

ADDENDUM NO. 1

November 3, 2021

TO REQUEST FOR PROPOSALS FOR 1, 2, 3- TCP Removal Project for Conejo Wells

NOTICE IS HEREBY GIVEN to bidders that this addendum is issued to make the following changes.

Acknowledge receipt of this Addendum in the space provided on the PROPOSED SCHEDULE OF WORK AND PRICES Page 21 of the front-end documents. Failure to do so may subject the Proposer to disqualify.

RESPONSE TO BIDDER QUESTIONS

1. Question 1:

What is the Engineer's Estimate for this project?

Answer:

Approximately \$5.75 million, not including owner-furnished materials.

2. Question 2:

What is the value of the owner-furnished equipment/materials?

Answer:

Estimated at approximately \$2.4 million.

3. Question 3:

Can you provide a complete bill of materials for all owner-furnished materials, including services provided with owner-furnished packages (field services, provided integration, delivery, lead times, startup/testing, O&M manuals, source testing, anchorage, seismic calculations, manufacturer shop painting or coating, any appurtenances included, racks, pipe supports, valves, blowoffs, nozzles, carbon amount and packaging, etc.)?

Answer:

The following equipment packages and materials will be provided by the Owner:

- A) GAC Vessel Pairs*
- B) Activated Carbon Media*
- C) Carbon Dioxide Storage and Feed System*
- D) Main Electrical Switch Gear and MCCs*

This equipment will be provided with shop coating, O&M manuals, and field inspection and startup services specific to the equipment. However, all installation, electrical and piping connections, and associated field work shall be completed within this RFP contract. The MCC arc flash study will be included in the Owner's electrical switch gear and MCC contract with the supplier.

4. Question 4:

A note on the plans indicates the generator and fuel system are to be supplied by Owner. However, per Specification Section 01 11 10 1.4, the generator and fuel system is not owner-supplied. Is the generator and fuel system owner-furnished?

Answer:

The generator and fuel system will not be owner-furnished.

On Sheet G-3 of the Plans, revise General Note 16 to read:

“16. The following items are owner-furnished (FOB District Headquarters), contractor installed and integrated:

A) GAC Vessel Pairs

B) Activated Carbon Media

C) Carbon Dioxide Storage and Feed System

~~D) Standby Engine Generator with Fuel System~~

D) Main Electrical Switch Gear and MCCs”

5. Question 5:

Is the Intrusion Switch listed on page 597 of Division 40 96 31, 2.5.B a part of the instrumentation scope? The intrusion switch is also shown in the Plans on Sheet E-1.4 as BSTR-ZS-01. If a part of scope, can you please provide specifications?

Answer:

Contractor shall provide an Edwards Signaling 2507A-L or equal which is an SPDT magnetic switch with brackets as maybe required.

6. Question 6:

Are the flow elements on Plan Sheets E-1.1 – E-1.5 from the provided Plans a part of the instrumentation scope? If a part of scope, can you please provide specifications?

Answer:

Three new Contractor-furnished flow meters are included in the project: 40-FIT/FE-01 and -02 at the Backwash Reclaim / Non-Potable pumping station and flow meter Z2-FIT-00 located at the reduced pressure backflow preventer. The Contractor shall also be responsible for wiring and integrating the flow meters included with the Owner-furnished GAC vessel skids and carbon dioxide system and shall be responsible for wiring and integrating all existing facility flow meters to the new electrical panels.

Revise Detail W-48 on Sheet D-18, legend item 7 as follows:

*"Meter w/Strainer ~~(By District)~~ **(By Contractor)**"*

The specification for the flow meters is:

*Pump Station: FER111.250.K.1.S.4.A1.B.1.A.1.A.0.A.1.B.3.A.1-...V3.CWA
Size; 10", ABB WaterMaster FER111 Electromagnetic Flowmeter with Elastomer Liner, reduced bore, 316SS Electrodes, 150# Flanged Connections, SS Grounding Rings, Integral Mounted Transmitter, backlit Graphical Display, Flow Rate Indicator & Totalizer, 4-20mA & Pulse Outputs, Hart Protocol Communications, Accuracy; +/- 0.4%*

*Backflow Preventer: FER111.300.K.1.S.4.A1.B.1.A.1.A.0.A.1.B.3.A.1-...V3.CWA
Size; 12", ABB WaterMaster FER111 Electromagnetic Flowmeter with Elastomer Liner, reduced bore, 316SS Electrodes, 150# Flanged Connections, SS Grounding Rings, Integral Mounted Transmitter, backlit Graphical Display, Flow Rate Indicator & Totalizer, 4-20mA & Pulse Outputs, Hart Protocol Communications, Accuracy; +/- 0.4%*

7. Question 7:

There are no Pressure Gauges depicted on Plan Sheets E-1.1 – E-1.5. Eight (8) pressure gauges are shown on drawing G-7, but names and ranges are not provided. Can the District provide further information on these instruments?

Answer:

The pressure gauges shown on sheet G-7 are part of the Owner-furnished GAC system. The only Contractor-furnished pressure gauges are the two gauges located on the Backwash Reclaim / Non-Potable Pump discharge manifolds (refer to Detail 1 on Plan Sheet D-16)

Three new Contractor-furnished pressure transducers are included on the project: the replacement for the treated water storage tank level sensing pressure transducer (BSTR-LIT-01); the Backwash Reclaim / Non-Potable pump station discharge pressure transducer (PIT-40-01); and the GAC manifold differential pressure transducer (GAC-DPIT-01). The Contractor shall also be responsible for wiring and integrating all existing facility flow meters to the new electrical panels.

*BSTR-LIT-01 shall be Endress Hauser Cerabar PMP71 - ABC1K61RAAAU 30psi.
PIT-40-001 shall be, Endress Hauser Cerabar PMP71 - ABC1P61RAAAU 150psi.
GAC-DPIT-01 shall be, Endress Hauser Deltabar S PMD75-ABC7H61DAAU+N3*

8. Question 8:

Specification Section 40 51 20, 1.09.A Spare I/O states "Refer to Appendix 40 50 00-C&D PLC Input/Output list for signals designated as 'Dedicated Spares.'" Where can we find the list of Input/Output signals?

Answer:

IO List of needed and spare IO points for the project has been attached to this Addendum. Provide spare parts per 40 50 00, 2.04.

9. Question 9:

Does the backwash tank need to be risk factor 4 or can you lower the risk factor so the tank does not require as much freeboard?

Answer:

Both tanks must be Risk Category 4.

10. Question 10:

Can the engineer provide a copy of the Geotechnical Investigation report for this project?

Answer:

A copy of the Geotechnical Engineering Investigation Report has been attached to this Addendum.

11. Question 11:

On Plan Sheet G-3, Note 15 states: "Contractor to provide chemicals," and Specification Section 01 11 10, 1.5.A states that the District will be furnishing chemicals. Which is correct?

Answer:

Revise Note 15 to read:

"The Owner will provide the initial loads of diesel fuel, carbon dioxide, and sodium hydroxide"

12. Question 12:

Cut and Fill Summary calls for net import of approximately 3535 c.y. of import fill at R-value of 50. Does the District have a borrow site that can be used that meets this spec? If so, where is it located?

Answer:

The District does not have a borrow site for the fill material.

13. Question 13:

On Plan Sheet C-3, Note 4 states: "Contractor to include 20 bollards per Detail 3, Sheet D-8, at locations selected by owner." Are these locations to be in openly accessible areas? Are there utilities in the vicinity of these that will need potholing?

Answer:

The Contractor shall assume that the bollards will be in openly accessible areas with no utilities in the vicinity that will necessitate potholing.

14. Question 14:

On Plan Sheet C-2, Demolition Callout 4 calls for the Contractor to upgrade pumps and motors on all 4 wells on the project. Specification Section 43 21 52 provides well pump data as called out on Plan Sheets. On Plan Sheet G-5, the Well Pump Design Criteria Table has a note at the bottom that states wells are being rehabilitated and pumps replaced as part of a separate project. Are the Pumps to be upgraded as part of this project or not?

Answer:

A separate project will seek to rehabilitate the wells and replace the pumps.

15. Question 15:

Specification Section 01 22 00, Bid Item #11 description includes furnishing, installation, integration, and testing of a 1 MW Standby Diesel Engine Generator. This conflicts with Plan Sheet G-3, Note 16, which states the generator is to be owner-furnished. Which is correct? If furnished by owner, please provide a bill of materials and installation details for contractor to review.

Answer:

The generator and fuel tank described in Specification 26 32 13 are to be furnished by the Contractor. Refer to response to Question #4 of this Addendum 1.

16. Question 16:

Specification Section 01 57 50, 1.2.A calls for the Contractor to provide survey and staking. Will the engineer provide onsite existing monument data for surveyor's reference?

Answer:

The onsite existing monument data is provided on Plan Sheet C-1.

17. Question 17:

Specification Section 02 01 20, 1.1.B.3. addresses payment and bidding guidance for addressing uncovered underground facilities not shown. Can an allowance be assigned to the resulting work? Can work be completed on a T&M basis?

Answer:

Delete Specification Section 02 01 20, 1.1.B.3.

18. Question 18:

For the Owner-furnished GAC and CO2 System, Specifications Section 01 11 10, 1.4.B.1 states that the "...initial submittals...have been included with the contract documents for reference." Where can they be found?

Answer:

The initial submittals have been attached to this Addendum.

19. Question 19:

Excluding the Remote I/O Panel located in what was referred to as the "electrical shack" which would be part of RoviSys scope, can you confirm the District is building the control panels and providing their internals?

Answer:

RoviSys shall provide the control panel and remote I/O for Santa Rosa Well 8.

20. Question 20:

What is the approximate I/O count for the Remote I/O Panel located in what was referred to as the “electrical shack”?

Answer:

Refer to the I/O List attached to this Addendum.

21. Question 21:

Is telemetry work required for this project? If required, what is the scope? Will hardware be provided by the District? Will RoviSys be responsible for configuration of the radios/service aspect?

Answer:

The site currently has telemetry. There is a cambium radio mounted on the existing water tank that will need to be relocated onto the new tank. The radio is configured but will need to be connected to the new network onsite by RoviSys.

22. Question 22:

Does the District have the required licensing for its OITs?

Answer:

Contractor shall provide licenses for OITs.

23. Question 23:

Will Specification Section 26 05 73 be included with the Equipment being provided under a separate contract?

Answer:

Specification Section 26 05 73 will be provided by Royal via the District. The bidding Contractor can disregard this Specification Section 26 05 73.

24. Question 24:

Are submittals for the electrical equipment being provided under a separate contract Available for distribution?

Answer:

The preliminary submittals for the electrical equipment being supplied by the District has been attached to this Addendum.

25. Question 25:

On Plan Sheet E-1.2, in the (N) Equipment Enclosure, there appears to be (2) light fixtures designated as A and AE. Is there any specification for these fixtures?

Answer:

Type A is a Lithonia #FEM-I48-6000LM-IMAFL-MD-120-GZ10-40K-80CRI-ANGBKT-SPD-STSL-WLF-SBOR10P or equal 6000 lumen, 38W with integral occupancy sensor/photocell and wet listed. Type AE is the same as Type A with the addition of the BE6WCP emergency driver option.

26. Question 26:

Is the Contractor responsible for furnishing temporary power and connections for the onsite office trailer described in Specification Section 01 50 00?

Answer:

The Contractor can use existing onsite power provided by the District. If the workflow on the electrical equipment prevents this connection, then the Contractor is responsible for obtaining their own temporary power from Southern California Edison.

27. Question 27:

Do the existing electrical conduit and duct banks need to be removed/demolished?

Answer:

The existing electrical conduits and duct banks only need to be removed to the extent necessary for construction of the improvements.

NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIERS

28. Add the following to Page 2 of the Front-End Documents, NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIERS:

“NOTE: The District office is currently closed for renovation. When delivering bids, please call (805) 388-0226 upon arriving. District personnel will meet you outside and register your bid. Do not leave bids unattended.”

NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIERS shall be replaced by the NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIERS attached to this Addendum.

PROPOSAL

29. On Page 14 of the Front-End Documents, PROPOSAL, the Completion Time for the project has been revised to the following:

***“330 Calendar Days from Notice to Proceed to completion of project exclusive of scope relating to the generator and appurtenances
360 Calendar Days from Notice to Proceed to completion of entire project, inclusive of generator and appurtenances”***

PROPOSAL sheet shall be replaced by the PROPOSAL attached to this Addendum.

PLANS

30. ELECTRICAL SHEETS E-1.5, E-3.1, E-3.2, and E-4.2 shall be replaced with the ELECTRICAL SHEETS E-1.5, E-3.1, E-3.2, and E-4.2 attached to this Addendum.
31. PROCESS SHEET D-13 shall be replaced with the PROCESS SHEET D-13 attached to this Addendum.

SPECIFICATIONS

32. Specification Section 40 50 00, Add Paragraph 1.01.I:
“PCSS is to network the existing Compactlogix PLC and Industrial PC/OIT into the new process network. Both the new and existing Industrial PC/OIT shall incorporate the new and existing I/O as well as new and existing graphical screens. PCSS shall provide all necessary licenses for a local Wonderware workstation on the new OIT which will communicate back the master radio and server. PCSS shall coordinate programming of new VFD with District in accordance with District’s programming standards. Also PCSS shall re-use the existing SCADA radio and antenna, however new cabling and termination are to be installed.”
33. Specification Section 40 50 00, Add Paragraph 1.01.J:
“Provide a preliminary I/O list for both new and existing points throughout the plant which are affected under this Project.”

APPROVED:



Becca Bugielski, PE

11/3/2021

Date

IO LIST

IPC PCM

SLOT 1: 16 PT DISCRETE INPUT

0	UPS ON BATT	UPS5
1	UPS FAIL/LOW BATT	UPS5
2		
3		
4		
5		
6		
7		
8	PUMP STATUS RUN	CHM-MTR-PMP-01
9	PUMP STATUS REMOTE	CHM-MTR-PMP-01
10	PUMP STATUS FAULT	CHM-MTR-PMP-01
11	PUMP STATUS RUN	CHM-MTR-PMP-02
12	PUMP STATUS REMOTE	CHM-MTR-PMP-02
13	PUMP STATUS FAULT	CHM-MTR-PMP-02
14		
15		

SLOT 2: 16 PT DISCRETE INPUT

0	VALVE POSITION OPEN	GAC-ACTU-01A
1	VALVE POSITION CLOSE	GAC-ACTU-01A
2	VALVE STATUS REMOTE	GAC-ACTU-01A
3	VALVE POSITION OPEN	GAC-ACTU-01B
4	VALVE POSITION CLOSE	GAC-ACTU-01B
5	VALVE STATUS REMOTE	GAC-ACTU-01B
6	VALVE POSITION OPEN	GAC-ACTU-02A
7	VALVE POSITION CLOSE	GAC-ACTU-02A
8	VALVE STATUS REMOTE	GAC-ACTU-02A
9	VALVE POSITION OPEN	GAC-ACTU-02B
10	VALVE POSITION CLOSE	GAC-ACTU-02B
11	VALVE STATUS REMOTE	GAC-ACTU-02B
12	VALVE POSITION OPEN	GAC-ACTU-05A
13	VALVE POSITION CLOSE	GAC-ACTU-05A
14	VALVE STATUS REMOTE	GAC-ACTU-05A
15		

SLOT 3: 16 PT DISCRETE INPUT

0	VALVE POSITION OPEN	GAC-ACTU-03A
1	VALVE POSITION CLOSE	GAC-ACTU-03A
2	VALVE STATUS REMOTE	GAC-ACTU-03A
3	VALVE POSITION OPEN	GAC-ACTU-03B
4	VALVE POSITION CLOSE	GAC-ACTU-03B
5	VALVE STATUS REMOTE	GAC-ACTU-03B
6	VALVE POSITION OPEN	GAC-ACTU-04A
7	VALVE POSITION CLOSE	GAC-ACTU-04A
8	VALVE STATUS REMOTE	GAC-ACTU-04A
9	VALVE POSITION OPEN	GAC-ACTU-04B

10	VALVE POSITION CLOSE	GAC-ACTU-04B
11	VALVE STATUS REMOTE	GAC-ACTU-04B
12	VALVE POSITION OPEN	GAC-ACTU-04B
13	VALVE POSITION CLOSE	GAC-ACTU-04B
14	VALVE STATUS REMOTE	GAC-ACTU-04B
15		
SLOT 4: 16 PT DISCRETE OUTPUT		
0	VALVE COMMAND OPEN	GAC-ACTU-01A
1	VALVE COMMAND CLOSE	GAC-ACTU-01A
2	VALVE COMMAND OPEN	GAC-ACTU-01B
3	VALVE COMMAND CLOSE	GAC-ACTU-01B
4	VALVE COMMAND OPEN	GAC-ACTU-02A
5	VALVE COMMAND CLOSE	GAC-ACTU-02A
6	VALVE COMMAND OPEN	GAC-ACTU-02B
7	VALVE COMMAND CLOSE	GAC-ACTU-02B
8	VALVE COMMAND OPEN	GAC-ACTU-03A
9	VALVE COMMAND CLOSE	GAC-ACTU-03A
10	VALVE COMMAND OPEN	GAC-ACTU-03A
11	VALVE COMMAND CLOSE	GAC-ACTU-03A
12		
13		
14		
15		
SLOT 5: 16 PT DISCRETE OUTPUT		
0	VALVE COMMAND OPEN	GAC-ACTU-04A
1	VALVE COMMAND CLOSE	GAC-ACTU-04A
2	VALVE COMMAND OPEN	GAC-ACTU-04B
3	VALVE COMMAND CLOSE	GAC-ACTU-04B
4	VALVE COMMAND OPEN	GAC-ACTU-05A
5	VALVE COMMAND CLOSE	GAC-ACTU-05A
6	VALVE COMMAND OPEN	GAC-ACTU-05B
7	VALVE COMMAND CLOSE	GAC-ACTU-05B
8		
9		
10		
11		
12		
13		
14	PUMP START/CALL	CHM-MTR-PMP-01
15	PUMP START/CALL	CHM-MTR-PMP-02
SLOT 6: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	SPEED INPUT	CHM-MTR-PMP-01
1	SPEED INPUT	CHM-MTR-PMP-02
2	NITRATE ANALZER	AIT-01
3	ROSEMOUNT 2CH	AIT-02A
4	ROSEMOUNT 2CH	AIT-02A

