings, including cooling control valve bodies and union fittings up to unit coil connection. Omit insulation on buried piping unless otherwise indicated and pre-insulated equipment.
 - 2. For hot water heating systems, insulate piping and omit insulation on unions, flanges, strainers, check valves, balance valves, control valve bodies, buried piping, unless otherwise indicated and pre-insulated equipment.
 - 3. Insulate ventilation, heating, air conditioning, and exhaust ductwork and fittings, as specified or indicated on Drawings.

1.02 SUBMITTALS

- A. Shop Drawings: Contractor shall submit a list of insulation to be used prior to beginning any application work.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. General Requirements: Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. State Building Code (Most Current Edition)
 - 2. State Energy Code (Most Current Edition)
 - 3. State Mechanical Code (Most Current Edition)
 - 4. Local Codes and Ordinances (Most Current Edition)
 - 5. Local Authority having jurisdiction

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Johns Manville (Basis of Design)
 - 2. Armaflex/Armacell/Imcoa
 - 3. CertainTeed
 - 4. Knauf
 - 5. Owens-Corning
- B. Insulation Materials: Insulation materials manufacturing facilities must be certified and registered with an approved Registrar for conformance with ISO 9000 Quality Standard.
- C. Fire and Smoke Hazard Ratings:
 - 1. Insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E84, NFPA 255, and UL 723 not exceeding:
 - a. Flame Spread 25
 - b. Smoke Developed 50
 - 2. Accessories, including adhesives, mastics, cement tapes, glass fabric, and fire resistant cloth for fittings, shall have the same component ratings as listed above.

3. Products or their shipping cartons or packages shall bear a label indicating that flame and smoke ratings do not exceed above requirements. Stencil duct liners with "MEETS 90A REQUIREMENTS".
4. All insulation used for mechanical systems shall have the name of the manufacturer, the thermal resistance R-value at the specified installation thickness, and the flame spread and smoke-developed ratings of the composite materials.

2.02 MATERIALS

- A. Jackets and Facing Descriptions: AP high intensity white kraft bonded to aluminum foil, reinforced with fiberglass yarn. Kraft to be permanently treated for fire and smoke safety, and to prevent corrosion of foil. Beach puncture 50 ox. in./in./year, tensile strength 35 pounds per inch width, Mullen Burst 70 psi, perm rating 0.02 perm. AP-T shall be a factory applied self-seal system and may be used at the Contractor's option.
 1. FSK reinforced foil and paper (Foil Scrim Kraft). Aluminum foil, minimum 0.75 mil thick, reinforced with fiber glass yarn mesh and laminated to 40-pound chemically treated fire resistant Kraft, UL rated.
 2. Dura Mesh glass fabric shall be white resin coated 10 by 10 mesh.
 3. PVC pipe jacketing and fitting covers, high-impact, white, 20 mil, UV resistant PVC jacketing and preformed fitting covers applied with waterproof adhesive, all components meeting the 25/50 fire and smoke hazard ratings. Johns Manville Zeston 2000 with Perma-Weld adhesive.
- B. Inserts: Install insulation inserts at outside hangers and supports for piping 1 1/2 inches and larger. Inserts between the pipe and pipe hangers shall be of equal thickness to the adjoining insulation and insulation saddles, and shall be provided with a vapor barrier. Insulation inserts shall be as manufactured by Pipe Shields Incorporated, Insul-Shield Uni-Grip or Johns Manville Thermo 12/Gold. Shield shall be installed between hanger and insulation on all piping.

PIPE SIZE	"INSULATION" INSERTS NOT LESS THAN THE FOLLOWING LENGTHS	SHIELD LENGTH	MINIMUM GAUGE
LESS THAN 1-1/2 INCHES	C	10 INCHES	26
1-1/2 INCH TO 2-1/2 INCHES	10" LONG	12 INCHES	24
3 INCHES TO 6 INCHES	12" LONG	14 INCHES	20
8 INCHES TO 10 INCHES	16" LONG	18 INCHES	16
12 INCHES AND OVER	22" LONG	24 INCHES	16

1. At hanger and support points for insulated piping, install an insert around the lower 1/3 circumference. Shields shall overlap inserts 1 inch on each side.
2. Insulation shields shall be installed between insulation and pipe hangers for all pipe sizes.
- C. Glass Fiber Insulation: Johns Manville "Micro-Lok" AP-T, meeting ASTM C547 or Owner approved equal, having average thermal conductivity not exceeding 0.23 btu per inch per square foot per degrees F per hour at mean temperature of 75 degrees F.
- D. Flexible Foam Insulation: Rubatex R-180-FS tubing insulation been compounded to meet the indicated flame spread and smoke density rating.
 1. Insulation thicknesses of 3/8, 1/2, and 3/4 inch, tested independently, shall have a maximum fire/smoke rating of 25/50. Other thicknesses are rated at 25/100.

- E. Flexible Cellular Polyolefin Foam: (Imcoa - ASTM C534)
1. Insulation: Imcoa, Imcolock with pre-slit longitudinal seam with each mating surface adhesive coated and protected with a mylar release liner.
 - a. No external vapor barrier jacket shall be required if the water vapor permeability is 0.01 perm inch or less. Insulation which is UV stabilized can be exposed to sunlight and weathering without any special paint coating. The insulation can be directly buried underground without any protective jacket if the manufacturer warrants its underground use.
 2. Description: Imcolock shall meet requirements of ASTM C534, UL 94HBF, UBC42-1 Class I, ASTM E84 25/50, NFPA 255, UL 723.
 - a. 24 at 75 degrees F
 - 1) .26 at 90 degrees F
 - b. ASTM E96 (0.0) Zero perm inch
 - c. -110 degrees F
 - d. 210 degrees F
 - e. ASTM E84 25
 - f. ASTM E84 50
 - g. Contains no potential corrosive constituents associated with stress corrosion failure of copper tubing.
 - h. Piping System Temperature Range
 - 1) -110 degrees +210 degrees
 - 2) -110 degrees +210 degrees
 - 3) 32 degrees +210 degrees by Insulation Manufacturer
- F. Polyisocyanurate Insulation:
1. Insulation: Closed-cell polyisocyanurate thermal Insulation in accordance with ASTM C591. Maximum thermal conductivity of 0.19 btu per inch per square foot per degrees F per hour at 75 degrees F mean temperature (0.027 W/C C) with a nominal density of 2.0 lbs/ft3 with a service temperature of minus 300 degrees F to plus 300 degrees F. Factory/field applied PVDC vapor retarder film and tape as recommended by insulation manufacturer with protective jacketing if required. Permeance of vapor retarder film will be less than 0.02 perm for applications above 32 degrees F and less than 0.01 perm for applications below 32 degrees F. When service temperature is above ambient, vapor retarder is not required. Permeance of vapor retarder tape will be less than 0.03 perm for applications above 32 degrees F and less than 0.02 perms for applications below 32 degrees F. When service temperature is above ambient, vapor retarder is not required.
 - a. Adhesive: As recommended by insulation material manufacturer.
 - b. The Dow Chemical Company:
 - 1) Polyisocyanurate Thermal Insulation:
 - (a) Vapor Retarder Film: Saran*540, Saran*560
 - (b) Vapor Retarder Tape: Saran*520, Saran*560
- G. Cellular Glass Insulation:
1. Insulation shall be cellular glass insulation manufactured in accordance with ASTM C552, "Standard Specification for Cellular Glass Thermal Insulation" by Pittsburgh Corning Corporation, or equal.
 2. Weather Barrier Mastic – PITTCOTE 404 Coating by Pittsburgh Corning Corporation, or equal.
 3. Joint Sealant – PITTSEAL 444N Sealant or PITTSEAL 727 sealant or equal.
 4. Tape shall be 0.75" wide fiber reinforced tape such as Scotch #880 or equal
 5. For buried conditions, apply PITTWRAF CW PLUS jacketing, 50 mil thick self-sealing polymer modified bituminous reinforced with a glass fabric and 1 mil aluminum top film and release backing.

- H. Hot Equipment Insulation: Insulate surfaces with Johns Manville No. 814 Spin-Glass meeting ASTM C612, 3-pound density fiberglass board or Roxul RXL 30A, 3-pound density mineral wool board.
- I. External Duct Insulation:
 - 1. Fiber Glass Blanket Insulation: Where fiber glass blanket insulation is called for, insulate rectangular ducts, oval ducts, and round ducts with Johns Manville Type 100 w/FSK 1 pound density fiber glass blanket with foil scrim kraft vapor barrier facing or Owner approved equal. Insulation shall have a conductivity not to exceed 0.27 Btu per inch per square foot, per degrees F, per hour at 75 degree F mean temperature.
 - 2. Fiber Glass Board Insulation: Where fiber glass board insulation is called for, neatly insulate duct as follows: Insulate rectangular ducts with 3-pound density fiberglass board with all-purpose vapor barrier jacket, Johns Manville 814 Spin-Glass AP, or FSK, or Owner approved equal. Insulation shall have a conductivity of 0.23 Btu per inch per square foot per degrees F per hour at mean temperature of 75 degrees F.

PART 3 - EXECUTION

3.01 PIPING SPECIALTIES REQUIREMENTS

- A. General Requirements: Insulation shall be applied on clean, dry surfaces. Contractor shall clean and prepare all surfaces to be insulated prior to application.
 - 1. Insulation shall be continuous through wall and ceiling openings and sleeves.
 - a. Where insulated pipe passes through a fire rated wall, ceiling or floor, insulation shall stop at fire barrier face and start at opposite side. On chilled water piping, the insulation shall carry through the sleeve with no unsealed joints.
 - 2. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal. Hangers, supports, and anchors that are secured directly to cold surfaces shall be adequately insulated and vapor-sealed by cementing pieces of vapor barrier over and around same.
 - 3. Provide closed cell foam insulation on exposed pipe hangers/rods below 7 feet above finished floor, except in tunnels and crawl spaces.
- B. Fittings, Expansion Joints, Valve Bodies, Strainers, and Flanges: Insulate elbows, tees, and valves with Johns Manville Zeston 2000 system of premolded PVC fittings and fiberglass inserts installed in accordance with manufacturer's instructions. Fittings may be insulated with 3/4-pound Microlite blanket compressed to 1/2 the thickness of adjoining pipe covering and secured with 3-ply jute twine or mitered pipe insulation segments secured with 3-ply jute twine and finished with Ryder's Thermokote No. 1 cement. After cement is dry, finish fittings with (2) coats Benjamin Foster 30-36 reinforced with Dura-Mesh or 6 ounce canvas overlapping adjacent jacket.

3.02 INSULATING PIPING

- A. General Requirements: Insulate piping with Johns Manville Micro-Lok AP-T jacketed fiberglass, IMCOA insulation or Owner approved equal as indicated.
 - 1. Seal jacket laps and end laps with Insul-Cooustic 215 or Owner approved equal mastic applied to (2) surfaces.
 - 2. Piping run in walls shall be fully insulated.
 - 3. Piping shall be insulated up to coil headers of all equipment, unless noted otherwise.
 - 4. Insulation shall allow access to balance devices in a fashion which does not compromise vapor barrier.
 - 5. Exposed piping with insulation shall have PVC shield and Aluminum Jacket where subject to damage.

- B. Pool AHU Condenser Water and Glycol Chilled Water Piping Insulation in Return Air Plenums: Insulation shall be continuous up to coil headers (equipment drain pans). Supply and return piping shall be insulated with fiberglass or flexible cellular polyolefin foam insulation in accordance with the following schedule:

PIPE SIZE	THICKNESS
THROUGH 1-1/2 INCH	1 INCH THICK
2 INCH AND OVER	1-1/2 INCH THICK

- C. Pool AHU Condenser Water and Glycol Chilled Water Piping Insulation in Non-Return Air Plenums (Mechanical Rooms and Tunnels, Crawl Spaces or Exterior of Building): Insulate supply and return piping with closed-cell polyisocyanurate insulation in accordance with the following schedule:

PIPE SIZE	THICKNESS
THROUGH 1-1/2 INCH	1 INCH THICK
2 INCH AND OVER	1-1/2 INCH THICK

- D. Pool AHU Condenser Water and Glycol Chilled Water Piping Insulation at Exterior of Building: Insulate supply and return piping in its entirety and to 5 feet inside of the building with cellular glass insulation in accordance with the following schedule:

PIPE SIZE	THICKNESS
2 INCH AND OVER	3 INCH THICK

- E. Chilled Water Piping Glycol Chilled Water Piping Insulation underground: Insulate supply and return piping in its entirety and to 5 feet inside of the building with cellular glass insulation in accordance with the following schedule:

PIPE SIZE	THICKNESS
2 INCH AND OVER	3 INCH THICK

- F. Air Conditioning Drain Lines Insulation: Insulate drain lines not in mechanical equipment rooms with fiberglass or flexible cellular polyolefin foam insulation in accordance with the following schedule:

PIPE SIZE	THICKNESS
THROUGH 1 INCH	1/2 INCH THICK
1-1/4 INCHES	3/4 INCH THICK
1-1/2 INCHES THROUGH 8 INCHES	1 INCH THICK

- G. Heat Recovery Piping and Pool Heating Piping Insulation Schedule: Supply and return piping shall be insulated with fiberglass or flexible cellular polyolefin foam in accordance with the following schedule:

FLUID TEMP 141 THROUGH 200 DEGREES	
PIPE SIZE	THICKNESS
THROUGH 1 INCH	1-1/2 INCH THICK
1-1/4 INCHES THROUGH 2 INCHES	1-1/2 INCH THICK
2-1/2 INCHES THROUGH 6 INCHES	1-1/2 INCH THICK
8 INCHES AND OVER	1-1/2 INCH THICK
FLUID TEMP 105 THROUGH 140 DEGREES	
PIPE SIZE	THICKNESS
THROUGH 1 INCH	1 INCH THICK
1 INCH THROUGH 1-1/4 INCHES	1 INCH THICK
1-1/2 INCHES THROUGH 6 INCHES	1-1/2 INCH THICK
8 INCHES AND OVER	1-1/2 INCH THICK

- H. Humidifier, Glycol Hot Water Heating Supply and Return Piping and Radiator Piping Insulation: Insulation pipe and fittings shall be complete up to coil headers of mechanical units unless noted otherwise. End of strainers with plug shall not be covered. Pipe insulation shall be fiberglass in accordance with the following schedule:

PIPE SIZE	THICKNESS
THROUGH 1-1/4 INCH	1-1/2 INCH THICK
1-1/2 INCH AND OVER	2 INCH THICK

- Hot water supply and return piping in radiator covers shall not be insulated unless noted otherwise on Drawings.

3.03 INSULATING DIRECT EXPANSION REFRIGERANT PIPING

- Insulation: Insulate refrigerant suction and hot gas line piping with flexible cellular polyolefin foam pipe insulation.
- Exterior Insulation: Insulate refrigerant suction, liquid line, and hot gas piping, exposed to weather, or below grade, with flexible cellular polyolefin foam insulation. Provide a PVC jacket on the piping that is exposed to weather. In lieu of flexible cellular polyolefin foam insulation, Contractor may use HT/Armaflex insulation.
- Fittings: Insulate sweat type fittings with flexible cellular polyolefin foam insulation of same size as that used on adjacent tubing.
 - Bond slit and butt joints with flexible cellular polyolefin foam insulation adhesive (Fuse-Seal).
 - Insulate screwed type fittings with sleeves of aerotube having an inside diameter large enough to overlap the insulation of adjacent tubing or pipe.
 - Sleeves shall be made by cementing (2) miter-cut pieces of larger size flexible cellular polyolefin foam together.

- D. Application: Bond joints and butt ends with adhesive by applying to both surfaces. Press both surfaces together after adhesive is non-tacky to touch.
- E. Direct Expansion Refrigerant Piping Insulation Schedule:

PIPE SIZE	THICKNESS
THROUGH 1-1/2 INCH	1 INCH THICK
2 INCH AND OVER	1-1/2 INCH THICK

3.04 PROTECTION OF PIPE INSULATION EXPOSED TO WEATHER

- A. Piping insulation shall be protected from damage, including damage from sunlight, moisture, equipment maintenance, and wind, and shall provide shielding from solar radiation to deter degradation of the material. Adhesive tape shall not be permitted. Piping insulation shall comply with both the following requirements:
1. Insulation exposed to weather shall be suitable for outdoor service and shall be protected by aluminum, sheet metal, painted canvas, plastic cover, or similar materials. Cellular foam insulation shall be protected as above and
 2. Unless the insulation is vapor-retardant, insulation covering chilled-water piping or refrigerant suction piping located outside the conditioned space shall include vapor retardant located outside the insulation. All penetrations and joints shall be sealed.

3.05 CHILLED WATER PUMPS, SIDE STREAM FILTERS, AND CHILLED WATER SYSTEM AIR SEPARATORS

- A. General Requirements: Equipment housings shall be insulated using 1-inch thick Rubatex sheet insulation cut to fit contour of housing and adhered to pump housing.
1. Low temperature systems (less than 32 degrees F) shall be insulated with 1 1/2-inch thick flexible elastomeric foam insulation.

3.06 INSULATING COIL HEADERS

- A. General Requirements: Insulate exposed heating and cooling coil headers at air handling units with 1-inch thick, 3-pound density fiberglass board boxed over return bends with all-purpose covering overlapping sheet metal 2 inches and secured with adhesive glass cloth tape.
- B. VAV box coil headers shall be insulated with external duct insulation.

3.07 INSULATING HOT WATER STORAGE TANKS, BOILER FEED WATER HEATERS, AIR SEPARATORS, CONDENSATE RECEIVERS, FUEL OIL HEATERS, SIDE STREAM FILTERS, AND CONVERTORS

- A. Thermal Insulation Schedule: Insulate the above hot equipment with fiberglass board or mineral wool board insulation in accordance with the following schedule:

TEMPERATURE	THICKNESS
150 DEGREES F	2 INCHES
200 DEGREES F	3 INCHES
250 DEGREES F	3-1/2 INCHES
300 DEGREES F	4-1/2 INCHES
350 DEGREES F	5 INCHES (2 LAYERS)

1. Insulation shall be cut, scored or mitered to fit contour of equipment with edges tightly butted and secured with 1/2-inch by 0.015-inch galvanized steel bands or 18 gauge galvanized wire on 12-inch centers. Welded pins and clips may be used on flat surfaces, if approved. Stagger joints where possible.

2. Over insulation, apply 1-inch galvanized hexagonal mesh wire tightly secured and finished with a heavy coat of mineral fiber cement.
3. When cement is dry, apply a 6 ounce canvas jacket with suitable adhesive.

3.08 INSTALLATION APPLICATION - EXTERNAL DUCT INSULATION

A. Fiber Glass Blanket Insulation:

1. Apply insulation with edges tightly butted and secured over mastic adhesive applied in 6-inch wide strips around full perimeter of duct on 18-inch centers. Ductwork larger than 16 inches wide shall have welded pins and clips applied to bottom of duct on 15-inch centers holding insulation to duct.
2. Insulation joints shall have both edges buttered with mastic, lapped not less than 2-inch width, and firmly adhered together.
3. Staples may be used to hold adhesive joints while drying. Vapor barrier shall not have open penetrations.
4. Ductwork 16 inches and smaller may be less welded pins and clips, but shall have 2-inch wide adhesive tape applied on 4-foot centers completely around duct with 4-inch overlap at ends. Vertical ductwork and sides of duct 36 inches and greater shall have welded pins and clips on bottom third of duct on 18-inch centers.
5. Round ducts greater than 16-inch diameter shall have welded pins and clips on bottom third of duct on 18-inch centers, with 4-inch wide glass fiber tape glued over joints and ends stapled. Round ducts 16 inches and smaller may be less pins and clips, but shall have 4-inch overlap at ends.

B. Fiber Glass Board Insulation:

1. Apply insulation with edges buttered with mastic and tightly butt and impale over welded pins and secure with clips. Space pins to hold insulation securely in place, but not over 18 inches on center. Seal joints with 4-inch wide glass cloth vapor barrier tape, permanently glued in place, ends stapled.
2. Insulate exposed round and oval ducts similar as concealed ducts, unless otherwise indicated.

INTERNAL DUCT INSULATION IS SPECIFIED IN SECTION 23 33 00, AIR DUCT ACCESSORIES.

SUPPLY AND RETURN DUCTWORK EXPOSED TO THE WEATHER IS SPECIFIED IN SECTION 23 31 13 AS SINGLE WALL DUCT WITH EXTERIOR RIGID INSULATION AND BUTTON PUNCH TYPE STANDING SEAM ALUMINUM JACKET.

3.09 EXTERNAL DUCT INSULATION SCHEDULE

- A. Schedule: Provide insulation on the following ductwork systems as indicated:

Type of Duct System	Type of Insulation	Density
HVAC Ductwork: Supply ductwork (heated and cooled air) shall be externally insulated from air handling unit to air outlet.	Fiber glass blanket insulation in concealed areas. Fiber glass board insulation in exposed areas.	1 pound 3 pound
HVAC Ductwork: Return ductwork in non-return air plenum shall be externally insulated from air handling unit to air outlet.	Fiber glass blanket insulation in concealed areas. Fiber glass board insulation in exposed areas.	1 pound 3 pound

Heat Pump Ductwork: Round and rectangular supply (heated and cooled air) and return heat pump duct work shall be externally insulated as indicated on Drawings.	Fiber glass blanket insulation in concealed areas. Fiber glass board insulation in exposed areas.	1 pound 3 pound
Exhaust Ductwork: Vertical ductwork from roof penetrations to drip pans, drip pans, and exhaust/relief louver plenums shall be externally insulated. If horizontal ductwork is not internally lined, provide external insulation for 15 feet from drip pan. (See separate article in this Section for Kitchen exhaust ductwork insulation).	Fiber glass blanket insulation in concealed areas. Fiber glass board insulation in exposed areas.	1 pound 3 pound
Relief Ductwork: Shall be externally insulated for 15 feet from roof opening or louver.	Fiber glass blanket insulation in concealed areas. Fiber glass board insulation in exposed areas.	1 pound 3 pound
Energy Recovery Unit Supply Ductwork: Ductwork shall be externally insulated from energy recovery unit supply outlet to air handling unit mixing box. (Note: All ductwork exposed to weather shall be double-wall ductwork. Refer to Section 23 31 13.)	Fiber glass board insulation.	3 pound
Outside Air Ductwork: Outside air Ductwork shall be externally insulated from intake hood/louver to the air handling unit mixing box.	Fiber glass board insulation.	3 pound
Mixed Air Ductwork: Mixed air ductwork shall be externally insulated. Insulated Duct Exposed to Outdoors: SA, RA, and exhaust duct systems exposed to outdoors are required to be protected with an aluminum protective jacket over the insulation with offsetting standing seam type construction. Aluminum jacket gauge shall meet SMACNA and mechanical codes.	Fiber glass board insulation.	3 pound

Location of Duct System	Supply Duct Requirements	Return Duct Requirements	Exhaust and Relief Duct Requirements
Exterior of Building	R-12, V and W	R-12, V and W	R-12, V and W
Attics, Garages, and Ventilated Crawl Spaces	R-12, V	R-12, V	R-6, V
Temperature Difference Greater than 40F	R-5, V	None	R-5,V
Temperature Difference Greater than 15F and Less Than or Equal to 40F	R-3.3, V	None	R-3.3,V
Within Concrete or Within Ground	R-3.5,V	R-3.5, V	None
Within Conditioned Spaces	None	None	None
Temperature Difference Less than or Equal to 15F	None	None	None

V = Vapor retarder required in accordance with the MN Mechanical Code. When a retarder is required, duct insulation required by this section shall be installed without respect to other building envelope insulation

W = Approved weatherproof barrier

B. General Requirements:

1. External duct insulation shall be omitted where double wall duct construction is used and where internal lining is used. See Section 23 31 13 of the Specifications.
2. Insulation shall cover sound attenuators if installed in ductwork.
3. Insulate supply, return, and exhaust ducts through unconditioned spaces: Attic Spaces, Non-Plenum Ceiling Spaces, and Non-Plenum Mechanical Rooms.
4. Insulate plenums and unit housings not pre-insulated at factory.
5. Exposed supply and return ductwork shall be uninsulated in these spaces: Auditorium, Gymnasium, Shop, and Stage.
6. When ductwork is located in an occupied area and it is below 7 feet above finished floor, except in tunnels and crawl spaces, provide closed cell foam insulation on ductwork.

END OF SECTION

**SECTION 230933
VARIABLE FREQUENCY DRIVES**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories necessary to furnish and install complete variable frequency motor drive controller consisting of a pulse width modulator inverter, for use on a standard NEMA Design B induction motor.
 - 1. Variable frequency systems shall be for continuous duty and shall be suitable for use on motors connected by power transmission components to HVAC equipment.

1.02 SYSTEM DESCRIPTION

- A. Performance Requirements: Variable frequency/speed drive controller shall be capable of accepting an electronic signal to determine quantity of air required and resultant frequency and voltage output to satisfy conditions.
 - 1. Unit shall require (1) incoming power connection. Wiring from VFD controller to motor shall be by Electrical Contractor (Division 26).

1.03 SUBMITTALS

- A. Shop Drawings: Provide a portfolio to include the following for approval by Architect/Engineer:
 - 1. Submit manufacturer's performance data, including dimensional drawings, customer connection drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's full load amp ratings, certification agency file numbers, and catalog information.

1.04 QUALITY ASSURANCE

- A. Qualifications: It is required that the drive manufacturers shall have the following:
 - 1. A sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
 - 2. An independent service organization
 - 3. A parts stocking depot local to installation site
- B. Factory Tests: To ensure quality and minimize infantile failures at the jobsite, complete VFD shall be tested by manufacturer. VFD shall operate a dynamometer at full load, and load and speed shall be cycled during test.
 - 1. Optional features shall be functionally tested at the factory for proper operation.
 - 2. Optional features shall be factory mounted, wired, tested, and complete with UL or ETL listing as an assembled package.
- C. Regulatory Requirements:
 - 1. State Building Code
 - 2. Local Codes and Ordinances
 - 3. Local Authority having jurisdiction
- D. Testing:
 - 1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. VFD shall then be subjected to a preliminary functional test, minimum 8-hour burn-in, and computerized final test. Burn-in shall be at 104 degrees F (40 degrees C), at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Allen Bradley, Power Flex 400 Series
 - 2. ABB, ACH 550

- B. Acceptable Manufacturers for Packaged Variable Speed Drive Controller: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
1. Allen Bradley, Power Flex 400
 2. ABB, ACH 550

2.02 VARIABLE FREQUENCY INVERTER

- A. General: System shall be complete variable frequency drive as specified herein for the fans and air handling units scheduled at the end of this section. Both the standard and optional features shall be included within the VFD enclosure, unless otherwise specified.
1. VFD enclosure shall be NEMA 1 and not exceed 12 inches in width.
 2. Provide a lockable input disconnect switch to aid in VFD service. This disconnect shall function as the motor disconnect when in sight of the motor.
 3. Each VFD vendor shall review the 1-line power distribution drawing(s), included for reference with the Mechanical Drawings, and calculate the voltage and current distortions induced by all the VFDs at full speed.
 - a. If the THD (Total Harmonic Distortions) exceed the IEEE 519 Guidelines of 5 percent voltage THD and 20 percent current THD as calculated, the VFD vendor shall include the necessary harmonic mitigation equipment sufficient to reduce the THD to the allowable level.
- B. Converter Section: The VFD shall include a converter and inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage.
1. Each VFD shall include input line reactors of a minimum 1.5 percent impedance.
- C. Inverter Section: The inverter section of the VFD shall invert the DC voltage from the converter into a quality output wave form, with adjustable voltage and frequency for stepless motor speed control. The VFD shall maintain a constant squared volt to Hertz ratio.
- D. Modulation Range: The VFD shall convert 3 phase, 60 Hertz utility power to adjustable voltage and frequency, 3 phase power for stepless motor speed control from 10 percent to 100 percent of the motor's 60 Hertz speed. Input voltage shall be 460 volts.
- E. Tests: The VFD and options shall be tested to ANSI/UL Standard 508. The complete drive, including all specified options, shall be listed by a nationally recognized testing agency such as UL or ETL.
- F. Carrier Frequency: The VFD out carrier frequency shall be field adjustable from 1 KHz to 12 KHz.
- G. Noise Limitations: The motor noise as a result of the VFD shall be limited to the 3 db above across the line operation over the audible range of frequencies, measured at 3 feet from the motor's center line.
- H. Ampacity: The VFD's full load amp rating shall meet or exceed NEC Table 430-150 for a specified horsepower.
- I. Protective Features:
1. Individual motor overload protection for each motor controlled.
 2. Protection against input power under-voltage, over-voltage phase loss.
 3. Protection against output current overload and instantaneous over-current.
 4. Protecting against over-temperature within the VFD enclosure.
 5. Protection against over-voltage on the DC bus.
 6. Protect VFD from sustained power or phase loss. Under-voltage trip activates automatically when line voltage drops more than 10 percent below rated input voltage.
 7. Programmable to automatically reset faults due to under-voltage, over-voltage, phase loss or over-temperature.
 8. Protection against output short circuit and motor winding shorting to case faults, as defined by UL 508.
 9. Status lights or digital display for indication of individual fault conditions.

10. Controller capable of operating without a motor or any other equipment connected to the drive output to facilitate start-up and troubleshooting.
 11. VFD shall be programmable for incoming job site power.
- J. Interface Features:
1. Door mounted Hand/Off/Auto selector switch to start and stop the VFD. In the auto position, the VFD will start/stop from a remote contact closure. In the hand position, the VFD will run regardless of the remote contact position.
 2. Manual speed control capability by keypad.
 3. Local/remote selector switch. In the remote position, motor speed is determined by the follower signal. In the local position, motor speed is determined by the manual speed control.
 4. Power/on light to indicate that the VFD is receiving utility power.
 5. Fault light to indicate that the VFD had tripped on a fault condition.
 6. Digital meter with selector switch to indicate percent speed, percent load, and output amps.
 7. A set of Form-C, dry contacts to indicate when the VFD is in the run mode.
 8. A set of Form-C, dry contacts to indicate when the VFD is in the fault mode.
 9. A 4 to 20 mA or 0 to 10 VDC, output signal to vary in direct proportion to the controller's speed.
 10. VFD to have terminal strip to accept N.C. safety contacts such as freezestats, smoke alarms, etc. VFD to safely shut down in drive mode when contacts open.
 11. VFD to accept an additional N.C. contact to interface with the Hand/Off/Auto switch for remote stop/start control.
 12. VFD shall accept a 4 to 20 Ma, 0 to 5 VDC, or 0 to 10 VDC grounded or ungrounded signal.
- K. Adjustments:
1. Maximum speed, adjustable 0 to 100 percent base speed.
 2. Minimum speed, adjustable 0 to 100 percent base speed.
 3. Acceleration, time, adjustable 3 to 180 seconds.
 4. Deceleration time, adjustable 3 to 180 seconds with override circuit to prevent nuisance trips of deceleration time is set to short.
 5. Current time, adjustable 0 to 150 percent.
 6. Overload trip set point.
 7. Offset and gain to condition the input speed signal.
- L. Service Conditions:
1. Ambient temperature, 32 to 104 degrees F (0 to 40 degrees C)
 2. 0 to 95 percent relative humidity, non-condensing.
 3. Elevation to 3,300 feet (1,000 meters) with derating.
 4. AC line voltage variation, minus 10 percent to plus 10 percent of normal jobsite conditions.
- M. Special Features: The following special features shall be included in the VFD enclosure. The unit shall maintain its UL or ETL listing.
1. Manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line or from the line to the controller. The bypass circuitry shall be mounted in a separate section of the VFD enclosure. Motor overload protection shall be provided in both drive and bypass models.
 2. A door interlocked, pad lockable drive disconnect switch shall be provided to disconnect power from the VFD only.
 3. A second fused disconnect switch or circuit breaker shall be provided as a means of disconnecting all the power to both the VFD and bypass circuits, as well as providing short circuit and locked rotor protection to the motor while in the bypass mode.
 4. The disconnect and bypass functions may be accomplished via disconnects, contactors and overloads, or with a 4-position Drive/Off/Line/Test switch with motor starter and bypass fuses.

2.03 ARCHITECTURE/COMMUNICATION

- A. General Requirements: The project shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between system controllers and workstations. Communications between system controllers and sub-networks of custom application controllers and/or application specific controllers shall utilize BACnet/MSTP (RS485) communications.
 - 1. Each system controller shall perform communications to a network of custom application and application specific controllers using BACnet/MSTP (RS485) as prescribed by the BACnet standard.
 - a. Each system controller shall function as a BACnet router to each unit controller providing a unique BACnet device ID for all controllers within the system.
 - 2. For the minimum points to be mapped to the BMS by BACnet, refer to the BMS point list. As part of the Shop Drawing submittal for this equipment, indicate confirmation of the minimum points by BACnet and provide a list of additional points that are available.

PART 3 -EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Contractor shall verify that jobsite conditions for installation meet factory recommended and code required conditions for VFD installation prior to start-up. These shall include as a minimum:
 - 1. Clearance Spacing.
 - 2. Temperature, Contamination, Dust and Moisture of Environment.
 - 3. Separate Conduit Installation of Motor Wiring, Power Wiring, and Control Wiring
 - 4. Installations per Manufacturer's Recommendations.
- B. Equipment Protection: The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

3.02 INSTALLATION

- A. Power: Electrical Contractor shall make a single, 208 or 460 volt, 3 phase, 60 Hertz connection for each VFD to a power source and from each VFD to its respective motor.
 - 1. Contractor shall make provisions for Temperature Control Contractor to furnish, install, and connect an electronic sensor/controller to control the VFD output.
 - 2. Contractor shall coordinate all wiring with the Electrical Contractor to ensure that all input power, output power, and control wiring are in separate conduits for each VFD.
- B. Control: Transformers, transducers, and voltage/phase reducing devices shall be incorporated in the variable frequency drive motor control NEMA 1 panel.
- C. Panel Location: Variable frequency drive motor control NEMA 1 panel shall be free standing or surface mounted as shown on Drawings, Panel location shall be coordinated with the Electrical Contractor to meet the requirements of NEW and local codes for motor service.