5	NAHO TANK LEVEL	CHM-LIT-01
6		
7		
SLOT 7: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	GAC FLOWMETER	GAC-FIT-01A
1	GAC FLOWMETER	GAC-FIT-01B
2	GAC FLOWMETER	GAC-FIT-02A
3	GAC FLOWMETER	GAC-FIT-02B
4	GAC FLOWMETER	GAC-FIT-03A
5	GAC FLOWMETER	GAC-FIT-03B
6	GAC FLOWMETER	GAC-FIT-04A
7	GAC FLOWMETER	GAC-FIT-04B
SLOT 8: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	GAC FLOWMETER	GAC-FIT-05A
1	GAC FLOWMETER	GAC-FIT-05B
2	GAC DIFF PRESSURE	GAC-DPIT-01
3	GAC FLOWMETER	GAC-FIT-06
4		
5		
6		
7		
SLOT 9: 8 CHANNEL (CURRENT) ANALOG OUTPUTS		
0	SPEED COMMAND	CHM-MTR-PMP-01
1	SPEED COMMAND	CHM-MTR-PMP-02
2		
3		
4		
5		
6		
7		

MCC2-PMC

SLOT 1: 16 PT DISCRETE INPUT

0	UPS ON BATT	UPS2
1	UPS FAIL/LOW BATT	UPS2
2		
3	GENSET RUNNING	EG-1
4	GENSET FAIL	EG-1
5	GENSET HAND	EG-1
6	GENSET AUTO	EG-1
7	UTILITY STATUS	ATS-1
8	EMERG STATUS	ATS-1
9	DUPLEX PUMP RUNNING	EG-FPMP-1
10	DUPLEX PUMP FAULT	EG-FPMP-1
11		
12		
13		
14		
15		

SLOT 2: 16 PT DISCRETE INPUT

0	VFD HOA HAND	WELL-PMP-C4
1	VFD HOA OFF	WELL-PMP-C4
2	VFD HOA AUTO	WELL-PMP-C4
3	VFD RUNNING	WELL-PMP-C4
4	VFD FAULTED	WELL-PMP-C4
5	VFD IP TRIP	WELL-PMP-C4
6	PUMP SEAL LEAK STATUS	WELL-PMP-C4
7	VALVE POSITION OPEN	C4-ACT-01
8	VALVE POSITION CLOSE	C4-ACT-01
9	VFD HOA HAND	40-PMP-01
10	VFD HOA OFF	40-PMP-01
11	VFD HOA AUTO	40-PMP-01
12	VFD RUNNING	40-PMP-01
13	VFD FAULTED	40-PMP-01
14	VFD IP TRIP	40-PMP-01
15	PUMP PSL	40-PSL-01

SLOT 3: 16 PT DISCRETE INPUT

0	VFD HOA HAND	Z2-PMP-01
1	VFD HOA OFF	Z2-PMP-01
2	VFD HOA AUTO	Z2-PMP-01
3	VFD RUNNING	Z2-PMP-01
4	VFD FAULTED	Z2-PMP-01
5	VFD IP TRIP	Z2-PMP-01
6	PUMP SEAL LEAK STATUS	Z2-PMP-01
7	VALVE POSITION OPEN	Z2-PMP-ACT-01
8	VALVE POSITION CLOSE	Z2-PMP-ACT-01
9	VFD HOA HAND	40-PMP-02

10	VFD HOA OFF	40-PMP-02
11	VFD HOA AUTO	40-PMP-02
12	VFD RUNNING	40-PMP-02
13	VFD FAULTED	40-PMP-02
14	VFD IP TRIP	40-PMP-02
15	PUMP PSL	40-PSL-02
SLOT 4: 16 PT DISCRETE INPUT		
0	VFD HOA HAND	Z2-PMP-02
1	VFD HOA OFF	Z2-PMP-02
2	VFD HOA AUTO	Z2-PMP-02
3	VFD RUNNING	Z2-PMP-02
4	VFD FAULTED	Z2-PMP-02
5	VFD IP TRIP	Z2-PMP-02
6	PUMP SEAL LEAK STATUS	Z2-PMP-02
7	VALVE POSITION OPEN	Z2-PMP-ACT-02
8	VALVE POSITION CLOSE	Z2-PMP-ACT-02
9		
10		
11		
12		
13		
14		
15		
SLOT 5: 16 PT DISCRETE OUTPUT		
0	VFD STOP/ENABLE	WELL-PMP-C4
1	VFD START/CALL	WELL-PMP-C4
2	VFD SPEED SELECT	WELL-PMP-C4
3	VFD RESET	WELL-PMP-C4
4	VALVE COMMAND	C4-ACT-01
5	PRELUBE SOLENIOD	C4-SV-01
6		
7		
8	VFD STOP/ENABLE	40-PMP-01
9	VFD START/CALL	40-PMP-01
10	VFD SPEED SELECT	40-PMP-01
11	VFD RESET	40-PMP-01
12	VFD STOP/ENABLE	40-PMP-02
13	VFD START/CALL	40-PMP-02
14	VFD SPEED SELECT	40-PMP-02
15	VFD RESET	40-PMP-02
SLOT 4: 16 PT DISCRETE OUTPUT		
0	VFD STOP/ENABLE	Z2-PMP-ACT-01
1	VFD START/CALL	Z2-PMP-ACT-01
2	VFD SPEED SELECT	Z2-PMP-ACT-01
3	VFD RESET	Z2-PMP-ACT-01
4		

5		
6		
7		
8	VFD STOP/ENABLE	Z2-PMP-ACT-02
9	VFD START/CALL	Z2-PMP-ACT-02
10	VFD SPEED SELECT	Z2-PMP-ACT-02
11	VFD RESET	Z2-PMP-ACT-02
12		
13		
14		
15		
SLOT 5: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	MAIN FUEL TANK LEVEL	EG-FPMP-1
1	VFD SPEED INPUT	WELL-PMP-C4
2	FLOWMETER	C4-FIT-01
3	PRESSURE TRANSDUCER	C4-PIT-01
4	WELL SOUNDER	C4-LIT-01
5		
6		
7		
SLOT 6: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	SYSTEM PRESSURE	Z2-PIT-01
1		
2	VFD SPEED INPUT	Z2-PMP-01
3	FLOWMETER	Z2-FIT-01
4	VFD SPEED INPUT	Z2-PMP-02
5	FLOWMETER	Z2-FIT-02
6		
7		
SLOT 7: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	VFD SPEED INPUT	40-PMP-01
1	VFD SPEED INPUT	40-PMP-02
2	BACKWASH TANK LEVEL	40-LIT-01
3	SYSTEM PRESSURE	40-PIT-01
4		
5		
6		
7		
SLOT 8: 8 CHANNEL (CURRENT) ANALOG OUTPUTS		
0	VFD SPEED COMMAND	WELL-PMP-C4
1	VFD SPEED COMMAND	Z2-PMP-01
2	VFD SPEED COMMAND	Z2-PMP-02
3	VFD SPEED COMMAND	40-PMP-01
4	VFD SPEED COMMAND	40-PMP-02
5		
6		

7		
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MCC3 PMC

SLOT 1: 16 PT DISCRETE INPUT

0	UPS ON BATT	UPS3
1	UPS FAIL/LOW BATT	UPS3
2		
3		
4		
5		
6		
7	VFD HOA HAND	WELL-PMP-C2
8	VFD HOA OFF	WELL-PMP-C2
9	VFD HOA AUTO	WELL-PMP-C2
10	VFD RUNNING	WELL-PMP-C2
11	VFD FAULTED	WELL-PMP-C2
12	VFD IP TRIP	WELL-PMP-C2
13	PUMP SEAL LEAK STATUS	WELL-PMP-C2
14	VALVE POSITION OPEN	C2-ACT-01
15	VALVE POSITION CLOSE	C2-ACT-01

SLOT 2: 16 PT DISCRETE INPUT

0	VFD HOA HAND	BSTR-PMP-P4
1	VFD HOA OFF	BSTR-PMP-P4
2	VFD HOA AUTO	BSTR-PMP-P4
3	VFD RUNNING	BSTR-PMP-P4
4	VFD FAULTED	BSTR-PMP-P4
5	VFD IP TRIP	BSTR-PMP-P4
6	PUMP SEAL LEAK STATUS	BSTR-PMP-P4
7	PRESSURE SWITCH	P4-PS-01
8	VALVE POSITION OPEN	P4-VALV-01
9	VALVE POSITION CLOSE	P4-VALV-01
10		
11		
12		
13		
14		
15		

SLOT 3: 16 PT DISCRETE INPUT

0	VFD HOA HAND	BSTR-PMP-P5
1	VFD HOA OFF	BSTR-PMP-P5
2	VFD HOA AUTO	BSTR-PMP-P5
3	VFD RUNNING	BSTR-PMP-P5
4	VFD FAULTED	BSTR-PMP-P5
5	VFD IP TRIP	BSTR-PMP-P5
6	PUMP SEAL LEAK STATUS	BSTR-PMP-P5
7	PRESSURE SWITCH	P5-PS-01
8	VALVE POSITION OPEN	P5-VALV-01
9	VALVE POSITION CLOSE	P5-VALV-01

10		
11		
12		
13		
14		
15		
SLOT 4: 16 PT DISCRETE INPUT		
0	VFD HOA HAND	BSTR-PMP-P6
1	VFD HOA OFF	BSTR-PMP-P6
2	VFD HOA AUTO	BSTR-PMP-P6
3	VFD RUNNING	BSTR-PMP-P6
4	VFD FAULTED	BSTR-PMP-P6
5	VFD IP TRIP	BSTR-PMP-P6
6	PUMP SEAL LEAK STATUS	BSTR-PMP-P6
7	PRESSURE SWITCH	P6-PS-01
8	VALVE POSITION OPEN	P6-VALV-01
9	VALVE POSITION CLOSE	P6-VALV-01
10		
11		
12		
13		
14		
15		
SLOT 5: 16 PT DISCRETE INPUT		
0	VFD HOA HAND	BSTR-PMP-P7
1	VFD HOA OFF	BSTR-PMP-P7
2	VFD HOA AUTO	BSTR-PMP-P7
3	VFD RUNNING	BSTR-PMP-P7
4	VFD FAULTED	BSTR-PMP-P7
5	VFD IP TRIP	BSTR-PMP-P7
6	PUMP SEAL LEAK STATUS	BSTR-PMP-P7
7	PRESSURE SWITCH	P7-PS-01
8	VALVE POSITION OPEN	P7-VALV-01
9	VALVE POSITION CLOSE	P7-VALV-01
10		
11		
12		
13		
14		
15		
SLOT 6: 16 PT DISCRETE OUTPUT		
0	VFD STOP/ENABLE	WELL-PMP-C2
1	VFD START/CALL	WELL-PMP-C2
2	VFD SPEED SELECT	WELL-PMP-C2
3	VFD RESET	WELL-PMP-C2
4	VALVE COMMAND	C2-ACT-01

5	PRELUBE SOLENIOD	C2-SV-01
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

SLOT 7: 16 PT DISCRETE OUTPUT

0	VFD STOP/ENABLE	BSTR-PMP-P4
1	VFD START/CALL	BSTR-PMP-P4
2	VFD SPEED SELECT	BSTR-PMP-P4
3	VFD RESET	BSTR-PMP-P4
4	VALVE COMMAND	P4-SV-02
5	PRELUBE SOLENIOD	P4-SV-01
6		
7		
8	VFD STOP/ENABLE	BSTR-PMP-P5
9	VFD START/CALL	BSTR-PMP-P5
10	VFD SPEED SELECT	BSTR-PMP-P5
11	VFD RESET	BSTR-PMP-P5
12	VALVE COMMAND	P5-SV-02
13	PRELUBE SOLENIOD	P5-SV-01
14		
15		

SLOT 8: 16 PT DISCRETE OUTPUT

0	VFD STOP/ENABLE	BSTR-PMP-P6
1	VFD START/CALL	BSTR-PMP-P6
2	VFD SPEED SELECT	BSTR-PMP-P6
3	VFD RESET	BSTR-PMP-P6
4	VALVE COMMAND	P6-SV-02
5	PRELUBE SOLENIOD	P6-SV-01
6		
7		
8	VFD STOP/ENABLE	BSTR-PMP-P7
9	VFD START/CALL	BSTR-PMP-P7
10	VFD SPEED SELECT	BSTR-PMP-P7
11	VFD RESET	BSTR-PMP-P7
12	VALVE COMMAND	P7-SV-02
13	PRELUBE SOLENIOD	P7-SV-01
14		
15		

SLOT 9: 8 CHANNEL (CURRENT) ANALOG INPUTS

0	VFD SPEED INPUT	BSTR-PMP-P4
1	VFD SPEED INPUT	BSTR-PMP-P5
2	VFD SPEED INPUT	BSTR-PMP-P6
3	VFD SPEED INPUT	BSTR-PMP-P7
4		
5	FLOWMETER MANIFOLD	BSTR-FIT-01
6	PRESSURE MANIFOLD	BSTR-PIT-01
7	TANK LEVEL	BSTR-LIT-01
SLOT 10: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	FLOWMETER	BSTR-FIT-02
1	PRESSURE	BSTR-PIT-02
2		
3		
4	VFD SPEED INPUT	WELL-PMP-C2
5	FLOWMETER	C2-FIT-01
6	PRESSURE TRANSDUCER	C2-PIT-01
7	WELL SOUNDER	C2-LIT-01
SLOT 11: 8 CHANNEL (CURRENT) ANALOG OUTPUTS		
0	VFD SPEED COMMAND	BSTR-PMP-P4
1	VFD SPEED COMMAND	BSTR-PMP-P5
2	VFD SPEED COMMAND	BSTR-PMP-P6
3	VFD SPEED COMMAND	BSTR-PMP-P7
4		
5	VFD SPEED COMMAND	WELL-PMP-C2
6		
7		

PLC-4

SLOT 1: 16 PT DISCRETE INPUT

0	UPS ON BATT	UPS4
1	UPS FAIL/LOW BATT	UPS4
2		
3		
4	VFD HOA HAND	WELL-PMP-C3
5	VFD HOA OFF	WELL-PMP-C3
6	VFD HOA AUTO	WELL-PMP-C3
7	VFD RUNNING	WELL-PMP-C3
8	VFD FAULTED	WELL-PMP-C3
9	VFD IP TRIP	WELL-PMP-C3
10	PUMP SEAL LEAK STATUS	WELL-PMP-C3
11	VALVE POSITION OPEN	C3-ACT-01
12	VALVE POSITION CLOSE	C3-ACT-01
13		
14		
15		

SLOT 2: 16 PT DISCRETE INPUT

0	VFD HOA HAND	WELL-PMP-SR8
1	VFD HOA OFF	WELL-PMP-SR8
2	VFD HOA AUTO	WELL-PMP-SR8
3	VFD RUNNING	WELL-PMP-SR8
4	VFD FAULTED	WELL-PMP-SR8
5	VFD IP TRIP	WELL-PMP-SR8
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

SLOT 3: 16 PT DISCRETE OUTPUT

0	VFD STOP/ENABLE	WELL-PMP-C3
1	VFD START/CALL	WELL-PMP-C3
2	VFD SPEED SELECT	WELL-PMP-C3
3	VFD RESET	WELL-PMP-C3
4	VALVE COMMAND	C3-ACT-01
5	PRELUBE SOLENIOD	C3-SV-01
6		
7		
8	VFD STOP/ENABLE	WELL-PMP-SR8
9	VFD START/CALL	WELL-PMP-SR8

10	VFD SPEED SELECT	WELL-PMP-SR8
11	VFD RESET	WELL-PMP-SR8
12		
13		
14		
15		
SLOT 4: 8 CHANNEL (CURRENT) ANALOG INPUTS		
0	VFD SPEED INPUT	WELL-PMP-C3
1	FLOWMETER	C3-FIT-01
2	PRESSURE TRANSDUCER	C3-PIT-01
3	WELL SOUNDER	C3-LIT-01
4	VFD SPEED INPUT	WELL-PMP-SR8
5		
6		
7		
SLOT 5: 8 CHANNEL (CURRENT) ANALOG OUTPUTS		
0	VFD SPEED COMMAND	WELL-PMP-C3
1	VFD SPEED COMMAND	WELL-PMP-SR8
2		
3		
4		
5		
6		
7		

RIO-SR8

SLOT 1: 16 PT DISCRETE INPUT

0	UPS ON BATT	UPSSR8
1	UPS FAIL/LOW BATT	UPSSR8
2		
3	VALVE POSITION OPEN	SR8-ACT-01
4	VALVE POSITION CLOSE	SR8-ACT-01
5		
6	DISCONNECT AUX CONTACT	WELL-PMP-SR8
7	FIELD HOA HAND	WELL-PMP-SR8
8	FIELD HOA OFF	WELL-PMP-SR8
9	FIELD HOA AUTO	WELL-PMP-SR8
10	PUMP SEAL LEAK STATUS	WELL-PMP-SR8
11	PUMP MOTOR TEMP	WELL-PMP-SR8
12		
13		
14		
15		

SLOT 2: 16 PT DISCRETE OUTPUT

0	VALVE COMMAND	SR8-ACT-01
1	PRELUBE SOLENIOD	SR8-SV-01
2	PUMP RUN LT	WELL-PMP-SR8
3	PUMP POWER LT	WELL-PMP-SR8
4	PUMP FAULT LT	WELL-PMP-SR8
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

SLOT 3: 8 CHANNEL (CURRENT) ANALOG INPUTS

0	FLOWMETER	SR8-FIT-01
1	PRESSURE TRANSDUCER	SR8-PIT-01
2	WELL SOUNDER	SR9-LIT-01
3		
4		
5		
6		
7		

GEOTEHCNICAL ENGINEERING INVESTIGATION REPORT



**GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
CAMROSA WD GAC TREATMENT
THOUSAND OAKS, CALIFORNIA**

BSK PROJECT G21-033-11B

PREPARED FOR:

**PROVOST & PRITCHARD CONSULTING GROUP
286 W. CROMWELL AVENUE
FRESNO, CA 93711**

APRIL 28, 2021

**GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
CAMROSA WD GAC TREATMENT
THOUSAND OAKS, CALIFORNIA**

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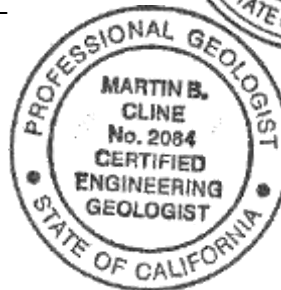
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1. INTRODUCTION

This report presents the results of a Geotechnical Engineering Investigation Report conducted by BSK Associates (BSK), for the proposed Camrosa Water District GAC Treatment Project in Thousand Oaks, California (Site). The Site is located southeast of the intersection of Santo Rosa Road and Hill Canyon Road. The Sites is located in Thousand Oaks, Ventura County, CA, as shown on the Site Vicinity Map, Figure A-1. The geotechnical engineering investigation was conducted in accordance with revised BSK Proposal GB21-21505, dated January 21, 2021.

This report provides a description of the geotechnical conditions at the Site and provides specific recommendations for the planned improvements at the Site. In the event that changes occur in the design of the project, this report's conclusions and recommendations will not be considered valid unless the changes are reviewed with BSK and the conclusions and recommendations are modified or verified in writing.

1.1. Planned Construction

BSK understands that the proposed improvements include five (5) pairs of GAC vessels on a mat foundation, two (2) 40-foot tall water storage tanks on ring wall foundations, and a storm water detention pond. BSK understands the Site lies within the flood plain and all structures will need to be elevated. BSK understands a building will be constructed in the future but it will not be part of this project.

In the event that significant changes occur in the design of the proposed improvements, this report's conclusions and recommendations will not be considered valid unless the changes are reviewed with BSK and the conclusions and recommendations are modified or verified in writing.

1.2. Purpose and Scope of Services

The objective of this geotechnical investigation was to assess soil conditions and provide geotechnical engineering recommendations for the proposed improvements and characterize the subsurface conditions in the areas of the proposed structures, and provide geotechnical engineering recommendations for the preparation of plans and specifications and bearing and lateral earth pressure condition at the Site. The scope of the investigation included a field exploration, laboratory testing, engineering analyses, and preparation of this report.

2. FIELD INVESTIGATION AND LABORATORY TESTING

2.1. Field Exploration

The field exploration for this investigation was conducted under the oversight of a BSK staff member. Four (4) total borings were drilled at the Site to a maximum depth of 49.5 feet beneath the existing ground surface (bgs) on February 24, 2021 using a CME-95 Hollow Stem Auger Drill Rig provided by Choice Drilling.

The soil materials encountered in the Borings were visually classified in the field, and the logs were recorded during the drilling and sampling operations. Visual classifications of the materials encountered in the borings were made in general accordance with the Unified Soil Classification System (ASTM D 2488). A soil classification chart is presented in Appendix A.



Boring logs are presented in Appendix A and should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff based on observations made at the time of drilling, while the actual boundaries between soil types may be gradual and soil conditions may vary at other locations.

2.2 Laboratory Testing

Laboratory tests were performed on selected soil samples to evaluate moisture content, dry density, shear strength, compressibility & collapse potential, expansion index, and fines content. A description of the laboratory test methods and results are presented in Appendix B.

3. SITE AND GEOLOGY/SEISMICITY CONDITIONS

The following sections address the Site descriptions and surface conditions, regional geology and seismic hazards, subsurface conditions, and groundwater conditions at the Site. This information is based on BSK's field exploration and published maps and reports.

3.1 Site Description and Surface Conditions

The Site is located southeast of the intersection of Santo Rosa Road and Hill Canyon Road in Thousand Oaks, California. The Site is currently an existing Camrosa Water District facility and an adjacent farm field. The Site is in Township 2 North, Range 20 West of the San Bernardino Meridian. The WGS84 coordinates are 34.23404 degrees North latitude and 118.93059 degrees West longitude.

3.2 Regional Geology and Seismic Hazards Assessment

Our Scope of services included a review of published maps and reports to assess the regional geology and potential for seismic hazards.

3.2.1 Regional Geology

The site is located in the Santa Rosa Valley portion of the Transverse Range geomorphic province. The Site is located in the coastal uplands which consist of northwest trending folded Miocene to Pliocene sedimentary rocks. Locally, south of the site are hills consisting of Miocene Conejo Volcanics of andesitic and basaltic flow breccias. North of the site are the Santa Rosa Hills comprised of Plio-Pleistocene Saugus Formation sandstone and conglomerate. The Site is situated in a valley consisting of recent alluvial deposits. As shown on Figure C-3 in Appendix C, the Site is situated on young (Late Pleistocene) alluvial valley deposits.

3.2.2 Seismic Hazards Assessment

The types of geologic and seismic hazards assessed include surface ground fault rupture, liquefaction, seismically induced settlement, slope failure, flood hazards and inundation hazards.

The purpose of the Alquist-Priolo Geologic Hazards Zones Act, as summarized in CDMG Special Publication 42 (SP 42), is to "prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture." As indicated by SP 42, "the State Geologist is required to delineate "earthquake fault zones" (EFZs) along known active faults in California. Cities and counties affected by the zones must regulate certain development 'projects' within the zones. They must



withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting.

The Site is not located in an Earthquake Fault Zone. The closest Earthquake Fault Zone is associated with the Simi-Santa Rosa fault zone located approximately 500 feet north of the Site.

Zones of Required Investigation referred to as "Seismic Hazard Zones" in CCR Article 10, Section 3722, are areas shown on Seismic Hazard Zone Maps where site investigations are required to determine the need for mitigation of potential liquefaction and/or earthquake-induced landslide ground displacements. The Site is located in a State Liquefaction Hazard Zone.

3.2.3 Liquefaction

Settlement of the ground surface with consequential differential movement of structures is a major cause of seismic damage for buildings founded on alluvial deposits. Vibration settlement of relatively dry and loose granular deposits beneath structures can be readily induced by the horizontal components of ground shaking associated with even moderate intensity earthquakes. Silver and Seed (1971) have demonstrated that settlement of dry sands due to cyclic loading is a function of 1) the relative density of the soil; 2) the magnitude of the cyclic shear stress; and 3) the number of strain cycles. As indicated above, seismically-induced ground settlement can also occur due to the liquefaction of relatively loose, saturated granular deposits.

In order for liquefaction triggering to occur due to ground shaking, it is generally accepted that four conditions will exist:

1. The subsurface soils are in a relatively loose state.
2. The soils are saturated.
3. The soils have low plasticity.
4. Ground shaking is of sufficient intensity to act as a triggering mechanism.

We estimate the historical depth to groundwater is 25 feet bgs. A liquefaction/seismic settlement analysis was performed using the program Liquefy Pro version 5.8k using boring data from borings B-1 and B-2. Input parameters for the liquefaction and settlement analysis were based upon:

- Soil densities estimated from soil boring data.
- PGA based upon the geometric mean peak ground acceleration of 0.725g.
- Magnitude 6.86 of controlling earthquake from Deaggregation of the seismic hazard.
- Assumed depth to groundwater of 25 feet bgs.
- A Factor-of-Safety of 1.3 was used for analysis.

The results of our liquefaction and seismic settlement analysis based upon data from soil borings B-1 and B-2 are provided in Appendix C. Based on our liquefaction analysis, during the design earthquake the liquefaction potential is low.



3.2.5 *Seismic Settlement*

Another type of seismically induced ground failure, which can occur as a result of seismic shaking, is dynamic compaction, or seismic settlement. Such phenomena typically occur in unsaturated, loose granular material or uncompacted fill soils.

Input parameters for the liquefaction and settlement analysis were based upon:

- Soil densities estimated from soil boring data.
- PGA based upon the site specific geometric mean peak ground acceleration or 0.725g.
- Magnitude 6.86 of controlling earthquake from Deaggregation of the seismic hazard.
- Assumed depth to groundwater of 25 feet bgs.
- A Factor-of-Safety of 1.3 was used for analysis.

Based on the analysis, the total seismic settlement is estimated at 0.5 inch with a differential settlement of 0.3 inch over 30 feet.

3.3 **Subsurface Conditions**

The subsurface material generally consisted of clays and silts in the upper 20 feet. Below 20 feet bgs, the material generally consisted of clays throughout to the bottom of the boreholes.

The upper 5 feet of material is anticipated to have high to very high potential for expansion with an expansion index of 114 at Boring B-1 and an expansion index of 131 at Boring B-2.

Based on the results of the collapse potential test, the on-site soils below 5 feet are considered to have a low potential for hydrocompaction.

The boring logs in Appendix A provide a more detailed description of the materials encountered, including the applicable Unified Soil Classification System symbols.

3.4 **Groundwater Conditions**

Groundwater was not encountered at the Site on February 24, 2021. Figure C-2 in Appendix C presents a historical groundwater contour map from the California Geologic Survey, Seismic Hazard Zone Report (CGS, 2002) for the Newbury Park Quadrangle. This map indicates that shallow groundwater was present at approximately 25 feet below the ground surface (bgs).

Please note that the groundwater level may fluctuate both seasonally and from year to year due to variations in rainfall, temperature, pumping from wells and possibly as the result of other factors such as irrigation, that were not evident at the time of our investigation.

4. **CONCLUSIONS AND RECOMMENDATIONS**

Based upon the data collected during this investigation, and from a geotechnical engineering standpoint, it is our opinion that the soil conditions would not preclude the construction of the proposed improvements.



4.1 Seismic Design Criteria

For the general seismic design criteria, please refer to Appendix C of this report.

4.2 Soil Corrosivity

Surface soil samples obtained from the Site were tested to provide a preliminary screening of the potential for concrete deterioration or steel corrosion due to attack by soil-borne soluble salts. The test results are presented in Appendix B.

The corrosivity evaluation was performed by BSK on soil samples obtained at the time of drilling. The soil was evaluated for minimum resistivity (ASTM G57), pH (ASTM D4972), and soluble sulfate and chlorides (CT 417 and CT 422). At Boring B-1, the minimum resistivity was 860 ohm-cm, pH was 6.83, sulfate was detected at 50 parts per million (ppm), and chloride was not detected. At Boring B-2, the minimum resistivity was 510 ohm-cm, pH was 6.72, sulfate was not detected, chloride was detected at 25 ppm.

The water-soluble sulfate content severity class is considered negligible to concrete (Exposure Category S0 per Table 19.3.1.1 of ACI 318-14). Representative samples of the Site soil have a minimum resistivity between 510 ohm-cm and 860 which is considered very severely corrosive to buried metal conduit. Therefore, buried metal conduits, ferrous metal pipes, and exposed steel should have a protective coating in accordance with the manufacturer's specification.

4.3 Site Preparation Recommendations

The following procedures must be implemented during Site preparation for the proposed earthwork operations. References to maximum dry density, optimum moisture content, and relative compaction are based on ASTM D 1557 (latest test revision) laboratory test procedures.

1. The areas of proposed improvements must be cleared of surface vegetation and debris. Materials resulting from the clearing and stripping operations must be removed and properly disposed of off-site. In addition, all undocumented fills should be removed where encountered and where fills or structural improvements will be placed.
2. Where existing utilities, inlets, or underground tanks are present, they should be removed to a point at least 2 feet horizontally outside the proposed foundation and pavement areas. Resultant cavities must be backfilled with engineered fill compacted in accordance with the recommendations presented in this report.
3. Following the stripping operations, the areas where shallow foundations are proposed must be overexcavated to a minimum depth of one foot below existing site grades or one foot below the bottom of the footing elevation, whichever is deeper. Over excavation should extend laterally three feet beyond the edge of foundations for shallow footings. After overexcavation, the bottom of the exposed soil should be scarified 8 inches, moisture conditioned to near optimum moisture content, and compacted to 90% of ASTM D1557. We recommend that non-expansive soil ($EI < 20$) be used below the bottom of shallow foundations.
4. For ring wall tank foundations, BSK recommends overexcavation to a minimum depth of two feet below existing site grades or two feet below the bottom of the footing elevation, whichever is



deeper. Because of the expansive material ($EL > 20$) found at the Tank Site, either low expansive ($EL < 20$) select onsite soils or low expansive ($EL < 20$) import engineered fill should be placed below the ring wall foundations. Over excavation should extend laterally three feet beyond the edge of the ring wall foundations. After overexcavation, the bottom of the exposed soil should be scarified 8 inches, moisture conditioned to near optimum moisture content, and compacted to 90% of ASTM D1557. Yielding areas should be observed by the geotechnical consultant and removed a recompacted if necessary.

5. Following the required stripping and overexcavation, in the areas of proposed shallow foundations, the exposed ground surface at the bottom of the overexcavation must be inspected by a Geotechnical Engineer to evaluate if loose or soft zones are present that will require additional overexcavation.
6. Screening of oversize material should be anticipated if native soils are planned for use as trench backfill or engineered fill.
7. Imported soil or native excavated soils, free of organic materials or deleterious substances, may be placed as compacted engineered fill. The material must be free of oversized fragments greater than 3-inches in greatest dimension. Engineered fill must be placed in uniform layers not exceeding 8-inches in loose thickness, moisture conditioned to within 2 to 4 percent above optimum moisture content, and compacted to at least 90 percent relative compaction. Engineered fill placed on fill slopes must be placed in uniform layers not exceeding 8-inches in loose thickness, moisture conditioned to near optimum moisture content, and compacted to at least 90 percent of relative compaction.
8. BSK must be called to the site to verify the import material properties through laboratory testing.
9. If possible, backfill operations should be scheduled during a dry, warm period of the year. Should these operations be performed during or shortly following periods of inclement weather, unstable soil conditions may result in the soils exhibiting a “pumping” condition. This condition is caused by excess moisture in combination with moving construction equipment, resulting in saturation and zero air voids in the soils. If this condition occurs, the adverse soils will need to be over-excavated to the depth at which stable soils are encountered, and replaced with suitable soils compacted as engineered fill. Alternatively, the Contractor may proceed with grading operations after utilizing a method to stabilize the soil subgrade, which should be subject to review and approval by BSK prior to implementation.
10. Import fill materials must be free from organic materials or deleterious substances. The project specifications must require the contractor to contact BSK to review the proposed import fill materials for conformance with these recommendations at least one week prior to importing to the Site, whether from on-site or off-site borrow areas. Imported fill soils must be non-hazardous and derived from a single, consistent soil type source conforming to the following criteria:

Plasticity Index:	< 12
Expansion Index:	< 20 (Very Low Expansion Potential)
Maximum Particle Size:	3 inches
Percent Passing #4 Sieve:	65 - 100
Percent Passing #200 Sieve:	20 - 45
Low Corrosion Potential:	Soluble Sulfates < 1,500 ppm



Soluble Chlorides < 150 ppm
Minimum Resistivity > 3,000 ohm-cm

4.4 Foundations

Provided the recommendations contained in this report are implemented during design and construction, it is our opinion that the structures can be supported on shallow or mat foundations. A structural engineer should evaluate reinforcement and embedment depth based on the requirements for the structural loadings, shrinkage and temperature stresses, and soil conditions present at the site.

4.4.1 Shallow Foundations

Continuous and isolated spread footings must have a minimum width of 12 inches and 24 inches, respectively and a minimum depth of footing of 18 inches. Continuous and isolated spread footing foundations may be designed using a net allowable bearing pressure of 1,900 pounds per square foot (psf). The net allowable bearing pressure may be increased by 1/3 where used with the alternative basic load combinations of CBC Section 1605A.3.2 that include wind or earthquake loads.

Total foundation settlements for lightly loaded structures are expected to be less than one-half inch and differential settlements between similarly loaded (DL + LL) and sized footings are anticipated to be less than one-quarter inch. Differential settlement of continuous footings, expressed in terms of angular distortion, is estimated to be approximately 1/600. The majority of the settlement is expected to occur within a few months after the design loads are applied.

Total foundation settlements for tank ring foundations are expected to be less than one inch and differential settlements between similarly loaded (DL + LL) and sized footings are anticipated to be less than one-half inch. Differential settlement of continuous footings, expressed in terms of angular distortion, is estimated to be approximately 1/300. The majority of the settlement is expected to occur within a few months after the design loads are applied.

4.4.2 Mat Foundations

We understand that the proposed GAC vessels may be supported on a concrete mat foundation. The mat foundation may be designed to impose a maximum allowable pressure of 2,000 psf due to dead plus live loads. This value may be increased by one-third for transient loads such as seismic or wind. The concrete mat foundation should be embedded at least 8 inches below the lowest adjacent grade.

Settlements: Based on the results of our laboratory tests and analyses, total static settlements of the mat foundation under the allowable bearing pressure are expected to be approximately 1-inch, and maximum differential settlements are expected to be about 1/2-inch.

4.5 Lateral Earth Pressures and Frictional Resistance

Provided the Site is prepared as recommended above, the following earth pressure parameters for footings may be used for design purposes. The parameters shown in the table below are for drained conditions of select engineered fill or undisturbed native soil.



Table 2: Recommended Static Lateral Earth Pressures for Footings	
Lateral Pressure Condition	Equivalent Fluid Density (pcf) Drained Condition
Active Pressure	30
At Rest Pressure	50
Passive Pressure	330

The lateral earth pressures listed herein are obtained by the conventional equation for active, at rest, and passive conditions assuming level backfill and a bulk unit weight of 120 pcf for the Site soils. A coefficient of friction of 0.30 may be used between soil sub-grade and the bottom of footings.

The coefficient of friction and passive earth pressure values given above represent ultimate soil strength values. BSK recommends that a safety factor consistent with the design conditions be included in their usage in accordance with Sections 1806.3.1 through 1806.3.3 of the 2019 CBC. BSK should be consulted for specific recommendations once the anticipated shoring configuration is developed.

4.6 Trench Backfill and Compaction

A minimum of 6 inches of bedding material is recommended for pipe installations. The bedding material and backfill within the pipe envelope (up to 12 inches above the pipe) should consist of sandy material with not more than 10 percent passing the #200 sieve, 100 percent passing the 3/8-inch sieve, and a sand equivalent of at least 30.

In the case of flexible pipe installation, a minimum of eight inches (8") of bedding material is recommended for pipe installation. Bedding material must consist of medium- or coarse-grained sand with a Sand Equivalent of at least 25. As an alternative to using sand, the pipe bedding and envelope material may consist of Class 2 Aggregate Base as specified in Section 26 of the Caltrans Standard Specifications or sand-cement slurry that contains 1.5 to 2.0 sacks of cement per yard of material and has a 4- to 6-inch slump.

Bedding and pipe envelope must be placed in loose thickness not exceeding 10-inches and compacted to at least 90 percent of the maximum dry density of ASTM D1557. Soil backfill moisture content during compaction must be maintained within two percent (2 percent) of optimum. Water jetting to attain compaction should not be allowed. Class 2 Aggregate Base, when used for bedding or pipe envelope must be compacted to at least 92 percent of ASTM D1557.

Processed on-Site soils, which are free of organic material, are suitable for use as general trench backfill above the pipe envelope. Native soil with particles less than three inches in the greatest dimension may be incorporated into the backfill and compacted as specified above, provided they are properly mixed into a matrix of friable soils. The backfill must be placed in thin layers not exceeding 12 inches in loose thickness, be well-blended and consistent texture, moisture conditioned to at least optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined by the ASTM D1557. The uppermost 12 inches of trench backfill below pavement sections must be compacted to at



least 95 percent of the maximum dry density as determined by ASTM D1557. Moisture content within two percent of optimum must be maintained while compacting this upper 12 inch trench backfill zone.

We recommend that trench backfill be tested for compliance with the recommended Relative Compaction and moisture conditions. Field density testing should conform to ASTM Test Methods D1556 or D6938. We recommend that field density tests be performed in the utility trench bedding, envelope and backfill for every vertical lift, at an approximate longitudinal spacing of not greater than 150 feet. Backfill that does not conform to the criteria specified in this section should be removed or reworked, as applicable over the trench length represented by the failing test so as to conform to BSK recommendations.