3.03 START-UP SERVICE

- A. Commissioning: The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services.
 - 1. The commissioning personnel shall be the same personnel that will provide factory service and warranty repairs at the customer's site.
 - a. Only factory certified technicians for drive field repair shall be acceptable as commissioning agents.
- B. Start-Up: Start-up services shall include checking for verification of proper operation and installation for the VFD, its options, and its interface wiring to the BMS. Included in the service, as a minimum, shall be:
 - 1. Verification of Contractor wire terminations to the VFD and its optional circuitry.

2. Installation verification and coordination with the related Contractors for proper operations and reliability of the VFD, the motor being driven, and the BMS.
3. Up to (1) hour of customer operator training on operation and service diagnostics at the time of the equipment commissioning.
4. Measurement for verification of proper operation on each of the following items:
 - a. Motor voltage and frequency. Verification of proper motor operation.
 - b. Control output from proper BMS interface and control calibration.
 - c. Calibration check for the following set points and adjustments:
 - 1) Minimum Speed
 - 2) Maximum Speed
 - 3) Acceleration and Deceleration Rates
 - d. Vendor shall file a report to Architect/Engineer verifying conformance with paragraph above Part 2 in reference to Total Harmonic Distortion.

3.04 WARRANTY

- A. **Description: The VFD shall be warranted by the manufacturer for a period of 24 months from the date of startup. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide authorized on-site service.**
 1. **The motor(s) which are directly connected to the VFD shall be warranted by the VFD manufacturer against insulation breakdown which is directly attributed to the VFD. The length of the motor insulation warranty shall be the same as the VFD warranty.**
 - a. **If a motor has been driven by another VFD, it shall void this portion of the warranty.**

END OF SECTION

**SECTION 232123
HYDRONIC PUMPS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Include labor, materials, equipment, and accessories to furnish and install pumping equipment and make connections to systems served. Note: chiller pumps to be part of the chiller skid and furnished with the chillers. Secondary pumps to be part of a modular mechanical room pump house package with all related components as scheduled and shown on plans. The pump house has been pre-ordered for Phase 1 by the district and will be delivered to site for contractor installation.
- B. Description of Work:
 - 1. Extent of HVAC pumps required by this Section are indicated on Drawings and Schedules, and by requirements of this Section
 - 2. Types of pumps specified in this Section include the following:
 - a. Frame Mounted End Suction
 - 3. Pumps furnished as part of factory fabricated equipment are specified as part of equipment assembly in other Division 23 sections.
 - 4. Refer to Division 26 sections for the following work; not work of this Section:
 - a. Power Supply Wiring From Power Source to Power Connection On Pumps; include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed, by manufacturer
 - b. Interlock Wiring Between Pumps, and Between Pumps and Field Installed Control Devices
 - c. Interlock Wiring; specified as factory installed is work of this Section

1.02 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacture of general-use centrifugal pumps with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. HI Compliance: Design, manufacture, and install HVAC pumps in accordance with HI "Hydraulic Institute Standards".
 - 2. UL Compliance: Design, manufacture, and install HVAC pumps in accordance with UL 778, "Motor Operated Water Pumps".
 - 3. UL and NEMA Compliance: Provide electric motors and components, which are listed and labeled by UL and which meet NEMA Standards.
 - 4. Applicable Standards (Modular Mechanical Room)
 - ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process. Manufacturer Qualifications: Firms regularly engaged in manufacture of general-use centrifugal pumps with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
 - ASTM E 72 – Standard Test Methods for Conducting Strength Test of Panels for Building Construction.
 - ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Wall by Uniform Static Air Pressure Difference.
 - ASTM E 1646 – Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
 - ASTM E 1680 – Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems
 - FM 4880 – Class 1 Fire Rating of Insulated Wall, Ceiling and Roof Panels.

AAMA 501.1 – Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure.

ASTM A 792 – Standard Specification for Steel Sheet, Aluminum-Zinc Alloy Coated Steel by the Hot-Dip Process.

ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's pump specifications, installation, and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated. Provide modular mechanical room drawings and calculations stamped by a professional engineer registered in the state of project location. Outline drawings shall include structural loading requirements. provide exterior elevation drawings, base plan, bill of materials, wall, roof and floor construction details and general arrangement of all equipment with required clearances.
- B. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to HVAC pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of pump, control, and accessory, including troubleshooting maintenance guide. Include this data, Product Data, Shop Drawings, and wiring diagrams in maintenance manual in accordance with Section 01 33 00.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Handling: Handle HVAC pumps and components carefully to prevent damage, breaking, denting, and scoring. Do not install damaged HVAC pumps or components; replace with new.
- B. Storage: Store HVAC pumps and components in a clean, dry place. Protect pumps from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Unloading: Meet manufacturer's rigging and installation instructions for unloading HVAC pumps and moving them to final location.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers for Modular Mechanical Room pump house: (Pump House will be furnished by owner)
 - 1. ProPak Solutions (Basis of Design)
 - 2. Approved Equal (Must submit Documentation for approval)
- B. Acceptable Manufacturers for Flex-Coupled Base Mounted Pumps: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Bell & Gossett (Basis of Design)
- C. Acceptable Manufacturers for Close Coupled Pumps: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Bell & Gossett (Basis of Design)
- D. Acceptable Manufacturers for Suction Diffusers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
 - 1. Bell & Gossett (Basis of Design)
 - 2. Armstrong
- E. Triple Duty Valves: Triple duty valves should not be used. Individual components shall be used.

2.02 MATERIALS AND EQUIPMENT

- A. Condition: Pumps and related equipment shall be as specified and scheduled in Part 3 of this Section.

- B. Nameplates: Each major item of equipment shall have a standard nameplate securely affixed in a conspicuous place showing the serial number and the manufacturer's name and address. In addition, the nameplate for each pump shall show the capacity in gallons per minute at rated speed as the minimum information required by NEMA MG 1-10.38.
- C. Guards: Provide 20 gauge galvanized steel guards over belt drives, drive shafts, and couplings with 16 gauge galvanized 3/8-inch mesh over belts and large areas. Guards shall have angle iron bracing and angle iron supports bolted to floor or equipment. Guards over pump and motor shafts and couplings shall be easily removable for checking and servicing.
- D. Motor Driver: Motor driver shall be selected in accordance with the pump's non-overloading performance characteristics. Motor horsepower rating shall be chosen in keeping with the pump's possible peak horsepower requirements. In sizing the motor, the maximum brake horsepower may not exceed the motor's nominal nameplate rating.
 - 1. Motor shall be mounted with pump on baseplate at pump manufacturer's plant and shipped out as (1) unit.
- E. Seals: Internally flushed seals shall be mechanical type glycol seal, suitable for continuous operation with a temperature range of minus 20 degrees F to plus 250 degrees F, and a pH range of 7 to 12.5, for applications up to a 50 percent glycol, 50 percent water concentration. The seals shall be capable of being serviced without disconnecting the pump from piping.
- F. Impellers: Provide material and labor to shave impellers after initial balance report on pumps with no speed adjustment, and larger than 10 horsepower motors.
- G. Pumps: Provide factory tested pumps, thoroughly cleaned, and painted with (1) coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed in pump schedule. Provide pumps of same type by same manufacturer.

2.03 MODULAR MECHANICAL ROOM ENCLOSURE CRITERIA AND FABRICATION REQUIREMENTS - FURNISHED BY OWNER

- A. All materials will be new and shall be listed by a nationally recognized testing laboratory in every case where listings have been established for the materials. All materials shall bear the name of the manufacturer and shall be of the quality specified.
- B. The work shall be done by skilled craftsmen working under competent supervision, using the best installation practices of the trade.
- C. **Base Frame and Floor (SKID)**
 - 1. The basic structural design of the skid (base frame and floor) shall be suitable for unit installation with no visible distortion on raised concrete or steel columns, located at a maximum of 8-foot intervals. Deflection across the span shall be limited to L/360.
 - 2. The skid shall be structurally rigid for equipment support and provided with removable lifting and jacking attachments for lifting each module during transportation and installation.
 - 3. The basic structural design of the skid (base frame and floor) shall be suitable for unit installation with no visible distortion on raised concrete or steel columns, located at a maximum of 8-foot intervals. Deflection across the span shall be limited to L/360.
 - 4. The skid shall be structurally rigid for equipment support and provided with removable lifting and jacking attachments for lifting each module during transportation and installation.
 - 5. Welded shop connections are to be welded in accordance with AWS D1.1. Intermittent design fillet welded connections shall receive a 1/8" seal weld. All field connections shall be bolted.
 - 6. Structural steel members such as W-beams or channels shall be coated to prevent corrosion.
 - 7. The interior flooring shall be solid 1/4" inch minimum steel plate of non-slip diamond type.

D. Fabrication - Building

1. The structural frame of the building shall consist entirely of:
 - a. Horizontal and vertical wall members, wall headers, rafters, vertical corner posts & penetration framing - ASTM A500 HSS structural tube steel with a minimum thickness of 11ga
 - b. Base Channel - ASTM A36 hot rolled plate of 1/8" minimum thickness sheared and formed to per project drawing
2. Welded shop connections are to be welded in accordance with AWS D1.1. Intermittent design fillet welded connections shall receive a 1/8" seal weld.
3. Structural steel members shall be coated to prevent corrosion and provide an easily washable surface.
4. The wall shall be assembled from UL listed galvanized steel insulated metal panels (IMP's) manufactured by Falk or equivalent mfg.
 - a. Female ends of each panel shall be affixed to the structural steel frame at all horizontal member locations. Panels shall also be through fastened at all wall header locations with a minimum on center spacing of 24". Panel joints shall be designed and fabricated to preclude the ingress of sand, dirt, water, etc., and to prevent loss of air conditioned. All visible panel joints shall be hidden fastener construction. Riveted joints, when required, shall use 3/16" structural HUCK type aluminum rivets. Self-tapping hot dip galvanized or stainless-steel sheet metal screws with washer and neoprene grommet are also acceptable. All visible screws and washers shall be color coated to match panels. Corner plates shall be provided as required to provide rigid water and dust-tight assembly.
 - b. IMP's shall be of a minimum 3" thickness and comprised of minimum thickness 24ga galvanized steel inner and outer skins with male/female lock and groove joint assembly. Skins will be free from defects and protected with a Kynar (PFVD) coating or other colorfast equivalent with a minimum warranty of 20yrs.
 - c. The core of the IMP will be composed of either Class 1 Polyurethane (PUR) or Class 1 Polyisocyanurate (PIR). Minimum insulation density shall be 2.64lb/ft³.
5. The roof deck shall be constructed of structural insulated metal ribbed roof panels of a minimum 3" thickness laid across A500 HSS structural tube rafters. These panels are comprised of minimum thickness 24ga galvanized steel inner and outer skins with male/female lock and groove joint assembly. skins will be free from defects and protected with a Kynar (PFVD) coating or other colorfast equivalent with a minimum warranty of 20yrs. The core of the IMP will be composed of either Class 1 Polyurethane (PUR) or Class 1 Polyisocyanurate (PIR). Minimum insulation density shall match that of wall panels
6. Interior walls shall be the interior facing steel skin of the Falk IMP's. All interior panel faces shall be White in color.
7. The roof shall be weatherproofed by one of the following systems per project requirement:
 - a. Top Shield Pro #85 White Silicone Coating (or equivalent)
 - b. 60mil thermoplastic polyolefin roofing (TPO) by Genflex (or equivalent mfg) Either system shall be installed by experienced, certified installers working under competent supervision, using the best installation practices of the trade.
8. Indoor lighting shall be controlled by a switch located at the entrance.
9. Each means of egress shall have an egress fixture with battery backup.
10. The pitch of the roof shall be 1/2" per foot, unless otherwise requested by the client.

E. Doors:

1. Each building shall have an equipment door of sufficient size for all present and future equipment that will be installed in the building. All door and panel hardware shall UL Listed for the application.
2. Door leafs shall be double walled galvanized steel with a minimum thickness of 14ga and fastened to a knock down style frame. Frames shall be through-bolted to the walls using 1/4" bolts, EPDM backed washers and nylon lock nuts at a minimum 24" on center spacing.
3. Building doors shall be provided with panic hardware, keyed exterior lever type handles, bulb type weatherstripping, rain lip, door sweep & hydraulic closure with hold open feature.

F. Grounding

1. All electrical equipment shall be bonded and grounded per the NEC. All lighting panels, indoor and outdoor transformers, HVAC equipment, lighting fixtures, receptacles, major electrical equipment, etc. shall be grounded.
2. Ground conductors shall be sized per the NEC, but shall not be smaller to than No. 14 AWG.
3. The building shall have stainless steel ground pads on the outside four (4) corners of the building, which shall allow connection to the ground grid. Grounding conductors penetrating steel floors shall be installed in a cable fitting with a neoprene bushing.
4. All above ground connections shall be bolted type
5. Ground pads shall be provided with compression lugs for #2/0 - 4/0 AWG ground cables.

G. Lighting & Receptacles

1. Interior lighting shall be provided, (2) 5000 Lumen 4-foot LED fixtures. Internal lights shall be 120 Volt and shall be controlled by an interior wall mounted switch.
2. A minimum of two duplex, 120 Volt, 20 Amp, two-pole, three-wire GFI receptacles, shall be provided, one at each end, for the building interior. Additional receptacles shall be provided, such that, a fifty foot extension cord can reach any point inside the building.
3. Emergency lighting shall be provided by means of wall mounted, self-contained, battery powered emergency lighting units. These units shall consist of a battery, battery charger, inverter, solid state switch, indicator lamp, and test switch. A minimum of two directionally adjustable lamps shall be mounted on each unit.

H. HVAC

1. Buildings shall be provided with thermostatically controlled electric unit heater and ventilation fan and louver.

I. Mechanical Equipment

1. Mechanical equipment and piping package shall be pre-assembled and include all inter-connecting piping and wiring.
2. All interconnecting piping shall be as specified in the appropriate piping specification. All interior piping shall be factory-pressure tested for any leaks.
3. All power and control wiring shall be run in EMT conduit with set-screw fittings. Modular equipment room shall include wiring from VFDs to pumps, wiring between switches and lights, wiring to outlets. Div 26 shall bring wiring to pump house and connect to all required equipment, outlets and lights. Electrical and control wiring shall be factory-tested for continuity.

2.04 FLEX-COUPLED BASE MOUNTED PUMPS

- A. Type: Base mounted pumps shall be single stage, end suction centrifugal type of vertical split case design, of cast iron and bronze construction; designed, except where otherwise specified, to service internal components without disturbing pump volute or motor alignment.

- B. Pump Casing: Pump casing shall be close grained cast iron and shall be designed to permit replacement of wearing parts. Pump casings shall be of uniform quality and free from blow-holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects.
 - 1. Pump casing shall have gauge tappings at the suction and the discharge nozzles, and shall include vent and drain ports.
 - 2. Pumps shall be rated for minimum of 175 psi working pressure at 225 degrees F.
- C. Impellers: Impellers shall be of enclosed design and shall be constructed of bronze, carefully finished with smooth water passageways, and shall be statically and dynamically balanced. Impellers shall be securely keyed to the pump shaft. Provisions shall be made for vertical impeller adjustment at the top of the motor. Impellers on vertical-split case pumps shall be additionally secured with a self-locking nut. End size impellers shall be allowed only at the Architect/Engineer's option.
- D. Shaft: Shaft shall be of high grade steel accurately machined and shall be of sufficient size and strength to perform the work required. Provide bronze renewable shaft sleeves for protection of the shaft in contact with water or packing. Key shaft sleeves to the pump shaft.
- E. Drive: Couplings shall be of the heavy-duty flexible type, keyed and locked to the shaft.
 - 1. Coupling and drive shaft shall be covered with a factory installed pump guard.
- F. Balance: Rotating parts of equipment shall operate throughout the required range without excessive end thrust, vibration or noise.
- G. Bearings: Bearings shall be ball or roller type and the main bearings shall take all radial and end thrust with a minimum life of L10-200,000 hours. Pumps that depend only on hydraulic balance to overcome end thrust shall not be acceptable.
 - 1. Lubrication: Where applicable, provide grease type bearings with fittings for a grease gun.
- H. Base Plates: Provide centrifugal pumps with a common base for mounting each pump and driving unit of the pump on the same base. Construct each base of cast iron with a raised lip tapped for drainage, or of welded steel shapes with suitable drainage pan.
- I. Electric Motors: Each pump shall be driven by a continuous duty, open drip-proof electric motor. Refer to Section 23 05 13, Common Motor Requirements for HVAC Equipment, or the Equipment Schedule for voltage and rpm requirements. Refer to Section 23 05 13 for motor minimum efficiency.
 - 1. On pumps that have a variable frequency drive, provide factory mounted motor-shaft ground system. Motor shall be inverter duty type motor.

2.05 SUCTION DIFFUSERS

- A. General Requirements: Provide a suction diffuser at each base mounted pump indicated in schedule in Part 3 of this Section. Unit shall consist of an angle type body with straightening vanes and combination diffuser/strainer/orifice cylinder with 3/16-inch diameter openings for pump protection. Locate a permanent magnet within the flow stream which shall be removable for cleaning.
 - 1. Equip orifice cylinder with a disposable fine mesh strainer which shall be removed after pump start-up. Design orifice cylinder to withstand pressure differential equal to pump shut-off head, with a free area equal to 5 times the cross section area of pump suction opening.
 - 2. Furnish unit with adjustable support foot to carry weight of suction piping.

PART 3 - EXECUTION

3.01 INSPECTION

- A. General Requirements: Examine areas and conditions under which HVAC pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION OF PUMPS

- A. General Requirements: Install HVAC pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that HVAC pumps meet requirements and serve intended purposes.
- B. Access: Provide access space around HVAC pumps for service as indicated, but in no case less than that recommended by manufacturer. Motor bases shall be located for direct drive pumps that will permit motors to be removed without disturbing piping.
- C. Support: Install base mounted pumps on minimum of 4-inch high concrete base, equal or greater than (3) times total weight of pump and motor, with anchor bolts poured in place. Set and level pump; grout under pump base with non-shrink grout.
- D. Electrical Wiring: Install electrical devices furnished by manufacturer, but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- E. Operating Conditions: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- F. Fittings and Valves: Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 3 inches and over.
 - 1. Supply and return piping connections shall be as specified in Section 23 21 13.23, Aboveground Hydronic Piping, and shown on Drawings.
 - a. Do not use triple duty valves for this Project.
 - 2. Provide air cock and drain connections on horizontal pump casings.
 - 3. Provide drains for bases and seals, piped to and discharging into floor drains or floor sinks.

3.03 ADJUSTING AND CLEANING

- A. Alignment: Check alignment, and where necessary, realign shafts of motors and pumps within 0.005 inch and in the presence of manufacturer's service representative. Qualified millwright shall check, align, and certify base mounted pumps prior to start-up.
- B. Start-Up: Lubricate pumps before start-up. Start up in accordance with manufacturer's instructions. Mechanical Contractor shall inspect the strainer prior to start-up of pump and shall remove the fine mesh brass strainer after a short running period. Space shall be provided for removal of strainer and connection of blow-down valve.
- C. Balancing: Refer to Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, for pump system balancing; not work of this Section.
- D. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.04 MODULAR MECHANICAL ROOM BUILDING ENVELOPE PERFORMANCE CRITERIA

- A. **Structural Wall Performance**
 - 1. Structural Tests: The design load/deflection criteria shall be verified from tests per ASTM E 72 "Air Bag Method" using a 20 psf (.96 kPa) simulated wind load. A deflection limit of L/180 shall apply to all wall panels.
- B. **Thermal Transmission**
 - 1. Testing IAW ASTM C 518, "Measurement of Steady State Thermal Transmission", the panels shall provide a K-factor of .140 btu/sf/hr./deg. F at 75°F (24°C) mean temperature.

C. Vapor Barrier

1. Air Infiltration: Air infiltration shall not exceed .03 cfm per square foot of wall area when tested per ASTM E 283 at a static pressure of 1.57 psf (.075kPa).
2. Air Infiltration: Air infiltration shall not exceed .03 cfm per square foot of roof and floor area when tested per ASTM E 1680 at a static pressure of 1.57 psf (.075kPa).
3. Static Water Penetration: There shall be no uncontrolled water penetration through the wall panel joints at a static pressure of 6.24 psf (.30kPa) when tested per ASTM E 331.
4. Static Water Penetration: There shall be no uncontrolled water penetration through the roof panel joints at a static pressure of 6.24 psf (.30kPa) when tested per ASTM E 1646.
5. Dynamic Water Penetration: There shall be no uncontrolled water penetration through the panel joints when subjected to a 95 mph (153 kph) slipstream airflow and application of water for a 15 minute period per AAMA 501.1

D. Fire

1. Surface Burning Characteristics: The mineral wool core shall have been tested IAW ASTM E 84 and CAN/ULC S102 for surface burning characteristics. The core shall have a maximum flame spread of 0 and a maximum smoke developed rating of 5.
2. Surface Burning Characteristics: The insulated SIP roof panels shall have been tested IAW ASTM E 84 and CAN/ULC S102 for surface burning characteristics. The core shall have a maximum flame spread of 25 and a maximum smoke developed rating of 450.

E. Painted Finish

1. Coatings Manufacturer and applicator to warrant paint for a period of 20 years after the effective date. The factory applied panel finish applied by the applicator:
 - a. Will not chip, crack or peel (lose adhesion) but does not include minute fracturing which may occur in proper fabrication of building parts
 - b. Will not chalk in excess of ASTM D 4214-89 number eight (8) rating, determined by the procedure outlined in ASTM d 4214-89 specification test.
 - c. Will not change color more than five (5) Delta-E Hunter units (square root of the sum of the Delta L, Delta a, and Delta b) as determined by ASTM method D 2244. It is acknowledged that fading or color changes may not be uniform if the surfaces are not equally exposed to the sun and elements.

3.05 MODULAR MECHANICAL ROOM BUILDING INSTALLTION

- A. Installing contractor shall be responsible for setting and anchoring the modular mechanical room.
- B. Buildings located three feet or higher above finished grade shall have grated steel entrance platforms and stair treads including hand rails provided by installer.
- C. Installer shall flush and clean system piping upon completion of installation, in accordance with manufacturer's start-up instructions.
- D. All external piping shall be brought to building connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping.

3.06 EQUIPMENT SCHEDULES

- A. Refer to Drawings for schedules.

END OF SECTION

Expected Submittals to Support MPS Specifications for the Pump House:

1. Air Control Submittal
2. Check Valves Submittal
3. Chilled Water Pumps Submittal
4. Inertia Bases Submittal
5. Pump Accessories Submittal
6. Pump Flexible Connectors Submittal
7. Pump Flow Measuring Valve Submittal
8. Pump House Submittal
9. Pump Isolation Valve Submittal
10. Pump Side Stream Filter Submittal
11. Space Heater Submittal

Job/Project: Southwest High School Pump House		Representative: Nick Davis	
ESP-Systemwise: WIZE-6B92271E	05/29/2025	Phone: 651-686-8580	
Location/Tag: Minneapolis, MN	TAG: AS-1	Email:	
Engineer: ATS&R	Submitted By: Mulcahy Company		Date:
Contractor: ISD #1	Approved By:		Date:

Rolairtrol Air Separator Hot & Chilled Water

Bell & Gossett Model: RL-8F

The Bell & Gossett Rolairtrol is a patented air separator with significant advantages. The Rolairtrol is capable of removing the air that commonly causes problems in commercial hot and chilled water systems. The Rolairtrol provides air free flow, improving efficiency and performance of the HVAC system

Designed and constructed per ASME Section VIII, Division 1



Separator Selection

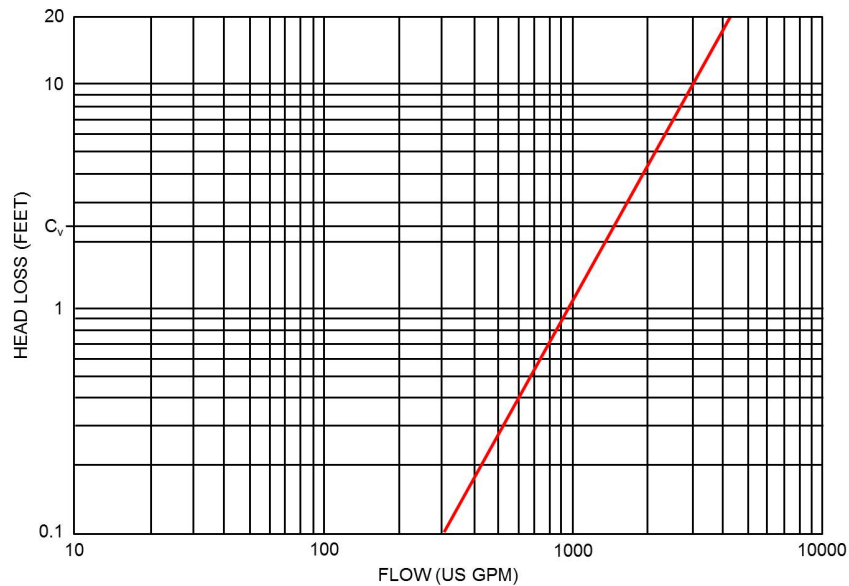
Model	RL-8F
Size	8.0 in
Recommended Max Flow	1900.0 gpm
ASME Certified	true
Pressure Drop @ Design Flow	0.0'
Shipping Weight	420.0 lbs
Flooded Weight	1171.0 lbs

Cv	1445.0
Design Flow	0.0 GPM
Type of Separator	Centrifugal, Without Strainer

Performance Coverage Chart:

RL-8F

RL-8F Rolairtrol Air Separator Performance Chart



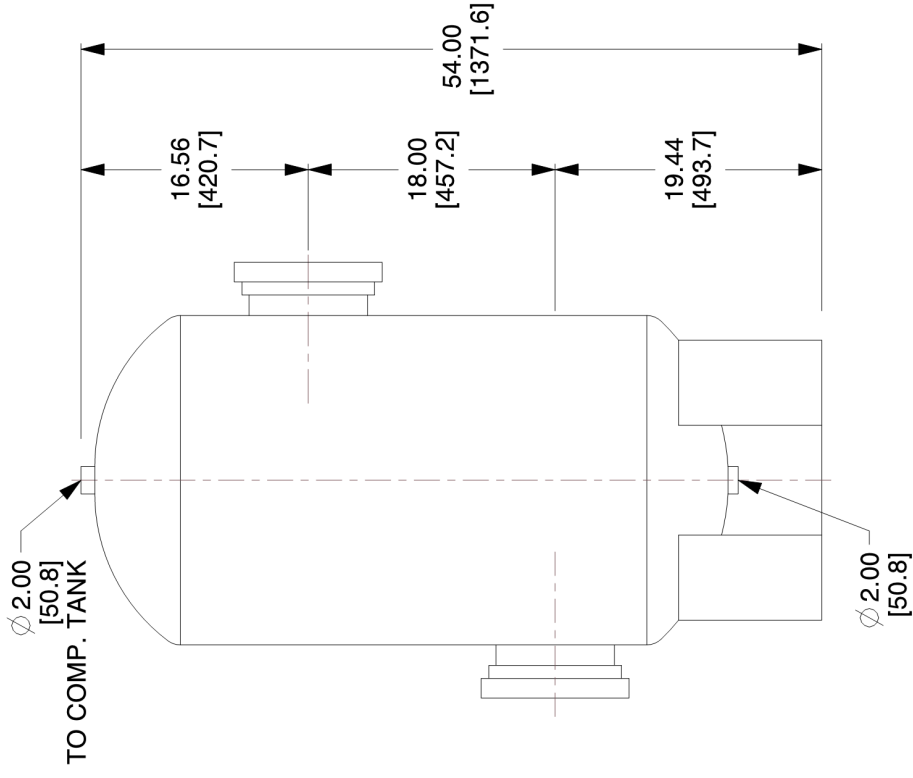
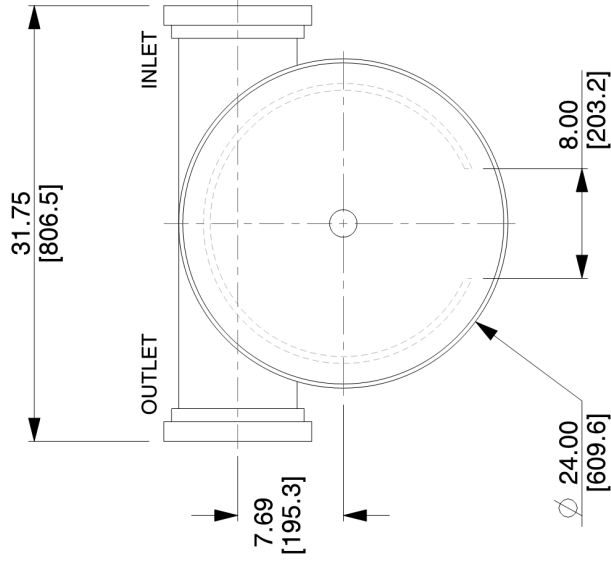
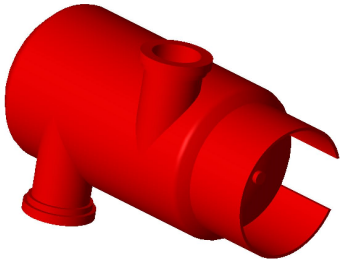
Materials of Construction

Body	Carbon Steel
------	--------------

Maximum Working Pressure

Max Working Pressure	125psig
Max Operating Temperature	350°F

Consult local rep for higher working pressures and temperatures.



8200 N. Austin Ave.
Morton Grove, IL 60053, USA

This drawing and the information depicted therein is the property of Xylem. Copies are issued in strict confidence and shall not be reproduced or copied, or used as the basis for the manufacture or sale of products without prior written permission of Xylem.

Dimensions are subject to change
Not to be used for construction unless certified

5363-08F-12-004

ROLAIRTROL Air Separator
Flanged Less Strainer Air Control and Elimination

Dimensions : INCH [MM] Scale : N.T.S. Approval :

JOB: Southwest High School Pump House

REPRESENTATIVE: Mulcahy Company

UNIT TAG:

ENGINEER: ATS&R

CONTRACTOR:

ORDER NO.

SUBMITTED BY: Nick Davis

APPROVED BY:

DATE:

DATE: 5-29-25

DATE:

ISD #1



Miscellaneous Accessories

DESCRIPTION

NO. 87, 67, and 7 AUTOMATIC AIR VENTS - are designed to vent the accumulation of troublesome air wherever it can be trapped. These non-ferrous automatic air vents are 4-3/4"x2-1/4", 3-3/16"x1-1/2", and 4-1/6"x2-3/16"(height and width), respectively, and are rated for a maximum operating temperature of 240°F at pressures of 150, 35, and 75 PSI, respectively. The No. 87 has a combination of 1/2" FPT / 3/4"MPT connection, whereas No's. 67 and 7 have 1/8" MPT and 1/8" FPT connections, respectively.

No. 26 VACUUM BREAKER - Designed to protect closed vessels and piping systems against collapse when the induced vacuum exceeds design conditions. When used on steam heating piping systems, the No. 26 Vacuum Breaker controls induced vacuum permitting normal return of condensate to the boiler. Adjustable range 1/4" to 20" (mercury) vacuum - 150 PSIG maximum working pressure - 300 °F maximum operating temperature (Factory set at 4" mercury).

No. 17 SR. AUTOMATIC AIR VALVE - No. 17 Sr. Valve is a deluxe, hygroscopic air valve with manual shut-off. 1/8" MNPT connection.

30 PSIG Working Pressure
225 °F Maximum Operating Temperature

No. 4V "COIN-OPERATED" AIR VENT - This vent is specially designed for the new types of radiators. A particular feature is that it projects only slightly, being almost flush with the radiator.

150 PSIG Working Pressure
250 °F Maximum Operating Temperature

NO. 107A HIGH CAPACITY AIR VENT - A rugged High Capacity Air Vent designed to purge free air from liquid systems at operating pressures up to 150 psig. The Model 107A Air Vent has a cast iron body and bonnet, with stainless steel, brass, and EPDM internal components and is suitable for a maximum operating temperature of 250°F. The Model 107A Air Vent has a 3/4" FNPT inlet and 3/8" FNPT outlet.

RV-125A READOUT VALVE AND RP-250B READOUT PROBE -

The RV-125A is designed for use wherever pressure tapings are required to monitor flow or pressures. This Readout Valve is fitted with an EPT insert which incorporates a unique check valve feature designed to check flow when the Readout Valve is not being used to monitor flow. Use companion RP-250B Readout Probes with the RV-125A Readout Valve. 300 PSIG working pressure - 250°F maximum operating temperature.

DT-2 DRAIN-O-TANK® AIR CHARGER - The Drain-O-Tank Air Charger offers a sure, quick way to recharge a water-logged compression tank.

125 PSIG Working Pressure
240 °F Maximum Operating Temperature

No. 97 Air Vent - is a float type automatic air vent that is designed to vent troublesome air from hydronic heating systems. The 97 vent has forged brass body and cap with non-ferrous internals. The vent is 3-1/8"x1-7/8" with a maximum operating pressure of 150 PSI and temperature of 240°F.

150 PSIG Working Pressure
240 °F Maximum Operating Temperature

No. 98 Air Vent - is a high capacity automatic air vent that is designed to remove air in closed systems. The No. 98 high capacity air vent has brass body and cap with non-ferrous internals. The vent is 4-1/2"x2-1/4" with 1/2" NPTF connection.

150 PSIG Working Pressure
250 °F Maximum Operating Temperature

SCHEDULE

MODEL NUMBER	PART NUMBER	PRODUCT	MAXIMUM WORKING PRESSURE PSIG	MAXIMUM OPERATING TEMPERATURE °F	TAGGING INFORMATION	QUANTITY
4V	113055	Air Vent	150	250		
67	113020	Automatic Air Vent	35	240		
7	113001	Automatic Air Vent	75	240		
87	113021	Automatic Air Vent	150	240		
107A	113076	High Capacity Automatic Air Vent	150	250	AS-1 ACCY	1
17 Sr.	113004	Automatic Air Valve	30	225		
26	113075	Vacuum Breaker	150	300		
DT-2	113041	Drain-O-Tank	125	240		
97	113222	Automatic Air Vent	150	240	ET-1 ACCY	1
98	113246	High Capacity Automatic Air Vent	150	250		
RV-125A	113100	Readout Valve	300	250		
RP-250B	113102	Readout Probe	300	250		

DIMENSIONS AND WEIGHTS

MODEL NUMBER	PART NUMBER	DIMENSIONS INCHES		CONNECTIONS INCHES NPT		APPROX. SHPG. WT. LBS.	
		WIDTH	HEIGHT	SIZE	TYPE	CARTON OF	TOTAL
4V	113055	5/8	5/8	1/8	M	48	2.0
67	113020	1-1/2	3-3/16	1/8	M	12	3.0
7	113001	2-3/16	4-1/16	1/8	F	12	6.0
87	113021	2-1/4	4-3/4	3/4 1/2	M F	12	8.0
107A	113076	4-1/2	9-5/8	3/4	F	1	10.0
17 Sr.	113004	13/16	1-1/4	1/8	M	12	2.0
26	113075	1-1/4	3	3/4	M	6	3.0
DT-2	113041	2-1/4	9-5/16	1/2	M	12	8.0
97	113222	1-7/8	3-1/8	1/8	M	10	4.0
98	113246	2-1/4	4-1/2	1/2	F	10	8.0
RV-125A	113100	1/2	1-3/32	1/8	M	50	4.0
RP-250A	113102	1/2	1-31/32	7/16	M	6	0.1

* All dimensions and weights are approximate and not to be used for construction, pre-piping or freight rating unless certified by Bell & Gossett in writing.

MATERIALS OF CONSTRUCTION

Body (all products except Model 107A High Capacity Air Vent): Brass

Body & Bonnet (Model 107A High Capacity Air Vent): Cast Iron

Internals: Nonferrous



Xylem Inc.
8200 N. Austin Avenue
Morton Grove, IL 60053
Phone: (847)966-3700
Fax: (847)965-8379
www.xylem.com/bellgossett

Bell & Gossett is a trademark of Xylem Inc. or one of its subsidiaries.
© 2021 Xylem Inc. A-338G R2 December 2021



Job Southwest High School Pump House

Representative Mulcahy Company

Unit tag ET-1

Order number

Date

Engineer AST&R

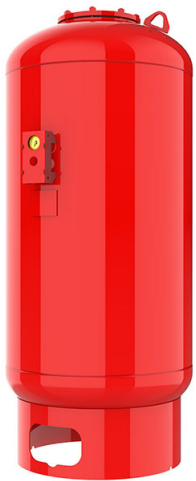
Submitted by Nick Davis

Date 5-29-25

Contractor ISD #1

Approved by

Date



Series "B" (ASME) Pressurized Expansion Tanks

Not for potable water systems

Series "B" expansion tanks are ASME rated precharged bladder-type pressure vessels. The Series "B" tank is designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The heavy duty bladder contains system water thereby eliminating tank corrosion and waterlogging problems. All Series "B" tanks include an integral bladder integrity monitor and are available with sight glass and/or seismic restraints.

Construction materials

System connection: Forged steel

Shell: Carbon steel

Bladder: Heavy duty butyl rubber, designed and constructed per ASME Section VIII, Division 1

Maximum operating limits

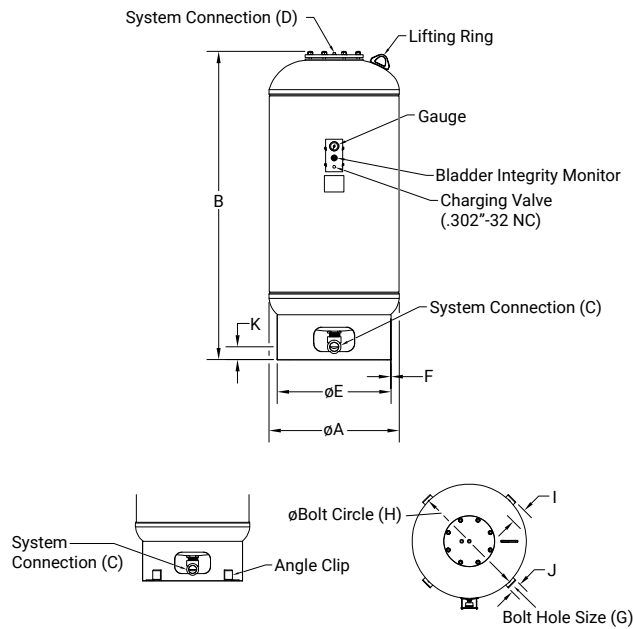
Maximum design pressure: 125 PSI (862 kPa)

Design temperature: 240°F (115°C)

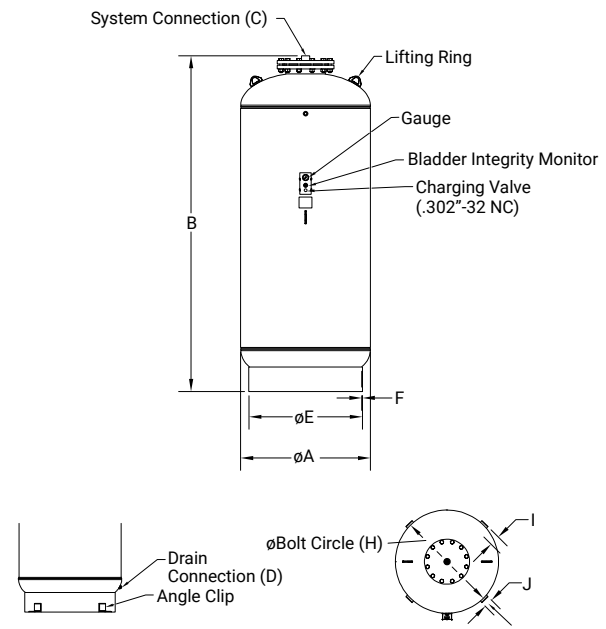
Schedule

Model no.	Part numbers				Tank and acceptance volume gal (L)	Tagging information	Quantity
	Pressurized expansion tanks	With sight glass	With seismic restraints	With sight glass & seismic restraints			
B200	116051	116070	116089	116108	53 (200)		
B300	116052	116071	116090	116109	80 (300)		
B400	116053	116072	116091	116110	106 (400)		
B500	116054	116073	116092	116111	132 (500)		
B600	116055	116074	116093	116112	158 (600)	ET-1	1
B800	116056	116075	116094	116113	211 (800)		
B1000	116057	116076	116095	116114	264 (1,000)		
B1200	116058	116077	116096	116115	317 (1,200)		
B1400	116059	116078	116097	116116	370 (1,400)		
B1600	116060	116079	116098	116117	422 (1,600)		
B2000	116061	116080	116099	116118	528 (2,000)		
B2500	116062	116081	116100	116119	660 (2,500)		
B3000	116063	116082	116101	116120	792 (3,000)		
B3500	116064	116083	116102	116121	925 (3,500)		
B4000	116065	116084	116103	116122	1,057 (4,000)		
B5000	116066	116085	116104	116123	1,321 (5,000)		
B7500	116067	116086	116105	116124	1,980 (7,500)		
B10000	116068	116087	116106	116125	2,640 (10,000)		
B15000	116069	116088	116107	116126	3,963 (15,000)		

Series “B” (ASME) pressurized expansion tanks



Models B200 thru B800



Models B1000 thru B15000

NOTES

Tanks are factory pre-charged at 40 PSI (276 kPa). Allow a minimum of 18" (457.2 mm) clearance for system piping. Sight glass and seismic restraints available. Tanks can be installed in the horizontal position with the gauge/bladder integrity monitor located above the horizontal centerline of the tank.

Dimensions and weights

Model	A in (mm)	B in (mm)	C FNPT (in)	D in (mm)	E in (mm)	F in (mm)	G in (mm)	H in (mm)	I in (mm)	J in (mm)	K in (mm)	Ship Wt. lbs (kg)	Flooded Wt.* lbs (kg)
B-200	24 (610)	43 (1,092)	1½	¾	20 (508)	0.14 (4)	⅞ (14)	22 (559)	2 (51)	2 (51)	5.25 (133)	210 (95)	651 (295)
B-300	24 (610)	55 (1,397)	1½	¾	20 (508)	0.14 (4)	⅞ (14)	22 (559)	2 (51)	2 (51)	5.25 (133)	225 (102)	891 (404)
B-400	30 (762)	49 (1,245)	1½	¾	24 (610)	0.14 (4)	⅞ (14)	27 (686)	3 (76)	3 (76)	5.25 (133)	300 (136)	1,183 (537)
B-500	30 (762)	57 (1,448)	2	¾	24 (610)	0.14 (4)	⅞ (14)	27 (686)	3 (76)	3 (76)	5.25 (133)	335 (152)	1,435 (651)
B-600	30 (762)	65 (1,651)	2	¾	24 (610)	0.14 (4)	⅞ (14)	27 (686)	3 (76)	3 (76)	5.25 (133)	360 (163)	1,676 (760)
B-800	32 (813)	76 (1,930)	2	¾	28 (711)	0.14 (4)	⅞ (14)	31 (787)	3 (76)	3 (76)	5.25 (133)	475 (215)	2,233 (1,013)
B-1000	36 (914)	76 (1,930)	1½	¾	30 (762)	0.14 (4)	⅞ (14)	33 (838)	3 (76)	3 (76)	N/A	552 (250)	2,751 (1,248)
B-1200	36 (914)	88 (2,235)	1½	¾	30 (762)	0.14 (4)	⅞ (14)	33 (838)	3 (76)	3 (76)	N/A	679 (308)	3,320 (1,506)
B-1400	36 (914)	100 (2,540)	1½	¾	30 (762)	0.14 (4)	⅞ (14)	33 (838)	3 (76)	3 (76)	N/A	688 (312)	3,770 (1,710)
B-1600	48 (1,219)	74 (1,880)	1½	¾	42 (1,067)	0.14 (4)	⅞ (14)	45 (1,143)	3 (76)	3 (76)	N/A	1,046 (474)	4,561 (2,068)
B-2000	48 (1,219)	86 (2,184)	1½	¾	42 (1,067)	0.20 (5)	⅞ (14)	45 (1,143)	3 (76)	3 (76)	N/A	1,150 (522)	5,548 (2,516)
B-2500	48 (1,219)	104 (2,642)	2	¾	42 (1,067)	0.20 (5)	⅞ (14)	46 (1,168)	4 (102)	4 (102)	N/A	1,444 (655)	6,942 (3,148)
B-3000	48 (1,219)	124 (3,150)	2	¾	42 (1,067)	0.20 (5)	⅞ (14)	46 (1,168)	4 (102)	4 (102)	N/A	1,658 (752)	8,255 (3,744)
B-3500	54 (1,372)	111 (2,819)	2	¾	42 (1,067)	0.31 (8)	⅞ (14)	46 (1,168)	4 (102)	4 (102)	N/A	1,868 (847)	9,573 (4,341)
B-4000	60 (1,524)	105 (2,667)	2	¾	54 (1,372)	0.31 (8)	⅞ (14)	58 (1,473)	4 (102)	4 (102)	N/A	2,238 (1,015)	11,043 (5,008)
B-5000	60 (1,524)	128 (3,251)	2	¾	54 (1,372)	0.31 (8)	⅞ (14)	58 (1,473)	4 (102)	4 (102)	N/A	2,617 (1,187)	13,621 (6,177)
B-7500	72 (1,829)	131 (3,327)	3	1	66 (1,676)	0.31 (8)	⅞ (14)	70 (1,778)	4 (102)	4 (102)	N/A	3,768 (1,709)	20,261 (9,189)
B-10000	72 (1,829)	162 (4,115)	3	1	66 (1,676)	0.31 (8)	⅞ (14)	70 (1,778)	4 (102)	4 (102)	N/A	4,628 (2,099)	26,619 (12,072)
B-15000	72 (1,829)	233 (5,918)	3	1	66 (1,676)	0.31 (8)	⅞ (14)	70 (1,778)	4 (102)	4 (102)	N/A	5,925 (2,687)	38,937 (17,659)

Dimensions subject to change. Not to be used for construction purposes. *Approximate weight 100% full occurs if bag fails or if air charge is lost.

Xylem
8200 N. Austin Avenue
Morton Grove, IL 60053

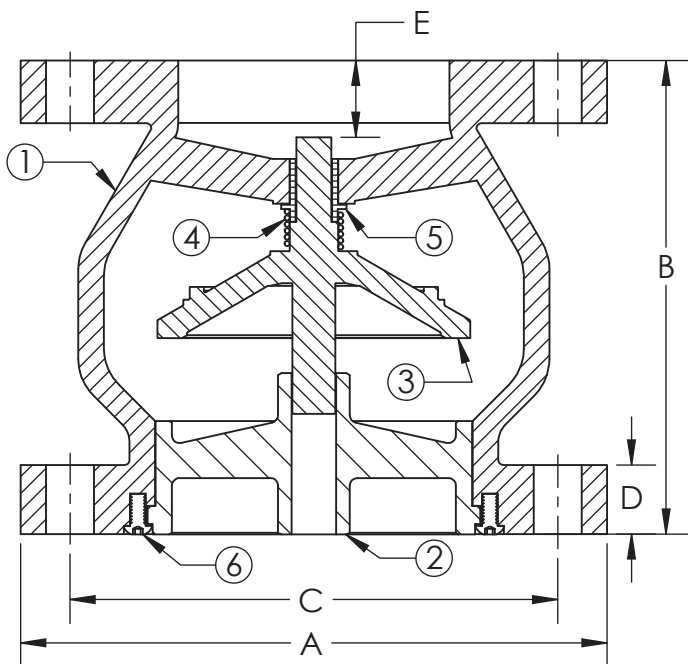
Tel +1 847.966.3700
Fax +1 847.965.8379
xylem.com/bellgossett

This information is subject to revision without notice. Users are responsible for evaluating suitability for specific applications. Xylem makes no implied warranties including without limitation warranties as to fitness for a particular purpose. Xylem makes no representation regarding the completeness or accuracy of this information and is not liable for any direct or indirect damages arising from or relating to this information or its use.

© 2025 Xylem Inc. or its affiliate. All rights reserved. Bell & Gossett is a trademark of Xylem or one of its subsidiaries.

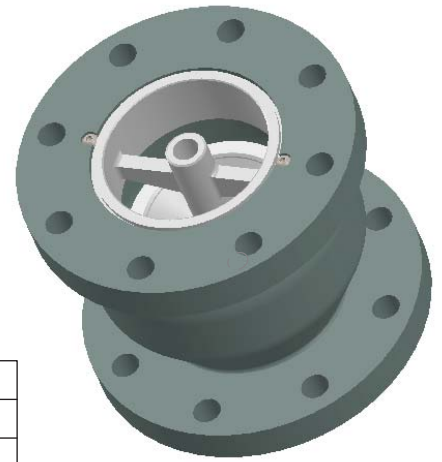
A-3421 March 2025

xylem
Let's Solve Water



MAX NON-SHOCK WORKING PSI

TEMPERATURE	PSI
150 °F	200
200 °F	190



NSF 372 - LEAD FREE

The wetted surface of this product contacted by consumable water contains less than one quarter of one percent (0.25%) of lead by weight. Material complies with state codes and standards, where applicable, requiring reduced lead content. Not suitable for potable water systems due to materials of construction.

ITEM	PART NAME	MATERIAL	ASTM NO.
1	BODY	CAST IRON	A126 CL. B
2	SEAT	STAINLESS	T304
3	PLUG	STAINLESS	T304
4	SPRING	STAINLESS	T304
5	BUSHING	STAINLESS	T304
6	SCREW	STAINLESS	T304



FOR ADDITIONAL FLOW STRAIGHTENING
SEE THE VANE FLEX AT
www.metralflex.com/vaneflex

Notes:

Valve is designed for liquid service only. Install 5 to 10 pipe diameters downstream from pump discharge or elbows to avoid flow turbulence. The intake side of CVO 900 series check valves must be mated to a ANSI B16.5 flat faced steel flange. The discharge side can be mated to a ANSI B16.5 flat face steel flange or a wafer style butterfly valve without the use of spools or adapters.

Valve complies with MSS-SP-125-2010.

2-1/2" valve trim is threaded into body.

Qty.	Part Number	Size I.D. (in)	A (in)	B (in)	C (in)	D (in)	E (in)	Cv*	Weight (Lbs)	Bolt Size (in)	Number Of Bolts
	CVOSS9025	2-1/2	7	5-1/2	5-1/2	11/16	1-3/16	110	20	5/8	4
	CVOSS903	3	7-1/2	6	6	15/16	1-3/8	155	26	5/8	4
	CVOSS904	4	9	7-1/4	7-1/4	15/16	1-3/4	278	44	5/8	8
	CVOSS905	5	10	8-1/2	8-1/2	15/16	2	435	56	3/4	8
3	CVOSS906	6	11	9-3/4	9-1/2	1	2-1/2	625	79	3/4	8
	CVOSS908	8	13-1/2	12-1/2	11-3/4	1-1/8	3-1/4	1115	137	3/4	8
	CVOSS910	10	16	15-1/2	14-1/4	1-3/16	4-1/4	1770	223	7/8	12

*Cv is the number of U.S. gallons/minute of 60 °F water that will flow through a valve with 1 PSI of pressure drop across the valve.

PROJECT INFO
TAG: CWP-4,5,6

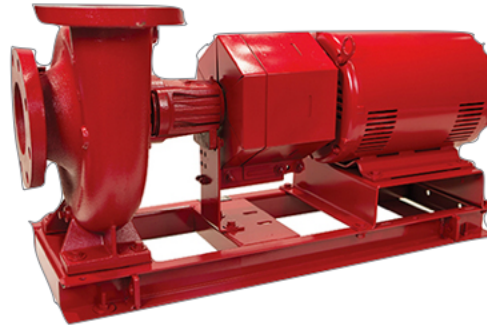
CUSTOMER: ISD #1
PROJECT: Southwest High School Pump House
ENGINEER: ATS&R

REV.	1	DRAWING REVISED	DATE 10/14/2013
2323 W. HUBBARD ST. CHICAGO, IL 60612 TEL: 312-738-3800 FAX: 312-738-0415 WWW.METRAFLEX.COM			
MODEL CVO900-125-10-SS 2.5" - 10" 125# GLOBE STYLE SILENT CHECK VALVE W/ SS TRIM			
DRAWN BY: DKISH		DATE: 8/27/2013	
APPROVED: JC		DATE: 8/27/2013	
SCALE: NONE		DRAWING NUMBER: CVO900-125-10-SS	

Job/Project: Southwest High School Pump House	Representative: Nick Davis	
ESP-Systemwize: WIZE-6B92271E	Created On: 05/29/2025	Phone: 651-686-8580
Location/Tag: CWP-4,5,6	Minneapolis, MN	Email:
Engineer: ATS&R	Submitted By: Mulcahy Company	Date:
Contractor: ISD #1	Approved By:	Date:

Base Mounted End Suction Pump**Series: e-1510****Model: 4GC****Features & Design**

ANSI/OSHA Coupling Guard
 Center Drop Out Spacer Coupling
 Fabricated Heavy Duty Baseplate
 Internally Self-Flushing Mechanical Seal

**Pump Selection Summary**

Duty Point Flow	515.0 US gpm
Duty Point Head	140.0 ft
Control Head	30.0 ft
Duty Point Pump Efficiency	75.2 %
Part Load Efficiency Value (PLEV)	0.0 %
Impeller Diameter	12.375 in
Motor Power	40 hp
Duty Point Power	28.7 bhp
Motor Speed	1800 rpm
RPM @ Duty Point	1770 rpm
NPSHr	8.46 ft
Minimum Shutoff Head	164 ft
Minimum Flow at RPM	183 US gpm
Flow @ BEP	794 US gpm
Fluid Temperature	68 °F
Fluid Type	Water
Weight (approx. - consult rep for exact)	905 lbs
Pump Floor Space Calculation	7.23 ft²

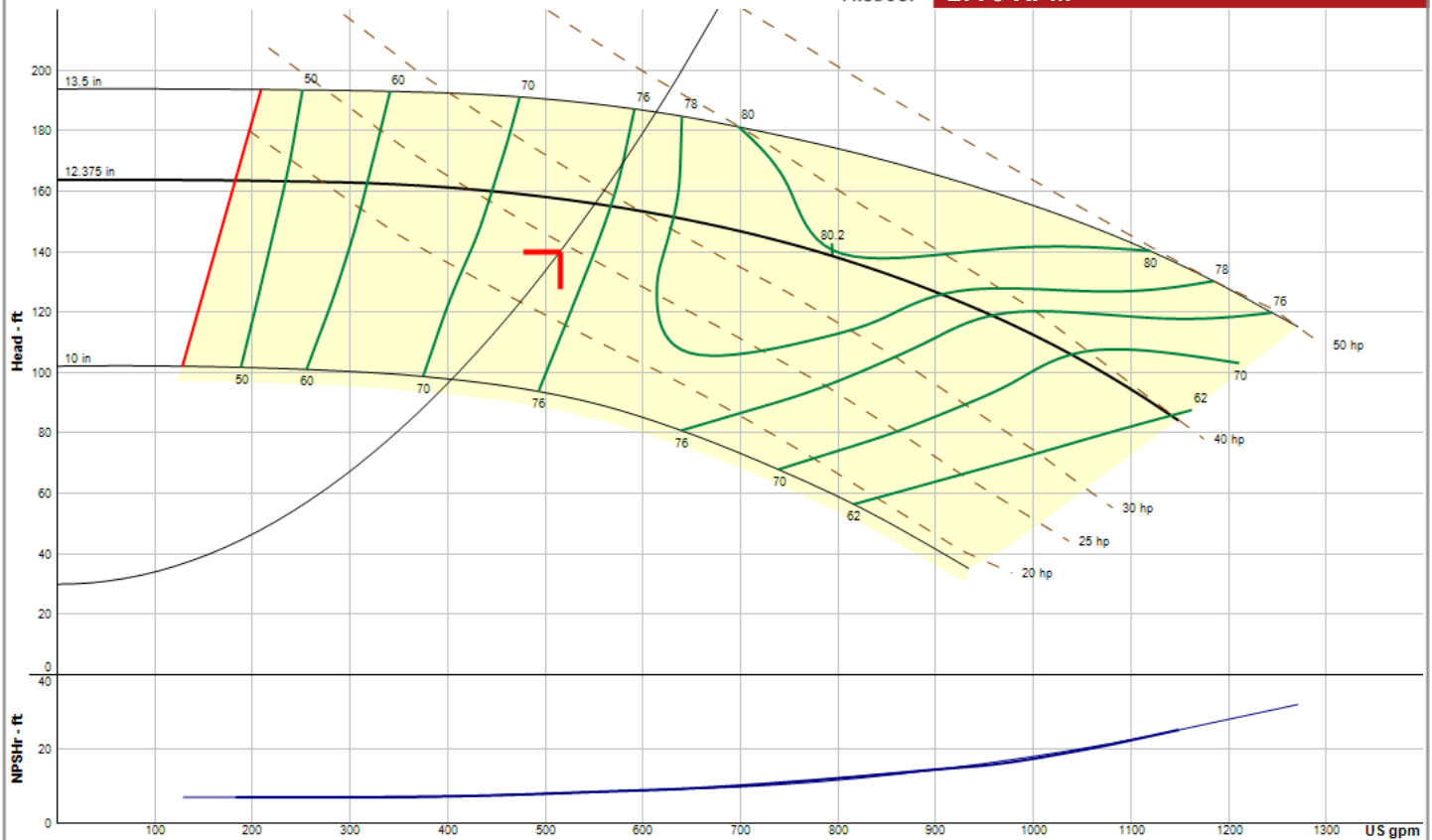
*The Bell & Gossett Series e-1510 is available in 26 sizes and a variety of configuration options that enable customization and flexibility to fit a broad range of operating conditions.

<http://bellgossett.com/pumps-circulators/end-suction-pumps/e-1510/>

Performance Curve**Energy Efficiency Ratings:**

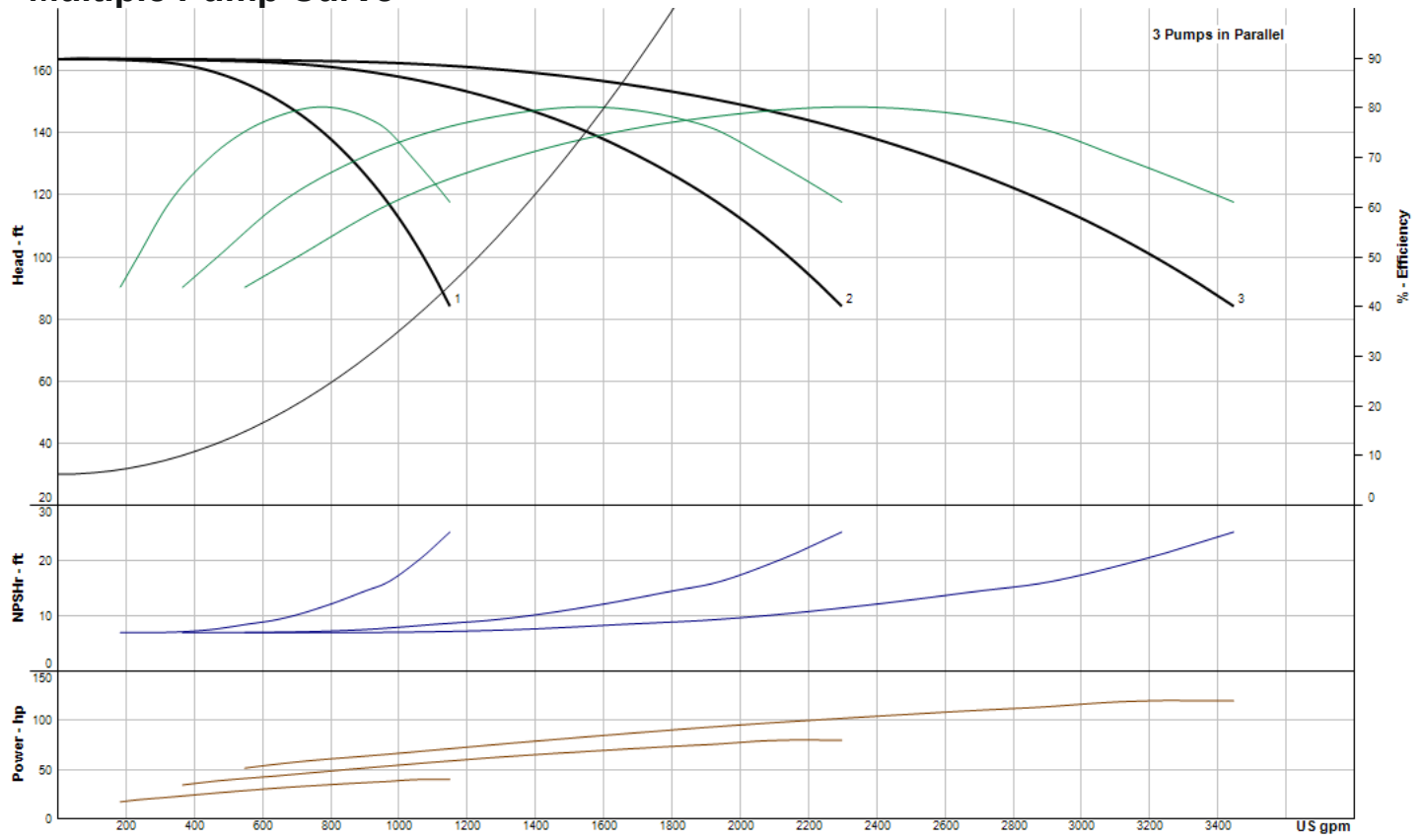
Pump & Motor PEIcl: 0.91 ERcl: 9

Pump, Motor & Drive: PEIvl: 0.45 ERvl: 55


e-1510
4GC
1770 RPM


Performance curve meets 14.6 / ISO 9906 acceptance criteria

Multiple Pump Curve

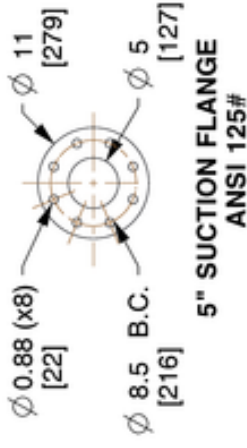
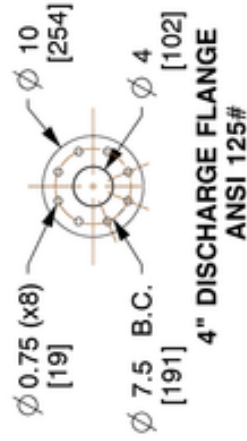
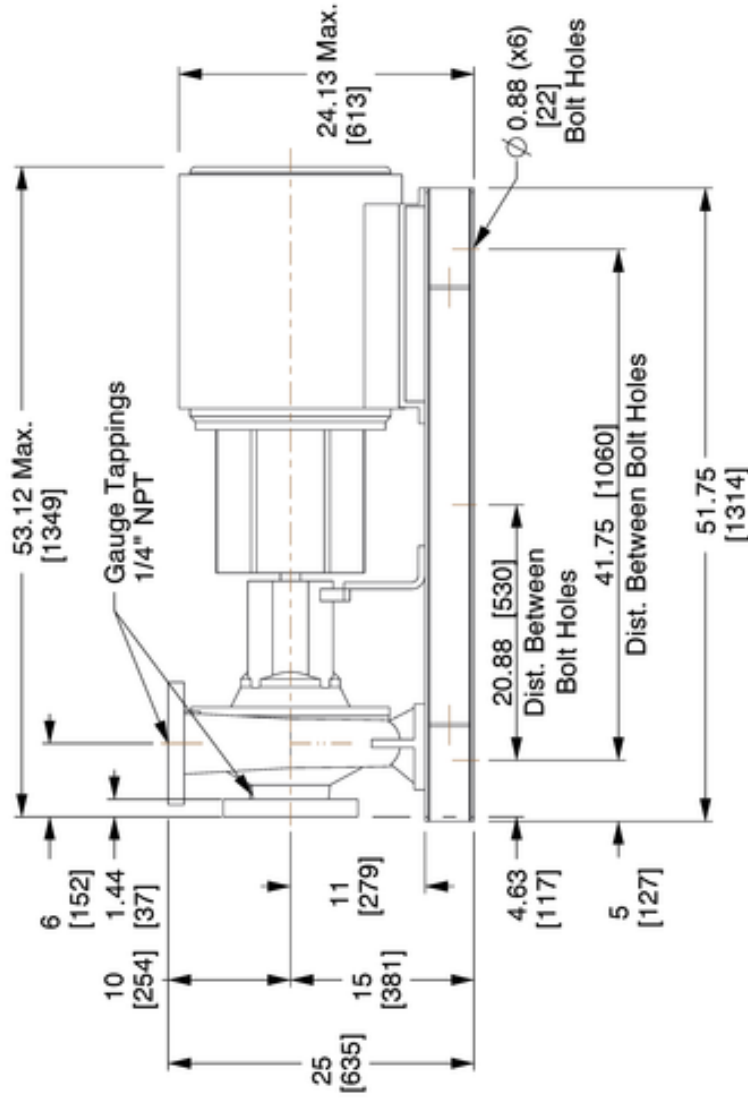
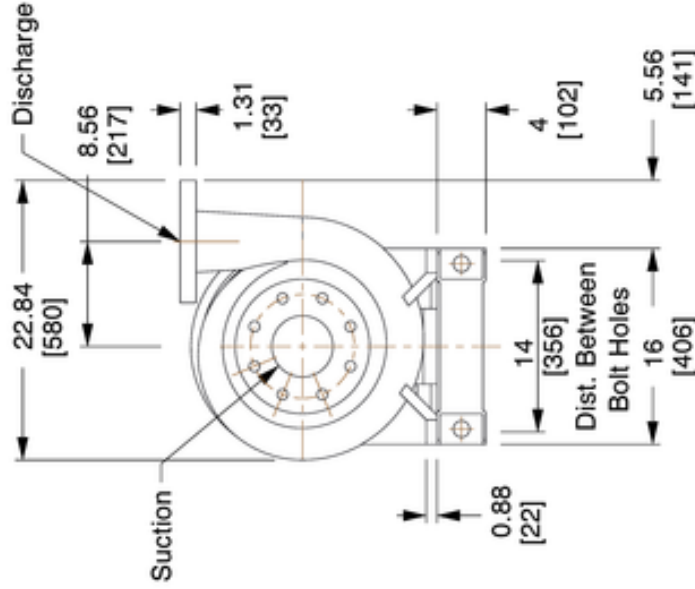


Materials Of Construction

Pump Information\Construction	
Pump Series	e1510
Pump Size	4 GC
Seal Type	Standard Seal
Seal Material	STD-Buna/Carbon/Ceramic/SS/Bronze
Material of Construction	Stainless Steel Fitted
Impeller Diameter	12.375 inches
Sleeve Material	Stainless Steel Sleeve

VFD Details	
VFD_Nema	None
Variable_Speed	1800

Motor Details	
Motor Power	40
Motor Speed	1800
Frequency	60
Phase	3
Voltage	230/460
Frame	324T
Enclosure	ODP
Motor Manufacturer	BG Choice
Motor Status	STK
Motor Comments	NEMA Premium w/Shaft Grounding Rings



8200 N. Austin Ave.
Morton Grove, IL 60053, USA

This drawing and the information depicted therein is the property of Xylem. Copies are issued in strict confidence and shall not be reproduced or copied, or used as the basis for the manufacture or sale of products without prior written permission of Xylem.

Dimensions are subject to change

Not to be used for construction unless certified

BG-E1510-4GC-SS-324T-L

Series e-1510 Centrifugal Pumps - Base Mounted

Seal Type: Standard Seal | Motor Frame: 324T | Frame Type: L | Flange: ANSI 125#

Dimensions : IN (mm)

Scale : N.T.S.