4.7 Excavation Stability

Soils encountered within the depth explored are generally classified as Type C soils in accordance with OSHA (Occupational Safety and Health Administration). The slopes surrounding or along temporary excavations may be vertical for excavations that are less than five feet deep and exhibit no indication of potential caving, but should be no steeper than 1.5H:1V for excavations that are deeper than five feet, up to a maximum depth of 15 feet. Certified trench shields or boxes may also be used to protect workers during construction in excavations that have vertical sidewalls and are greater than 5 feet deep. Temporary excavations for the project construction should be left open for as short a time as possible and should be protected from water runoff. In addition, equipment and/or soil stockpiles must be maintained at least 10 feet away from the top of the excavations. Because of variability in soils, BSK must be afforded the opportunity to observe and document sloping and shoring conditions at the time of construction. Slope height, slope inclination, and excavation depths (including utility trench excavations) must in no case exceed those specified in local, state, or federal safety regulations, (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations).

4.10 Drainage Considerations

The control surface drainage in the project areas is an important design consideration. BSK recommends that final grading around shallow foundations must provide for positive and enduring drainage away from the structures, and ponding of water must not be allowed around, or near the shallow foundations. Ground surface profiles next to the shallow foundations must have at least a 2 percent gradient away from the structures.

5. PLANS AND SPECIFICATIONS REVIEW

BSK recommends that it be retained to review the draft plans and specifications for the project, with regard to drilling operations and earthwork, prior to their being finalized and issued for construction.

6. CONSTRUCTION TESTING AND OBSERVATIONS

Geotechnical testing and observation during construction is a vital extension of this geotechnical investigation. BSK recommends that it be retained for those services. Field review during Site preparation and drilling allows for evaluation of the exposed soil conditions and confirmation or revision of the assumptions and extrapolations made in formulating the design parameters and recommendations. BSK recommends periodic site visits and testing during backfill operations and full-time observation during drilling and pipe boring and jacking operations.



If a firm other than BSK is retained for these services during construction, then that firm must notify the owner, project designers, governmental building officials, and BSK that the firm has assumed the responsibility for all phases (i.e., both design and construction) of the project within the purview of the geotechnical engineer. Notification must indicate that the firm has reviewed this report and any subsequent addenda, and that it either agrees with BSK's conclusions and recommendations, or that it will provide independent recommendations.

7. LIMITATIONS

The analyses and recommendations submitted in this report are based upon the data obtained from the Borings performed at the locations shown on the Boring Location Map, Figure A-2. The report does not reflect variations which may occur between or beyond the Borings. The nature and extent of such variations may not become evident until construction is initiated. If variations then appear, a re-evaluation of the recommendations of this report will be necessary after performing on-Site observations during the excavation period and noting the characteristics of the variations.

The validity of the recommendations contained in this report is also dependent upon an adequate testing and observation program during the construction phase. BSK assumes no responsibility for construction compliance with the design concepts or recommendations unless it has been retained to perform the testing and observation services during construction as described above.

The findings of this report are valid as of the present. However, changes in the conditions of the Site can occur with the passage of time, whether caused by natural processes or the work of man, on this property or adjacent property. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation, governmental policy or the broadening of knowledge.

BSK has prepared this report for the exclusive use of the Client and members of the project design team. The report has been prepared in accordance with generally accepted geotechnical engineering practices which existed in Ventura County at the time the report was written. No other warranties either expressed or implied are made as to the professional advice provided under the terms of BSK's agreement with Client and included in this report.

8. REFERENCES

Department of Water Resources. <http://www.water.ca.gov/waterdatalibrary/>, Water Data Library, April 2021.

Earth Point. <http://earthpoint.us/townships.aspx>, Public Land Survey System, Google Earth, 2021, April 2021.

Lee, Norman. California Geomorphic Provinces (2012): n. pag. California Department of Conservation. California Geological Survey. April 2021

<http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_36/Documents/note_36.pdf>.



OSHPD Seismic Design Maps. SEAOC. <https://seismicmaps.org/>, April 2021.



APPENDIX A
FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

The field exploration for this investigation was conducted under the oversight of a BSK staff member. Four (4) total borings were drilled at the Site to a maximum depth 49.5 feet beneath the existing ground surface (bgs) on February 24, 2021 using a CME-95 Hollow Stem Auger Drill Rig provided by Choice Drilling.

The soil materials encountered in the test borings were visually classified in the field, and the logs were recorded during the drilling and sampling operations. Visual classification of the materials encountered in the test borings was made in general accordance with the Unified Soil Classification System (ASTM D 2488). A soil classification chart is presented herein. Boring logs are presented herein and should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff based on observations made at the time of drilling, while the actual boundaries between soil types may be gradual and soil conditions may vary at other locations.

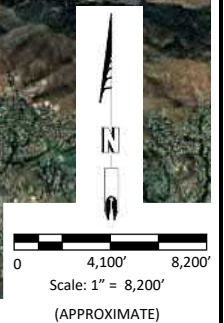
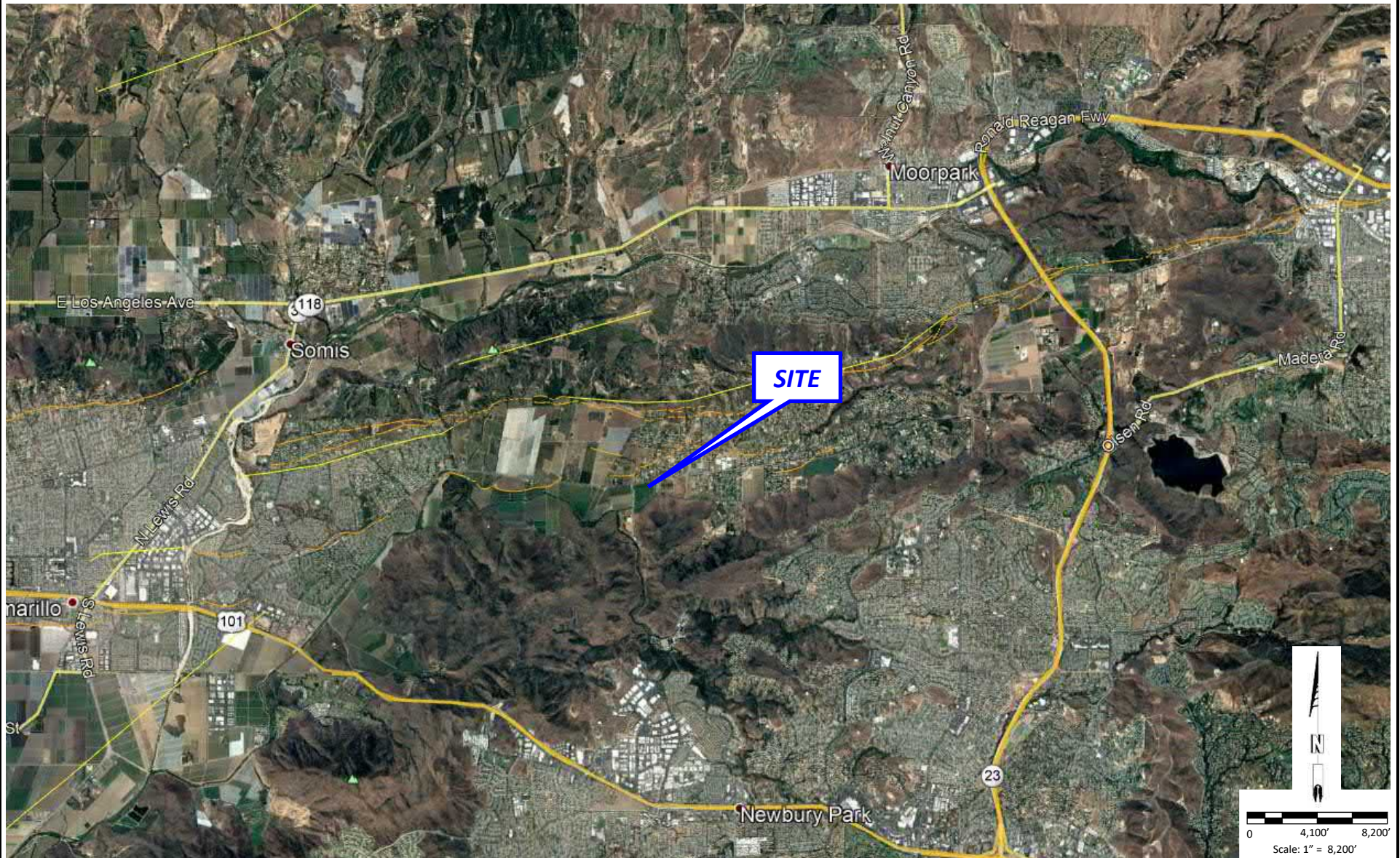
Subsurface samples were obtained at the successive depths shown on the boring logs by driving samplers which consisted of a 2.5-inch inside diameter (I.D.) California Sampler and a 1.4-inch I.D. Standard Penetration Test (SPT) Sampler. The samplers were driven 18 inches using a 140-pound hammer dropped from a height of 30 inches by means of either an automatic hammer or a down-hole safety hammer. The number of blows required to drive the last 12 inches was recorded as the blow count (blows/foot) on the boring logs. The relatively undisturbed soil core samples were capped at both ends to preserve the samples at their natural moisture content. Soil samples were also obtained using the SPT Sampler lined with metal tubes or unlined in which case the samples were placed and sealed in polyethylene bags. At the completion of the field exploration, the test borings were backfilled with the excavated soil cuttings.

It should be noted that the use of terms such as “loose”, “medium dense”, “dense” or “very dense” to describe the consistency of a soil is based on sampler blow count and is not necessarily reflective of the in-place density or unit weight of the soils being sampled. The relationship between sampler blow count and consistency is provided in the following Tables A-1 and A-2 for coarse-grained (sandy and gravelly) soils and fine grained (silty and clayey) soils, respectively.



Table A-1: Consistency of Coarse-Grained Soil by Sampler Blow Count		
Consistency Descriptor	SPT Blow Count (#Blows / Foot)	2.5" I.D. California Sampler Blow Count (#Blows / Foot)
Very Loose	<4	<6
Loose	4 – 10	6 – 15
Medium Dense	10 – 30	15 – 45
Dense	30 – 50	45 – 80
Very Dense	>50	>80

Table A-2: Apparent Relative Density of Fine-Grained Soil by Sampler Blow Count		
Consistency Descriptor	SPT Blow Count (#Blows / Foot)	2.5" I.D. California Sampler Blow Count (#Blows / Foot)
Very Soft	<2	<3
Soft	2 – 4	3 – 6
Firm	4 – 8	6 – 12
Very Firm	8 – 15	12 – 24
Hard	15 – 30	24 – 45
Very Hard	>30	>45



REFERENCE IMAGE: Google Earth 2021

ESK
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SITE VICINITY MAP

P&P GAC Treatment Camrosa WD Project
 Ventura County, California

FIGURE A-1

JOB NO.	G21-033-11B
DATE	April 2021
DR. BY	VS
CH. BY	AXT
SCALE AS SHOWN	
SHEET NO.	1
OF	1 SHEETS



REFERENCE IMAGE: Google Earth 2021

LEGEND:



APPROXIMATE PROPOSED BORING LOCATION

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BORING LOCATION MAP

P&P GAC Treatment Camrosa WD Project
Ventura County, California

FIGURE A-2

JOB NO. G21-033-11B
















DATE April 2021

DR. BY VS









CH. BY AXT

SCALE AS SHOWN

SHEET NO. 1
OF 1 SHEETS

MAJOR DIVISIONS				TYPICAL NAMES	
COARSE GRAINED SOILS More than Half >#200	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM		SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half <#200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH		INORGANIC SILTS , MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS		Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

Note: Dual symbols are used to indicate borderline soil classifications.

	Pushed Shelby Tube	RV	R-Value
	Standard Penetration Test	SA	Sieve Analysis
	Modified California	SW	Swell Test
	Auger Cuttings	TC	Cyclic Triaxial
	Grab Sample	TX	Unconsolidated Undrained Triaxial
	Sample Attempt with No Recovery	TV	Torvane Shear
CA	Chemical Analysis	UC	Unconfined Compression
CN	Consolidation	(1.2)	(Shear Strength, ksf)
CP	Compaction	WA	Wash Analysis
DS	Direct Shear	(20)	(with % Passing No. 200 Sieve)
PM	Permeability		Water Level at Time of Drilling
PP	Pocket Penetrometer		Water Level after Drilling (with date measured)

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Unified Soil Classification System



PLATE: Figure A-3



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LOG OF BORING NO. B-01

Project Name: **Camrosa WD GAC Treatment**
Project Number: **G21-033-11B**
Project Location: **Thousand Oaks, CA**
Logged by: **L. Prosser**
Checked by: **A. Terronez**

Depth, feet	Graphic Log	Surface El.: Location:	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
MATERIAL DESCRIPTION												
		Surface: 3/4 gravel.					76					
		CL: CLAY with Sand: dark yellowish brown, moist, fine grained sand.			19			103	14			
5		very firm										
		dark brown, very firm			15			82	36			
10		CL: CLAY: dark brown, hard.			30		93	96	28			
15		ML: SANDY SILT: dark brown with dark yellowish brown mottle, moist, hard, fine grained sand.			16		59		19			
20		CL: SANDY CLAY: dark brown, moist, hard, fine grained sand.			16		63		23			
25		CL: CLAY: dark brown, moist, hard.			18		88		31			
Completion Depth: 49.5 Date Started: 2/24/21 Date Completed: 2/24/21 California Sampler: 2.4" inner diameter SPT Sampler: 1.4" inner diameter				Drilling Equipment: CME 95 Drilling Method: Hollow Stem Auger Drive Weight: 140 pounds Hole Diameter: 8 inches Drop: 30 inches Remarks: Borings backfilled with neat cement.								

GEO_TARGET BORING LOGS.GPJ GEOTECHNICAL 08.GDT 4/5/21



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LOG OF BORING NO. B-01

Project Name: **Camrosa WD GAC Treatment**
Project Number: **G21-033-11B**
Project Location: **Thousand Oaks, CA**
Logged by: **L. Prosser**
Checked by: **A. Terronez**

Depth, feet	Graphic Log	Surface El.: Location:	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		MATERIAL DESCRIPTION										
30		CL: SANDY CLAY: dark brown, moist, hard, fine grained sand. (continued)										
		CL: CLAY with Sand: dark brown, moist, hard, fine to medium grained sand.	X		30		80		26			
35		hard	X		22		85		26			
40		brown, very hard	X		32		73		26			
45		CL: CLAY: brown, moist, very hard.	X		31		86		28			
		CL: CLAY with Sand: brown, moist, very hard, fine to medium grained sand.	X		31		72		26			
50		End of boring.										
55												

GEO_TARGET BORING LOGS.GPJ GEOTECHNICAL 08.GDT 4/5/21

Completion Depth: 49.5
Date Started: 2/24/21
Date Completed: 2/24/21
California Sampler: 2.4" inner diameter
SPT Sampler: 1.4" inner diameter








Drilling Equipment: CME 95
Drilling Method: Hollow Stem Auger
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with neat cement.



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LOG OF BORING NO. B-02

Project Name: **Camrosa WD GAC Treatment**
Project Number: **G21-033-11B**
Project Location: **Thousand Oaks, CA**
Logged by: **L. Prosser**
Checked by: **A. Terronez**

Depth, feet	Graphic Log	Surface El.: Location:	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		MATERIAL DESCRIPTION										
		Surface: silt, dry										
		CL: CLAY: dark brown, dark brown, moist.					88					
		very firm			19			96	23			
5		very firm			15			104	20			
10		hard.			28		93	87	26			
15		very firm			14		87		23			
20		CL: CLAY with Sand: dark brown, moist, very firm, fine grained sand.			13		77		24			
25		hard			21		85		28			

Completion Depth: 49.5
Date Started: 2/24/21
Date Completed: 2/24/21
California Sampler: 2.4" inner diameter
SPT Sampler: 1.4" inner diameter

Drilling Equipment: CME 95
Drilling Method: Hollow Stem Auger
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with neat cement.

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LOG OF BORING NO. B-02

Project Name: **Camrosa WD GAC Treatment**
Project Number: **G21-033-11B**
Project Location: **Thousand Oaks, CA**
Logged by: **L. Prosser**
Checked by: **A. Terronez**

Depth, feet	Graphic Log	Surface El.: Location:	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
MATERIAL DESCRIPTION												
30		CL: CLAY: dark brown, dark brown, moist. <i>(continued)</i>										
		very firm	X		12		81		26			
35		CL: SANDY CLAY: brown, moist, hard, fine grained sand.	X		28		60		22			
40		CL: CLAY: dark brown, moist, hard.	X		24		90		32			
45		CL: SANDY CLAY: brown, moist, hard, fine to medium grained sand.	X		16		73		29			
		hard	X		17		74		29			
50		End of boring.										
55												
Completion Depth: 49.5 Date Started: 2/24/21 Date Completed: 2/24/21 California Sampler: 2.4" inner diameter SPT Sampler: 1.4" inner diameter				Drilling Equipment: CME 95 Drilling Method: Hollow Stem Auger Drive Weight: 140 pounds Hole Diameter: 8 inches Drop: 30 inches Remarks: Borings backfilled with neat cement.								

GEO_TARGET BORING LOGS.GPJ GEOTECHNICAL 08.GDT 4/5/21



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LOG OF BORING NO. B-03

Project Name: **Camrosa WD GAC Treatment**
Project Number: **G21-033-11B**
Project Location: **Thousand Oaks, CA**
Logged by: **L. Prosser**
Checked by: **A. Terronez**

Depth, feet	Graphic Log	Surface El.: Location:	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
MATERIAL DESCRIPTION												
		Surface: silt, dry										
		CL: CLAY: dark brown, moist.										
		hard			27			107	19			
5		CL: CLAY with Sand: dark brown, moist, very firm, fine grained sand.			22			95	28			
		hard			24			89	29			
15		very firm			14				28			
		End of boring.										
20												
25												

Completion Depth: 16.5
Date Started: 2/24/21
Date Completed: 2/24/21
California Sampler: 2.4" inner diameter
SPT Sampler: 1.4" inner diameter

Drilling Equipment: CME 95
Drilling Method: Hollow Stem Auger
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with neat cement.












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LOG OF BORING NO. B-04

Project Name: **Camrosa WD GAC Treatment**
Project Number: **G21-033-11B**
Project Location: **Thousand Oaks, CA**
Logged by: **L. Prosser**
Checked by: **A. Terronez**

Depth, feet	Graphic Log	Surface El.: Location:	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
MATERIAL DESCRIPTION												
		Surface: silt, dry										
		CL: CLAY: dark brown, moist.										
		hard			28			101	19			
5		CL: CLAY with Sand: dark brown, moist, very firm, fine grained sand.			18			94	27			
		hard			36			105	18			
10		hard			17				22			
15		End of boring.										
20												
25												

Completion Depth: 16.5
Date Started: 2/24/21
Date Completed: 2/24/21
California Sampler: 2.4" inner diameter
SPT Sampler: 1.4" inner diameter

Drilling Equipment: CME 95
Drilling Method: Hollow Stem Auger
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with neat cement.