Submittal # : B-880.44C

Standard Mechanical Configuration

Standard Mechanical Seal	SM, LG, & XL Bearing Frames	ES Bearing Frame
Temperature Range	-20 to 225°F	-20 to 225°F
Maximum Pressure	175 PSI	175 PSI
pH Limitations	7.0 - 9.0	7.0 - 9.0
Elastomer	Buna	Buna
Rotating Face	Carbon	Carbon
Stationary Face	Ceramic	Silicon Carbide
Hardware	Stainless Steel / Brass	Stainless Steel

Mechanical Seal Options	SM, LG, & XL Bearing Frames		
Temperature Range	-20 to 250°F	-10 to 225°F	-20 to 250°F
Maximum Pressure	175 PSI	175 PSI	175 PSI
pH Limitations	7.0 - 11.0	7.0 - 9.0	7.0 - 12.5.0
Elastomer	EPR (Ethylene Propylene Rubber)	FKM (Viton™ or Fluoroelastomer)	EPR (Ethylene Propylene Rubber)
Rotating Face	Carbon	Carbon	Silicon Carbide
Stationary Face	Tungsten Carbide	Ceramic	Silicon Carbide
Hardware	Stainless Steel / Brass	Stainless Steel	Stainless Steel

Mechanical Seal Options	ES Bearing Frame		
Temperature Range	-20 to 250°F	-10 to 225°F	-20 to 250°F
Maximum Pressure	175 PSI	175 PSI	175 PSI
pH Limitations	7.0 - 11.0	7.0 - 9.0	7.0 - 12.5.0
Elastomer	EPR (Ethylene Propylene Rubber)	FKM (Viton™ or Fluoroelastomer)	EPR (Ethylene Propylene Rubber)
Rotating Face	Silicon Carbide	Carbon	Silicon Carbide
Stationary Face	Tungsten Carbide	Silicon Carbide	Silicon Carbide
Hardware	Stainless Steel / Brass	Stainless Steel	Stainless Steel

Stuffing Box Configuration

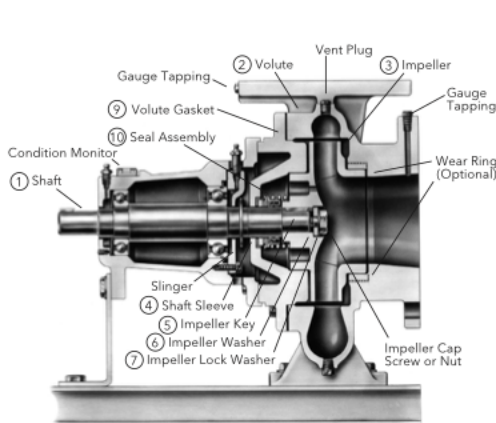
Mechanical Seal	SM, LG, & XL Bearing Frames
Temperature Range	-20 to 250°F*
Maximum Pressure	175 PSI (Optional 250 PSI)
pH Limitations	7.0 - 11.0
Elastomer	EPR (Ethylene Propylene Rubber)
Rotating Face	Tungsten Carbide
Stationary Face	Carbon
Hardware	Stainless Steel

Packing Option	
Temperature Range	0 to 250°F
Maximum Pressure	175 PSI
pH Limitations	7.0 - 9.0
Material	Braided Graphite Impregnated PTFE

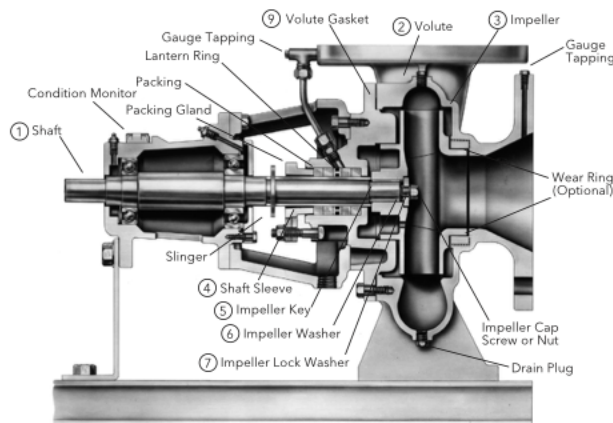
* For operating temperatures above 250°F a cooled flush is required and is recommended for temperatures above 225°F for optimum seal life. On closed systems cooling is accomplished by inserting a small heat exchanger in the flush line to cool the seal flushing fluid.

Flush-line Filters and Sediment Separators are available on special request.

Materials of Construction



Standard Configuration



Optional - S Configuration

Description	SM, LG, & XL Bearing Frames	ES Bearing Frame
1 Shaft	ASTM 108 Grade 1144	ASTM 108 Grade 1144
2 Volute	Cast Iron ASTM A48 Class 30B	Cast Iron ASTM A48 Class 30B
3 Impeller	ASTM A743 Grade CF8 - 304 Stainless Steel	ASTM A743 Grade CF8 - 304 Stainless Steel
4 Shaft Sleeve	ASTM 312 Grade TP304 - 304 Stainless Steel	ASTM 312 Grade TP304 - 304 Stainless Steel
5 Impeller Key	#304 Stainless Steel	NA
6 Impeller Washer	Steel	NA
7 Impeller Lock Washer	#304 Stainless Steel (18-8 XL FRM)	NA
8 Impeller Cap Screw	#304 Stainless Steel	NA
8 Impeller Nut	NA	316 Stainless Steel
9 Volute Gasket	Cellulose Fiber	Cellulose Fiber
10 Seal Assembly	Reference Seal Data Tables	Reference Seal Data Tables

Pump Options

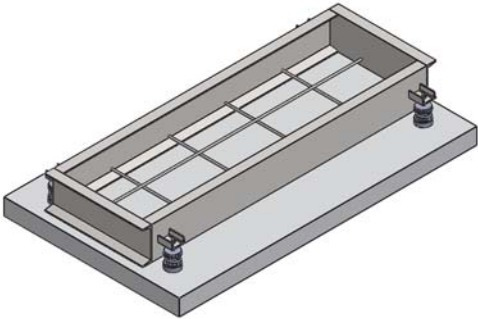
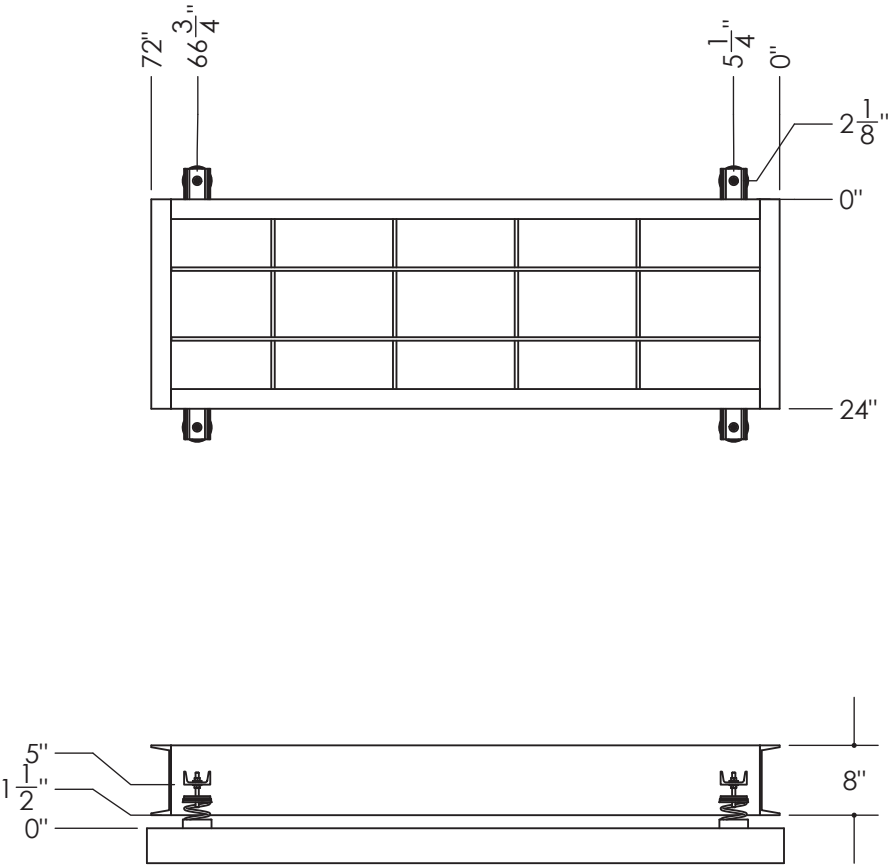
- Stainless Steel Volute Wear Ring
- Galvanized Steel Drip Pan
- Stainless Steel Shaft
- Rexnord Omega Spacer Coupling
- Falk T31 Spacer Coupling
- External Flush Line
- Stuffing Box Configuration
- Epoxy Coated Internal Cast Iron Components
- Special Impeller Balancing (ISO 1940 G2.5 or G1.0)
- Certified Performance Tests (Per HI Standard 14.6)
- 250 PSI Working Pressure

EQUIPMENT TAG #	QTY	EQUIPMENT DESCRIPTION	ISOLATORS		Concrete Inertia Base Model			Pump Stands		ANCHORS	
			MODEL	QTY	TYPE	DESCRIPTION/SIZE	QTY	MODEL	QTY	MODEL ^(5, 6) (Ø), (nominal embed.), (min. slab thk.) (min. edge dist.)	QTY
P-1,2,3	3	End Suction Pump	FS-SA-700	6	CIB	8"CIB72"X24" c/w(4)FS-SA	3				
			FS-SA-800	6							

NOTES:				Approval drawings must be returned marked "approved" prior to release for fabrication.				
(1) All quantities are total, NOT per equipment.								
(2) Seismic or other project specific requirement may change the CIB dimension or isolator selection								
VIBRATION ISOLATION & SEISMIC RESTRAINT SUMMARY FOR EQUIPMENT				Concrete Inertia Base SUMMARY PAGE				
Project : Southwest High School Pump House				Drawn by:				Date:
Customer: Mulcahy Company								
Consultant:								
Customer P.O. No.:				V-A PM:				Checked by:

Min. recommended housekeeping pad size is 73" X 43" .The recommended size is subject to change based on project specific load case.
Base is sufficient size to support long radius elbow at suction.

1	3	LOCATION	ISOLATOR
MOTOR END	PUMP END	1	FS-SA-700
2	4	2	FS-SA-700
Isolator locations		3	FS-SA-800
		4	FS-SA-800



Base Information

Shipping Wt. per Base: 201 lbs.
Base Finish: Gray Primer
Base(s) shipped in (1) piece
CIB 72" x 24" x 8"

Equipment Information

Eqt. Type: End Suction Pump
Manufacturer: Bell & Gossett
Model: E1510-4GC
Tag: **P-1,2,3**
Motor: 40 HP
RPM: 1800
Oper. Wt.: 807 lbs
*Total Wt.: 2709 lbs

Notes
1) Welded steel construction. Minimum 3000 psi normal weight concrete to be supplied by others.
*includes base weight, concrete weight equipment operating weight. Estimated 10ft of 4" suction piping & 5" discharge piping.

PROJECT: Southwest High School Pump House		CONCRETE INERTIA BASE SUBMITTAL QTY: 3			VIBRO-ACOUSTICS by Swegon	
CUSTOMER: Mulcahy Company						
CONSULTANT:		DRAWN BY:	SCALE: 1:22	A		
PROJECT NO.: 0 PM:		CHECKED BY:	DATE: 5/12/25	401		

tel: 416-291-7371 1-800-565-8401
fax: 416-291-8049 1-888-811-2264

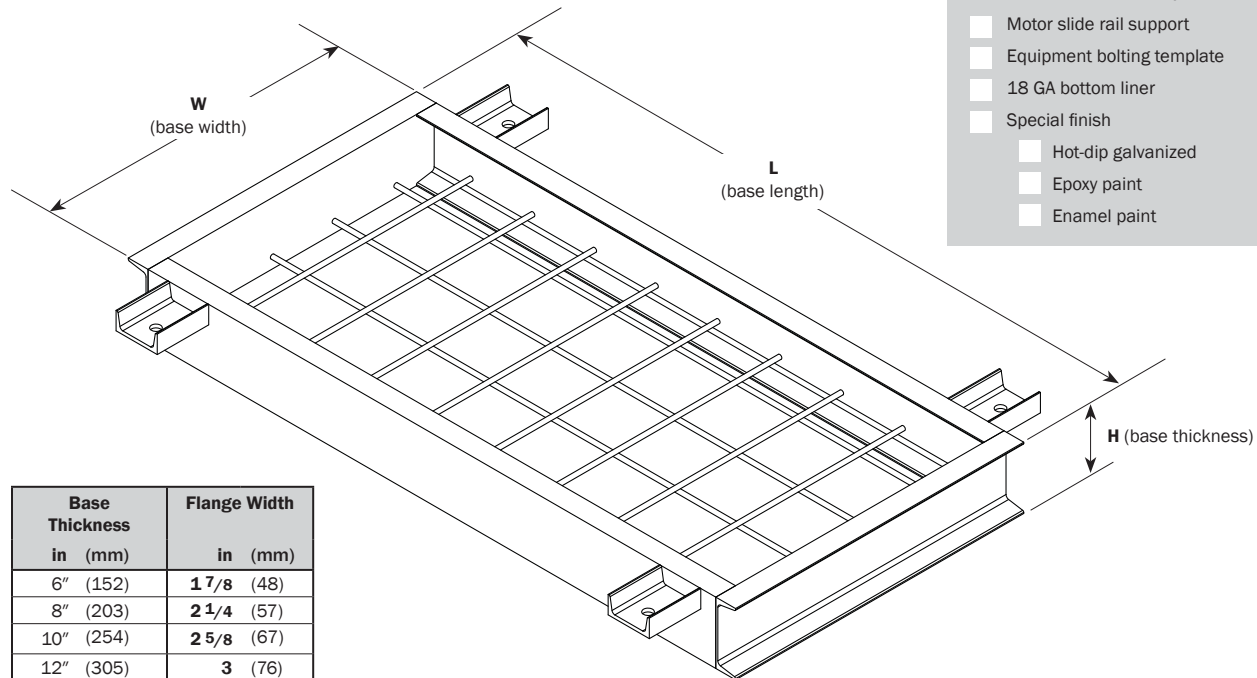
web: www.vibro-acoustics.com
eml: info@vibro-acoustics.com

File No.: DS-CIB-004

Date: 26 Sep 2013

Supersedes: DS-CIB-003

Date: 17 May 2013

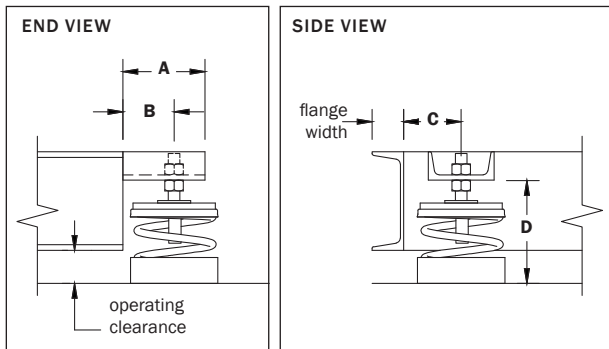


STANDARD OPTIONS (not shown in diagram)

- ☐ Motor slide rail support
- ☐ Equipment bolting template
- ☐ 18 GA bottom liner
- ☐ Special finish
 - ☐ Hot-dip galvanized
 - ☐ Epoxy paint
 - ☐ Enamel paint

Base Thickness in (mm)	Flange Width in (mm)
6" (152)	1 7/8 (48)
8" (203)	2 1/4 (57)
10" (254)	2 5/8 (67)
12" (305)	3 (76)

Custom base thicknesses available upon request



Corner bracket shown with FS isolator. See the table on the right for standard dimensions for different isolators.

Isolator	Base Thickness (inches)	DIMENSIONS				
		Operating Clearance in (mm)	A in (mm)	B in (mm)	C in (mm)	D in (mm)
FS-SA	6", 8", 10", 12"	1 1/2 (38)	3 1/2 (89)	2 1/8 (54)	3 (76)	5 (127)
FS-1A	6"	2 (51)	5 1/2 (140)	3 5/8 (92)	3 1/2 (89)	6 1/4 (159)
	8", 10", 12"	1 1/2 (38)				6 1/2 (165)
FS-2A	6"	2 (51)	5 1/2 (140)	3 5/8 (92)	3 1/2 (89)	8 (203)
	8", 10", 12"					7 7/8 (200)
FS-3A	6", 8"	3 (76)	5 1/2 (140)	3 5/8 (92)	3 1/2 (89)	9 (229)
	10", 12"					9 3/4 (248)
SFS-2N	6", 8", 10", 12"	2 1/2 (64)	5 1/2 (140)	3 5/8 (92)	3 1/2 (89)	8 1/2 (216)
SFS-SA	6", 8", 10", 12"	2 (51)	3 1/2 (89)	2 1/8 (54)	3 (76)	6 1/2 (165)
SFS-1A	8", 10", 12"	2 1/2 (64)	7 1/4 (184)	5 3/8 (136)	5 (127)	8 3/4 (222)
SFS-2A						

Equipment			Base Dimensions and Weight				Isolation	
Manufacturer	Model	Operating Weight (lb)	L (in)	W (in)	H (in)	Base Weight (lb)	Isolator Nominal Deflection (in)	Total Operating Weight (lb)

Project: Southwest High School Pump House			plan view of mount locations		1:	6:
Customer: Mulcahy Company					2:	7:
Consultant:					3:	8:
Dwg No.:	Rev:	Drawn by:			4:	9:
V-A Project Manager:					5:	10:
TAG:			EQUIPMENT:		QTY of sets required:	
COMMENTS:			DATE:			

tel: 416-291-7371 1-800-565-8401
fax: 416-291-8049 1-888-811-2264

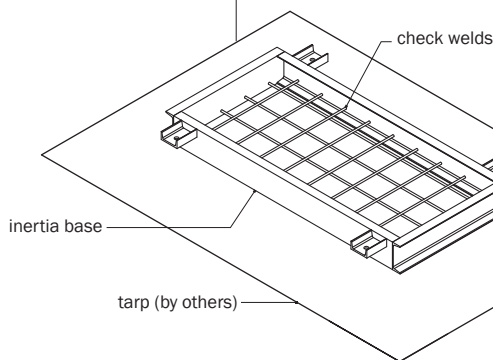
web: www.vibro-acoustics.com
eml: info@vibro-acoustics.com

File No.: INS-CIB-001
Supersedes: New

Date: 26 Apr 2013
Date: New

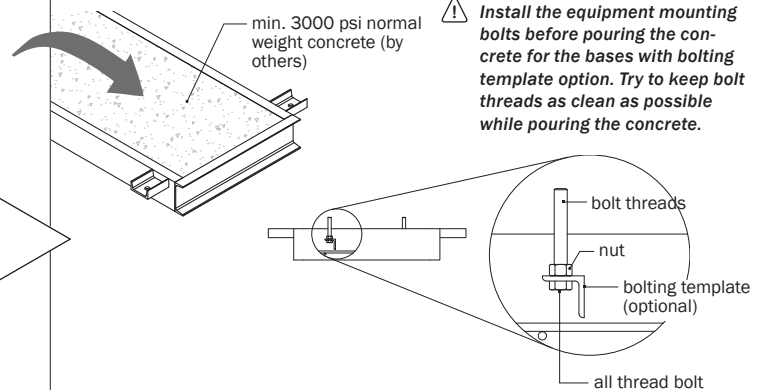
INSTRUCTIONS

1. Lay tarp (or polyethylene sheets or fiberboard) on a flat floor where the concrete will be poured and cured.



2. Place the inertia base on the tarp. Check rebar-to-perimeter channel welds, and repair those welds if necessary.

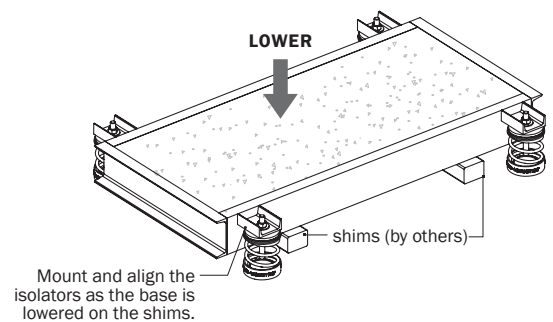
3. Pour 3000 psi normal weight concrete inside the inertia base unless otherwise specified in the submittal drawings. The concrete surface should be flat, smooth and level with the frame of the base.



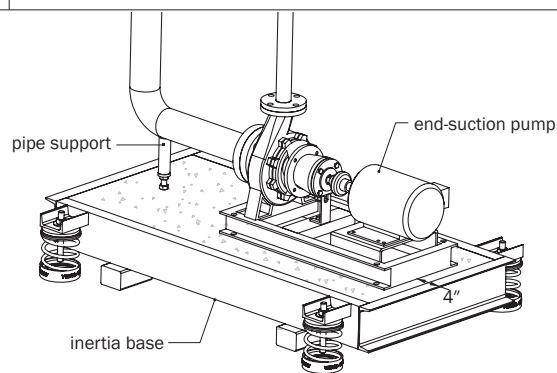
4. Once the concrete is fully dried and cured, lift the base either by floor jacks, a hoist or similar means. If the base is being lifted by a hoist mechanism where the height-saving brackets are used, make sure that the base is level at all times in order to prevent bracket failure.

5. Start lowering the inertia base on shims. See submittal drawings for required operating clearance from the floor. As the base is being lowered, make sure that the isolators are mounted to the brackets. As the base gets closer to sitting on the shims, align the isolators. Once all isolators are in proper position, completely lower the base on shims.

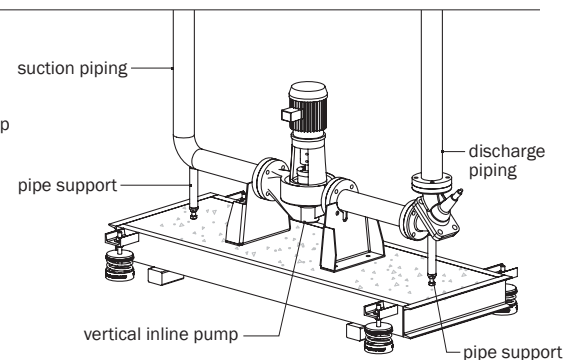
As a rule, use at least the same quantity of shims as isolator brackets and place them within the vicinity of the isolators.



6. Place and anchor the equipment on base either with post-installed anchors or by using the optional cast-in-place bolts. See seismic calculations for embedment and edge distance requirements on anchors. Make sure that the orientation of the equipment is in agreement with the submittal drawing (motor end, pump end, etc.)



! The pump shaft centerline should align with the centerline of the base width when installed. For end suction pumps, leave about 4" clearance from the motor end of the skid in order to leave room on the other end of the inertia base for the suction piping support.



! Position vertical inline pumps in such a way that the piping on both suction and discharge sides are supported on the inertia base. Ensure piping centerline aligns with the centerline of the base width.

Continue on the next page →

tel: 416-291-7371 1-800-565-8401
fax: 416-291-8049 1-888-811-2264

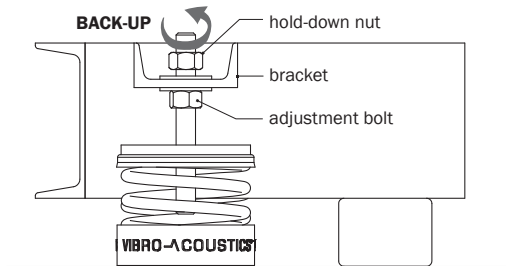
web: www.vibro-acoustics.com
eml: info@vibro-acoustics.com

File No.: INS-CIB-001
Supersedes: New

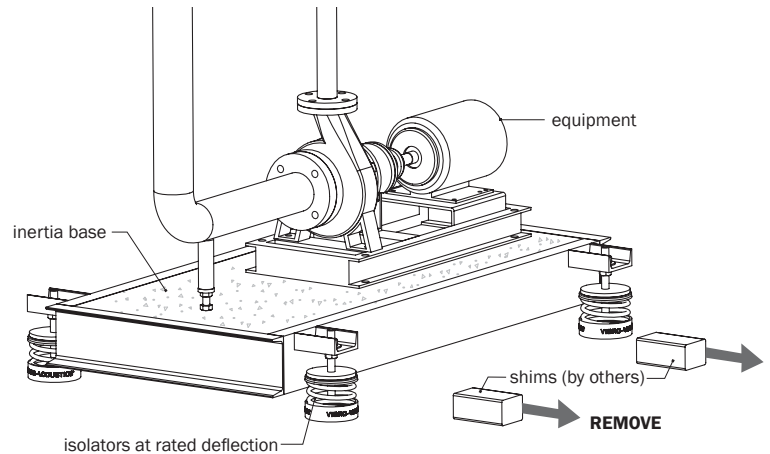
Date: 26 Apr 2013
Date: New

INSTRUCTIONS

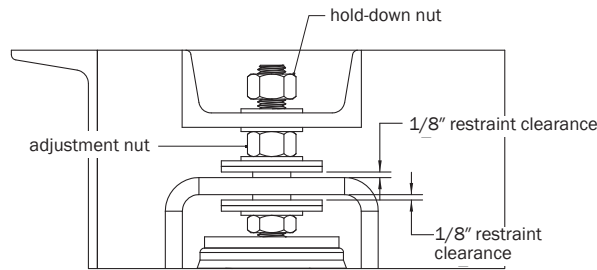
7. Back up the hold-down nut about a 1/4 of a turn. Adjust isolators. At this point, refer to the installation instructions of the isolator that is being used with the inertia base for further instructions on adjustment. Follow the isolator adjustment sequence below (Fig. 1).



8. As the base is lifted off the shims, stop adjusting. The shims can then be removed. Make sure that the inertia base is level.



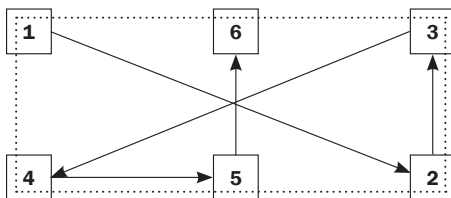
9. (For SFS isolators only) Check the restraint clearance with SFS isolators, and fine-adjust the springs until proper restraint clearance of 1/8" on each side of the housing is achieved.



10. Tighten the hold down nut for all isolators. Perform a final check for the base to see if it is level. Perform final adjustments if needed.

Installation complete.

Fig. 1. Isolator adjustment sequence example



Isolator adjustment sequence is similar for other quantities and configurations.

tel: 416-291-7371 1-800-565-8401
fax: 416-291-8049 1-888-811-2264

web: www.vibro-acoustics.com
eml: info@vibro-acoustics.com

FS Floor Mounted Isolators Installation Instructions

FS

SA, 1, 2, 3

File No.: INS-FS-006

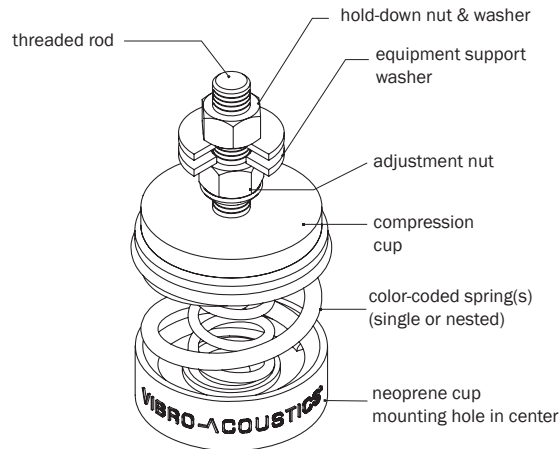
Date: 15 May 2013

Supersedes: INS-FS-005

Date: 31 Dec 2012

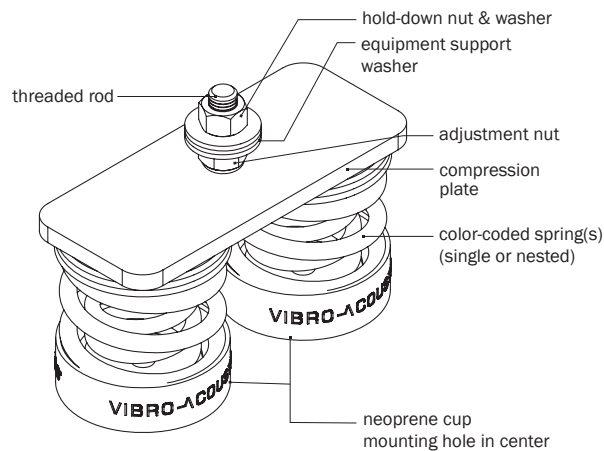
FS-SA/FS-1A/FS-2A/FS-3A

shown with cut-away



FS-1A/FS-2A/FS-3A (higher capacities)

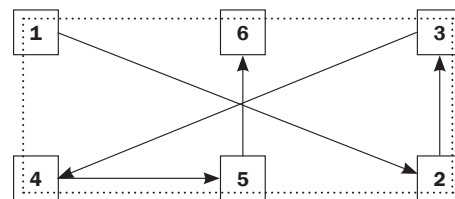
shown with cut-away



INSTRUCTIONS

1. Remove the hold-down nut and washer from the isolators.
2. Properly locate each isolator from the submittal drawing using isolator model and spring color(s) as identification. If isolators are to be attached to the supporting structure, mark locations and make preparations as appropriate (e.g., drill holes and install anchor bolts).
3. Block equipment to proper operating height using temporary supports. Operating height is maximum recommended height. Increasing operating height may result in excessive movement and instability. Lower operating heights are possible provided the following are met:
 - a. Clearances are maintained to prevent short-circuiting.
 - b. Connections to the isolated component can accommodate lower position.
4. Piping and equipment must be at operating weight before final adjustment can begin.
5. If required, attach base plate or neoprene cup to supporting structure.
6. Place isolators under base or equipment support points, passing threaded rod through mounting hole.
7. When loading isolators and during isolator spring adjustment, ensure each isolator is loaded in the center and the compression cup remains parallel to the floor.
8. Turn level adjustment nut counter-clockwise 4 complete turns on each isolator as shown in the sequence below. Repeat this pattern until the equipment just lifts off the temporary support.
9. Secure the equipment to the isolator using the upper hold-down nut and washer.

Isolator adjustment sequence example



Isolator adjustment sequence is similar for other quantities and configurations.

Job/Project: Southwest High School Pump House		Representative: Nick Davis	
ESP-Systemwise: WIZE-6B92271E		05/29/2025	Phone: 651-686-8580
Location/Tag: Minneapolis, MN TAG: CWP-4,5,6 ACCY 1		Email:	
Engineer: ATS&R		Submitted By: Mulcahy Company	Date:
Contractor: ISD #1		Approved By:	Date:

Suction Diffuser Plus

Bell & Gossett Model: GF-3X

The Bell & Gossett Suction Diffuser Plus is designed for direct application to the pump suction and provides ideal flow conditions for the pump, providing NPSH requirements are met. Its integrated Flow Cone directs flow through the unit and into the pump suction while working with the full length straightening vanes to create a more uniform flow profile. The orifice cylinder has a free area equal to five times the cross section of the pump suction opening and serves as a coarse strainer to protect the pump from large sediment. Type X-For Closed Systems

<http://bellgossett.com/hydronic-plumbing-accessories/pump-accessories/suction-diffuser/>

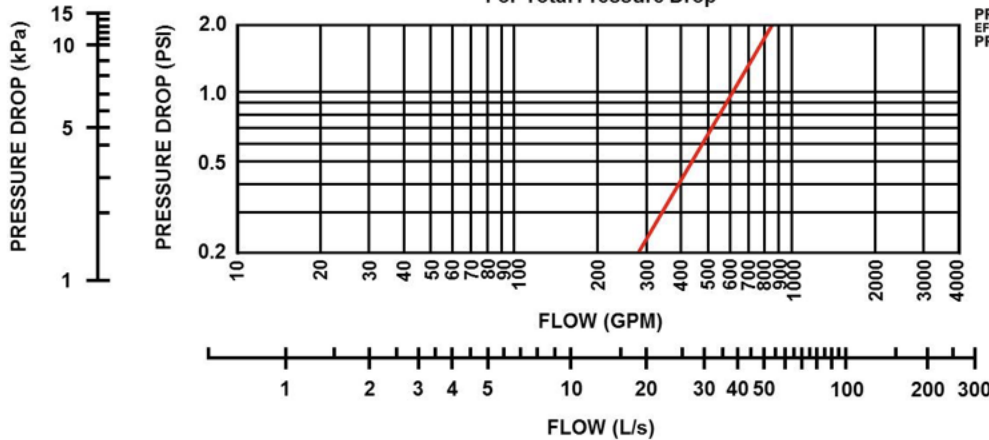


Suction Diffuser Selection

Model	GF-3X
System Size	6.0 in
Pump Size	5.0 in
Pressure Drop @ Design Flow	0.0'
Connection Type	Flanged/Flanged
Cv	625
Fluid Type	Water
Fluid Temp	68 °F

Performance characteristics:

For Total Pressure Drop



GF-3X

Materials of construction

Body	Cast Iron
Inlet Vanes	Steel
Orifice Cylinder	Steel
Start-up Strainer	16 Mesh Bronze

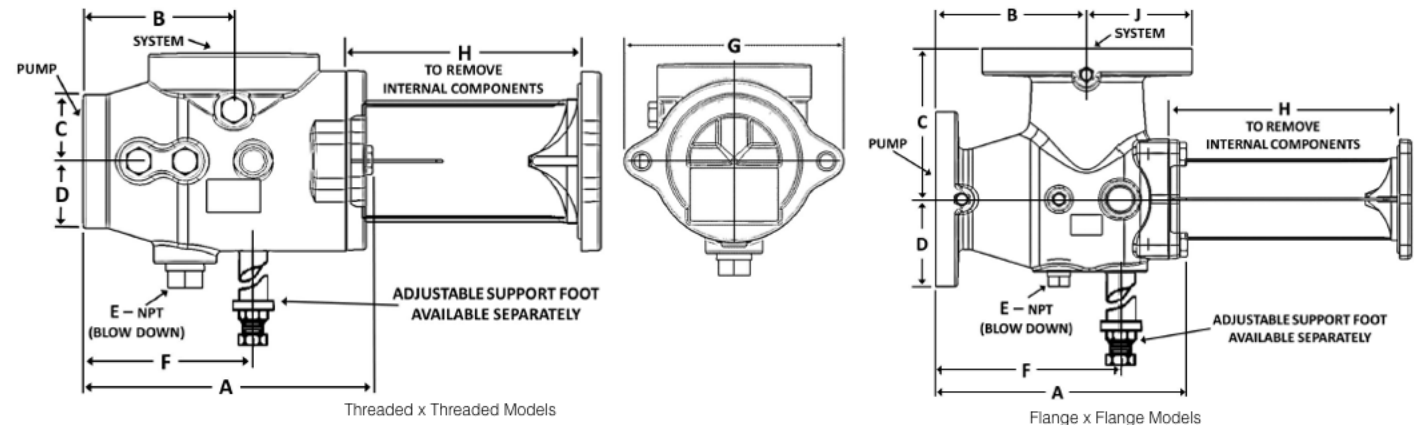
Operating Data

Max Working Pressure	175 psi
Max Temp	250°F

Dimensional data:

not for construction

*Dimensions include orifice cylinder + 2-1/2 (64) inch clearance.



DIMENSIONS - INCHES (mm)

Model No.	System Side	Pump Side	A	B	C	D	E	F	G	H	J	Orifice Cylinder Free Area in ² (cm ²)	Approx. Shpg. Wt. Lbs. (Kg)
GF-3	6 (152.4)	F 5 (127)	15.67 (398)	8 (203)	8 (203)	5 (127)	3/4 (19)	10.46 (266)	N/A	13.84 (351.5)	5.50 (140)	90 (581)	105 (48)



FLOW CONDITIONING CORP.

WWW.FLOW-C.COM

12 KIMLER DRIVE MARYLAND HEIGHTS, MO 63043-3797 (314) 878-7898 FAX (314) 878-6029

May 31st, 2023

FLOW CONDITIONING TRUMPET VALVE, HYDRONIC INDICATOR, AND FLANGE ADAPTER SELECTION SHEET

HYDRONIC INDICATOR SYSTEMS

TWO PORT SYSTEM

TVI-260	5#
TVI-2100	5#
TVI-2150	5#
TVI-2200	5#

THREE PORT SYSTEM

TVI-360	6#
TVI-3100	6#
TVI-3150	6#
TVI-3200	6#

FOUR PORT SYSTEM

TVI-460	6#
TVI-4100	6#
TVI-4150	6#
TVI-4200	6#

NOTE: Hydronic Indicator System Includes: 60#, 100#, 150# or 200# Indicator and Trumpet Valve with Bracket and Test Port Connector

HYDRONIC INDICATOR ONLY

HI-60	HI-100	HI-150	HI-200	3#
-------	--------	--------	--------	----

TRUMPET VALVE ONLY

TV-2	Two Port Trumpet Valve	2#
TV-3	Three Port Trumpet Valve	3#
TV-4	Four Port Trumpet Valve	3#

NOTE: Mounting Bracket and Test Port Connector included with Valve. If Tubing Connectors are required, use the following additions.
(Connectors are 1/4" MPT x 1/4" Compression)

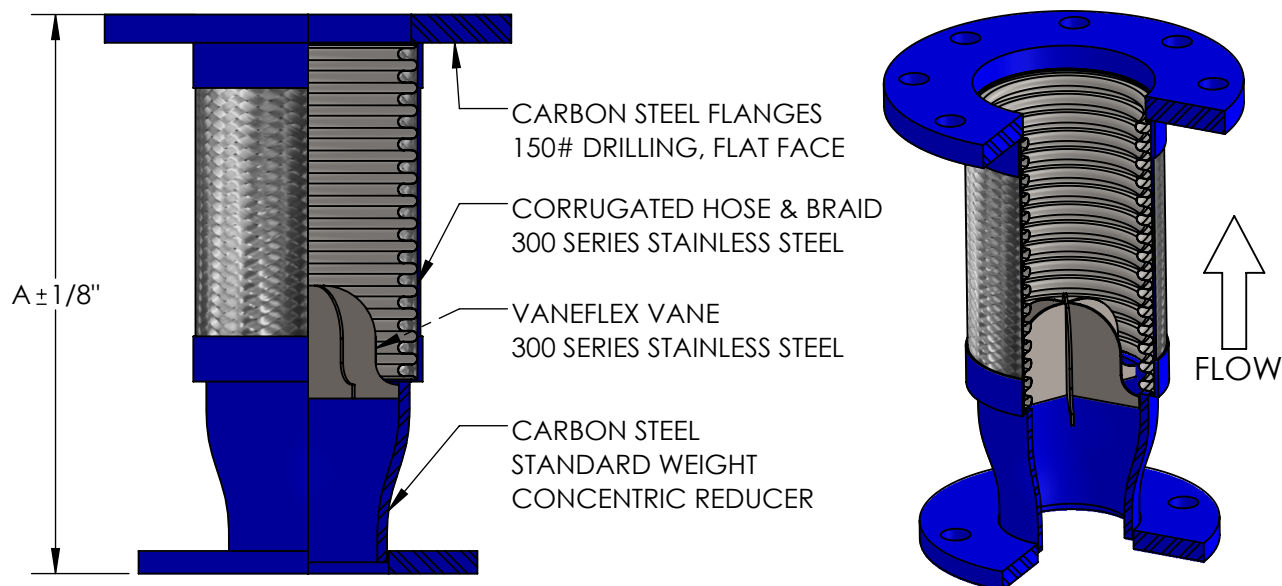
2PC	Two Port Connectors	(4 Connectors)
3PC	Three Port Connectors	(6 Connectors)
4PC	Four Port Connectors	(8 Connectors)

FLANGE ADAPTERS

<u>MODEL</u>		<u>A 125#FLG.</u>	<u>B 125#FLG.</u>	
FCC3025	Flange Adapter	3	2-1/2	19#
FCC4025	Flange Adapter	4	2-1/2	26#
FCC4030	Flange Adapter	4	3	28#
FCC5030	Flange Adapter	5	3	35#
FCC5040	Flange Adapter	5	4	39#
FCC6040	Flange Adapter	6	4	47#
FCC6050	Flange Adapter	6	5	50#
FCC8050	Flange Adapter	8	5	71#
FCC8060	Flange Adapter	8	6	77#
FCC1080	Flange Adapter	10	8	76#
FCC1210	Flange Adapter	12	10	105#
FCC1412	Flange Adapter	14	12	136#

SUCTION DIFFUSER PARTS

OCA	Orifice Cylinder Assembly - A-Body (less start-up strainer)	7#
OCB	Orifice Cylinder Assembly - B-Body (less start-up strainer)	9#
OCC	Orifice Cylinder Assembly - C-Body (less start-up strainer)	24#
ORA	O-Ring - A-Body	
ORB	O-Ring - B-Body	
ORC	O-Ring - C-Body	
SDF	Support Foot Assembly	1.4#

MODEL VFR**VANEFLEX WITH 150# PLATE FLANGES AND CONCENTRIC REDUCER**

QTY	PART NUMBER	PIPE SIZE		A	PRESSURE RATING (PSI)*	WEIGHT (LBS)	PROJECT INFORMATION
		SMALLER	LARGER				
	VFR0225	2"	2-1/2"	12-1/4"	387	17	
	VFR0203	2"	3"	12-1/4"	316	18	
	VFR2503	2-1/2"	3"	12-1/4"	316	19	
	VFR0204	2"	4"	12-3/4"	232	24	
	VFR2504	2-1/2"	4"	12-3/4"	232	24	
	VFR0304	3"	4"	12-3/4"	232	25	
	VFR2505	2-1/2"	5"	15-3/4"	191	33	
	VFR0305	3"	5"	15-3/4"	191	33	
	VFR0405	4"	5"	15-3/4"	191	34	
	VFR0306	3"	6"	16-1/4"	165	39	
3	VFR0406	4"	6"	16-1/4"	165	39	CWP-4,5,6 Discharge
	VFR0506	5"	6"	16-1/4"	165	40	
	VFR0408	4"	8"	17-1/2"	234	67	
	VFR0508	5"	8"	17-1/2"	234	68	
	VFR0608	6"	8"	17-1/2"	234	68	
	VFR0610	6"	10"	19-1/2"	230	100	
	VFR0810	8"	10"	19-1/2"	230	102	
	VFR1012	10"	12"	21-1/2"	161	142	

*FOR SAFE WORKING PRESSURE ABOVE 70°F, MULTIPLY THE PRESSURE SHOWN AT 70°F TIMES THE CORRECTION FACTOR OF THE REQUIRED TEMPERATURE.

TEMPERATURE (°F)	FACTOR
70	1.0
200	.91
300	.85
400	.78
500	.77
600	.76

MAX INTERMITTENT OFFSET FROM CENTERLINE 1/8"
MAX PERMANENT OFFSET FROM CENTERLINE 3/8"

NSF 372 - LEAD FREE

The wetted surface of this product contacted by consumable water contains less than one quarter of one percent (0.25%) of lead by weight. Material complies with state codes and standards, where applicable, requiring reduced lead content. Not suitable for potable water systems due to materials of construction.

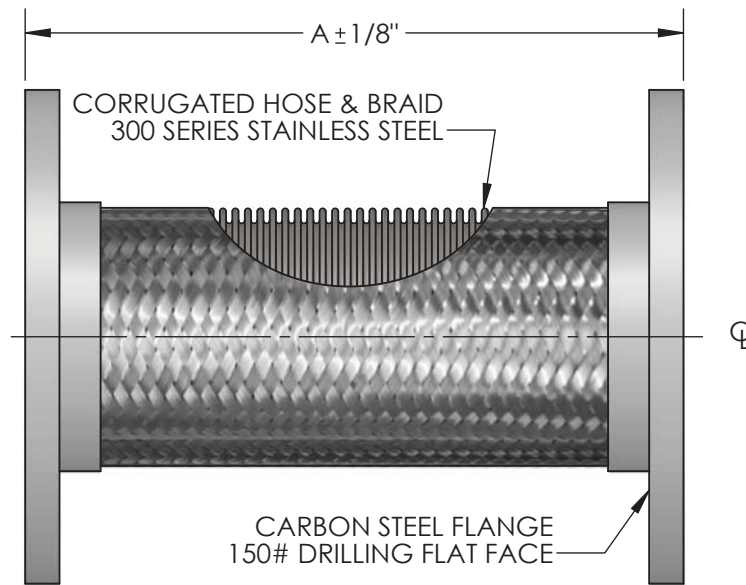
REV.	1	TEMP FACTOR UPDATED	DATE 1/4/2017
		2323 W. HUBBARD ST. CHICAGO, IL 60612 TEL: 312-738-3800 FAX: 312-738-0415 WWW.METRAFLEX.COM	
		MODEL VFR VF, 150# PLATE FLANGES, CONCENTRIC REDUCER	
DRAWN BY: DKISH		DATE: 11/22/2013	
APPROVED: JC		DATE: 11/22/2013	
SCALE: N/A		DRAWING NUMBER: VFR-1	

CUSTOMER: **ISD #1**

PROJECT: **Southwest High School Pump House**

ENGINEER: **ATS&R**

MODEL METRAMINI (MMCC) **FLANGED FLEXIBLE PUMP CONNECTOR**



QTY	PART NUMBER	PIPE SIZE		A	PRESSURE RATING (PSI)*	WEIGHT (LBS)	PROJECT INFORMATION
		INCH	MM				
	MMCC0200	2"	50	9"	516	9	
	MMCC0250	2-1/2"	65	9"	387	13	
	MMCC0300	3"	80	9"	316	14	
	MMCC0400	4"	100	9"	232	18	
	MMCC0500	5"	125	11"	191	25	
1	MMCC0600	6"	150	11"	165	28	CWP-4,5,6 Suction
	MMCC0800	8"	200	12"	234	52	
	MMCC1000	10"	250	13"	230	75	
	MMCC1200	12"	300	14"	161	105	
	MMCC1400	14"	350	14"	150	115	
	MMCC1600	16"	400	14"	110	145	
	MMCC1800	18"	450	14"	85	165	

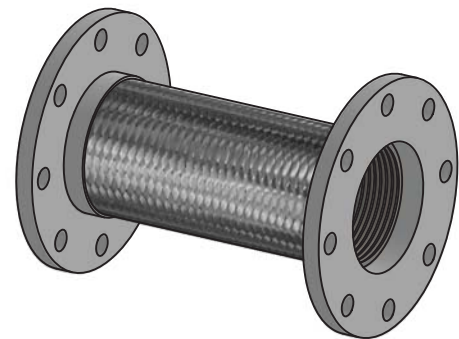
*FOR SAFE WORKING PRESSURE ABOVE 70°F, MULTIPLY THE PRESSURE SHOWN AT 70°F TIMES THE CORRECTION FACTOR OF THE REQUIRED TEMPERATURE.

MAX INTERMITTENT OFFSET FROM CENTERLINE 1/8"
 MAX PERMANENT OFFSET FROM CENTERLINE 3/8"

TEMPERATURE (°F)	FACTOR
70	1.0
200	.91
300	.85
400	.78
500	.77
600	.76

NSF 372 - LEAD FREE

The wetted surface of this product contacted by consumable water contains less than one quarter of one percent (0.25%) of lead by weight. Material complies with state codes and standards, where applicable, requiring reduced lead content. Not suitable for potable water systems due to materials of construction.



CUSTOMER: ISD #1
 PROJECT: Southwest High School Pump House
 ENGINEER: ATS&R

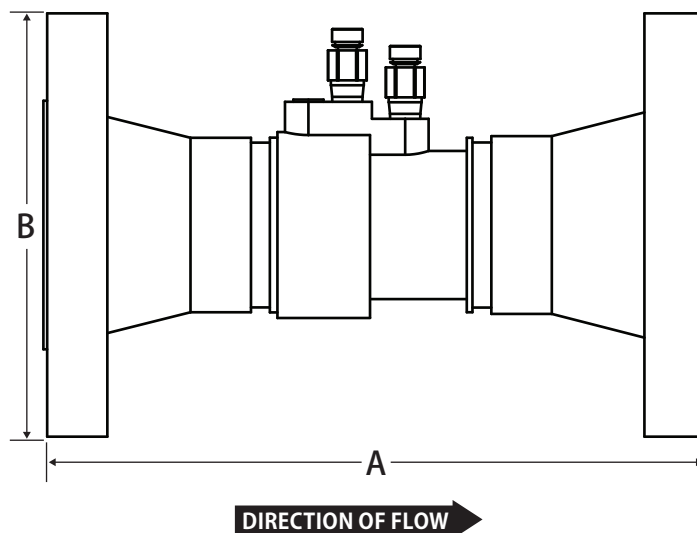
2	16" & 18" ADDED	9/21/2017
REV.	1	TEMP FACTOR UPDATED DATE 12/28/2016
2323 W. HUBBARD ST. CHICAGO, IL 60612 TEL: 312-738-3800 FAX: 312-738-0415 WWW.METRAFLEX.COM		
MODEL METRAMINI (MMCC) FLANGED FLEXIBLE PUMP CONNECTOR		
DRAWN BY: DKISH		DATE: 1/10/2014
APPROVED: JC		DATE: 1/10/2014
SCALE: N/A	DRAWING NUMBER: MMCC-2	

Metering Station

Fixed Orifice • Flange Connection • Class 150



MS Flange x Flange



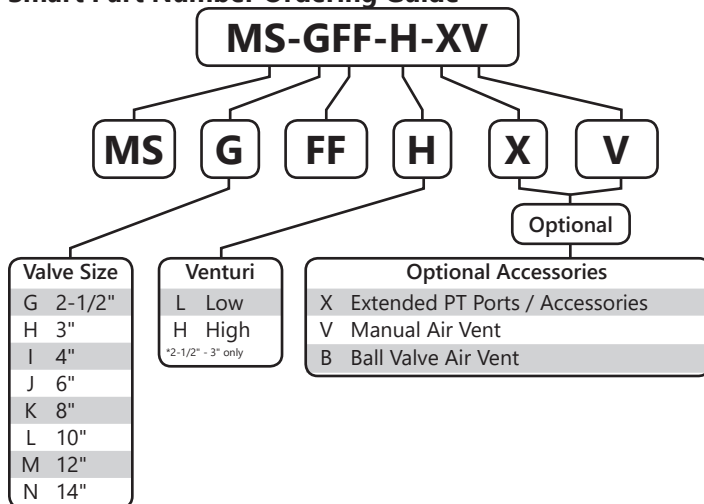
Features

- +/- 1% Accuracy
- Two pressure / temperature (PT) test ports
- Location tag
- Additional accessory tap
- Class 150 Flange
- 100% leak tested
- 5 straight pipe diameters are recommended upstream of metering station

Pressure and Temperature Rating

- 225 WOG
- 250°F Max

Smart Part Number Ordering Guide



Material Specifications

Part	Material
Venturi Body	Carbon Steel - ASTM 126
Flange (2)	Carbon Steel - ASTM 126

Dimensions

Size	A	B
2-1/2"	10.9	7.0
3"	11.3	7.5
4"	12.5	9.0
6"	15.0	11.0
8"	16.9	13.5
10"	20.6	16.0
12"	26.3	19.0

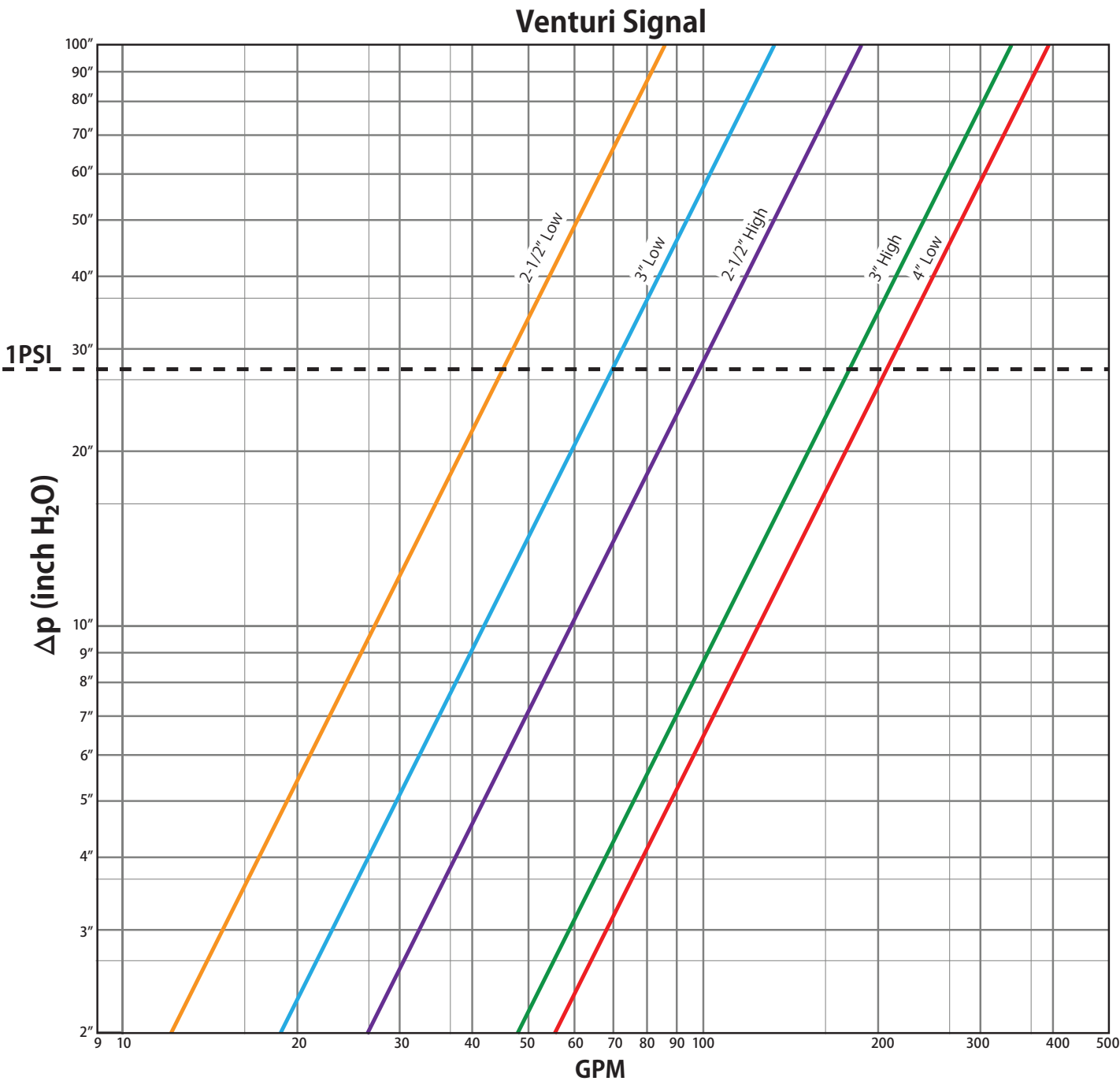


WARNING: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer, birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Pressure Drop Chart

MS (2-1/2" - 4")

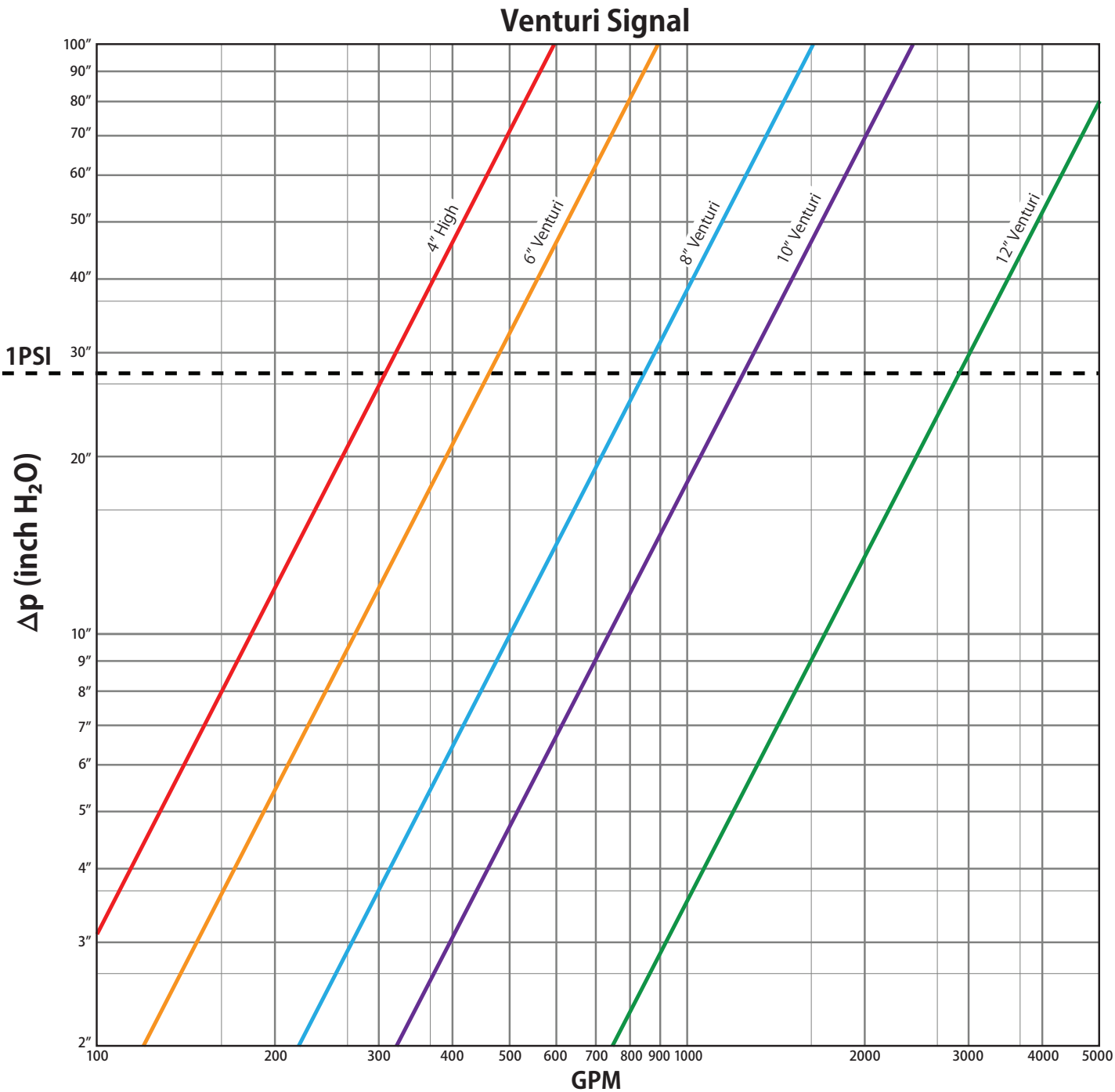
Permanent pressure loss is 6% of the differential pressure

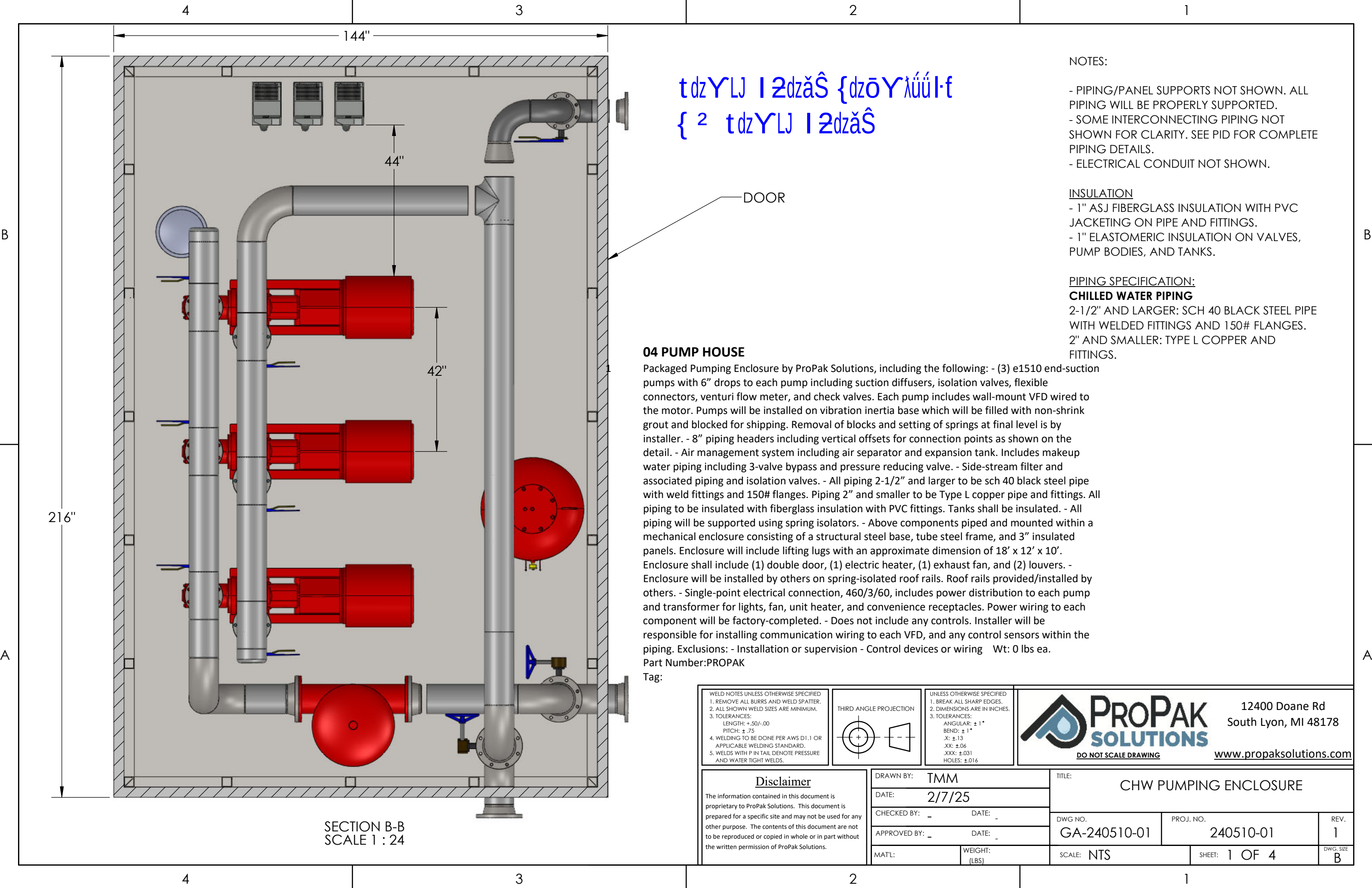


Pressure Drop Chart

MS (6" - 12")

Permanent pressure loss is 6% of the differential pressure





tdzY LJ I 2dzăŜ {dzōY λúúI-f
{ ² tdzY LJ I 2dzăŜ

DOOR

04 PUMP HOUSE

Packaged Pumping Enclosure by ProPak Solutions, including the following: - (3) e1510 end-suction pumps with 6" drops to each pump including suction diffusers, isolation valves, flexible connectors, venturi flow meter, and check valves. Each pump includes wall-mount VFD wired to the motor. Pumps will be installed on vibration inertia base which will be filled with non-shrink grout and blocked for shipping. Removal of blocks and setting of springs at final level is by installer. - 8" piping headers including vertical offsets for connection points as shown on the detail. - Air management system including air separator and expansion tank. Includes makeup water piping including 3-valve bypass and pressure reducing valve. - Side-stream filter and associated piping and isolation valves. - All piping 2-1/2" and larger to be sch 40 black steel pipe with weld fittings and 150# flanges. Piping 2" and smaller to be Type L copper pipe and fittings. All piping to be insulated with fiberglass insulation with PVC fittings. Tanks shall be insulated. - All piping will be supported using spring isolators. - Above components piped and mounted within a mechanical enclosure consisting of a structural steel base, tube steel frame, and 3" insulated panels. Enclosure will include lifting lugs with an approximate dimension of 18' x 12' x 10'. Enclosure shall include (1) double door, (1) electric heater, (1) exhaust fan, and (2) louvers. - Enclosure will be installed by others on spring-isolated roof rails. Roof rails provided/installed by others. - Single-point electrical connection, 460/3/60, includes power distribution to each pump and transformer for lights, fan, unit heater, and convenience receptacles. Power wiring to each component will be factory-completed. - Does not include any controls. Installer will be responsible for installing communication wiring to each VFD, and any control sensors within the piping. Exclusions: - Installation or supervision - Control devices or wiring Wt: 0 lbs ea. Part Number:PROPAK

Tag:

NOTES:

- PIPING/PANEL SUPPORTS NOT SHOWN. ALL PIPING WILL BE PROPERLY SUPPORTED.
- SOME INTERCONNECTING PIPING NOT SHOWN FOR CLARITY. SEE PID FOR COMPLETE PIPING DETAILS.
- ELECTRICAL CONDUIT NOT SHOWN.

INSULATION

- 1" ASJ FIBERGLASS INSULATION WITH PVC JACKETING ON PIPE AND FITTINGS.
- 1" ELASTOMERIC INSULATION ON VALVES, PUMP BODIES, AND TANKS.

PIPING SPECIFICATION:

CHILLED WATER PIPING

- 2-1/2" AND LARGER: SCH 40 BLACK STEEL PIPE WITH WELDED FITTINGS AND 150# FLANGES.
- 2" AND SMALLER: TYPE L COPPER AND FITTINGS.

WELD NOTES UNLESS OTHERWISE SPECIFIED 1. REMOVE ALL BURRS AND WELD SPATTER. 2. ALL SHOWN WELD SIZES ARE MINIMUM. 3. TOLERANCES: LENGTH: +.50/-00 PITCH: ±.75 4. WELDING TO BE DONE PER AWS D1.1 OR APPLICABLE WELDING STANDARD. 5. WELDS WITH P IN TAIL DENOTE PRESSURE AND WATER TIGHT WELDS.		THIRD ANGLE PROJECTION	UNLESS OTHERWISE SPECIFIED 1. BREAK ALL SHARP EDGES. 2. DIMENSIONS ARE IN INCHES. 3. TOLERANCES: ANGULAR: ±1° BEND: ±1° X: ±.13 XX: ±.06 XXX: ±.031 HOLES: ±.016	 PROPAK SOLUTIONS DO NOT SCALE DRAWING 12400 Doane Rd South Lyon, MI 48178 www.propaksolutions.com		
Disclaimer The information contained in this document is proprietary to ProPak Solutions. This document is prepared for a specific site and may not be used for any other purpose. The contents of this document are not to be reproduced or copied in whole or in part without the written permission of ProPak Solutions.		DRAWN BY: TMM DATE: 2/7/25 CHECKED BY: _ DATE: _ APPROVED BY: _ DATE: _ MAT'L: WEIGHT: (LBS)		TITLE: CHW PUMPING ENCLOSURE DWG NO. GA-240510-01 PROJ. NO. 240510-01 SCALE: NTS REV. 1 SHEET: 1 OF 4 DWG. SIZE B		

SECTION B-B
SCALE 1 : 24

4

3

2

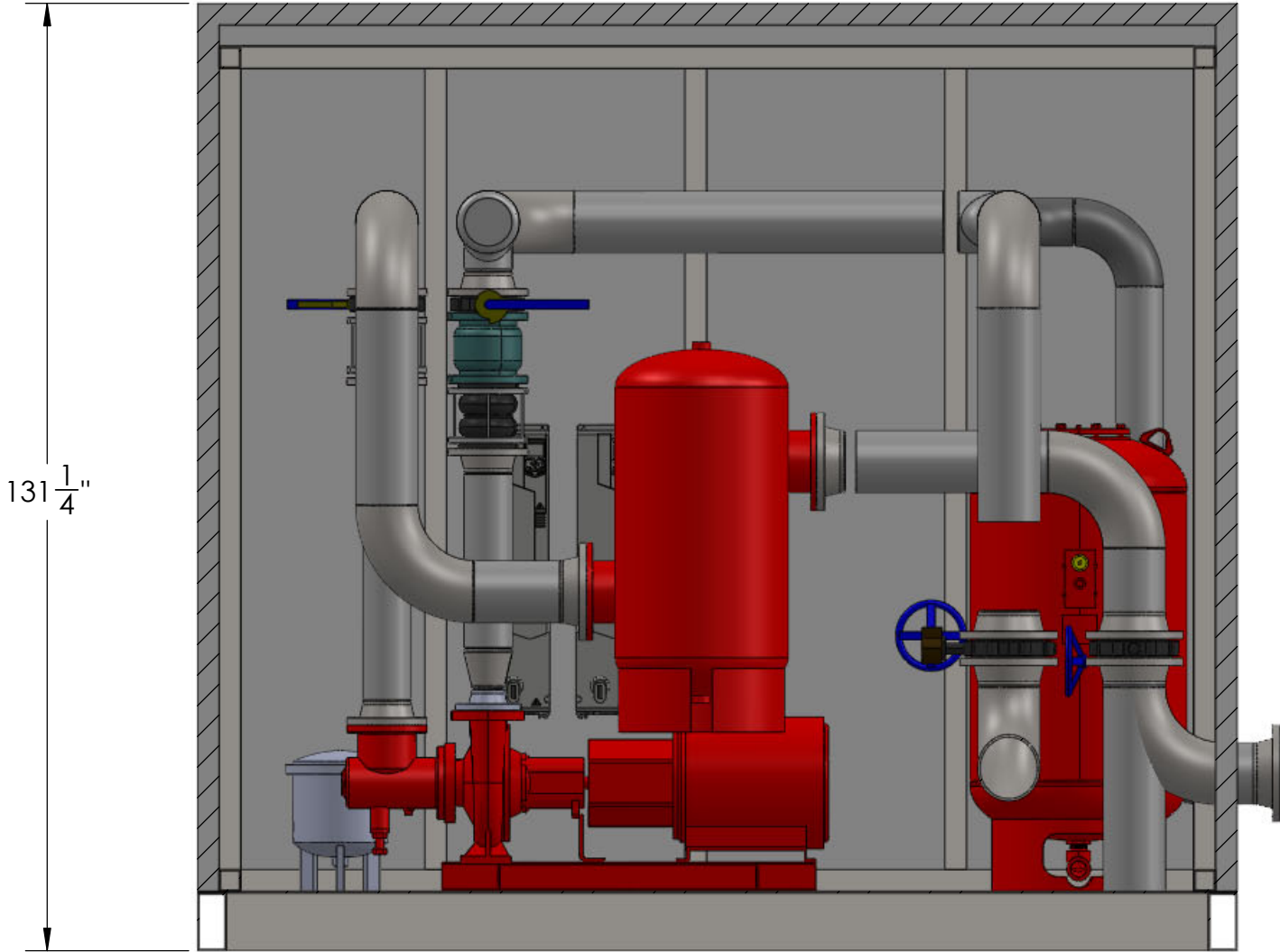
1

- NOTES:
- PIPING/PANEL SUPPORTS NOT SHOWN. ALL PIPING WILL BE PROPERLY SUPPORTED.
 - SOME INTERCONNECTING PIPING NOT SHOWN FOR CLARITY. SEE PID FOR COMPLETE PIPING DETAILS.
 - ELECTRICAL CONDUIT NOT SHOWN.