GEO_TARGET BORING LOGS.GPJ GEOTECHNICAL 08.GDT 4/5/21

APPENDIX B

LABORATORY TESTING RESULTS

APPENDIX B

LABORATORY TESTING

Moisture-Density Tests

The field moisture content, as a percentage of dry weight of the soils, was determined by weighing the samples before and after oven drying in accordance with ASTM D 2216 test procedures. Dry densities, in pounds per cubic foot, were also determined for undisturbed core samples in general accordance with ASTM D 2937 test procedures. Test results are presented on the boring logs in Appendix A.

Direct Shear Test

Two (2) Direct Shear Tests were performed on in-situ soil samples from selected Borings. The test was conducted to determine the soil strength characteristics. The standard test method is ASTM D 3080, Direct Shear Test for Soil under Consolidated Drained Conditions. The result of the direct shear test is presented graphically on Figures B-1 and B-2.

Collapse Potential Test

Two (2) Consolidation Tests were performed on relatively undisturbed soil samples to evaluate compressibility and collapse potential characteristics. The tests were performed in general accordance with ASTM D2435. The samples were initially loaded under as-received moisture content to a selected stress level, was then saturated, and then incrementally loaded up to a maximum load of 5200 psf. The test results are presented on Figures B-3 and B-4.

Expansion Index Test

Two (2) Expansion Index Tests were performed on bulk soil samples in the Site area. The tests were performed in general accordance with UBC Standard 18-2. The test results are presented on Figures B-5 and B-6.

Corrosivity

Two (2) Corrosivity Evaluations were performed on bulk soil samples obtained at the time of drilling in the area of planned construction. The soil samples were evaluated for minimum resistivity (ASTM G57), sulfate ion concentration (CT 417), chloride ion concentration (CT 422), and pH of soil (ASTM D4972). The test results are presented in Table B-1.

Minus #200 Wash Tests

Twenty (20) #200 Wash Tests were performed on selected soil samples obtained at the time of drilling in the area of planned construction. The test was performed to determine the amount of fine material present in the subsurface material. The test was performed in general accordance with ASTM Test Method D1140. The test results are presented in Table B-2 and the boring logs in Appendix A.



Table B-1: Summary of Corrosion Test Results				
Sample Location	pH	Sulfate, ppm	Chloride, ppm	Minimum Resistivity, ohm-cm
B-1 @ 0-5 feet bgs	6.83	50	Non-Detected	860
B-2 @ 0-5 feet bgs	6.72	Non-Detected	25	510

Table B-1: Summary of Minus #200 Wash Test Results	
Test Location	Percent Fines
B-1 @ 0-5 feet bgs	76
B-2 @ 0-5 feet bgs	88
B-1 @ 11-11.5 feet bgs	93
B-1 @ 15-16.5 feet bgs	59
B-1 @ 20-21.5 feet bgs	63
B-1 @ 25-26.5 feet bgs	88
B-1 @ 30-31.5 feet bgs	80
B-1 @ 35-36.5 feet bgs	85
B-1 @ 40-41.5 feet bgs	73
B-1 @ 45-46.5 feet bgs	86
B-1 @ 48-49.5 feet bgs	72
B-2 @ 11-11.5 feet bgs	93
B-2 @ 15-16.5 feet bgs	87
B-2 @ 20-21.5 feet bgs	77
B-2 @ 25-26.5 feet bgs	85
B-2 @ 30-31.5 feet bgs	81
B-2 @ 35-36.5 feet bgs	60
B-2 @ 40-41.5 feet bgs	90
B-2 @ 45-46.5 feet bgs	73
B-2 @ 48-49.5 feet bgs	74



Direct Shear Test

ASTM D 3080

700 22nd St
Bakersfield, CA
Ph: (661) 327-0671
Fax: (661) 324-4218

Project Name: Camrosa Water District GAC Treatment
Project Number: G21-033-11B
Lab Tracking ID:
Sample Location: B-1 @ 6.0-6.5 feet bgs
Sample Description: CL: CLAY: dark brown, moist.

Sample Date: 2/24/2021
Test Date: 3/4/2021
Report Date: 3/8/2021
Sampled By: L. Prosser
Tested By: I. Pacheco

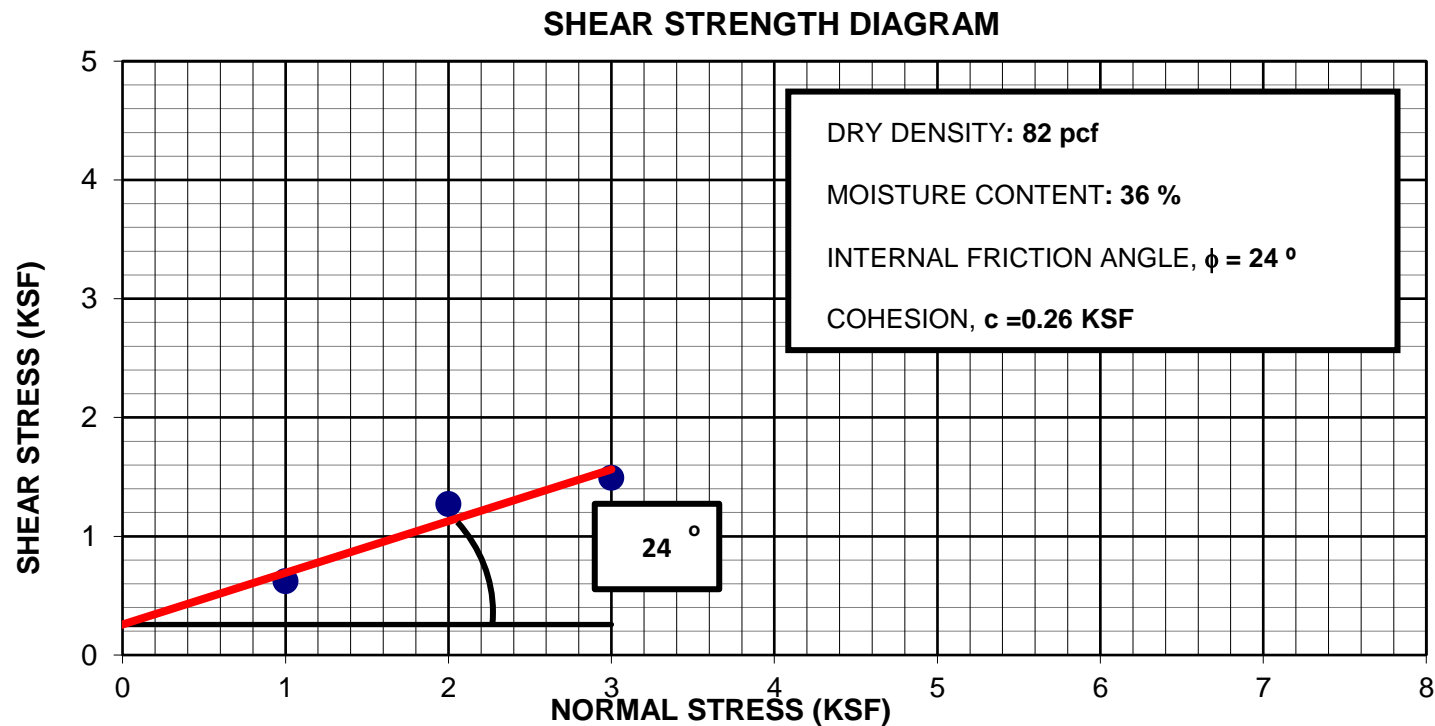


Figure B-1



Direct Shear Test

ASTM D 3080

700 22nd St
Bakersfield, CA
Ph: (661) 327-0671
Fax: (661) 324-4218

Project Name: Camrosa Water District GAC Treatment
Project Number: G21-033-11B
Lab Tracking ID:
Sample Location: B-2 @ 6.0-6.5 feet bgs
Sample Description: CL: CLAY: dark brown, moist.

Sample Date: 2/24/2021
Test Date: 3/4/2021
Report Date: 3/8/2021
Sampled By: L. Prosser
Tested By: I. Pacheco

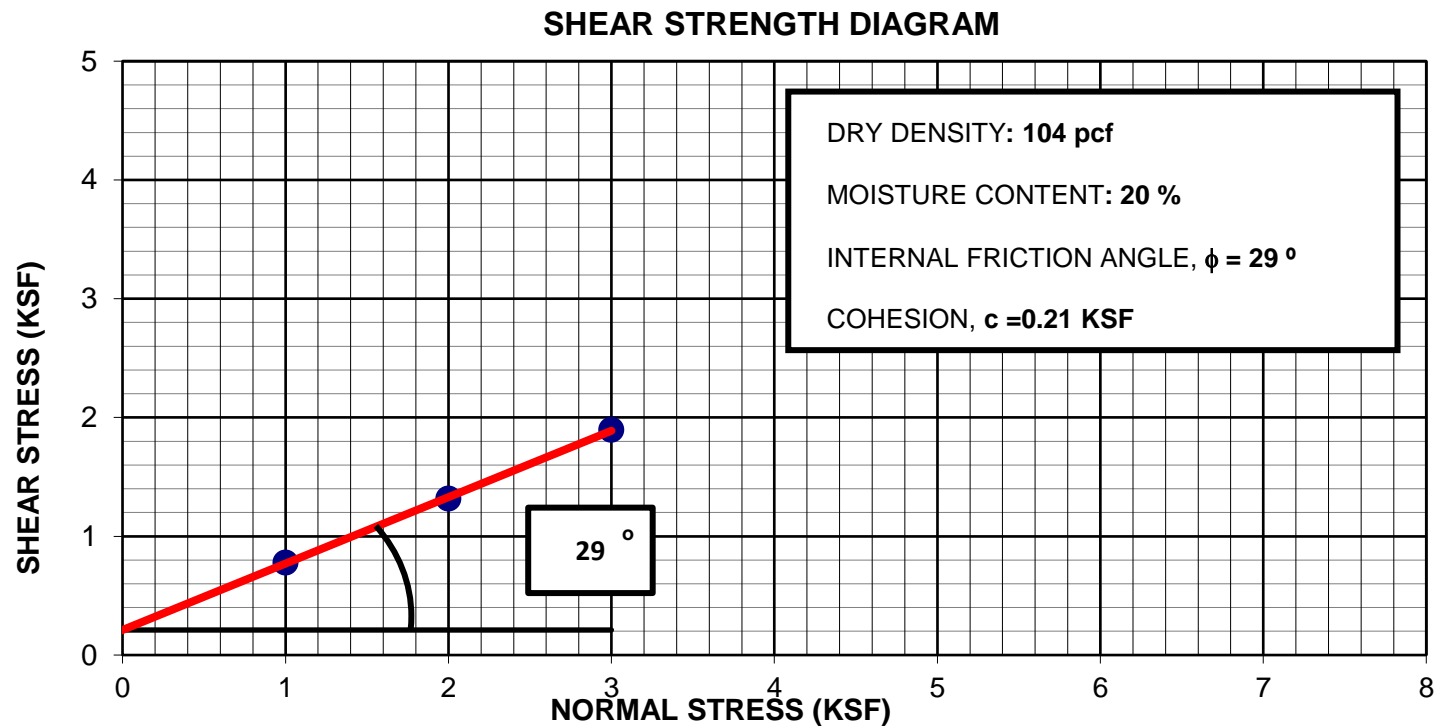


Figure B-2



Consolidation Test

ASTM D2435, One-Dimensional Analysis

700 22nd St
Bakersfield, CA
Ph: (661) 327-0671
Fax: (661) 324-4218

Project Name: Camrosa WD GAC Treatment
Project Number: G21-033-11B
Sample Location: B-1 @ 11.0-11.5 feet bgs
Sample Description: CL: CLAY: dark brown, moist.

Sample Date: 2/24/2021
Test Date: 3/10/2021
Sampled By: L. Prosser
Tested By: I. Pacheco

Collapse Potential: 0 percent collapse at 1300 psf
Peak Load (psf): 5200

Dry Density (pcf): 96
Initial Moisture Content (%): 28

CONSOLIDATION PROPERTIES

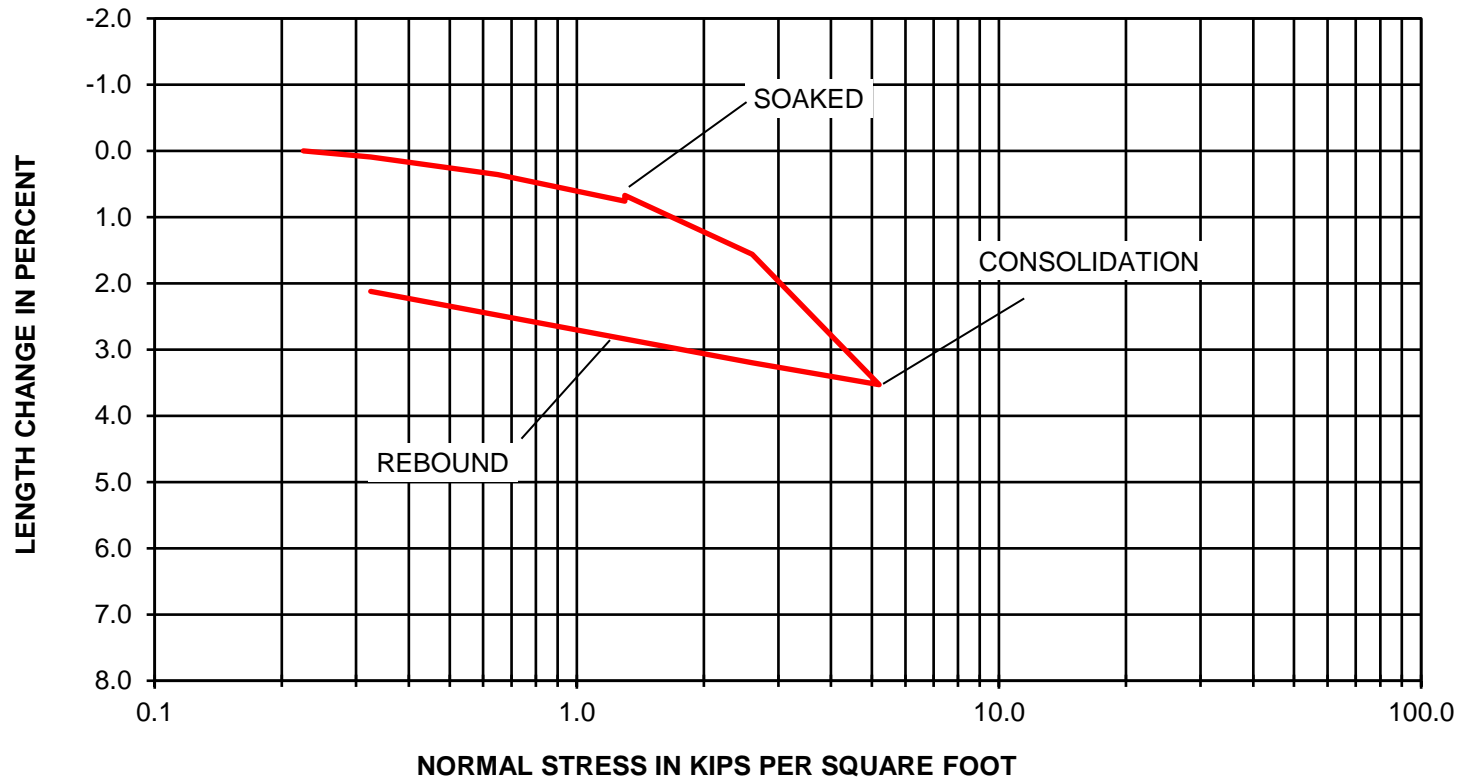


Figure B-1



Consolidation Test

ASTM D2435, One-Dimensional Analysis

700 22nd St
Bakersfield, CA
Ph: (661) 327-0671
Fax: (661) 324-4218

Project Name: Camrosa WD GAC Treatment
Project Number: G21-033-11B
Sample Location: B-2@ 6.0-6.5 feet bgs
Sample Description: CL: CLAY: dark brown, moist.

Sample Date: 2/24/2021
Test Date: 3/10/2021
Sampled By: L. Prosser
Tested By: I. Pacheco

Collapse Potential: 0 percent collapse at 1300 psf
Peak Load (psf): 5200

Dry Density (pcf): 104
Initial Moisture Content (%): 20

CONSOLIDATION PROPERTIES

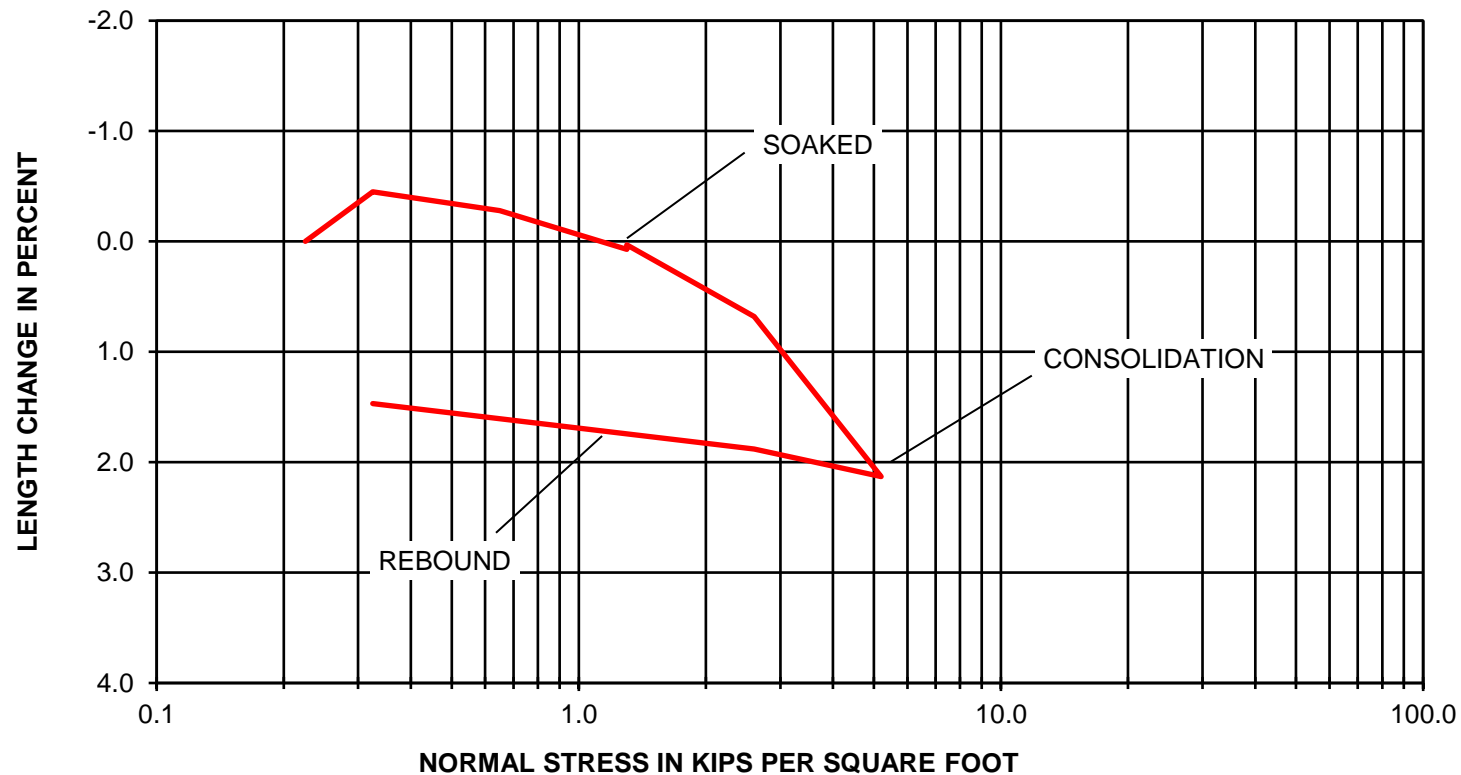


Figure B-2



EXPANSION INDEX OF SOILS

ASTM D 4829

700 22nd Street
Bakersfield, CA 93301
Ph: (661) 327-0671
Fax: (661) 324-4218

Project Name: Camrosa Water District GAC Treatment
Project Number: G21-033-11B
Sample Location: B1 @ 0-5 feet bgs
Source: Native
Lab ID No. B21-029
Sample Description: CL: CLAY: dark yellowish brown, moist.

Sample Date: 2/24/2021
Sampled By: L. Prosser
Test Date: 3/15/2021
Tested By: B. Jackson

TEST DATA

INITIAL SET-UP DATA		FINAL TAKE-DOWN DATA	
Sample + Tare Weight (g)	740.5	Sample + Tare Weight (g)	802.0
Tare Weight (g)	369.7	Tare Weight (g)	369.7
Moisture Content Data		Moisture Content Data	
Wet Weight + Tare	200.0	Wet Weight + Tare	802.0
Dry Weight + Tare	177.8	Dry Weight + Tare	699.1
Tare Weight (g)	0	Tare Weight (g)	369.7
Moisture Content (%)	12.5%	Moisture Content (%)	31.2%
Initial Volume (ft ³)	0.007272	Final Volume (ft ³)	0.008100
Remolded Wet Density (pcf)	112.4	Final Wet Density (pcf)	117.7
Remolded Dry Density (pcf)	99.9	Final Dry Density (pcf)	89.7
Degree of Saturation	49	Degree of Saturation	96

EXPANSION READINGS

Initial Gauge Reading (in)	0.2502
Final Gauge Reading (in)	0.364
Expansion (in)	0.1138

Uncorrected Expansion Index	114
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Classification of Expansive Soil

EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

Remarks: High expansion potential.

Reviewed By: I. Remontigue



EXPANSION INDEX OF SOILS

ASTM D 4829

700 22nd Street
Bakersfield, CA 93301
Ph: (661) 327-0671
Fax: (661) 324-4218

Project Name: Camrosa Water District GAC Treatment
Project Number: G21-033-11B
Sample Location: B2 @ 0-5 feet bgs
Source: Native
Lab ID No. B21-029
Sample Description: CL: CLAY: dark brown, moist.

Sample Date: 2/24/2021
Sampled By: L. Prosser
Test Date: 3/15/2021
Tested By: B. Jackson

TEST DATA

INITIAL SET-UP DATA		FINAL TAKE-DOWN DATA	
Sample + Tare Weight (g)	736.1	Sample + Tare Weight (g)	803.6
Tare Weight (g)	367.0	Tare Weight (g)	367.0
Moisture Content Data		Moisture Content Data	
Wet Weight + Tare	200.0	Wet Weight + Tare	803.6
Dry Weight + Tare	175.8	Dry Weight + Tare	691.8
Tare Weight (g)	0	Tare Weight (g)	367.0
Moisture Content (%)	13.8%	Moisture Content (%)	34.4%
Initial Volume (ft ³)	0.007272	Final Volume (ft ³)	0.008221
Remolded Wet Density (pcf)	111.9	Final Wet Density (pcf)	117.1
Remolded Dry Density (pcf)	98.4	Final Dry Density (pcf)	87.1
Degree of Saturation	52	Degree of Saturation	99

EXPANSION READINGS

Initial Gauge Reading (in)	0.2525
Final Gauge Reading (in)	0.383
Expansion (in)	0.1305

Uncorrected Expansion Index	131
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Classification of Expansive Soil

EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

Remarks: Very High expansion potential.

Reviewed By: I. Remontigue

APPENDIX C

GROUND MOTION HAZARD ANALYSIS

Appendix C

Ground Motion Hazard Analysis Camrosa WD GAC Treatment Project Ventura County, California

BSK Project G21-033-11B

April 28, 2021

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C1.0 INTRODUCTION

This report presents the geologic and seismic hazards assessment prepared in accordance with the 2019 California Building Code (CBC), CCR Title 24, Chapters 16 and 18 requirements for a Geotechnical/Engineering Geologic Report.

C1.1 Objective and Scope of Services

The purpose of the geologic and seismic hazards assessment is to provide the Client with an evaluation of potential geologic or seismic hazards which may be present at the site or due to regional influences. BSK's scope of services for this assessment included the following:

1. Review of published geologic literature, and current investigation at the site;
2. Evaluation of potential geologic hazards affecting the site;
3. Performance of a site-specific ground motion hazard analysis; and
4. A liquefaction and seismic settlement analysis.

C1.2 Site Location

The Camrosa Water District GAC Treatment Project is located on Hill Canyon Road in Ventura County, California (Site). The center of the Site coordinates are:

Latitude 34.23404°

Longitude -118.93059°

C1.3 Site Topography

The Site and surrounding area is relatively flat with a ground surface elevation of approximately 230 feet msl.

C1.4 Groundwater Conditions

The Site is within the Arroyo Santa Rosa Valley Basin Hydrologic Study Area. Arroyo Conejo Creek is located approximately 1,400 feet southwest of the Site.

Groundwater was not observed in our soil borings, completed to 49.5 feet below the ground surface (bgs) at the time of our borings were completed in February 2021. Please note that the groundwater level may fluctuate both seasonal and from year to year due to variations in rainfall, temperature, pumping from wells and possibly as the result of other factors that were not evident at the time of our investigation.

Figure C-2 presents a historical groundwater contour map from the California Geologic Survey, Seismic Hazard Zone Report (CGS, 2002) for the Newbury Park Quadrangle. This map indicates that shallow groundwater was present at approximately 25 feet below the ground surface (bgs).



C2.0 GEOLOGIC SETTING

The site is located in the Santa Rosa Valley portion of the Transverse Range geomorphic province. The Site is located in the coastal uplands which consist of northwest trending folded Miocene to Pliocene sedimentary rocks. Locally, south of the site are hills consisting of Miocene Conejo Volcanics of andesitic and basaltic flow breccias. North of the site are the Santa Rosa Hills comprised of Plio-Pleistocene Saugus Formation sandstone and conglomerate. The Site is situated in a valley consisting of recent alluvial deposits. As shown on Figure C-3, the Site is situated on young (Late Pleistocene) alluvial valley deposits.

Nearby active faults include the Simi-Santa Rosa fault located approximately 1 mile north of the Site, the Oak ridge (Onshore) fault located approximately 9 miles north of the Site and the Ventura-Pitas Point fault located approximately 13 miles northwest of the Site.

C2.1 Subsurface Soil Conditions

Subsurface conditions are described in the main body of the report. The Site was the subject of a field investigation program in February 2021 consisting of two soil borings. The subsurface units consist of mostly clay/sandy clay with sandy silt encountered at 15 feet to 20 feet bgs.

C3.0 GEOLOGIC/SEISMIC HAZARDS

The types of geologic and seismic hazards assessed include surface ground fault rupture, liquefaction, seismically induced settlement, slope failure, flood hazards and inundation hazards.

C3.1 Fault Rupture Hazard Zones in California

The purpose of the Alquist-Priolo Geologic Hazards Zones Act, as summarized in CDMG Special Publication 42 (SP 42), is to "prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture." As indicated by SP 42, "the State Geologist is required to delineate "Earthquake Fault Zones" (EFZs) along known active faults in California. Cities and counties affected by the zones must regulate certain development 'projects' within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting.

The Site is not located in an Earthquake Fault Zone, as shown on Figure C-4 the closest Earthquake Fault Zone is associated with the Simi-Santa Rosa fault zone located approximately 500 feet north of the Site.

C3.2 State of California Seismic Hazard Zones (Liquefaction and Landslides)

Zones of Required Investigation referred to as "Seismic Hazard Zones" in CCR Article 10, Section 3722, are areas shown on Seismic Hazard Zone Maps where site investigations are required to determine the need for mitigation of potential liquefaction and/or earthquake-induced landslide ground displacements. As shown on figure C-4, the Site is located in a Liquefaction Hazard Zone.



C3.3 Slope Stability and Potential for Slope Failure

The Site and surrounding area is essentially flat and the potential hazard due to landslides in the project area is minimal. Review of CGS Geologic Hazard Webmaps (CGS, 2020) did not show landslide hazard areas mapped near the Site.

C4.0 SEISMIC HAZARD ASSESSMENT

C4.1 Seismic Source Deaggregation

Seismically induced ground motion at a Site can be caused by earthquakes on any of the sources surrounding the site. Deaggregation of the seismic hazard was performed by using the USGS Interactive Deaggregation website. The deaggregation determination, at the maximum considered earthquake (MCE) hazard level, results in distance, magnitude and epsilon (ground-motion uncertainty) for each source that contributes to the hazard. Each source has a corresponding epsilon, which is the probabilistic value relative to the mean value of ground motion for that source.

Deaggregation based on a probabilistic model developed by the USGS indicates that the extreme seismic source with the highest magnitude that contributes to the peak ground acceleration (PGA) is a magnitude 7.56 earthquake from the Oak ridge fault. For liquefaction and seismic settlement, the modal magnitude (M_w) of 7.52 with a distance of 12.1 km would be appropriate for probabilistic input parameter that is consistent with the design earthquake ground motion.

C4.2 Earthquake Ground Motion, 2019 California Building Code

C4.2.1 Site Class

Based on Section 1613A.2.2 of the 2019 California Building Code (CBC), the Site shall be classified as Site Class A, B, C, D, E or F based on the Site soil properties and in accordance with Chapter 20 of ASCE 7-16. Based on the “N” values from our soil borings, as per Table 20.3-1 of ASCE 7-16, the Site is Class D ($15 \leq N \leq 50$).

C4.2.2 Seismic Design Criteria

The 2019 California Building Code (CBC) utilizes ground motion based on the Risk-Targeted Maximum Considered Earthquake (MCE_R) that is define in the 2019 CBC as the most severe earthquake effects considered by this code, determined for the orientation that results in the largest maximum response to horizontal ground motions and with adjustment for targeted risk. Ground motion parameters in the 2019 CBC are based on ASCE 7-16, Chapter 11.

The United States Geologic Survey (USGS) has prepared maps presenting the Risk-Targeted MCE spectral acceleration (5% damping) for periods of 0.2 seconds (S_S) and 1.0 seconds (S_1). The values of S_S and S_1 can be obtained from the OSHPD Seismic Design Maps Application available at:

<https://seismicmaps.org/>



Table C-1 below presents the spectral acceleration parameters produced for Site Class D by the OSHPD Ground Motion Parameter Application and Chapter 16 of the 2019 CBC based on ASCE 7-16. These values are based on the location of the pump station.

TABLE C-1 SPECTRAL ACCELERATION PARAMETERS RISK TARGETED MAXIMUM CONSIDERED EARTHQUAKE			
Criteria	Value		Reference
MCE Mapped Spectral Acceleration (g)	$S_s = 1.665$	$S_1 = 0.613$	USGS Mapped Value
Site Coefficients (Site Class D)	$F_a = 1.000$	$F_v = \text{Null}^1 (1.700)^1$	ASCE Table 11.4
Site Adjusted MCE Spectral Acceleration (g)	$S_{MS} = 1.665$	$S_{M1} = \text{Null}^1 (1.042)^1$	ASCE Equations 11.4.1-2
Design Spectral Acceleration (g)	$S_{DS} = 1.110$	$S_{D1} = \text{Null}^1 (0.695)^1$	ASCE Equations 11.4.3-4
Site Short Period - T_s (Seconds)	$T_s = 0.626$		$T_s = S_{D1} / S_{DS}$
Site Long-Period - T_L (Seconds)	$T_L = 8$		USGS Mapped Value

ASCE 7-16 Section 11.4.8 requires a site-specific ground motion analysis with Site Class D and E sites with S_1 greater than or equal to 0.2. The Site-Specific Ground Motion Analysis for the Site is included in Section C4.3.

C4.2.3 Geometric Mean Peak Ground Acceleration

As per Section 1803A.5.12 of the CBC, peak ground acceleration (PGA) utilized for dynamic lateral earth pressures and liquefaction, shall be based on a site specific study (ASCE 7-16, Section 21.5) or ASCE 7-16, Section 11.8.3. The USGS Ground Motion Parameter Application based on ASCE 7-16, Section 11.8.3 produced the values shown in Table C-2 based on Site Class D.

TABLE C-2 GEOMETRIC MEAN PEAK GROUND ACCELERATION MAXIMUM CONSIDERED EARTHQUAKE		
Criteria	Value	Reference
Mapped Peak Ground Acceleration (g)	$PGA = 0.723$	USGS Mapped Value
Site Coefficients (Site Class D)	$F_{PGA} = 1.100$	ASCE Table 11.8-1
Geometric Mean PGA (g)	$PGA_M = 0.795$	ASCE Equations 11.8-1

C4.3 Site-Specific Ground Motion Analysis

Section 11.4.8 of the ASCE 7-16 requires a ground motion hazard analysis for Site Class D sites with S_1 greater than or equal to 0.2 unless an exception is used. The ground motion hazard analysis shall be performed in accordance with ASCE 7 Chapter 21. It is our understanding that the Section 11.4.8

¹ Values from ASCE 7-16 supplement, shall only be used to calculate T_s



exception will not be used, therefore a site-specific ground motion analysis was performed. Our ground motion analysis includes:

1. Determination of risk-targeted maximum considered earthquake (MCE_R) ground motion, deterministic MCE ground motion, and probabilistic MCE_R ground motion; and
2. Determination of site-specific maximum considered earthquake geometric mean (MCE_G) peak ground acceleration.
3. The analysis was performed according to the requirements of ASCE 7-16, Sections 21.2 through 21.5.

C4.3.1 Methods

The site-specific ground motion analysis was completed using the following:

- USGS Unified Tool (UHT), Probabilistic, <https://earthquake.usgs.gov/hazards/interactive/>
- USGS Risk Targeted Ground Motion Calculator, Probabilistic, <https://earthquake.usgs.gov/designmaps/rtgm/>
- USGS Earthquake Scenario Map (BSSC 2014), Deterministic, <https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=14d2f75c7c4f4619936dac0d14e1e468>
- 2014 NGA West-2 GMPEs Spreadsheet, Deterministic, Pacific Earthquake Engineering Research Center, Dated 4/14/2015.

The method utilized ASCE 7-16, Section 21.2 to 21.5, with Section 21.2.1.2 Method 2 used to determine the probabilistic values.

C4.3.3 Deterministic MCE Ground Motion

The deterministic spectral response acceleration at each period was calculated as the 84th-percentile 5% damped spectral response acceleration using the maximum direction of horizontal response. The analysis included using the USGS Unified Tool, deaggregation tool to determine faults in the area contribute to the seismic hazard. Figure C-4 presents faults that are included in the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) fault database. Fault locations and dimensions were queried from the UCERF3 fault database. The maximum or characteristic magnitude for each fault was determined from the USGS Earthquake Scenario Map (BSSC 2014) that includes event scenarios for ruptures of single and multiple segments of a fault.

The deterministic fault parameters were used in the 2014 NGA West-2 GMPEs Spreadsheet that produced a weighted average using four Ground Motion Prediction Equations (GMPE). The GMPEs account for these effects and are used to make estimates of ground motion at a site resulting from a scenario earthquake. Many GMPEs have been developed to estimate the variation of spectral acceleration with earthquake magnitude and distance from the site to the source of an earthquake.



2014 Next Generation West2 Attenuation (2014NGAs) GMPEs were developed by the Pacific Earthquake Engineering Research (PEER) Center that presented GMPEs for shallow crustal earthquakes in Western North America.

The 84th percentile of geometric mean ground motion values were computed using four different Next Generation Attenuation relationships (2014NGAs). The geometric mean values were adjusted to maximum rotated component values using factors presented in ASCE 7-16, Section 21.2. The acceleration values from each of four attenuation relationships were averaged using equal weight. The following attenuation relationships were used in the analysis:

- Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
- Campbell & Bozorgnia 2014 NGA West-2 Model
- Chiou & Youngs 2014 NGA West-2 Model
- Abrahamson & Silva & Kamai 2014 NGA West-2 Model

Soil amplification was accounted for in the analysis using the shear wave velocity (V_s) of 224 m/s (736 ft/s), estimated from the N values from the soil borings B-1 and B-2 using correlation equations for clay, sand and gravel (Wair, 2012). Tables C-3 and C-4, below presents the method used to determine the site average V_s based on the correlation equations.