- INSULATION
- 1" ASJ FIBERGLASS INSULATION WITH PVC JACKETING ON PIPE AND FITTINGS.
 - 1" ELASTOMERIC INSULATION ON VALVES, PUMP BODIES, AND TANKS.

- PIPING SPECIFICATION:
CHILLED WATER PIPING
2-1/2" AND LARGER: SCH 40 BLACK STEEL PIPE WITH WELDED FITTINGS AND 150# FLANGES.
2" AND SMALLER: TYPE L COPPER AND FITTINGS.

B



B

A

A

SECTION D-D
SCALE 1 : 24

WELD NOTES UNLESS OTHERWISE SPECIFIED 1. REMOVE ALL BURRS AND WELD SPATTER. 2. ALL SHOWN WELD SIZES ARE MINIMUM. 3. TOLERANCES: LENGTH: +.50/- .00 PITCH: ± .75 4. WELDING TO BE DONE PER AWS D1.1 OR APPLICABLE WELDING STANDARD. 5. WELDS WITH P IN TAIL DENOTE PRESSURE AND WATER TIGHT WELDS.		THIRD ANGLE PROJECTION		UNLESS OTHERWISE SPECIFIED 1. BREAK ALL SHARP EDGES. 2. DIMENSIONS ARE IN INCHES. 3. TOLERANCES: ANGULAR: ± 1° BEND: ± 1° X: ± .13 XX: ± .06 XXX: ± .031 HOLES: ± .016		12400 Doane Rd South Lyon, MI 48178 www.propaksolutions.com							
<u>Disclaimer</u> The information contained in this document is proprietary to ProPak Solutions. This document is prepared for a specific site and may not be used for any other purpose. The contents of this document are not to be reproduced or copied in whole or in part without the written permission of ProPak Solutions.		DRAWN BY: TMM DATE: 2/7/25 CHECKED BY: _ DATE: _ APPROVED BY: _ DATE: _ MAT'L: WEIGHT: (LBS)		TITLE: CHW PUMPING ENCLOSURE <table><tr><td>DWG NO. GA-240510-01</td><td>PROJ. NO. 240510-01</td><td>REV. 1</td></tr><tr><td>SCALE: NTS</td><td>SHEET: 2 OF 4</td><td>DWG. SIZE B</td></tr></table>				DWG NO. GA-240510-01	PROJ. NO. 240510-01	REV. 1	SCALE: NTS	SHEET: 2 OF 4	DWG. SIZE B
DWG NO. GA-240510-01	PROJ. NO. 240510-01	REV. 1											
SCALE: NTS	SHEET: 2 OF 4	DWG. SIZE B											

4

3

2

1

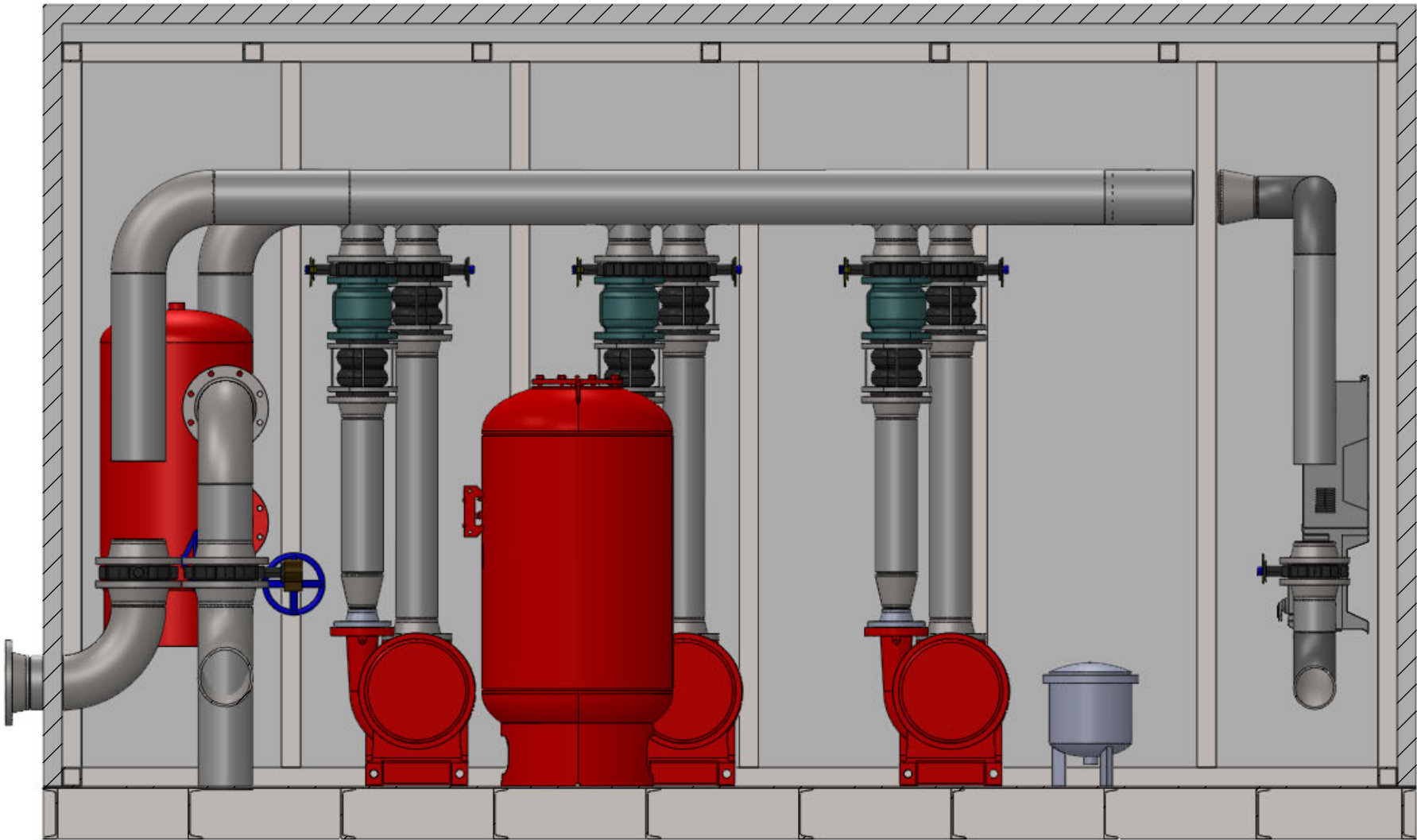
NOTES:

- PIPING/PANEL SUPPORTS NOT SHOWN. ALL PIPING WILL BE PROPERLY SUPPORTED.
- SOME INTERCONNECTING PIPING NOT SHOWN FOR CLARITY. SEE PID FOR COMPLETE PIPING DETAILS.
- ELECTRICAL CONDUIT NOT SHOWN.

INSULATION

- 1" ASJ FIBERGLASS INSULATION WITH PVC JACKETING ON PIPE AND FITTINGS.
- 1" ELASTOMERIC INSULATION ON VALVES, PUMP BODIES, AND TANKS.

PIPING SPECIFICATION:
CHILLED WATER PIPING
2-1/2" AND LARGER: SCH 40 BLACK STEEL PIPE WITH WELDED FITTINGS AND 150# FLANGES.
2" AND SMALLER: TYPE L COPPER AND FITTINGS.



SECTION F-F
SCALE 1 : 24

WELD NOTES UNLESS OTHERWISE SPECIFIED 1. REMOVE ALL BURRS AND WELD SPATTER. 2. ALL SHOWN WELD SIZES ARE MINIMUM. 3. TOLERANCES: LENGTH: +.50/- .00 PITCH: ± .75 4. WELDING TO BE DONE PER AWS D1.1 OR APPLICABLE WELDING STANDARD. 5. WELDS WITH P IN TAIL DENOTE PRESSURE AND WATER TIGHT WELDS.		THIRD ANGLE PROJECTION 		UNLESS OTHERWISE SPECIFIED 1. BREAK ALL SHARP EDGES. 2. DIMENSIONS ARE IN INCHES. 3. TOLERANCES: ANGULAR: ± 1° BEND: ± 1° X: ± .13 XX: ± .06 XXX: ± .031 HOLES: ± .016		 DO NOT SCALE DRAWING			12400 Doane Rd South Lyon, MI 48178 www.propaksolutions.com						
Disclaimer The information contained in this document is proprietary to ProPak Solutions. This document is prepared for a specific site and may not be used for any other purpose. The contents of this document are not to be reproduced or copied in whole or in part without the written permission of ProPak Solutions.						DRAWN BY: TMM		TITLE: CHW PUMPING ENCLOSURE							
						DATE: 2/7/25									
						CHECKED BY: _		DATE: _		DWG. NO. GA-240510-01		PROJ. NO. 240510-01		REV. 1	
						APPROVED BY: _		DATE: _		SCALE: NTS		SHEET: 3 OF 4		DWG. SIZE B	
MAT'L: _		WEIGHT: (LBS)													

4

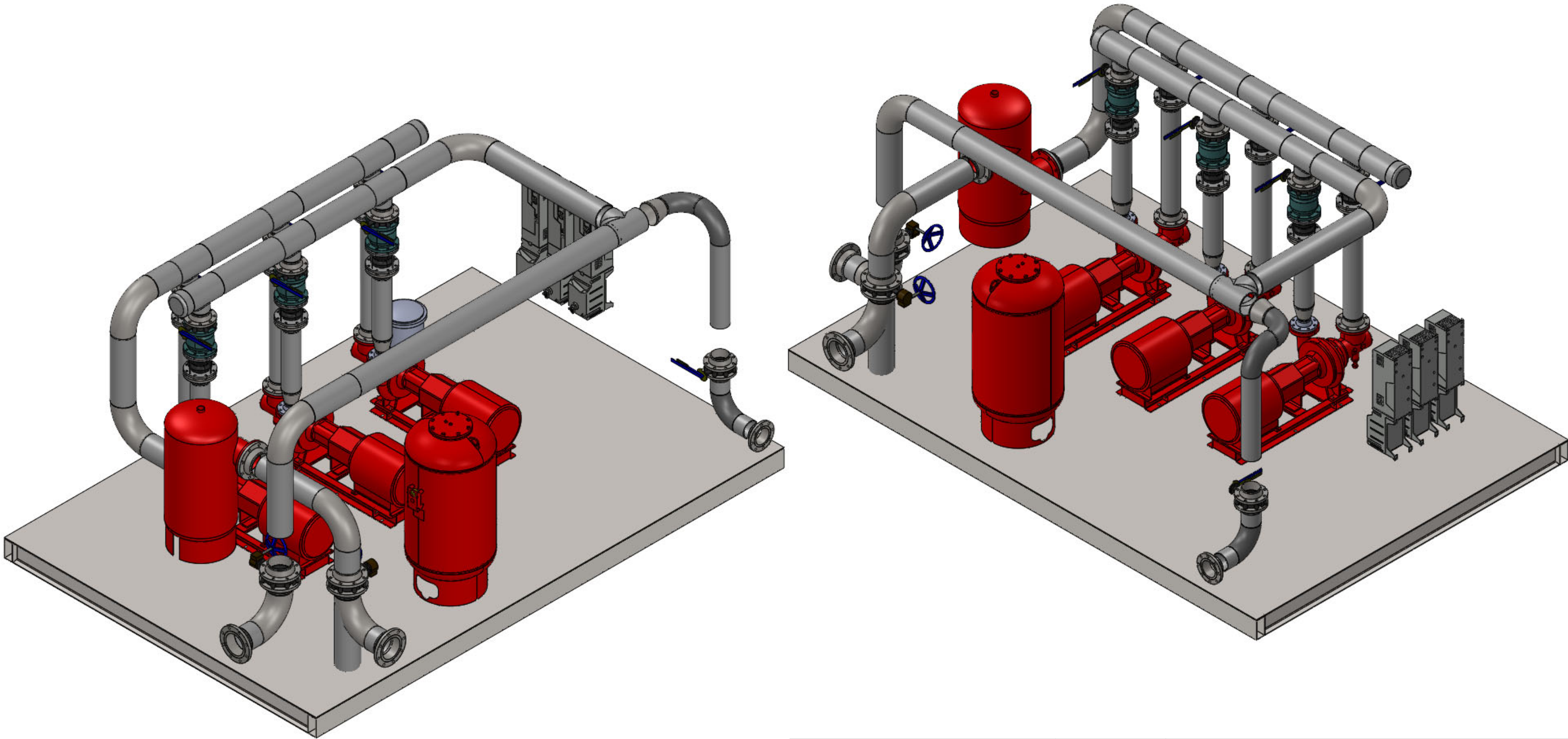
3

2

1

B

B



A

A

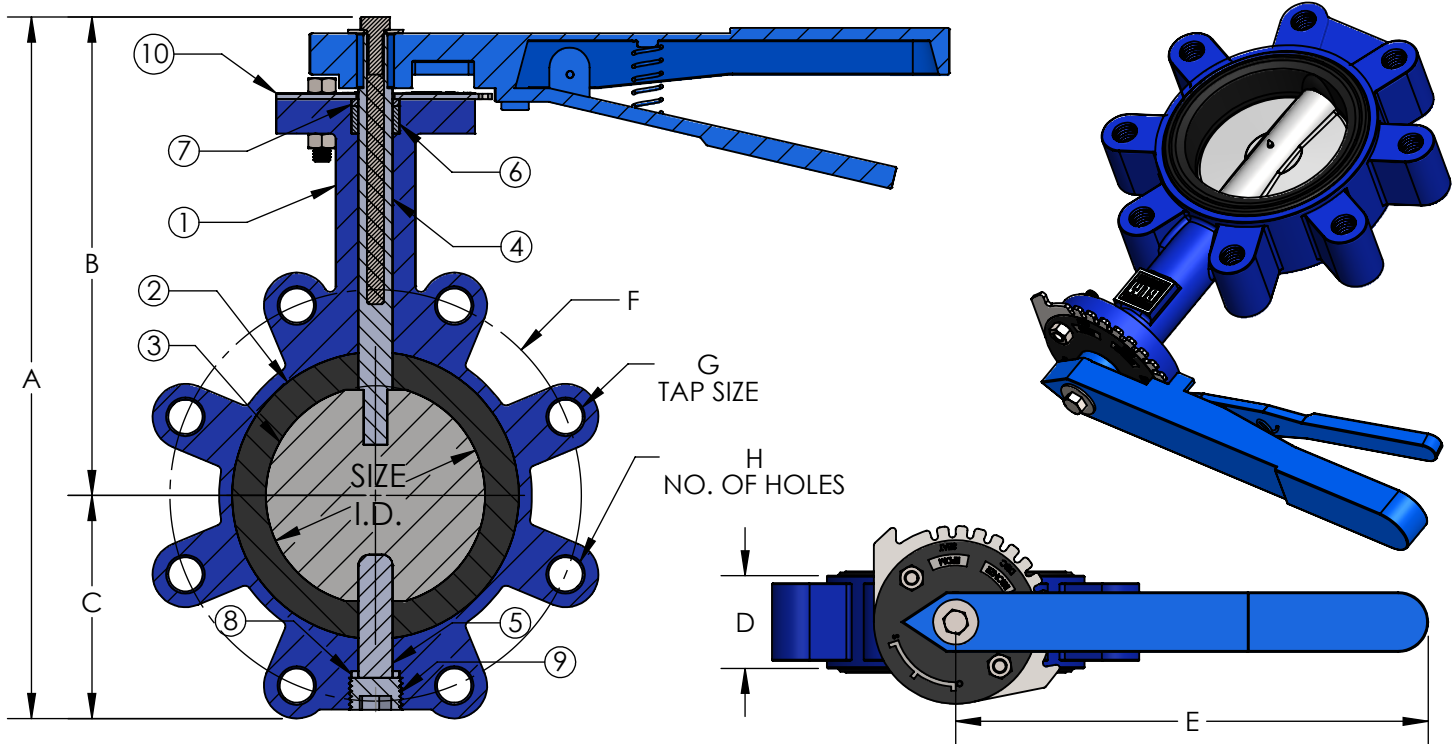
WELD NOTES UNLESS OTHERWISE SPECIFIED 1. REMOVE ALL BURRS AND WELD SPATTER. 2. ALL SHOWN WELD SIZES ARE MINIMUM. 3. TOLERANCES: LENGTH: $\pm .50/- .00$ PITCH: $\pm .75$ 4. WELDING TO BE DONE PER AWS D1.1 OR APPLICABLE WELDING STANDARD. 5. WELDS WITH P IN TAIL DENOTE PRESSURE AND WATER TIGHT WELDS.		THIRD ANGLE PROJECTION 		UNLESS OTHERWISE SPECIFIED 1. BREAK ALL SHARP EDGES. 2. DIMENSIONS ARE IN INCHES. 3. TOLERANCES: ANGULAR: $\pm 1^\circ$ BEND: $\pm 1^\circ$ X: $\pm .13$ XX: $\pm .06$ XXX: $\pm .031$ HOLES: $\pm .016$		 DO NOT SCALE DRAWING 12400 Doane Rd South Lyon, MI 48178 www.propaksolutions.com		
Disclaimer The information contained in this document is proprietary to ProPak Solutions. This document is prepared for a specific site and may not be used for any other purpose. The contents of this document are not to be reproduced or copied in whole or in part without the written permission of ProPak Solutions.		DRAWN BY: TMM		TITLE: CHW PUMPING ENCLOSURE				
		DATE: 2/7/25						
		CHECKED BY: _ DATE: _		DWG. NO. GA-240510-01		PROJ. NO. 240510-01		REV. 1
		APPROVED BY: _ DATE: _						
		MAT'L: _ WEIGHT: (LBS)		SCALE: NTS		SHEET: 4 OF 4		DWG. SIZE B

4

3

2

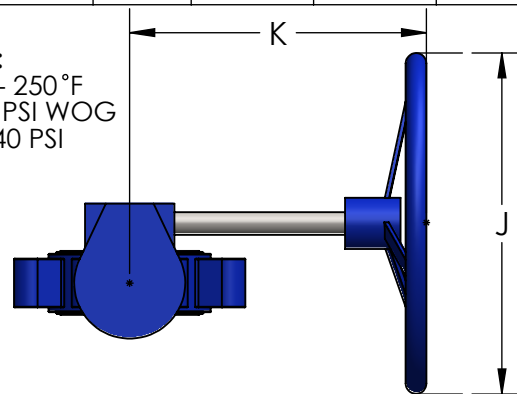
1



QTY	SIZE (in)	A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	H (in)	J (in)	K (in)	Wt (lbs)
	2	10-5/8	7-1/2	3-1/8	1-5/8	10-3/8	4-3/4	5/8-11 UNC	4	6	5-1/4	11
	2-1/2	11-1/2	8	3-1/2	1-3/4	10-3/8	5-1/2	5/8-11 UNC	4	6	5-1/4	12
	3	12	8-3/8	3-5/8	1-3/4	10-3/8	6	5/8-11 UNC	4	6	5-1/4	12-1/2
	4	13-1/2	9	4-1/2	2	10-3/8	7-1/2	5/8-11 UNC	8	6	5-1/4	20
	5	15	9-5/8	5-3/8	2-1/8	10-3/8	8-1/2	3/4-10 UNC	8	6	5-1/4	26
6	6	15-1/2	10	5-1/2	2-1/4	10-3/8	9-1/2	3/4-10 UNC	8	6	5-1/4	30
	8	17-1/2	10-3/4	6-3/4	2-1/4	10-3/8	11-3/4	3/4-10 UNC	8	12	9-1/2	70
	10	20-1/2	12-3/4	7-3/4	2-3/4	10-3/8	14-1/4	7/8-9 UNC	12	12	9-1/2	97
	12	23-3/4	14-1/2	9-1/4	3-1/8	10-3/8	17	7/8-9 UNC	12	12	10-1/8	129

ITEM	PART NAME	MATERIAL SPECIFICATION
1	CAST IRON BODY	ASTM A-126-B
2	EPDM LINER	ASTM D-2000
3	DUCTILE IRON DISC	ASTM A536, Ni COATING
4	UPPER STEM	AISI 420
5	LOWER STEM	AISI 420
6	UPPER STEM BEARING	PTFE
7	UPPER STEM O-RING	EPDM
8	LOWER STEM O-RING	EPDM
9	LOWER STEM SET SCREW	ASTM A-582
10	POSITION PLATE	CARBON STEEL

DESIGN DATA:
 Temperature - 250°F
 Pressure - 200 PSI WOG
 Dead End - 140 PSI



**GEAR OPERATOR IS RECOMMENDED FOR
8", 10", AND 12" VALVES.**

LEAD FREE - NSF 372

The wetted surface of this product contacted by consumable water contains less than one quarter of one percent (0.25%) of lead by weight. Material complies with state codes and standards, where applicable, requiring reduced lead content.

CUSTOMER: ISD #1

PROJECT: Southwest High School Pump House

ENGINEER: ATS&R

REV.	DATE
Metraflex <i>for pipes in motion</i>	
2323 W. HUBBARD ST. CHICAGO, IL 60612 TEL: 312-738-3800 FAX: 312-738-0415 WWW.METRAFLEX.COM	
BUTTERFLY VALVE, DINC DISK 2" - 12" LUG STYLE	
DRAWN BY: DEVINR	DATE: 02/27/2023
APPROVED:	DATE:
SCALE: N/A	DRAWING NUMBER: BLM03DINC-12

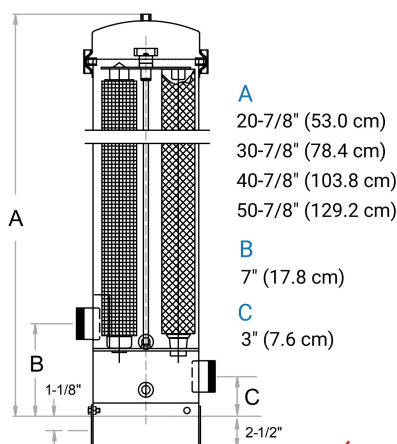
Multi-Cartridge Filter Housings

QFP Series Band Clamp Filter Housings

are designed for commercial and industrial liquid filtration applications. These multi-cartridge filter housings allow for flow rates up to 660 GPM. Universal seal cups and compression plates allow for use of DOE, 222/Flat and 222/Fin style cartridges.

Features

- Heavy Duty 304 or 316 SS construction
- External Poly-Coat Finish
- Easy Access Band Clamp closure
- Welded on Mounting/Support Legs
- Gauge/Drain & Vent Ports standard
- Manufactured in the USA
- Buna O-Ring
- Housings rated at 150 psi, 250°F
- Adjustable Top Plate with Spring Seal Assemblies



- A
20-7/8" (53.0 cm)
30-7/8" (78.4 cm)
40-7/8" (103.8 cm)
50-7/8" (129.2 cm)
- B
7" (17.8 cm)
- C
3" (7.6 cm)



304SS Part #	316SS Part #	# of Cartridges	Cartridge Length	In/Out	GPM Depth Cartridge	GPM Pleated Cartridge
QFP4X1-304	QFP4X1-316	4	10"	2" MNPT	20	30
QFP4X2-304	~~QFP4X2-316~~	4	20"	2" MNPT	40	60
QFP4X3-304	QFP4X3-316	4	30"	2" MNPT	60	90
QFP4X4-304	QFP4X4-316	4	40"	2" MNPT	80	120
QFP5X1-304	QFP5X1-316	5	10"	2" MNPT	25	38
QFP5X2-304	QFP5X2-316	5	20"	2" MNPT	50	75
QFP5X3-304	QFP5X3-316	5	30"	2" MNPT	75	115
QFP5X4-304	QFP5X4-316	5	40"	2" MNPT	100	150
QFP7X3-304	QFP7X3-316	7	30"	2" MNPT	105	150
QFP7X4-304	QFP7X4-316	7	40"	2" MNPT	140	200
QFP12X3-304	QFP12X3-316	12	30"	3" Flange	180	270
QFP12X4-304	QFP12X4-316	12	40"	3" Flange	240	360
QFP22X3-304	QFP22X3-316	22	30"	4" Flange	330	500
QFP22X4-304	QFP22X4-316	22	40"	4" Flange	440	660

** Flow rates are guidelines only. Actual flow rates vary based on micron rating, cartridge type, solids loading and other factors.



9001 Hanslik Ct., Naperville IL 60564
Ph: (630) 355-3330 • info@quantrol.net
www.quantrol.com

Quantrol, Inc.
US Distributor
since 1988.

CNS Trend & Plus Wall-Mounted Convection Heaters

Engineer/Architect:
ATS&R

Date:
5-29-25

Job Name/Customer:
Southwest High School Pump House

Phone:

Location:
Minndeapolis, MN

Date Required:

Contractor:
ISD #1

Phone:

Heater Specifications	Item No.	Quantity	kW	Voltage	Amperage
Model # CNS Trend/Plus	CNS 150-1 Plus	1	1500	120	12/5

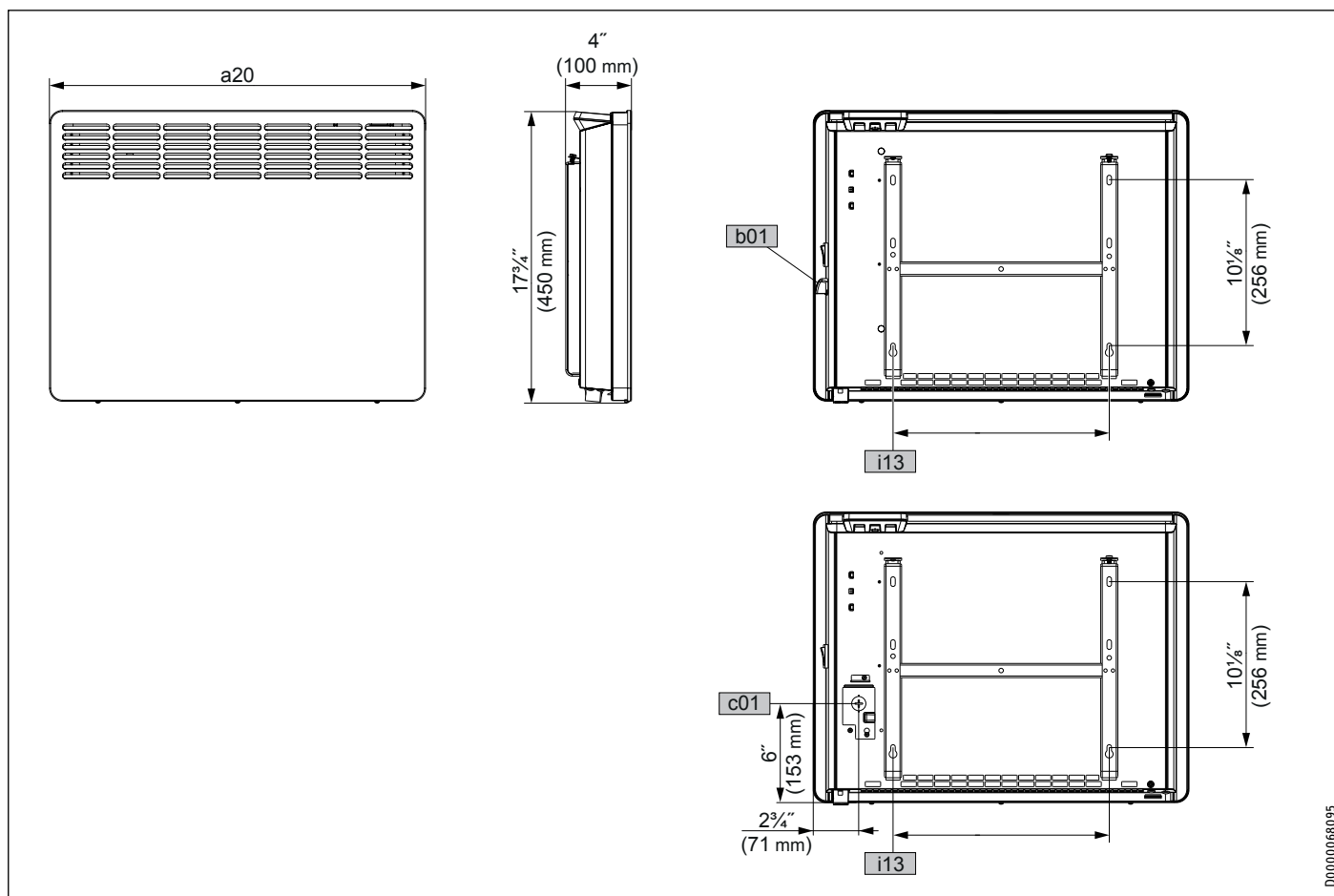
Description

CNS Trend/Plus are surface-mounted convection heaters that can be used as a replacement for traditional baseboard heaters or as a stand-alone heating system. The built-in thermostat can be used to control a single CNS or multiple CNS units can be placed strategically in larger spaces and their temperature settings adjusted individually. CNS Plus heaters feature a backlit digital thermostat/display. CNS heaters may be wired to use an existing wall-mounted thermostat. CNS is designed with a frost protection setting; the lowest setting will maintain a room above freezing temperature. Overheat protection is built into the unit. The external casing of the appliance is made from stove enameled sheet steel with some plastic trim pieces. Controls are located on top right looking at the appliance. Color is Alpine White.

Specifications									
Model	CNS 100-1 Trend	CNS 150-2 Trend	CNS 100-1 Plus	CNS 150-1 Plus	CNS 100-2 Plus	CNS 150-2 Plus	CNS 200-2 Plus	CNS 300-2 Plus	
Item number	201991	201992	201994	201996	201997	201998	201999	202000	
Voltage	120 V	240 V or 208 V	120 V	120 V	240 V or 208 V	240 V or 208 V	240 V or 208 V	240 V or 208 V	
Wattage	1000 W	1500 W 1125 W	1000 W	1500 W	1000 W 750 W	1500 W 1125 W	2000 W 1500 W	3000 W 2250 W	
Amperage	8.3 A	6.3 A 5.4 A	8.3 A	12.5 A	4.2 A 3.6 A	6.3 A 5.4 A	8.3 A 7.2 A	12.5 A 10.8 A	
Btu/hr	3412	5118 3839	3412	5118	3412 2559	5118 3839	6824 5118	10236 7677	
Electrical connection	Power cord with plug 71" (426 mm), hard-wired connection possible	Junction box, rear	Power cord with plug 71" (426 mm), hard-wired connection possible	Power cord with plug 71" (426 mm), hard-wired connection possible	Junction box, rear	Junction box, rear	Junction box, rear	Junction box, rear	
Required circuit breaker size ¹	15 A	10 A	15 A	15 A	10 A	10 A	15 A	15 A	
Required wire size (copper)	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	
Temperature range	41 °F–86 °F (5 °C–30 °C)								
Frost protection setting	45 °F (7 °C)								
Height	17¾" (450 mm)								
Depth	3½" (100 mm)								
Width	16¾" (426 mm)	22½" (582 mm)	16¾" (426 mm)	22½" (582 mm)	16¾" (426 mm)	22½" (582 mm)	29½" (738 mm)	41½" (1050 mm)	
Weight	10.1 lb (4.6 kg)	13.2 lb (6.0 kg)	10.1 lb (4.6 kg)	13.2 lb (6.0 kg)	10.1 lb (4.6 kg)	13.2 lb (6.0 kg)	17.0 lb (7.7 kg)	24.0 lb (10.9 kg)	
Room size estimate ²	100 sq. ft.	150 sq. ft.	100 sq. ft.	150 sq. ft.	100 sq. ft.	150 sq. ft.	200 sq. ft.	300 sq. ft.	