Table C-3
Estimation of Shear Wave Velocity

Depth (feet)	Thickness (feet)	Field N	N(60)	Vs (m/s)	Vs (ft/s)	Vs (m/s)	Vs (ft/s)	Vs (m/s)	Vs (ft/s)	Vs (ft/s)	Thickness/Vs (s)	Equation
Boring B-1				Equation 4.90		Equation 4.48		Equation 4.26		Combined		Used
2	2	12	16					201	659	659	0.003033	4.29
5	3	10	13					189	619	619	0.004850	4.29
10	5	20	25					227	746	746	0.006703	4.29
15	5	16	21					216	707	707	0.007071	4.29
20	5	16	21					216	707	707	0.007071	4.29
25	5	18	23					223	730	730	0.006850	4.29
30	5	30	39					255	838	838	0.005967	4.29
35	5	22	29					235	771	771	0.006489	4.29
40	5	32	42					260	853	853	0.005864	4.29
45	5	31	40					258	845	845	0.005915	4.29
49	4	31	40					258	845	845	0.004732	4.29
										Weighted Average Vs (ft/s)	759	
										Weighted Average Vs (m/s)	231	



Table C-4 Estimation of Shear Wave Velocity												
Depth (feet)	Thickness (feet)	Field N	N(60)	Vs (m/s)	Vs (ft/s)	Vs (m/s)	Vs (ft/s)	Vs (m/s)	Vs (ft/s)	Vs (ft/s)	Thickness/Vs (s)	Equation
Boring B-2				Equation 4.90		Equation 4.48		Equation 4.26		Combined		Used
2	2	12	16					201	659	659	0.003033	4.29
5	3	10	13					189	619	619	0.004850	4.29
10	5	18	24					223	732	732	0.006829	4.29
15	5	14	18					208	682	682	0.007331	4.29
20	5	13	17					204	669	669	0.007479	4.29
25	5	21	27					232	761	761	0.006571	4.29
30	5	12	16					199	654	654	0.007642	4.29
35	5	28	36					251	822	822	0.006080	4.29
40	5	24	31					241	789	789	0.006338	4.29
45	5	16	21					216	707	707	0.007071	4.29
49	4	17	22					219	719	719	0.005565	4.29
										Weighted Average Vs (ft/s)	712	
										Weighted Average Vs (m/s)	217	

Notes Equations to Convert from N to Vs are from: Wair, B.R., DeJong J.T. and Shantz, T.,
: Guidelines for Estimation of Shear Wave Velocity Profiles, PEE Report 2012/08, December 2012
Equation 4.48 for Sand: $Vs(m/s) = 88.4 * (N60 + 1)^{0.3}$
Equation 4.90 for Gravels: $Vs(m/s) = 63.0 * N60^{0.43}$
Equation 4.29 for Clay: $Vs(m/s) = 95.0 * (N60)^{0.27}$



In addition, some of the GMPEs require input for Z1.0 (defined as the depth in meters to a layer with $V_s = 1,000$ m/s) and Z2.5 (depth in km to a layer with $V_s = 2,500$ m/s). These two parameters intend to capture the basin effect on site response. The Site is located in a sedimentary basin, therefore a Z2.5 value of 0.8 km and a Z1.0 value of 0.35 km was used. These values were obtained from the SCEC Community Velocity Model Version 4 using the OpenSHA application (Field, 2003).

The following Table C-5 presents a summary of the fault parameters used in the deterministic analysis. Figure C-5 presents a fault map showing the locations of faults in the area. As specified in ASCE 7-16, Section 21.2.2, the deterministic spectral acceleration values representing the MCE_R are taken as the 84th percentile of the maximum rotated component 5% damped spectral accelerations. The deterministic response spectra for the faults in the area are shown on Figure C-6. The Simi-Santa Rosa fault controls the deterministic spectra. The 2014 NGA West-2 GMPEs Spreadsheets for the Simi-Santa Rosa fault is provided as Figure C-6a.



Table C-5
Summary of Fault Parameters

Source	Probabilistic R (km)	Probabilistic Mw	Dip Angle (Deg.)	Dip Direction	Slip Sense	Characteristic Mw BSSC 2014	Map Distance (km)	Rrup (km)	Rjb (km)	Rx (km)	Ztor - Top (km)	Bottom (km)
Simi-Santa Rosa	3.1	7.19	60	N	LL	6.86	2	2	2	2	1	12.1
Oak Ridge (Onshore)	14.2	7.58	65	S	Reverse	7.16	15	20	6	15	1	19
Malibu Coast (Extension)	19.8	7.70	74	N	Reverse	6.97	21	20	16	21	0	17
Ventura-Pitas Point	21.2	7.69	64	N	Reverse	7.12	21	21	21	21	1	15
San Cayetano	21.4	7.62	42	N	Thrust	7.16	20	20	20	20	0	16
San Andreas (Mojave N)	61.5	8.09	90	Vert	RL	8.18	62	62	62	62	0.0	13
Notes: Rrup= Closest distance to coseismic rupture (km) Rjb= Closest distance to surface projection of coseismic rupture (km) Rx= Horizontal distance from top of rupture measured perpendicular to fault strike (km) Ztor = Depth to top of coseismic rupture (km)						Probabilistic Mw: https://earthquake.usgs.gov/hazards/interactive/ Characteristic Mw: https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=14d2f75c7c4f4619936dac0d14e1e468						



C4.3.2 Deterministic Lower Limit

ASCE 7-16, Section 21.2.2 specifies that if the largest spectral response acceleration of the resulting deterministic ground motion response spectrum is less than $1.5 \times F_a$, then this response spectrum shall be scaled by a single factor such that the maximum response spectral acceleration equals $1.5 F_a$. The values of the deterministic ground motion response spectrum were greater than $1.5 F_a$ (1.5), therefore scaling was not necessary. The deterministic response spectra are presented on Figure C-6.

C4.3.3 Probabilistic MCE_R Risk Targeted Ground Motion

A probabilistic MCE_R response spectrum was generated by using data from USGS Hazard Curve Data from the USGS Unified Hazard tool entered into the USGS Risk Targeted Ground Motion Calculator. This procedure uses “Method 2” of ASCE 7-16 Section 21.2.1.2.

A probabilistic MCER response spectrum was generated by using data from USGS Hazard Curve Data from the USGS Unified Hazard tool entered into the USGS Risk Targeted Ground Motion Calculator (Luco, 2007). Data was extracted from USGS website (<https://earthquake.usgs.gov/nshmp-hazws/hazard>) using the computer program MATLAB® with a modified script (Luco, 2020). This procedure uses “Method 2” of ASCE 7-16 Section 21.2.1.2.

Figure C-7 shows the Risk Targeted Ground Motion (RTGM) and Uniform Hazard Ground Motion (UHGM) generated from the USGS RTGM Calculator. The resulting RTGM corresponds to a 1% probability of collapse in 50 years. The RTGM values represent the geometric mean values and were modified to the maximum rotated values (Rot100) using factors according to ASCE 7-16, Section 21.2.

C4.3.4 Design Response Spectrum

As shown on Figure C-8, the MCE_R deterministic spectrum is less than the probabilistic spectrum from the PGA to 0.4 seconds. According to ASCE 7-10 21.2.3 the lesser spectral values were used to construct the design spectrum. The site-specific design response spectrum is taken as 2/3 of the MCE_R spectral values.

As shown on Figure C-9, the site-specific design spectrum was adjusted such that values are greater than 80% of the general design spectrum and should be utilized for design (5% Damping).

C4.3.5 Site-Specific MCE_G Geometric Mean (MCE_G) Peak Ground Acceleration

Per ASCE 7-16, Section 21.5, the site-specific MCE_G peak ground acceleration (PGA_M) was taken as the lesser of the probabilistic geometric mean PGA and the deterministic geometric mean PGA.

The geometric mean values can be determined by dividing the MCER deterministic and probabilistic PGA values by 1.1 (recommended by NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, FEMA P-750 / 2009).



C4.3.6 Probabilistic MCE_G Peak Ground Acceleration

The probabilistic geometric mean peak ground acceleration is 0.771g and was taken from the UHGM PGA, shown on Figure C-7, value from the USGS RTGM Calculator. The PGA value is taken without the risk and maximum rotated scale factors applied.

C4.3.7 Deterministic MCE_G Peak Ground Acceleration

The deterministic geometric mean peak ground acceleration is 0.725g, a result of dividing 0.798 (PGA from Figure C-5) by 1.1. This value is greater than $0.5 \cdot F_{PGA}$ (0.550), where $F_{PGA}=1.1$ for a $PGA=0.50g$ as stipulated in ASCE 7-16 Section 21.5.2., therefore 0.725g should be used for the deterministic PGA. The controlling seismic source for the PGA is the Simi-Santa Rosa fault ($M_w=6.86$).

C4.3.8 Site-Specific MCE_G Peak Ground Acceleration

The lesser value of the geometric mean probabilistic and deterministic peak ground accelerations is the deterministic value, which is 0.725g. This value is greater than 80 percent of the PGA_M determined from ASCE 7-16 Section 11.8-1 (see Table C-2), therefore 0.725g should be used as the Site PGA value.

C4.4 Summary of Seismic Design Parameters

A summary of seismic design parameters based on the USGS general mapped values and the results of the site-specific analysis from Section 21.4 is presented in the following Table C-5. Site-specific values for S_{DS} and S_{D1} were developed by adjusting the site-specific values according to the requirements set in ASCE 7-16, Section 21.4.

TABLE C-5 SUMMARY OF DESIGN ACCELERATION PARAMETERS ASCE 7-16 SECTION 21.4		
Criteria	Value	Reference
USGS MAP BASED VALUES (GENERAL)		
Design Spectral Acceleration (g) S_{DS}	1.110	ASCE Equations 11.4.3-4
Design Spectral Acceleration (g) S_{D1}	1.022 ²	ASCE Equations 11.4.3-4
Geometric Mean PGA (g)	0.795	ASCE Equations 11.8-1
SITE-SPECIFIC DESIGN SPECTRAL ACCELERATION VALUES (SEE FIGURE C-9)		
0.2 Second Site-specific Design Spectral Acceleration (g)		1.009
0.2 Second Site-specific Spectral Acceleration (g) Adjustment 1		1.009
0.2 Second Site-specific Spectral Acceleration (g) Adjustment 2 (S_{DS})		1.238
1.0 Second Site-specific Design Spectral Acceleration (g)		1.017
1.0 Second Site-specific Spectral Acceleration (g) Adjustment 1		1.017
1.0 Second Site-specific Spectral Acceleration (g) Adjustment 3 (S_{D1})		1.183
Site-specific PGA (g) (Maximum Rotated Component)		0.798
Site-specific PGA (g) (Geometric Mean) Adjustment 4		0.725
Site-specific PGA (g) (Geometric Mean) Adjustment 1 (PGA)		0.725

² Based on $F_v=2.5$ as per ASCE 7-16, 21.3(ii)

TABLE C-5 SUMMARY OF DESIGN ACCELERATION PARAMETERS ASCE 7-16 SECTION 21.4
Adjustments Per ASCE 21.4
1) Site-specific value greater than 80% of General Value from USGS Maps and the PGA greater than $0.5F_{PGA}$
2) 0.2 Second S_a greater than 90% of S_a values at periods greater than 0.2 second
3) 1.0 Second S_a greater than $T_x S_a$ value at periods of 1 to 5 seconds
4) Geometric Mean PGA = Maximum Rotated Component/1.1

C4.5 Seismically Induced Ground Failure

C4.5.1 Liquefaction

Settlement of the ground surface with consequential differential movement of structures is a major cause of seismic damage for buildings founded on alluvial deposits. Vibration settlement of relatively dry and loose granular deposits beneath structures can be readily induced by the horizontal components of ground shaking associated with even moderate intensity earthquakes. Silver and Seed (1971) have demonstrated that settlement of dry sands due to cyclic loading is a function of 1) the relative density of the soil; 2) the magnitude of the cyclic shear stress; and 3) the number of strain cycles. As indicated above, seismically-induced ground settlement can also occur due to the liquefaction of relatively loose, saturated granular deposits.

In order for liquefaction triggering to occur due to ground shaking, it is generally accepted that four conditions will exist:

- The subsurface soils are in a relatively loose state,
- The soils are saturated,
- The soils have low plasticity,
- Ground shaking is of sufficient intensity to act as a triggering mechanism.

We estimate the historical depth to groundwater of 25 feet bgs. A liquefaction/seismic settlement analysis was performed using the program Liquefy Pro version 5.8k using boring data from borings B-1 and B-2 Input parameters for the liquefaction and settlement analysis were based upon:

- Soil densities estimated from soil boring data.
- PGA based upon the site specific geometric mean peak ground acceleration or 0.725g.
- Magnitude 6.86 of controlling earthquake from the Simi-Santa Rosa fault.
- Assumed depth to groundwater of 25 feet bgs.
- A Factor-of-Safety of 1.3 was used for analysis.

The results of our liquefaction and seismic settlement analysis based upon data from soil borings B-1 and B-2 are provided on Figure C-10 and C-11, respectively. Based on our analysis, the liquefaction potential is low.



C4.5.2 Lateral Spread

Lateral spreading is a potential hazard commonly associated with liquefaction where extensional ground cracking and settlement occur as a response to lateral migration of subsurface liquefiable material. These phenomena typically occur adjacent to free faces such as slopes and creek channels. Sloped ground or channel free-faces are not present in the area and the liquefaction potential is low, therefore the potential for lateral spreading to take place at the site is low.

C4.5.3 Dynamic Compaction/Seismic Settlement

Another type of seismically induced ground failure, which can occur as a result of seismic shaking, is dynamic compaction, or seismic settlement. Such phenomena typically occur in unsaturated, loose granular material or uncompacted fill soils.

Input parameters for the liquefaction and settlement analysis were based upon:

- Soil densities estimated from soil boring data.
- PGA based upon the site specific geometric mean peak ground acceleration or 0.725g.
- Magnitude 6.86 of controlling earthquake from Deaggregation of the seismic hazard.
- Assumed depth to groundwater of 25 feet bgs.
- A Factor-of-Safety of 1.3 was used for analysis.

Based on the analysis, the total seismic settlement is estimated at 0.5 inch with a differential settlement of 0.3 inch over 30 feet.



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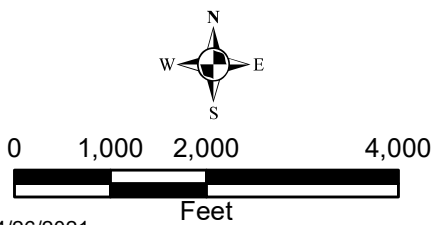
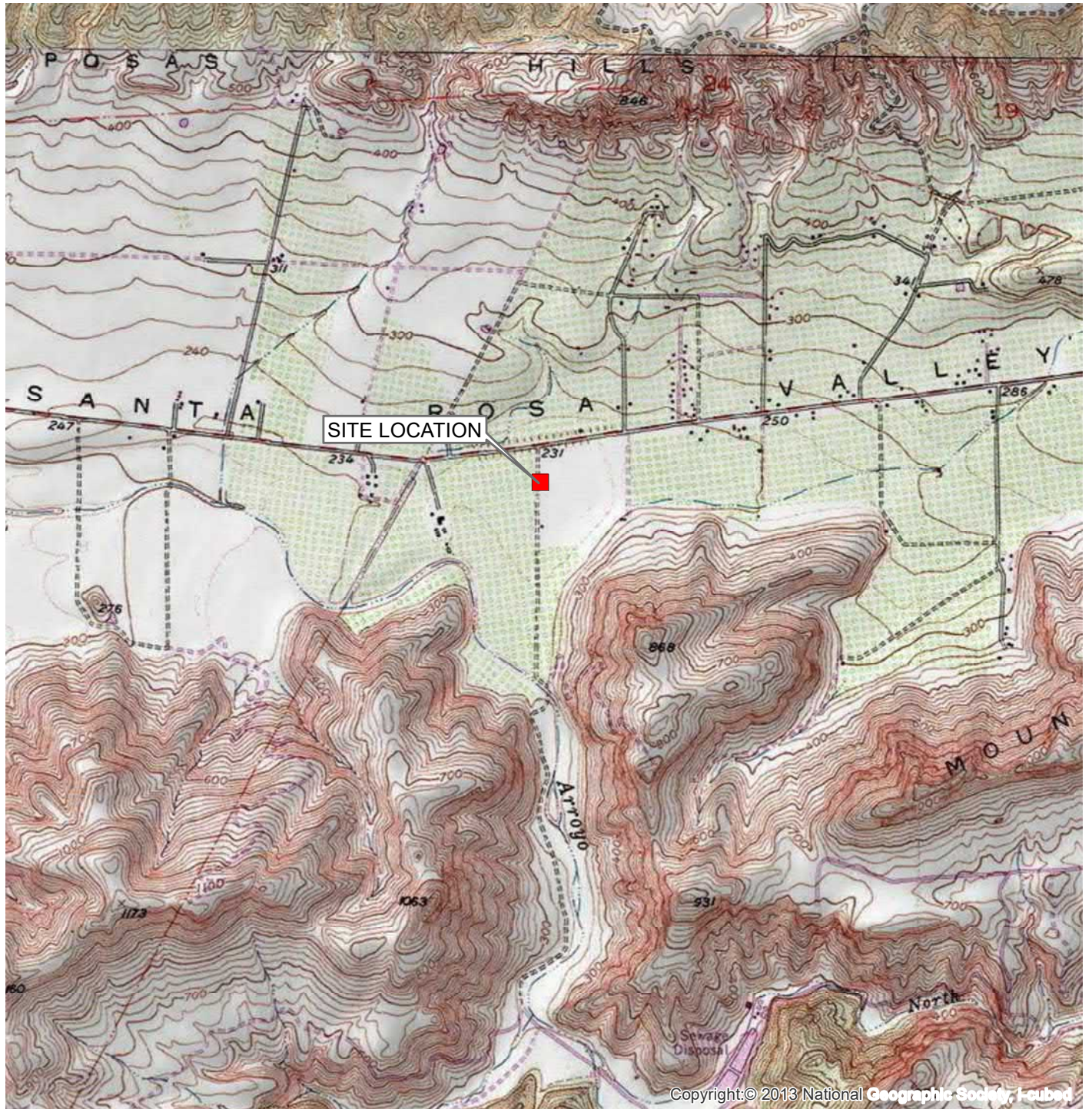
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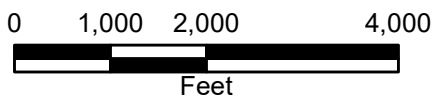
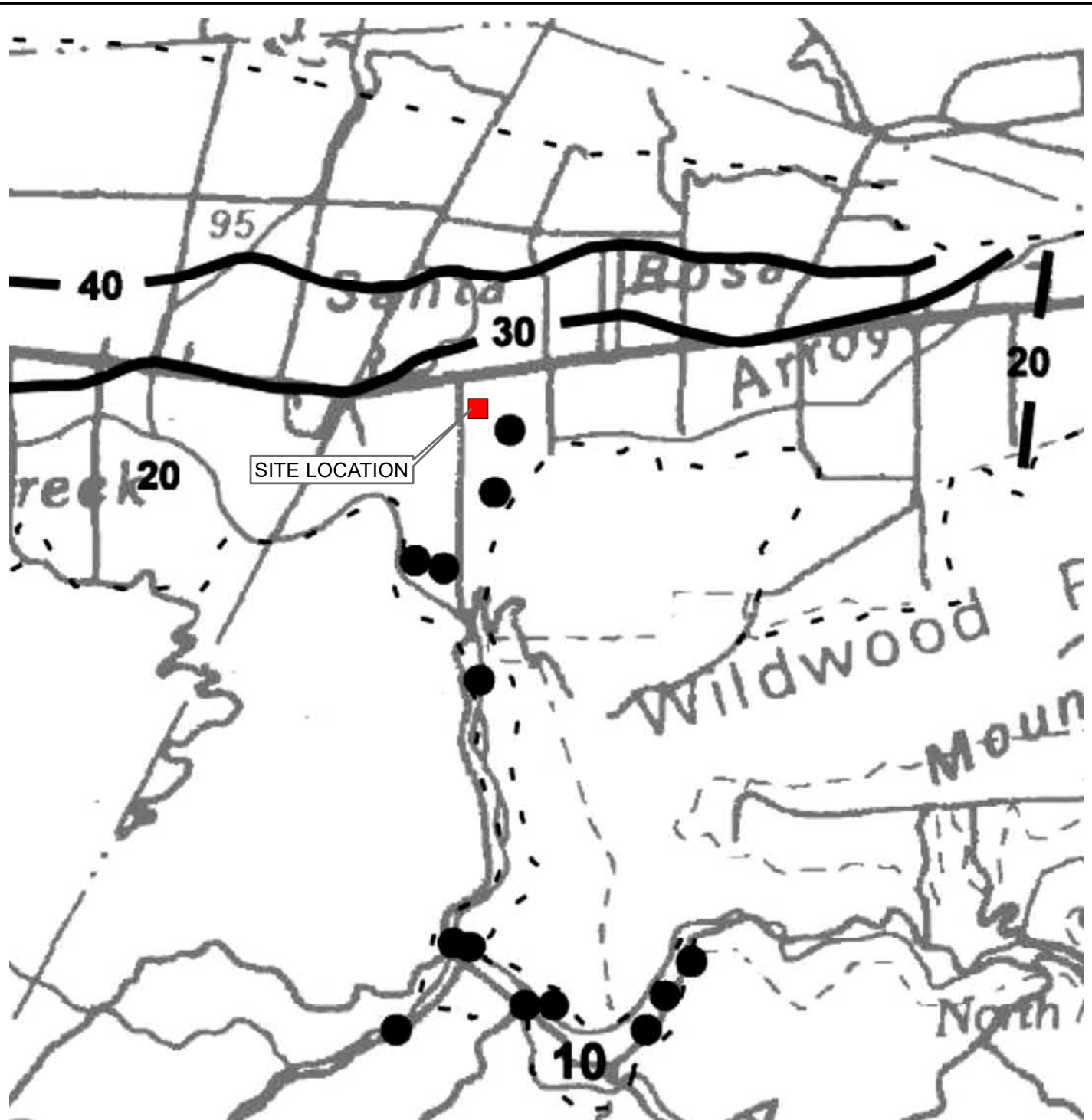