¹ This is our recommendation as the manufacturer. Check local codes for compliance if necessary.
² Based on average insulation

Dimensions & clearances



D0000068095

			CNS 100-1 Trend CNS 100-1 Plus CNS 100-2 Plus	CNS 150-1 Plus CNS 150-2 Trend CNS 150-2 Plus	CNS 200-2 Plus	CNS 300-2 Plus
a20	Heater	Width	16 3/4" (426 mm)	22 15/16" (582 mm)	29 1/16" (738 mm)	41 5/16" (1050 mm)
b01	Power cord entry, 120 V models					
c01	Position of junction box knockout, hard-wired 208-240 V models					
i13	Wall mounting bracket	Horizontal hole spacing	7 1/16" (179 mm)	13 3/16" (335 mm)	19 5/16" (491 mm)	31 5/8" (803 mm)



Conforms to UL Std. 1278, 2021
Certified to CAN/CSA Std. 22.2 No. 46



Warranty

Residential & commercial warranty: Stiebel Eltron warrants to the original owner that the CNS Trend or CNS Plus convection heater will be free from defects in workmanship and materials for a period of three (3) years from the date of purchase. Should the part(s) prove to be defective under normal use during this period, Stiebel Eltron, Inc. will be responsible for replacement of the defective part(s) only. Stiebel Eltron, Inc. is not responsible for labor charges to remove and/or replace the defective part(s), or any incidental or consequential expenses. Should the owner wish to return the convection heater for repair, the owner must first secure written authorization from Stiebel Eltron, Inc. The owner shall be required to show proof of purchase date, and to pay all transportation costs to return the defective part(s) or convection heater for repair or replacement. Warranty is void if water heater has been installed or used improperly or if design has been altered in any way.

Quotation Bill of Material

Item	Qty	Product Information
1	3	ACH580-PDR-052A-4 <i>ACH580 6-Pulse drive package rated UL (NEMA) Type 1. Provided with Main Input Disconnect with VFD fuses. Rated for 52 amps (40 HP) at 480 VAC three phase.</i>

Equipment Tag: CWP-4,5,6

Terms:

- ***FOB ABB Factory***
- ***Proposal valid for 30 days from quotation date***
- ***ABB Inc. Standard Terms and Conditions of Sale apply***
- ***Proposal based upon acceptance of Clarifications and Exceptions to Specifications and Terms provide later in this quotation***

Submittal Schedule

This schedule includes the products supplied as part of this submittal.

Schedule			Motor Data ¹			Drive Data			
Item	Qty	Tag	HP	FLA	Volts	Product ID	HP	Amps	Volts
1	3	CWP-4,5,6	40	52	460 VAC	ACH580-PDR-052A-4	40	52	
Notes: AC motor data is per National Electrical Code Table 430.250 for typical motors used in most applications. It is provided as typical data only. DC motor data is per typical industry standards. Actual motor data may vary									

Submittal Schedule Details for CWP-4,5,6

Item	Tag / Equipment ID	Product ID
1	CWP-4,5,6	ACH580-PDR-052A-4

Item Description
Input Voltage: 480 VAC Three Phase Rated Output Current: 52A Enclosure: UL (NEMA) Type 1 Nominal Horsepower: 40 HP Frame Size: R4 Input Disconnecting Means: Disconnect with VFD fuses Bypass: None Input Impedance: 5% equivalent impedance Short Circuit Current Rating: 100 kA Communication Protocols: Johnson Controls N2, Modbus RTU, BACnet (MS/TP) Other Options:

Drive Input Fuse Ratings	
Fuse Class	Amps (600 V)
Class J	80

Wire Size Capacities of Power Terminals		
Input Wiring	Output Wiring	Ground Wiring
#8...#1/0 4.6 lbf-ft	#20...#1 3 lbf-ft	#14...#2 #14...#10: 2.9 lbf-ft; #6...#4: 3.8 lbf-ft; #2: 4.1 lbf-ft

Dimensions and Weights			
Height <i>in</i> (mm)	Width <i>in</i> (mm)	Depth <i>in</i> (mm)	Weight <i>lbs</i> (kg)
40.6 (1032)	8.4 (213)	14.3 (362)	60 (27.2)

Heat Dissipation & Airflow Requirements			
Power Losses		Airflow	
BTU/Hr	Watts	CFM	CM/Hr
2,977	873	25	42.5

ACH580-01/-31

The ACH580 drive sets new standards in both simplicity and reliability, and ensures smooth, energy-efficient operation of your HVAC systems in normal and mission-critical situations.

ACH580-01, wall-mounted base drives

The ACH580-01 wall-mounted drives are available from 1 to 100 HP at 208/240 V, 1 to 350 HP at 480 V, and 2 to 250 HP at 575 V. The ACH580-01 drives are available in UL (NEMA) Type 1 and 12 configurations. In standard installations, the drive is mounted directly onto a wall and uses the provided conduit box. Conduit openings are provided for bottom conduit entry & exit. For mounting in a customer-supplied cabinet, the conduit box may be removed. The drive has a 100 kA SCCR rating when paired with appropriately sized upstream fuses.

ACH580-31, ultra low harmonic wall-mounted base drives

The ACH580-31 wall-mounted drives are available from 5 to 75 HP @208/230v and 5 to 400 HP @ 480 V. The ACH580-31 are available in UL (NEMA) Type 1 and 12 configurations. In standard installations, the drive is mounted directly onto a wall and uses the provided conduit box. Conduit openings are provided for bottom conduit entry and exit. For mounting in a customer-supplied cabinet, the conduit plate may be removed.

Features for HVAC

The ACH580 includes a Bluetooth control panel that allows you to configure, control, and monitor the drive. You can also use the DriveTune app on your mobile device for these functions remotely. An optional standard control panel is available with all the same configure, control and monitoring capabilities but without Bluetooth.

A robust HVAC firmware package provides drive, motor, and application protection features. Examples of drive protection features include undervoltage, overvoltage, overcurrent, and ground fault protection. The ACH580 also has a variety of motor protection features including overload and stall protections.

Application specific features, such as accepting four separate start interlocks (safeties), along with broken belt detection, are also included. The drive includes BACnet MS/TP, Modbus RTU, and Johnson N2 as standard. Additional protocols, such as BACnet/IP and LonWorks , are available with optional fieldbus adapters.

Technical specifications

Product compliance (complete list on following page)

ACH580-01/-31 CE, UL, cUL, and EAC

Supply connection

Input voltage (U_i)	
ACH580-xx-xxxA-2	208/230V
ACH580-xx-xxxA-4	480V
ACH580-xx-xxxA-6	600V
Input voltage tolerance	+10% / -15%
Phase	3-phase (1-phase, 240 V)
Frequency	48 to 63 Hz
Line Limitations	Max $\pm 3\%$ of nominal phase to phase input voltage
Power Factor ($\cos \phi$) at nominal load	
ACH580-01	0.98
ACH580-31	1.0
Efficiency at rated power	
ACH580-01	98.0%
ACH580-31	96.5%
Power Loss	Approximately 2% of rated power

Motor connection

Supported motor control	Scalar and vector
Supported motor types	Asynchronous motor, permanent magnet motor (vector), SynRM (vector)
Voltage	3-phase, from 0 to supply voltage
Frequency	0 to 500 Hz
Short Term Overload Capacity Variable Torque	110% for 1 min/10min
Peak Overload Capacity Variable Torque	1.35 for 2 second (2 sec / 10 min)
Switching Frequency	2, 4, 8 or 12 kHz Automatic fold back in case of overload
Acceleration/Deceleration Time	0 to 1800 s
Short Circuit Current Rating (SCCR)	100 ka with fusing

Inputs and outputs (drive)

2 analog inputs	Selection of Current/Voltage input mode is user programmable.
Voltage reference	0 (2) to 10 V, $R_{in} > 200 \text{ k}\Omega$
Current reference	0 (4) to 20 mA, $R_{in} = 100 \Omega$
Potentiometer reference value	10 V $\pm 1\%$ max. 20 mA
2 analog outputs	AO1 is user programmable for current or voltage. AO2 current
Voltage reference	0 to 10 V, $R_{load} > 100 \text{ k}\Omega$
Current reference	0 to 20 mA, $R_{load} < 500 \Omega$
Applicable potentiometer	1 k Ω to 10 k Ω
Internal auxiliary voltage	24 V DC $\pm 10\%$, max. 250 mA
Accuracy	+/- 1% full scale range at 25°C (77°F)
Output updating time	2 ms
6 digital inputs	12 to 24 V DC, 10 to 24 V AC, Connectivity of PTC sensors supported by a single digital input. PNP or NPN connection (5 DIs with NPN connection). Programmable
Input Updating Time	2 ms

3 relay outputs	Maximum switching voltage 250 V AC/30 V DC. Maximum continuous current 2 A rms. Programmable, Form C
Adjustable filters on analog inputs and outputs	
All control inputs isolated from ground and power	
Operation	
Air temperature	0 to -15 °C (32 to 5 °F). -15 to +50 °C (5 to 122 °F): No frost allowed. Output derated above +40 °C (104 °F)
Installation site altitude	0 to 4000 m (13123 ft) above sea level Output derated above 1000 m (3281 ft)
Relative humidity	5 to 95% No condensation allowed Maximum relative humidity is 60% in the presence of corrosive gasses
Atmospheric pressure	70 to 106 kPa (10.2 to 15.4 PSI) 0.7 to 1.05 atmospheres
Vibration	Risk category IV Certified (IBC 2018)
Environmental protections	
Chemical Gasses	Class 3C2
Solid Particles	Class 3S2 No conductive dust allowed
Pollution degree (IEC/EN 61800-5-1)	Pollution degree 2
Product compliance	
Standards and directives	Low Voltage Directive 2006/95/EC EMC Directive 2004/108/EC 60721-3-3: 2002 60721-3-1:1997 Quality assurance system ISO 9001 and Environmental system ISO 14001 CE, UL, cUL, and EAC approvals Galvanic isolation according to PELV RoHS2 (Restriction of Hazardous Substances) EN 61800-5-1: 2007; IEC/EN 61000-3-12; EN61800-3: 2017 + A1: 2012 Category C2 (1st environment restricted distribution); Safe torque off (EN 61800-5-2) BACnet Testing Laboratory (BTL) Seismic (IBC, OSHPD) Plenum (ACH580-01 only)
EMC (according to EN61800-3)	ACH580-01 and ACH580-31 class C2 (1st environment restricted distribution)

Storage (in Protective Shipping Package)

Air Temperature	-40 to +70 °C (-40 to +158 °F)
Relative Humidity	Less than 95% No condensation allowed Maximum relative humidity is 60% in the presence of corrosive gasses
Chemical Gasses	Class 1C2
Solid Particles	Class 1S2 Contact ABB regarding Class 1S3
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres
Vibration (ISTA)	
R1...R4	In accordance with ISTA 1A
R5...R9	In accordance with ISTA 3E

Transportation (in Protective Shipping Package)

Air Temperature	-40° to 70°C (-40° to 158°F)
Relative Humidity	Less than 95% No condensation allowed Maximum relative humidity is 60% in the presence of corrosive gasses
Atmospheric Pressure	60 to 106 kPa (8.7 to 15.4 PSI) 0.6 to 1.05 atmospheres
Free Fall	R1: 76 cm (30 in) R2: 61 cm (24 in) R3: 46 cm (18 in) R4: 31 cm (12 in) R5: 25 cm (10 in)
Chemical Gasses	Class 2C2
Solid Particles	Class 2S2
Shock/ Drop (ISTA)	
R1...R4	In accordance with ISTA 1A
R5...R9	In accordance with ISTA 3E
Vibration (ISTA)	
R1...R4	In accordance with ISTA 1A
R5...R9	In accordance with ISTA 3E

Feature overview

Communication

Protocols as standard (EIA-485): BACnet MS/TP, Modbus RTU, Johnson Controls N2
Available as plug-in options: BACnet/IP, Modbus TCP, PROFIBUS-DP, DeviceNet, EtherNet/IP, LonWorks (coming 2019)

Application functions

Start interlock
Delayed start
Run permissive (damper monitoring)
Override operation mode
Real-time clock (scheduling)
PID controllers for motor and process
Motor flying start
Motor preheating
Energy optimizer and calculators
Timer
2 or 3 wire start/stop
Ramp to stop
2 independent adjustable accel/decel ramp

Protection functions

Overvoltage controller
Undervoltage controller
Motor earth-leakage monitoring
Motor short-circuit protection
Motor overtemperature protection
Output and input switch supervision
Motor overload protection (UL508C)
Phase-loss detection (both motor and supply)
Under load supervision (belt loss detection)
Overload supervision
Stall protection
Loss of reference
Panel loss
Ground fault
External events
Overcurrent
Current limit regulator
Transient/Surge protection (MOV and choke)

Panel functions

First start assistant
Primary settings for HVAC applications
Hand-Off-Auto operation mode
HVAC quick set-up
Includes Day, Date and Time
Operator Panel Parameter Backup (read/write)
Full Graphic and Multilingual Display for Operator Control, Parameter Set-Up and Operating Data Display:

- Output Frequency (Hz)
- Speed (RPM)
- Motor Current
- Calculated % Motor Torque
- Calculated Motor Power (kW)
- DC Bus Voltage
- Output Voltage
- Heatsink Temperature
- Elapsed Time Meter (resettable)
- kWh (resettable)
- Input / Output Terminal Monitor
- PID Actual Value (Feedback) & Error Fault Text
- Warning Text
- Three (3) Scalable Process Variable Displays
- User-Definable Engineering Units

Motor control features

Scalar (V/Hz) and vector modes of motor control
V/Hz shapes

- Linear
- Squared

Energy optimization
IR compensation
Slip compensation
Three (3) Critical Frequency Lockout Bands

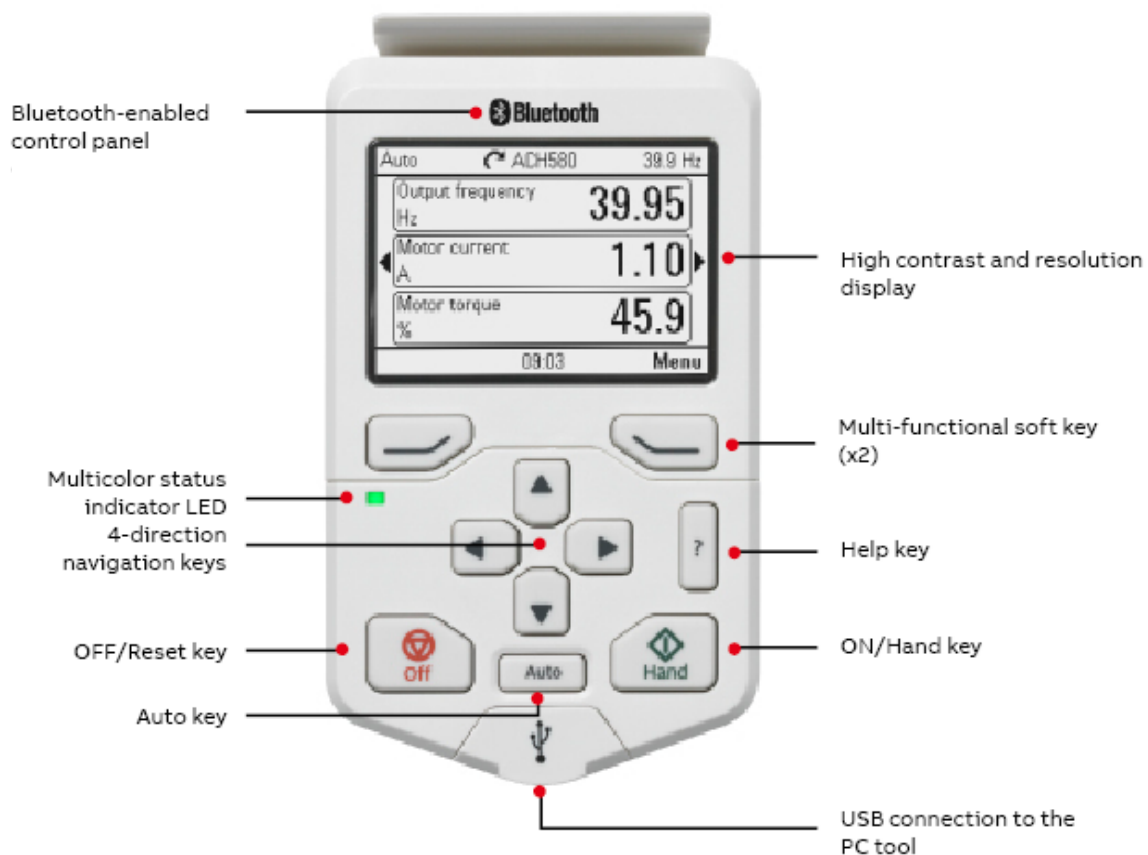
PID control

One (1) Process PID
Four (4) Integral Independent Programmable PID Setpoint Controllers (Process and External)
External Selection between Two (2) Sets of Process
PID Controller Parameters
PID Sleep/Wake-Up

Control panel features

The ACH580 Assistant Control Panel features:

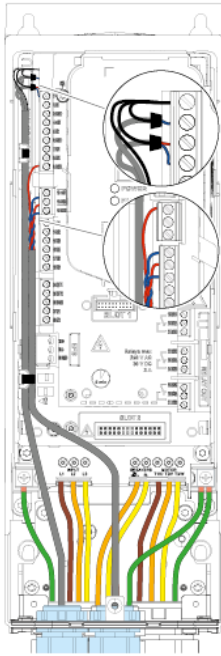
- Intuitive to operate
- Primary Setting menu to ease drive commissioning
- Real-time clock
- Diagnostic and maintenance functions
- Full-graphic display, including chart, graph, and meter options
- 21 editable home views
- USB interface for PC and tool connection as standard
- Parameters are alpha-numeric
- North American version supports 14 languages as standard
- Dedicated "Help" key
- 4 user sets
- Parameters are stored in control panel memory for later transfer to other drives or for backup of a particular system
- Back-up and restore parameters and/or motor data
- Automatic back-up 2 hours after parameter change
- Modified parameter display
- Creates unique short menu
- Shows parameters that differ from the default
-



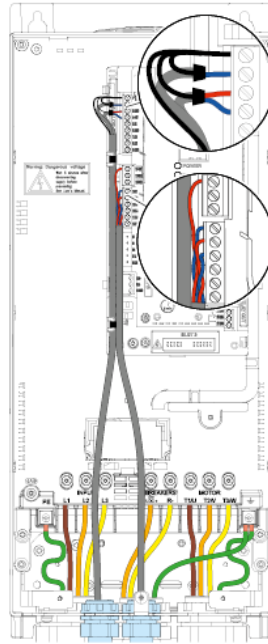
Cable connections

The following illustrations show the ACH580-01 and ACH580-31 cable connection points for the base drive. The illustrations indicate the location of input and output power connections as well as equipment and motor grounding connection points.

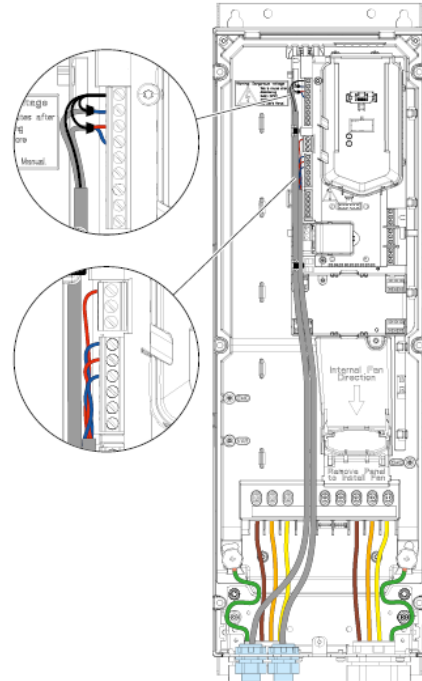
ACH580 drives are configured for wiring access from the bottom only. At least three separate metallic conduits are required, one for input power, one for output power to the motor and one for control signals.



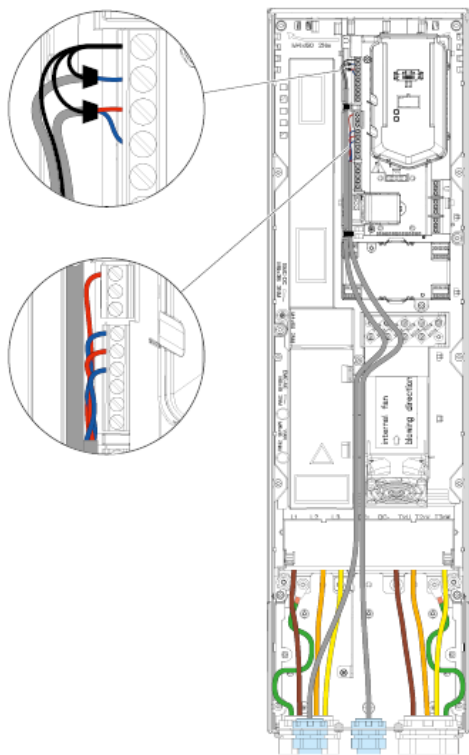
ACH580-01, R1-R2, UL (NEMA) Type 1 and 12



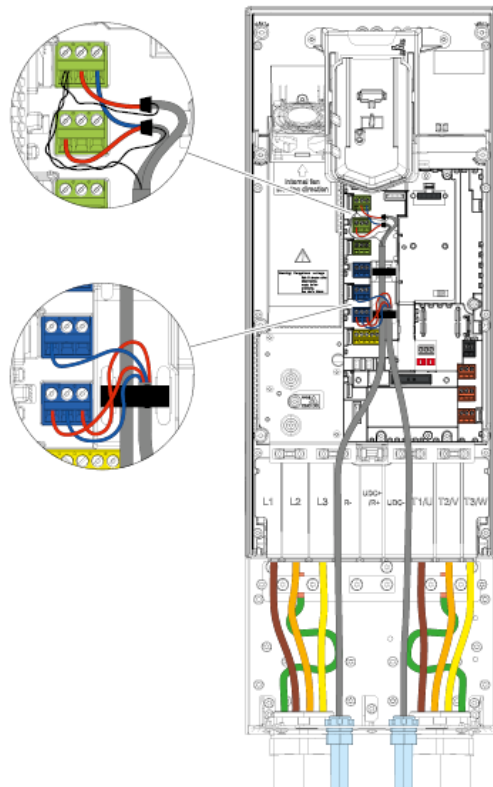
ACH580-01, R3, UL (NEMA) Type 1 and 12



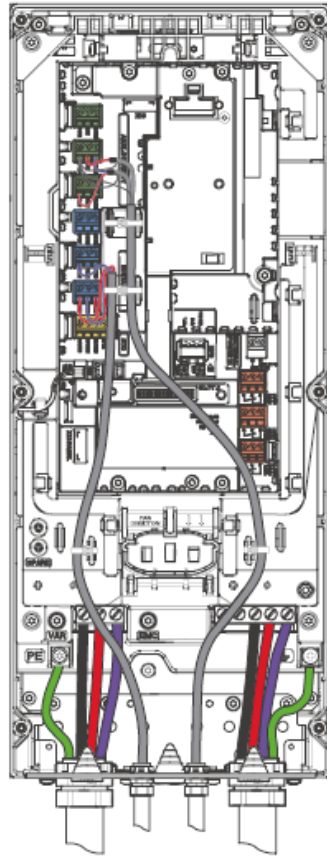
ACH580-01, R4, UL (NEMA) Type 1 and 12



ACH580-01, R5, UL (NEMA) Type 1 and 12



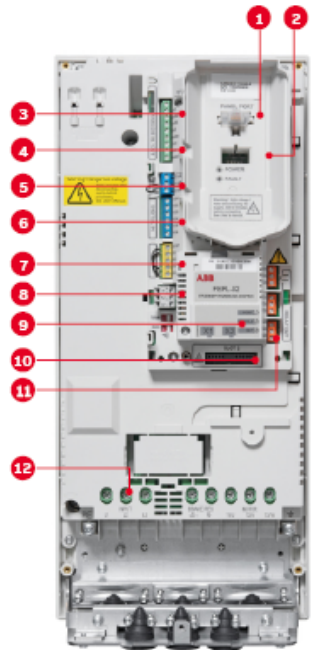
ACH580-01, R6-9, UL (NEMA) Type 1 and 12



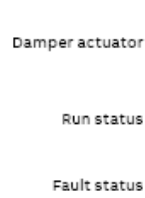
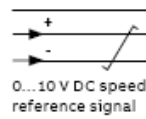
ACH580-31, R3, UL (NEMA) Type 1 and 12

Control connections

Default control connections



1. Panel port (PC tools, control panel)
2. ABB drive customizer port for programming the drive without mains
3. Analog inputs (2 × AI)
4. Analog outputs (2 × AO)
5. 24 V DC output
6. Digital inputs (6 × DI)
7. Safe torque off (STO)
8. Embedded fieldbus
9. Communication options (fieldbuses)
10. Analog and digital I/O extensions
11. Relay outputs (3 × RO)
12. Mains connection



Terminal	Meaning	Default macro connections		
X1 Reference voltage and analog inputs and outputs				
1	SCR	Signal cable shield (screen)		
2	AI1	Output frequency/speed reference: 0 to 10 V		
3	AGND	Analog input circuit common		
4	+10 V	Reference voltage 10 V DC		
5	AI2	Actual feedback: 0 to 20 mA		
6	AGND	Analog input circuit common		
7	AO1	Output frequency: 0 to 10 V		
8	AO2	Motor current: 0 to 20 mA		
9	AGND	Analog output circuit common		
X2 & X3 Aux. voltage output and programmable digital inputs				
10	+24 V	Aux. voltage output +24 V DC, max. 250 mA		
11	DGND	Aux. voltage output common		
12	DCOM	Digital input common for all		
13	DI1	Stop (0)/Start (1)		
14	DI2	Not configured		
15	DI3	Constant frequency/speed selection		
16	DI4	Start interlock 1 (1 = allow start)		
17	DI5	Not configured		
18	DI6	Not configured		
X6, X7, X8 Relay outputs				
19	RO1C		Damper control 250 V AC/30 V DC 2 A	Energize damper 19 connected to 21
20	RO1A			
21	RO1B			
22	RO2C		Running 250 V AC/30 V DC 2 A	Running 22 connected to 24
23	RO2A			
24	RO2B			
25	RO3C		Fault (-1) 250 V AC/30 V DC 2 A	Fault condition 25 connected to 26
26	RO3A			
27	RO3B			
X5 Embedded fieldbus				
29	B+	Embedded fieldbus, EFB (EIA-485)		
30	A-			
31	DGND			
54	TERM	Termination switch		
55	BIAS	Bias resistors switch		
X4 Safe torque off				
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter <i>The Safe torque off function</i> in the <i>hardware manual</i> of the drive.		
35	OUT2			
36	SGND			
37	IN1			
38	IN2			
X10 24 V AC/DC				
40	24 V AC/DC+ in	R6-R11 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.		
41	24 V AC/DC- in			

Notes:

- Connected with jumpers at the factory.
- Only frames R6-R11 have terminals 40 and 41 for external 24 V AC/DC input.

ACH580 Packaged Drives with Disconnect

The ACH580 drive sets new standards in both simplicity and reliability, and ensures smooth, energy-efficient operation of your HVAC systems in normal and mission-critical situations.

The ACH580 Packaged Drive is an ACH580 Variable Frequency Drive enclosed with either an input disconnect switch and fast acting fuses (ACH580-PDR) or an input circuit breaker (ACH580-PCR). The ACH580 Packaged Drive provides a door-mounted input disconnect operator (padlockable in the OFF position), electronic motor overload protection, a door mounted control panel with graphical display for local control, provisions for external control connections, and serial communications capability.

UL (NEMA) Type 1 and 12 Packaged Drive units are available from 1 to 100 HP at 208/230V, 1 to 550 HP at 460V, and 2 to 150 HP at 575V. UL (NEMA) Type 1 and 12 units are wall mounted from 1 to 200 HP and floor mounted from 250 to 550 HP.

For outdoor applications, UL (NEMA) Type 3R Packaged Drive units are available from 1 to 100 HP at 208/230V, 1 to 350 HP at 460V and 2 to 150 HP at 575V. Construction is sheet steel with a tough powder coat paint finish for corrosion resistance. A thermostatically controlled space heater and forced ventilated air cooling system are standard.

Features for HVAC

The ACH580 includes a Bluetooth control panel that allows you to configure, control, and monitor the drive. You can also use the DriveTune app on your mobile device for these functions remotely. An optional standard control panel is available with all the same configure, control and monitoring capabilities but without Bluetooth.

A robust HVAC firmware package provides drive, motor, and application protection features. Examples of drive protection features include undervoltage, overvoltage, overcurrent, and ground fault protection. The ACH580 also has a variety of motor protection features including overload and stall protections.

Application specific features, such as accepting four separate start interlocks (safeties), along with broken belt detection, are also included. The drive includes BACnet MS/TP, Modbus RTU, and Johnson N2 as standard. Additional protocols, such as BACnet/IP and LonWorks (coming 2019), are available with optional fieldbus adapters.

Technical specifications

Product compliance (complete list on following page)

ACH580-PxR

UL508A

Supply connection

Input voltage (U_1)	
ACH580-xx-xxxA-2	208/240V
ACH580-xx-xxxA-4	480V
ACH580-xx-xxxA-6	600V
Input voltage tolerance	+10% / -15%
Phase	3-phase (1-phase, 240 V)
Frequency	48 to 63 Hz
Line Limitations	Max $\pm 3\%$ of nominal phase to phase input voltage
Power Factor ($\cos \phi$) at nominal load	
ACH580-PxR	0.98
Efficiency at rated power	
ACH580-PxR	98.0%
Power Loss	Approximately 2% of rated power

Motor connection

Supported motor control	Scalar and vector
Supported motor types	Asynchronous motor, permanent magnet motor (vector), SynRM (vector)
Voltage	3-phase, from 0 to supply voltage
Frequency	0 to 500 Hz
Short Term Overload Capacity Variable Torque	110% for 1 min/10min
Peak Overload Capacity	1.35 for 2 second
Variable Torque	(2 sec / 10 min)
Switching Frequency	2, 4, 8 or 12 kHz Automatic fold back in case of overload
Acceleration/Deceleration Time	0 to 1800 s

Short Circuit Current Rating (SCCR)

	240V	480V	600V
-PCR	100kA	100kA	≤ 60 Hp: 25 kA ≥ 75 Hp: 10 kA
-PDR	100kA	100kA	100kA

Technical specifications

Inputs and outputs (drive)	
2 analog inputs	Selection of Current/Voltage input mode is user programmable.
Voltage reference	0 (2) to 10 V, $R_{in} > 200 \text{ k}\Omega$
Current reference	0 (4) to 20 mA, $R_{in} = 100 \Omega$
Potentiometer reference value	10 V $\pm 1\%$ max. 20 mA
2 analog outputs	AO1 is user programmable for current or voltage. AO2 current
Voltage reference	0 to 10 V, $R_{load} > 100 \text{ k}\Omega$
Current reference	0 to 20 mA, $R_{load} < 500 \Omega$
Applicable potentiometer	1 k Ω to 10 k Ω
Internal auxiliary voltage	24 V DC $\pm 10\%$, max. 250 mA
Accuracy	$\pm 1\%$ full scale range at 25°C (77°F)
Output updating time	2 ms
6 digital inputs	12 to 24 V DC, 10 to 24 V AC, Connectivity of PTC sensors supported by a single digital input. PNP or NPN connection (5 DIs with NPN connection). Programmable
Input Updating Time	2 ms
3 relay outputs	Maximum switching voltage 250 V AC/30 V DC. Maximum continuous current 2 A rms. Programmable, Form C
Contact material	Silver Tin Oxide (AgSnO_2)
PTC, PT100 and PT1000	Any of the analog inputs, or digital input 6, are configurable for PTC with up to 6 sensors.
Adjustable filters on analog inputs and outputs	
All control inputs isolated from ground and power	
Operation	
Air temperature	0 to -15 °C (32 to 5 °F). -15 to +50 °C (5 to 122 °F): No frost allowed. Output derated above +40 °C (104 °F)
Installation site altitude	0 to 1000 m (3281 ft) above sea level Output derated above 1000 m (3281 ft)
Relative humidity	5 to 95% No condensation allowed Maximum relative humidity is 60% in the presence of corrosive gasses
Atmospheric pressure	70 to 106 kPa (10.2 to 15.4 PSI) 0.7 to 1.05 atmospheres
Siesmic	Risk category IV Certified (IBC 2018)

Feature overview

Communication

Protocols as standard (EIA-485): BACnet MS/TP, Modbus RTU, Johnson Controls N2
Available as plug-in options: BACnet/IP, Modbus TCP, PROFIBUS-DP, DeviceNet, EtherNet/IP

Application functions

Start interlock
Delayed start
Run permissive (damper monitoring)
Override operation mode
Real-time clock (scheduling)
PID controllers for motor and process
Motor flying start
Motor preheating
Energy optimizer and calculators
Timer
2 or 3 wire start/stop
Ramp to stop
2 independent adjustable accel/decel ramp

Protection functions

Overvoltage controller
Undervoltage controller
Motor earth-leakage monitoring
Motor short-circuit protection
Motor overtemperature protection
Output and input switch supervision
Motor overload protection (UL508C)
Phase-loss detection (both motor and supply)
Under load supervision (belt loss detection)
Overload supervision
Stall protection
Loss of reference
Panel loss
Ground fault
External events
Overcurrent
Current limit regulator
Transient/Surge protection (MOV and choke)

Panel functions

First start assistant
Primary settings for HVAC applications
Hand-Off-Auto operation mode
HVAC quick set-up
Includes Day, Date and Time
Operator Panel Parameter Backup (read/write)
Full Graphic and Multilingual Display for Operator Control, Parameter Set-Up and Operating Data Display:

- Output Frequency (Hz)
- Speed (RPM)
- Motor Current
- Calculated % Motor Torque
- Calculated Motor Power (kW)
- DC Bus Voltage
- Output Voltage
- Heatsink Temperature
- Elapsed Time Meter (resettable)
- kWh (resettable)
- Input / Output Terminal Monitor
- PID Actual Value (Feedback) & Error Fault Text
- Warning Text
- Three (3) Scalable Process Variable Displays
- User-Definable Engineering Units

Motor control features

Scalar (V/Hz) and vector modes of motor control
V/Hz shapes

- Linear
- Squared

Energy optimization
IR compensation
Slip compensation
Three (3) Critical Frequency Lockout Bands

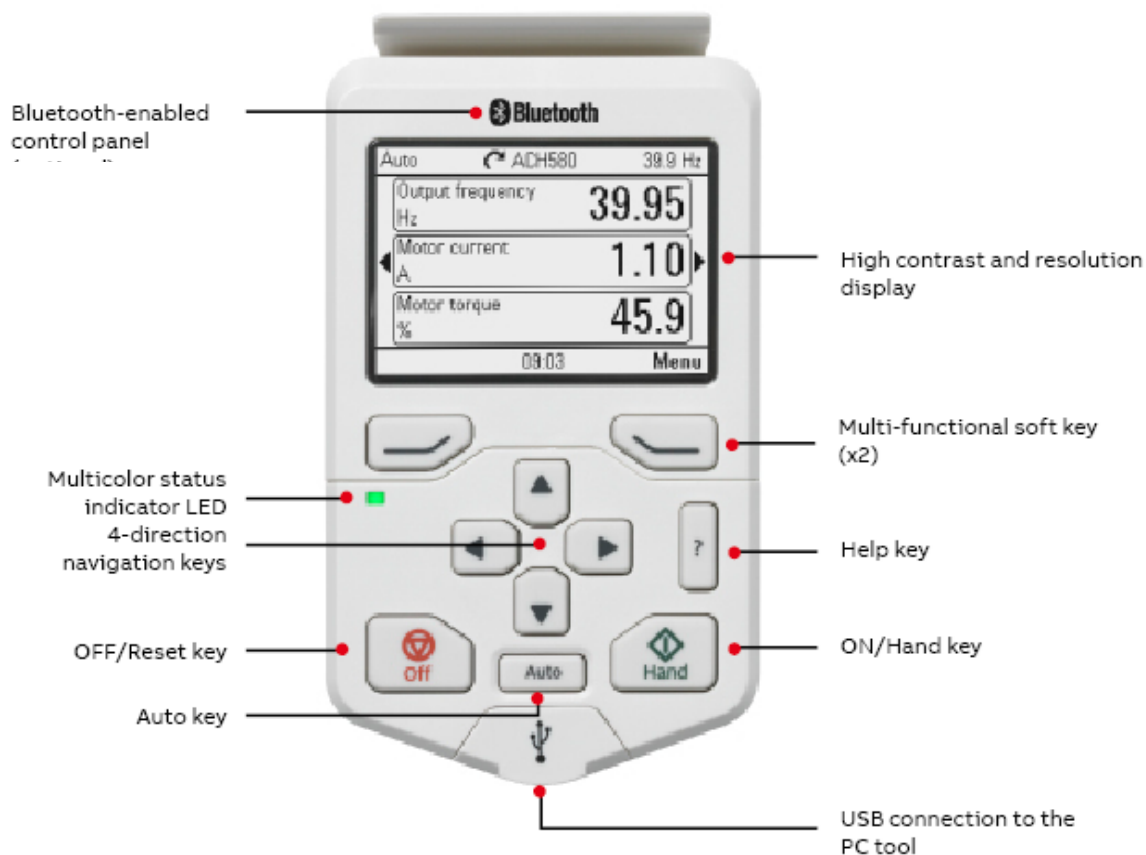
PID control

One (1) Process PID
Four (4) Integral Independent Programmable PID Setpoint Controllers (Process and External)
External Selection between Two (2) Sets of Process PID Controller Parameters
PID Sleep/Wake-Up

Control panel features

The ACH580 Assistant Control Panel features:

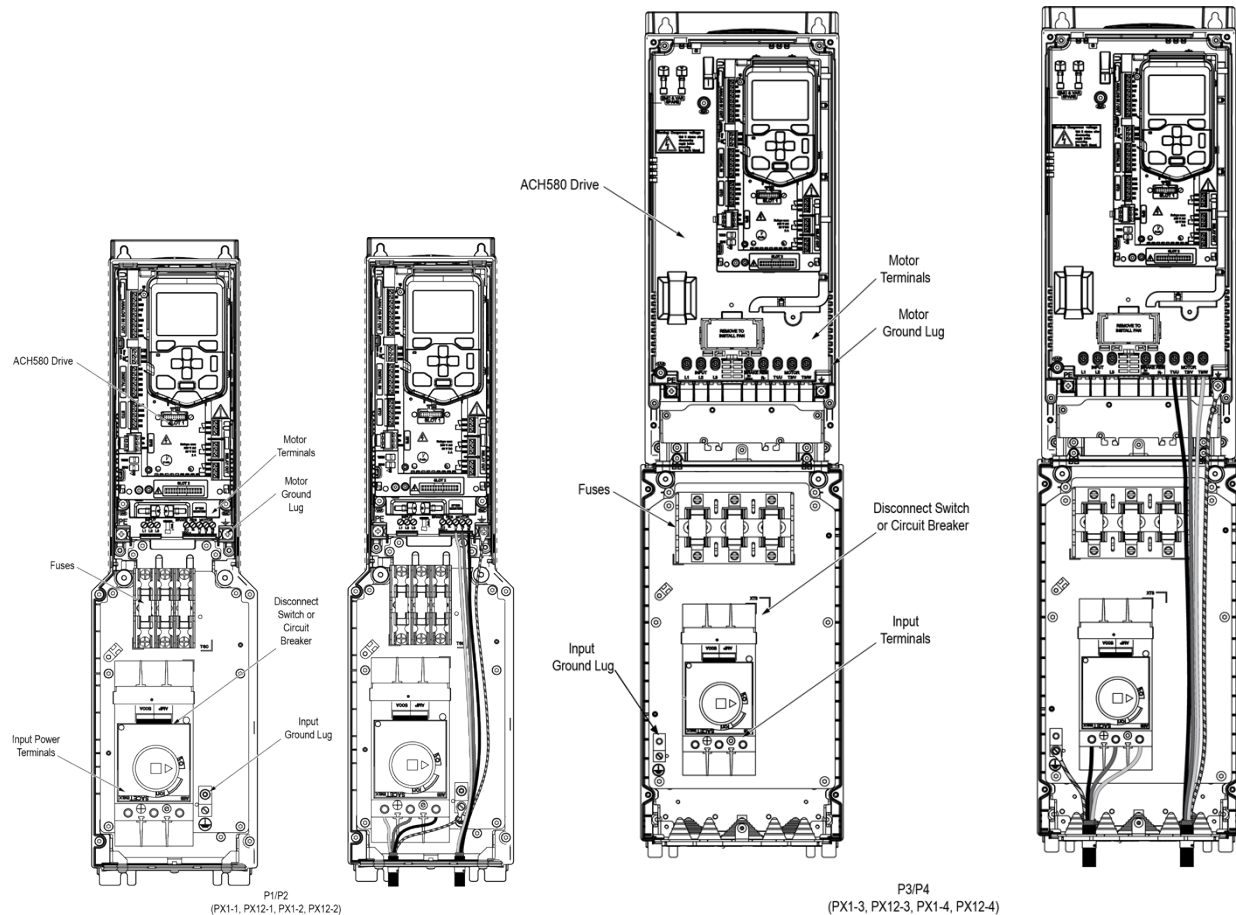
- Intuitive to operate
- Primary Setting menu to ease drive commissioning
- Real-time clock
- Diagnostic and maintenance functions
- Full-graphic display, including chart, graph, and meter options
- 21 editable home views
- USB interface for PC and tool connection as standard
- Parameters are alpha-numeric
- North American version supports 14 languages as standard
- Dedicated "Help" key
- 4 user sets
- Parameters are stored in control panel memory for later transfer to other drives or for backup of a particular system
- Back-up and restore parameters and/or motor data
- Automatic back-up 2 hours after parameter change
- Modified parameter display
- Creates unique short menu
- Shows parameters that differ from the default



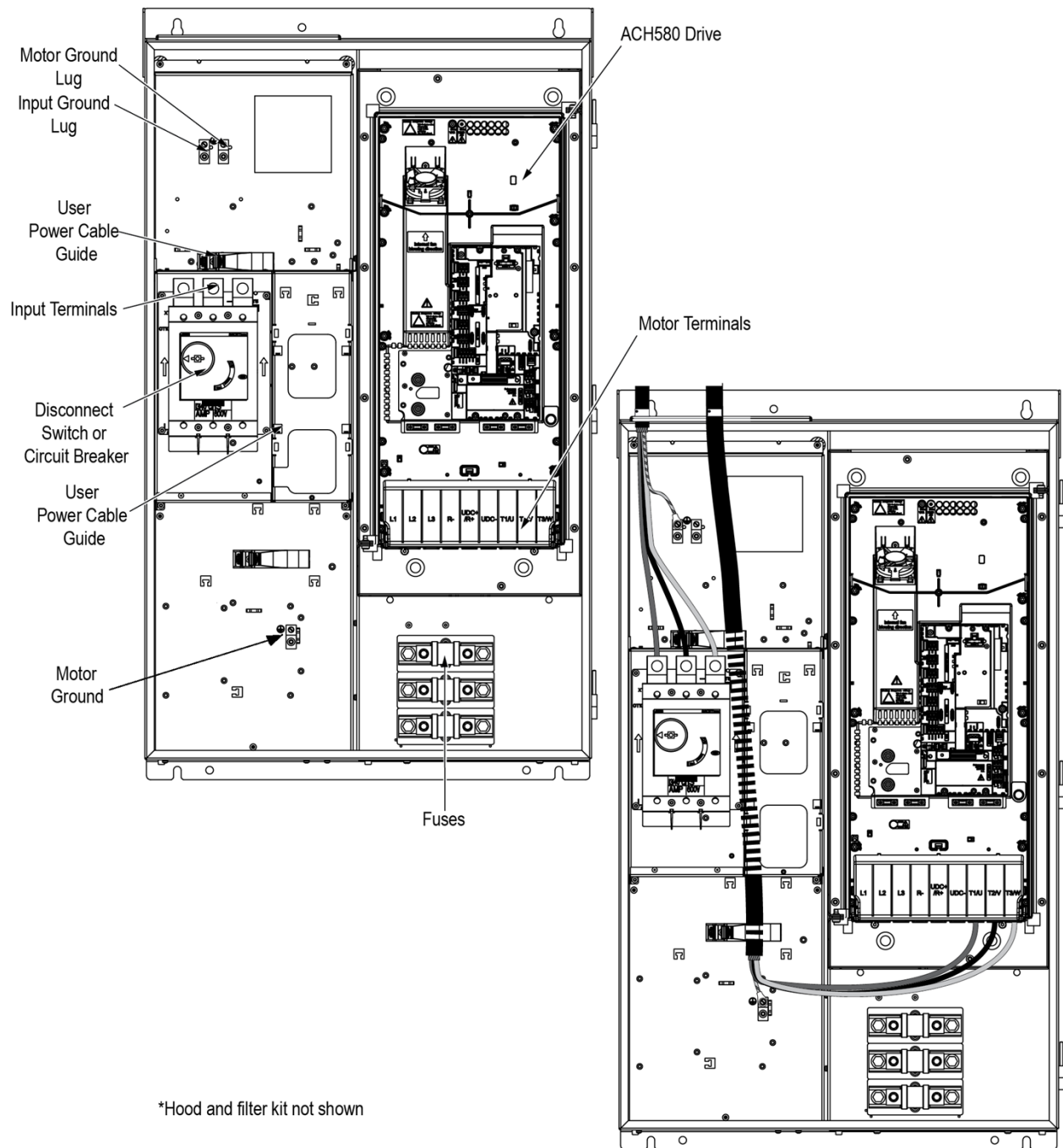
Cable connections

The following illustrations show the ACH580 Packaged Drive cable connection points for the various enclosure styles. The illustrations indicate the location of input and output power connections as well as equipment and motor grounding connection points.

ACH580-PCR and PDR packages are configured for wiring access from the bottom only on vertical wall mount units and from the top only on UL (NEMA) Type 1 and 12 standard wall mount units. UL (NEMA) Type 3R enclosures are configured for bottom access. At least three separate metallic conduits are required, one for input power, one for output power to the motor and one for control signals.

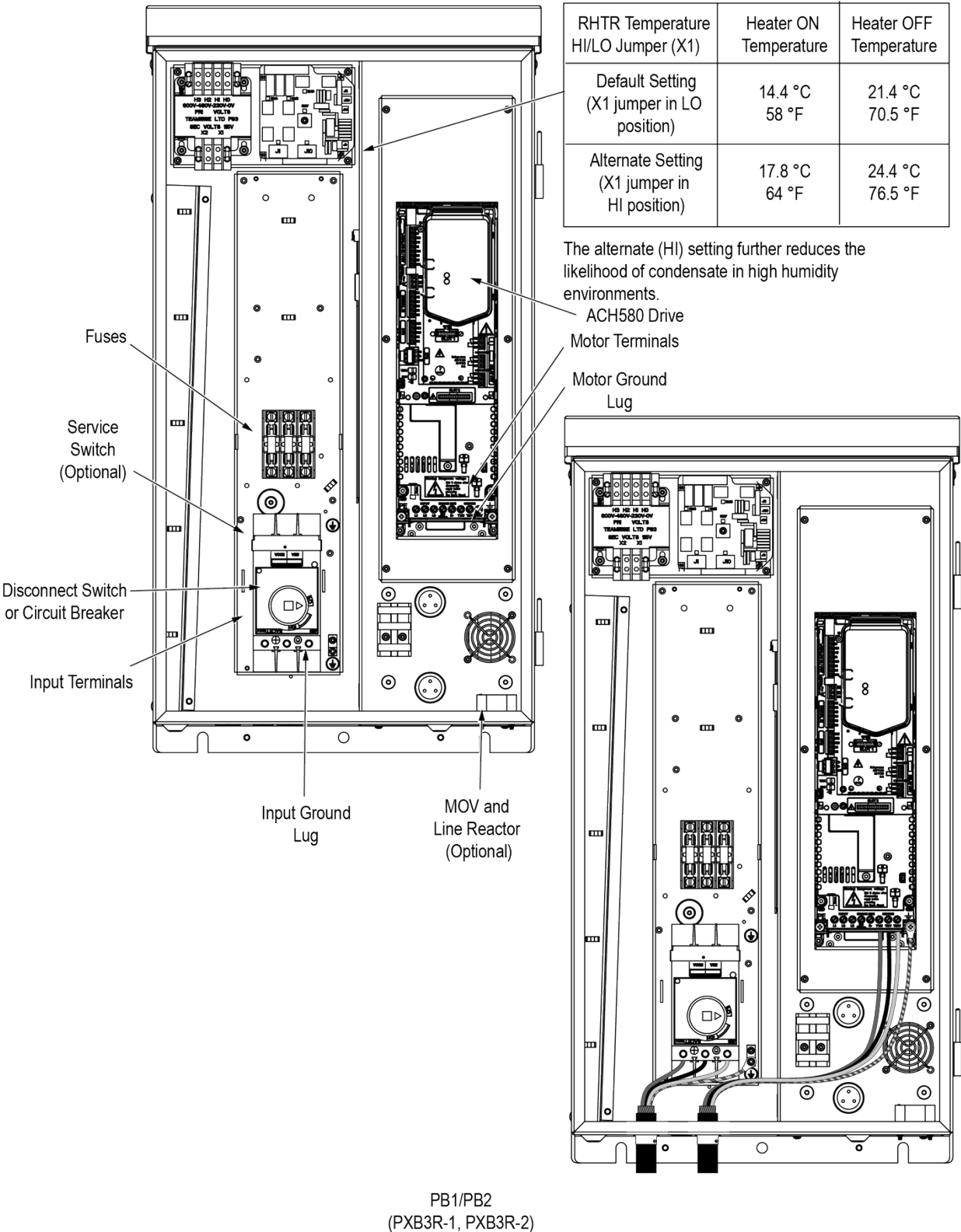


Control connections



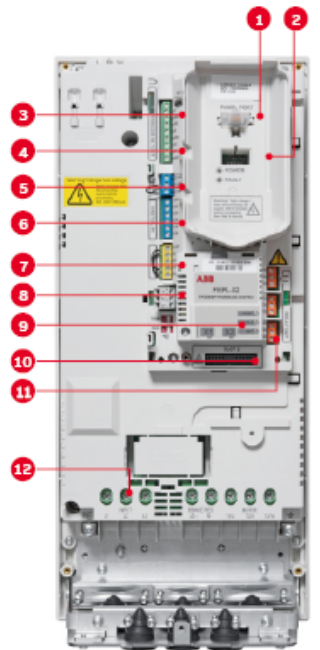
PB3
(PXB1-3, PXB12-3*)

Cable connections

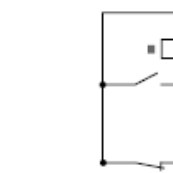
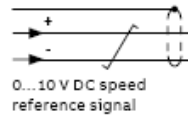


Control connections

Default control connections



1. Panel port (PC tools, control panel)
2. ABB drive customizer port for programming the drive without mains
3. Analog inputs (2 × AI)
4. Analog outputs (2 × AO)
5. 24 V DC output
6. Digital inputs (6 × DI)
7. Safe torque off (STO)
8. Embedded fieldbus
9. Communication options (fieldbuses)
10. Analog and digital I/O extensions
11. Relay outputs (3 × RO)
12. Mains connection



Damper actuator
Run status
Fault status

Terminal	Meaning	Default macro connections		
X1 Reference voltage and analog inputs and outputs				
1	SCR	Signal cable shield (screen)		
2	AI1	Output frequency/speed reference: 0 to 10 V		
3	AGND	Analog input circuit common		
4	+10 V	Reference voltage 10 V DC		
5	AI2	Actual feedback: 0 to 20 mA		
6	AGND	Analog input circuit common		
7	AO1	Output frequency: 0 to 10 V		
8	AO2	Motor current: 0 to 20 mA		
9	AGND	Analog output circuit common		
X2 & X3 Aux. voltage output and programmable digital inputs				
10	+24 V	Aux. voltage output +24 V DC, max. 250 mA		
11	DGND	Aux. voltage output common		
12	DCOM	Digital input common for all		
13	DI1	Stop (0)/Start (1)		
14	DI2	Not configured		
15	DI3	Constant frequency/speed selection		
16	DI4	Start interlock 1 (1 = allow start)		
17	DI5	Not configured		
18	DI6	Not configured		
X6, X7, X8 Relay outputs				
19	RO1C		Damper control 250 V AC/30 V DC 2 A	Energize damper 19 connected to 21
20	RO1A			
21	RO1B			
22	RO2C		Running 250 V AC/30 V DC 2 A	Running 22 connected to 24
23	RO2A			
24	RO2B		Fault (-1) 250 V AC/30 V DC 2 A	Fault condition 25 connected to 26
25	RO3C			
26	RO3A			
27	RO3B			
X5 Embedded fieldbus				
29	B+	Embedded fieldbus, EFB (EIA-485)		
30	A-			
31	DGND			
54	TERM	Termination switch		
55	BIAS	Bias resistors switch		
X4 Safe torque off				
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter <i>The Safe torque off function</i> in the <i>hardware manual</i> of the drive.		
35	OUT2			
36	SGND			
37	IN1			
38	IN2			
X10 24 V AC/DC				
40	24 V AC/DC+ in	R6-R11 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.		
41	24 V AC/DC- in			

Notes:

- Connected with jumpers at the factory.
- Only frames R6-R11 have terminals 40 and 41 for external 24 V AC/DC input.

Engineering Data Summary

Replacement Fuses

Drive input fuses are recommended to disconnect the drive from power in the event that a component fails in the drive's power circuitry. Recommended drive input fuse specifications are listed in the *Submittal Schedule Details* and in the *Fuse Ratings* Table. Fuse rating information is provided for customer reference.

Item	Catalog Number	Drive Input Fuse Ratings	
		Amps (600V)	Bussmann Type
1	ACH580-PDR-052A-4	80	Class J

Terminal Sizes / Cable Connection Requirements

Power and motor cable terminal sizes and connection requirements are shown in the *Submittal Schedule Details* and in the *Terminal Sizes / Cable Connection Requirements* Table. The information provided below is for connections to input power and motor cables. These connections may be made to an input circuit breaker or disconnect switch, a motor terminal block, overload relay, and/or directly to bus bars and ground lugs. The table also lists torque that should be applied when tightening terminals and spacing requirements where multiple mounting holes are provided in the bus bar.

Item	Catalog Number	Input Wiring	Output Wiring	Ground Wiring
1	ACH580-PDR-052A-4	#8...#1/0 4.6 lbf-ft	#20...#1 3 lbf-ft	#14...#2 #14...#10: 2.9 lbf-ft; #6...#4: 3.8 lbf-ft; #2: 4.1 lbf- ft

Heat Dissipation Requirements

The cooling air entering the drive must be clean and free from corrosive materials. The *Submittal Schedule Details* and the *Heat Dissipation Requirements* table below give the heat dissipated into the hot air exhausted from the drives. If the drives are installed in a confined space, the heat must be removed from the area by ventilation or air conditioning equipment.

Item	Catalog Number	Watts	BTU/Hr
1	ACH580-PDR-052A-4	873	2,977

Dimensions and Weights

Dimensions and weights of the drives provided are given in the *Submittal Schedule Details* and in the *Dimensions and Weights* Table. The table also lists the applicable dimension drawings that include additional detail. Dimension drawings may be provided in the back of this submittal.

Item	Catalog Number	Height mm (in)	Width mm (in)	Depth mm (in)	Weight kg (lbs)
1	ACH580-PDR-052A-4	1032 (40.63)	213 (8.39)	362 (14.26)	27.2 (60)

Free Space Requirements, Standalone

Free Space Requirements for standalone mounting.

Item	Catalog Number	Standalone, Above mm (in)	Standalone, Below mm (in)	Standalone, Sides mm (in)
1	ACH580-PDR-052A-4	53 (2.09)	200 (7.88)	150 (5.91)

Free Space Requirements, Side by Side

Free Space Requirements for side by side mounting.

Item	Catalog Number	Side by Side, Above <i>mm</i> (<i>in</i>)	Side by Side, Below <i>mm</i> (<i>in</i>)	Side by Side, Sides <i>mm</i> (<i>in</i>)
1	ACH580-PDR-052A-4	200 (7.88)	200 (7.88)	0 (0.01)

Product Short Circuit Current Rating

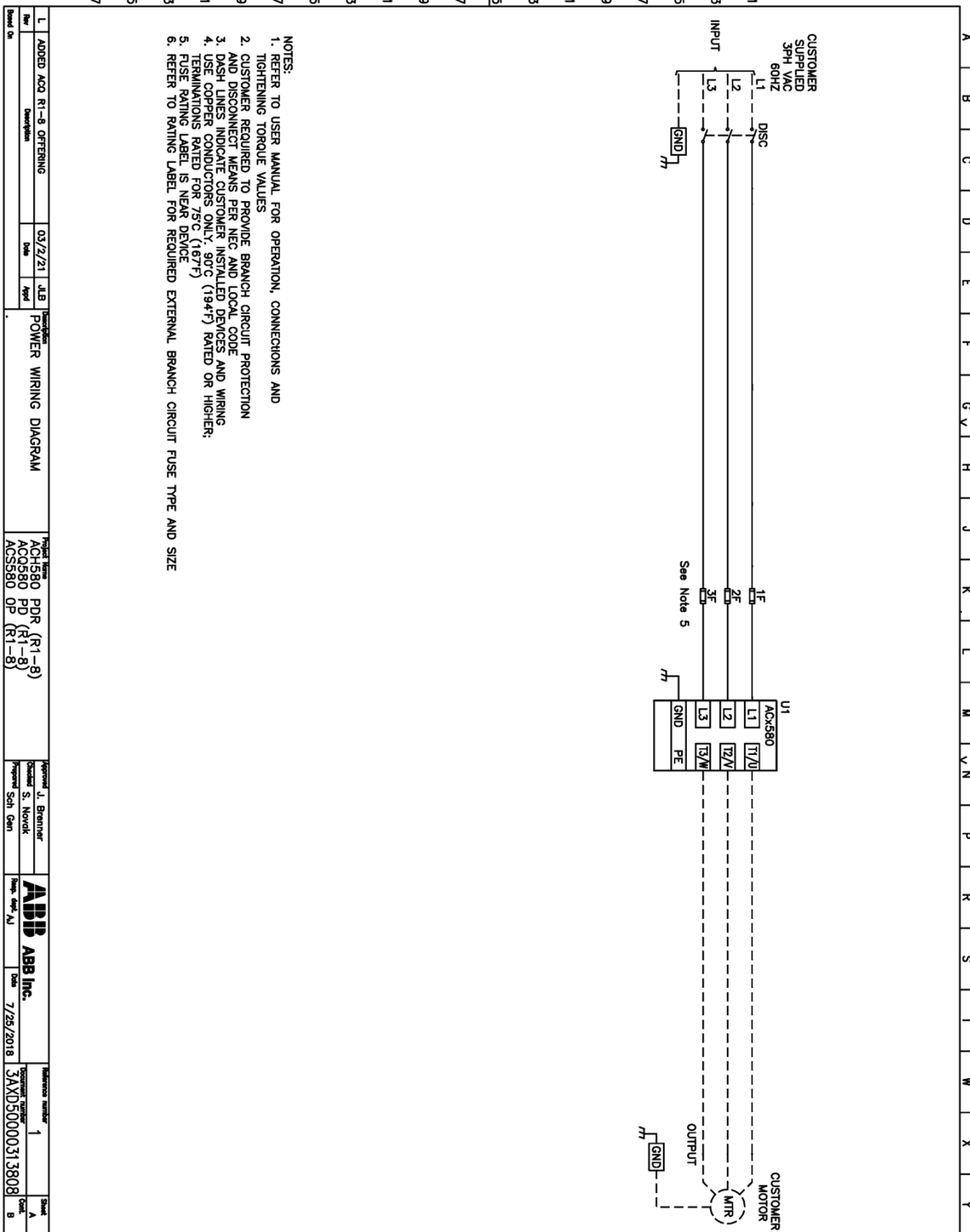
Short circuit ratings shown below are as show on the device rating label.

Item	Catalog Number	Short Circuit Current Rating
1	ACH580-PDR-052A-4	100 kA

Item	Part Number	Customer Designation
1	ACH580-PDR-052A-4	CWP-4,5,6

F-3BUAC080502-M, rev. 0 8-21-03

We reserve all rights in this document and the information contained therein. Reproduction, use, or disclosure to third parties without express written authority is strictly forbidden. © 2003 ABB Automation Inc. (53)

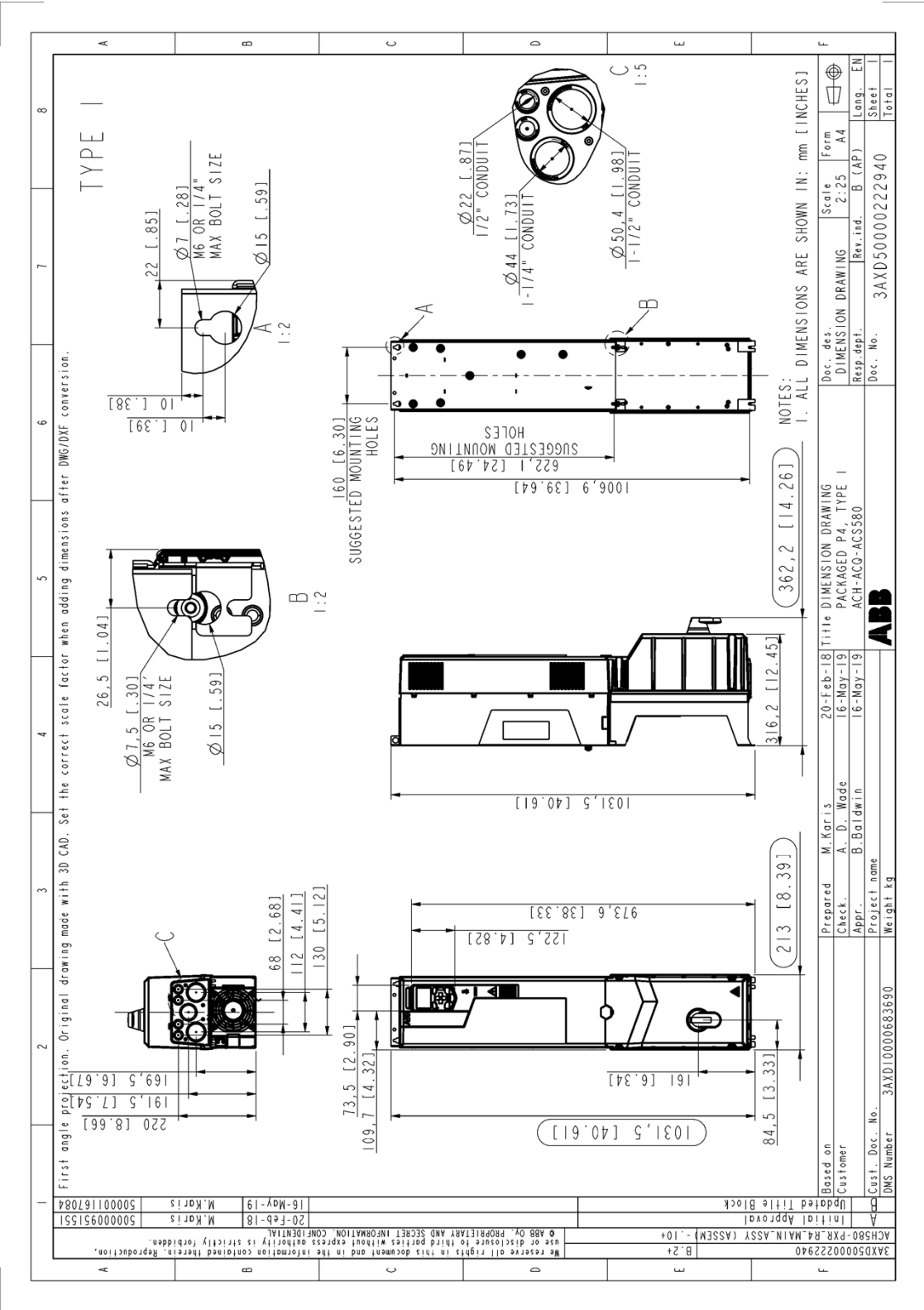


- NOTES:
1. REFER TO USER MANUAL FOR OPERATION, CONNECTIONS AND TIGHTENING TORQUE VALUES
 2. CUSTOMER REQUIRED TO PROVIDE BRANCH CIRCUIT PROTECTION AND DISCONNECT MEANS PER NEC AND LOCAL CODE
 3. DASH LINES INDICATE CUSTOMER INSTALLED DEVICES AND WIRING
 4. USE COPPER CONDUCTORS ONLY, 90°C (194°F) RATED OR HIGHER; TERMINATIONS RATED FOR 75°C (167°F)
 5. FUSE RATING LABEL IS NEAR DEVICE
 6. REFER TO RATING LABEL FOR REQUIRED EXTERNAL BRANCH CIRCUIT FUSE TYPE AND SIZE

Rev	Description	Date	Appr	Revision	Project Name	Approved By	Signature	Date	Revision	Part Number
1	ADDED ACD R1-8 OFFERING	03/2/21	ALB	1	POWER WIRING DIAGRAM	J. Brenner	ACH580 PDR (R1-8)	7/25/2018	1	ACH580-PDR-052A-4
2	ADDED ACD R1-8 OFFERING	03/2/21	ALB	2	POWER WIRING DIAGRAM	J. Brenner	ACH580 PD (R1-8)	7/25/2018	2	ACH580-PDR-052A-4
3	ADDED ACD R1-8 OFFERING	03/2/21	ALB	3	POWER WIRING DIAGRAM	J. Brenner	ACH580 OP (R1-8)	7/25/2018	3	ACH580-PDR-052A-4

{3AXD50000313808_1.PNG}

Item 1	Part Number ACH580-PDR-052A-4	Customer Designation CWP-4,5,6
------------------	---	--



{3AXD50000222940.PNG}

BID FORM

Project: Southwest High School HVAC Upgrades
3414 West 47th Street
Minneapolis, MN 55410

To: Minneapolis Public Schools (MPS)
Special School District No. 1
1250 West Broadway Avenue
Minneapolis, MN 55411

Official Publication Number: OP26-2602

Architect: Armstrong, Torseth, Skold & Rydeen, Inc.
8501 Golden Valley Road, Suite 300
Minneapolis, MN 55427

BIDDER: _____

TOTAL BASE BID PUMP HOUSE ASSEMBLY

- a. I have examined the work site and the Bidding Documents, and hereby propose and agree to furnish all labor, materials, and equipment required to complete the Work.

- b. Base Bid:

Written: _____ DOLLARS

Numerical: \$ _____

BREAK OUT PRICING – CHILLED WATER PUMPS

- a. Provide a breakout cost for pumps, Inertia Bases, Flex Connection, Flow Measuring, check valves, isolation valves and accessories

Written: _____ DOLLARS

Numerical: \$ _____

BREAK OUT PRICING – SIDE STREAM FILTER

- a. Provide a breakout cost for side stream filter unit and accessories

Written: _____ DOLLARS

Numerical: \$ _____

BREAK OUT PRICING -AIR CONTROL DEVICES AND ACCESSORIES

- a. Provide a breakout cost for Air Control Devices, Bladder tank and accessories

Written: _____ DOLLARS

Numerical: \$ _____

BREAK OUT PRICING -VARIABLE FREQUENCY DRIVES AND ELECTRICAL

- a. Provide a breakout cost for VFDs, Wiring and accessories

Written: _____ DOLLARS

Numerical: \$ _____

BREAK OUT PRICING -SPACE HEATER

- a. Provide a breakout cost for Space Heater wiring and control.

Written: _____ DOLLARS

Numerical: \$ _____

ADDENDA

- a. I acknowledge receipt of the following Addenda and have incorporated their provisions into the bid.

No. _____ Date _____ No. _____ Date _____

No. _____ Date _____ No. _____ Date _____

CONTRACT TIME

- a. I agree to substantially complete the Work by [_____].

BID GUARANTY PERIOD

- a. I agree to hold these bids open for a period of sixty (60) days after the bid opening. If this bid is accepted within that period, I agree to execute a contract with the Owner, and to furnish a Labor and Materials Payment Bond and a Performance Bond in the full amount of the Contract.

PROJECT LABOR AGREEMENT (See Document 00 73 00, Supplementary Conditions)

- a. If awarded a Contract, all labor employed on the Project will comply with the paying of the Project Labor Agreement (PLA). _____ yes _____ no

STATUS OF FIRM

- a. Bidder is: ___ A sole proprietor. ___ A partnership. ___ A corporation registered in the state of ____.

SIGNATURE

a. Name: _____ Title: _____

b. Signature: _____ Date: _____

c. Firm: _____

d. Address: _____
(Street) (City) (State) (Zip Code)

e. Telephone: _____ Fax: _____

- f. If a partnership, list name and address of all partners. If a corporation, affix corporate seal and list State of Incorporation.

- g. The person signing this form is a person authorized to bind the company they are signing for.

END OF DOCUMENT