Map Date: 4/26/2021



Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California

Figure C-1
Topographic Map
BSK Project G2103311B



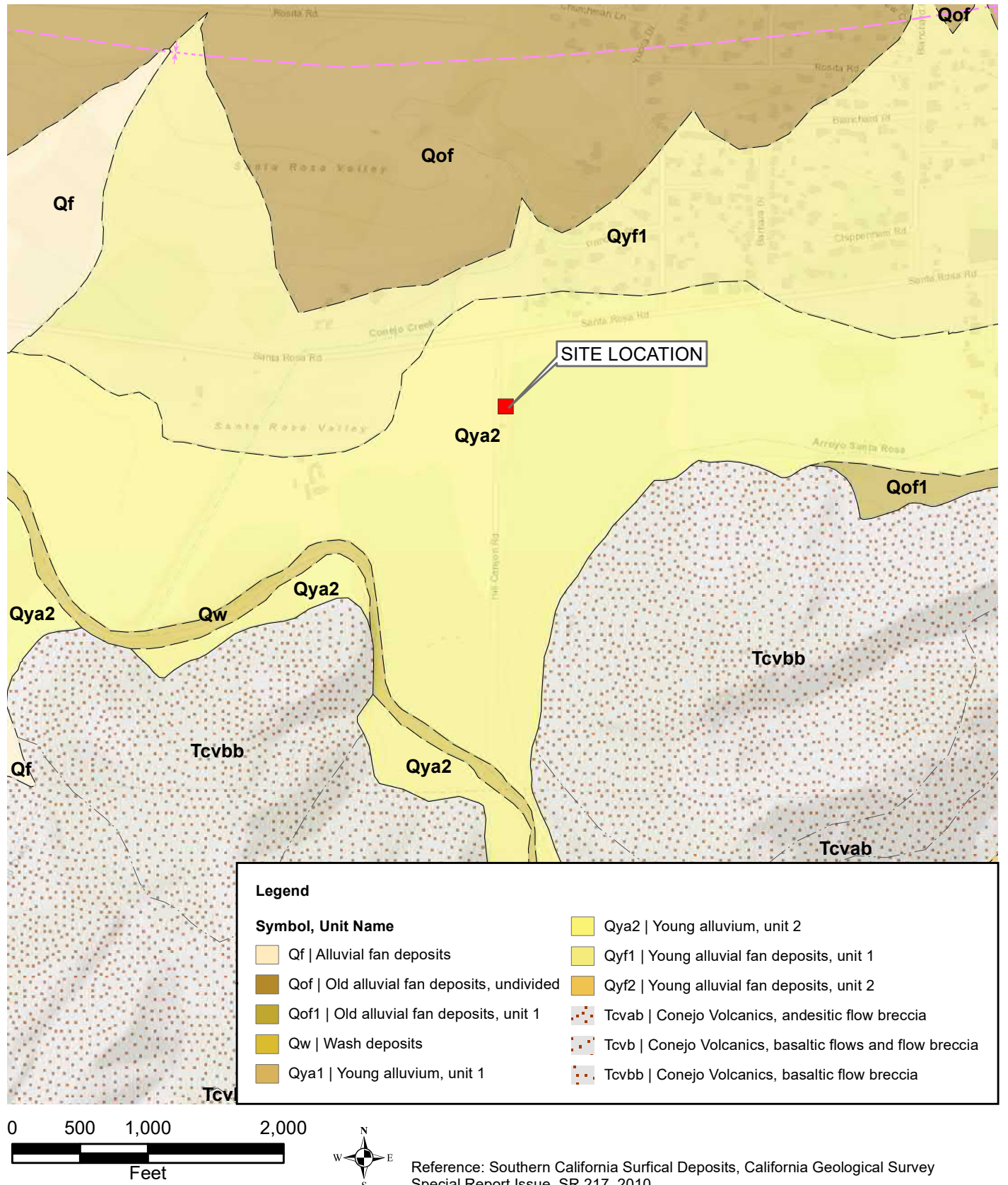
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Map Date: 4/26/2021



Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California

Figure C-2
Historic High Depth to
Groundwater
BSK Project G2003311B

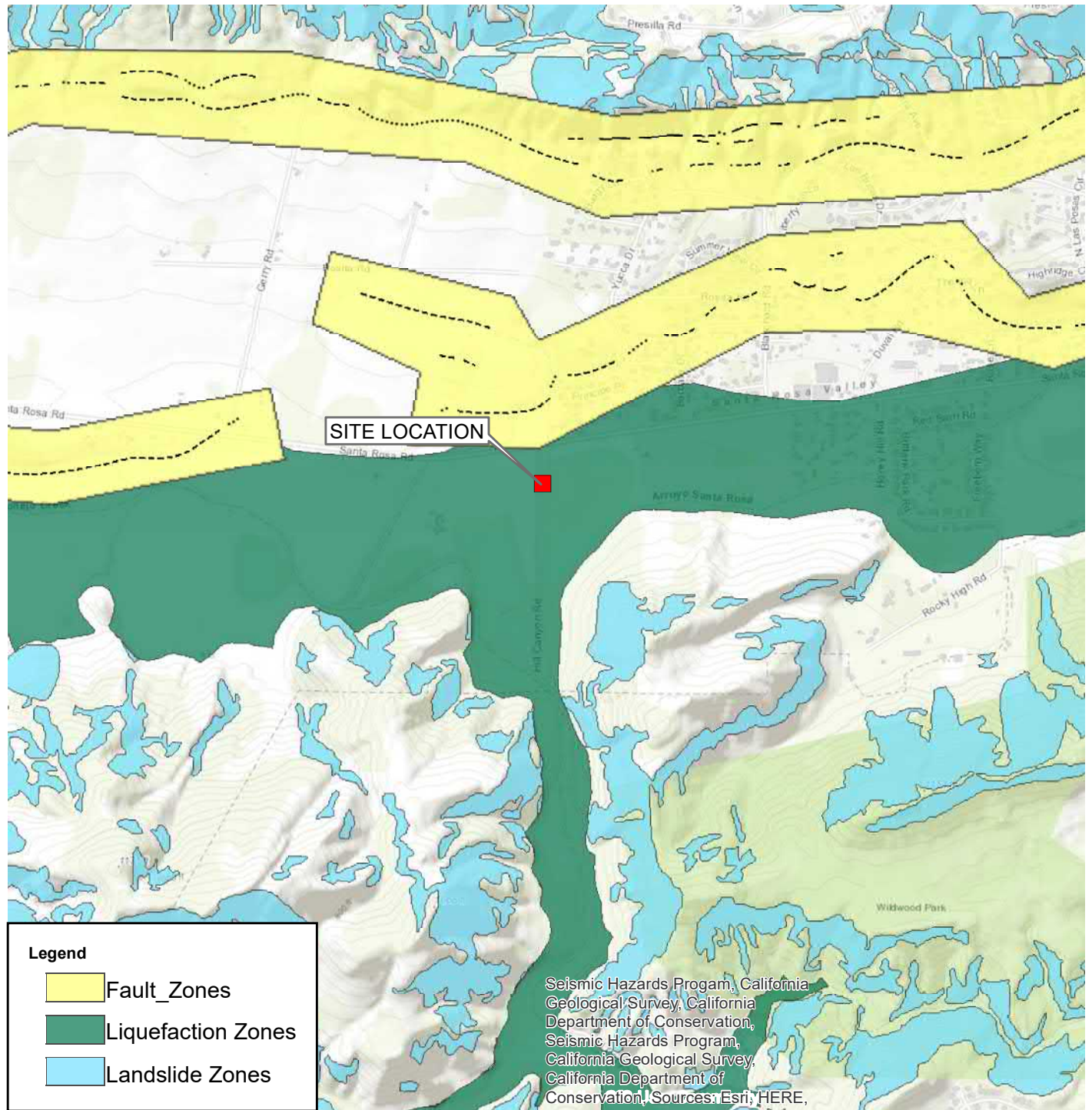


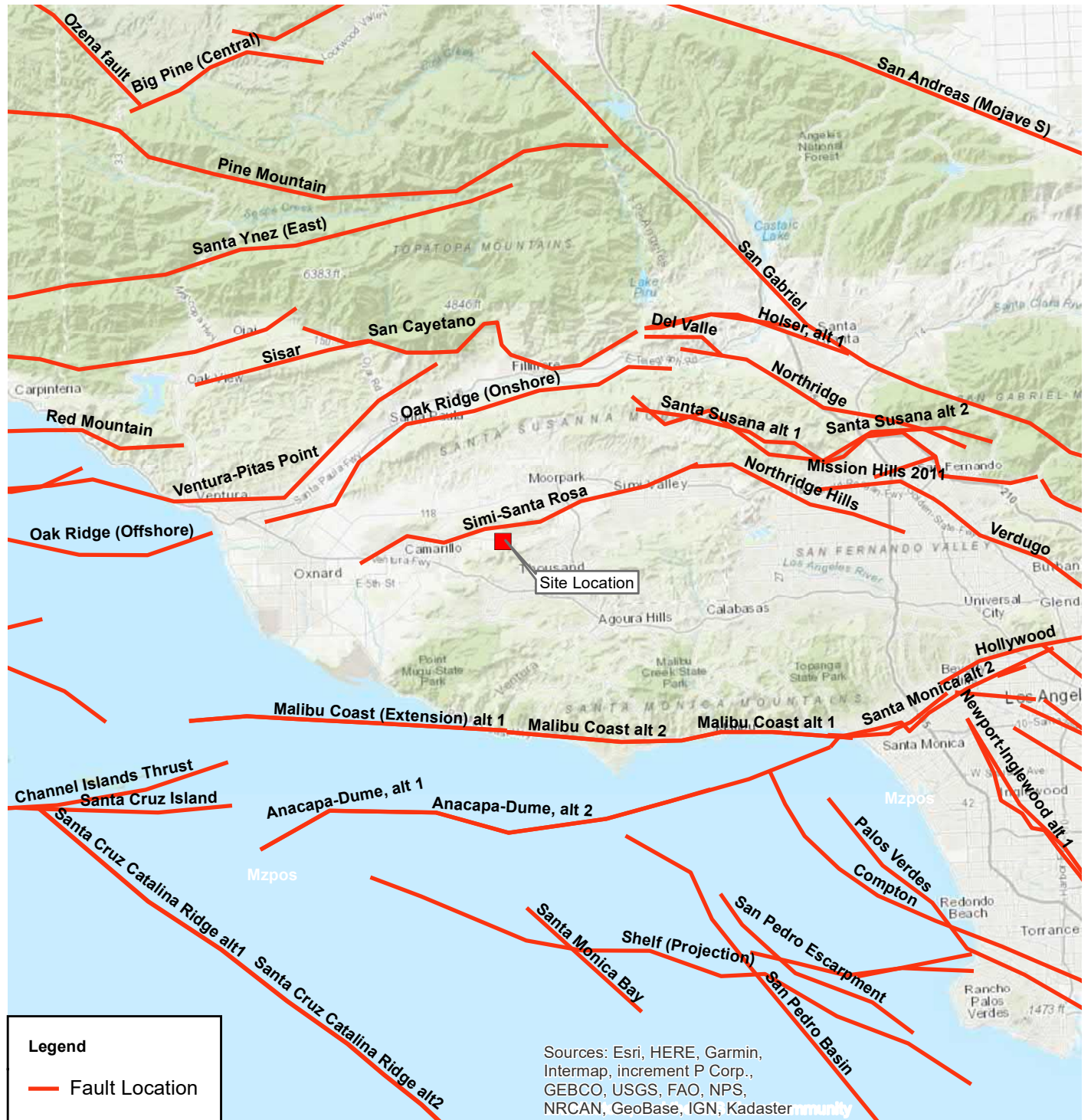
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Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California

Figure C-3
Geologic Map
BSK Project G203311B





Reference: CGS Map Sheet 48: Fault-based seismic sources used in the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3)
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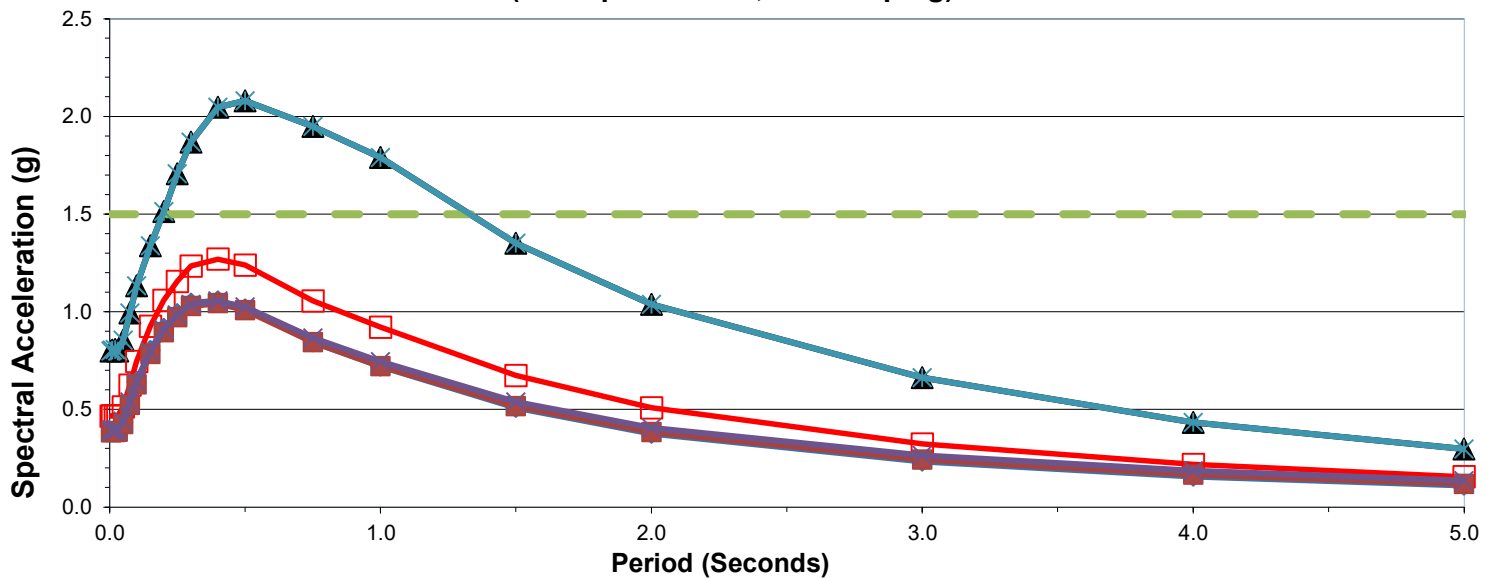
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Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California

Figure C-5
UCERF3 Seismic Sources
BSK Project G2103311B

**Deterministic Response Spectra
Maximum Rotated Horizontal Component
84th Percentile
(Site Specific Soil, 5% damping)**



Simi-Santa Rosa Oak Ridge (Onshore) Malibu Coast (Extension) Ventura-Pitas Point
 San Cayetano 1.5*Fa Maximum Value

		Fault Sources					
Period (Second)	Maximum Value Sa (g)	Simi-Santa Rosa Sa (g)	Oak Ridge (Onshore) Sa (g)	Malibu Coast (Extension) Sa (g)	Ventura-Pitas Point Sa (g)	San Cayetano Sa (g)	San Andreas Sa (g)
PGA	0.798	0.798	0.465	0.388	0.383	0.393	0.295
0.01	0.804	0.804	0.468	0.390	0.385	0.395	0.312
0.02	0.807	0.807	0.468	0.390	0.385	0.395	0.310
0.03	0.798	0.798	0.468	0.391	0.386	0.397	0.309
0.05	0.854	0.854	0.513	0.434	0.426	0.440	0.329
0.075	0.993	0.993	0.625	0.534	0.523	0.538	0.379
0.1	1.133	1.133	0.746	0.643	0.628	0.640	0.444
0.15	1.338	1.338	0.926	0.804	0.784	0.796	0.538
0.2	1.514	1.514	1.059	0.917	0.895	0.910	0.620
0.25	1.705	1.705	1.156	0.992	0.971	0.984	0.691
0.3	1.869	1.869	1.234	1.046	1.029	1.039	0.752
0.4	2.046	2.046	1.270	1.057	1.044	1.055	0.781
0.5	2.080	2.080	1.240	1.017	1.008	1.025	0.778
0.75	1.948	1.948	1.056	0.845	0.844	0.866	0.686
1	1.790	1.790	0.921	0.720	0.722	0.745	0.590
1.5	1.351	1.351	0.674	0.509	0.517	0.538	0.462
2	1.037	1.037	0.509	0.375	0.384	0.406	0.364
3	0.663	0.663	0.323	0.234	0.244	0.265	0.264
4	0.432	0.432	0.219	0.157	0.167	0.186	0.203
5	0.297	0.297	0.156	0.111	0.120	0.135	0.158

Blue Cells=Controlling Fault

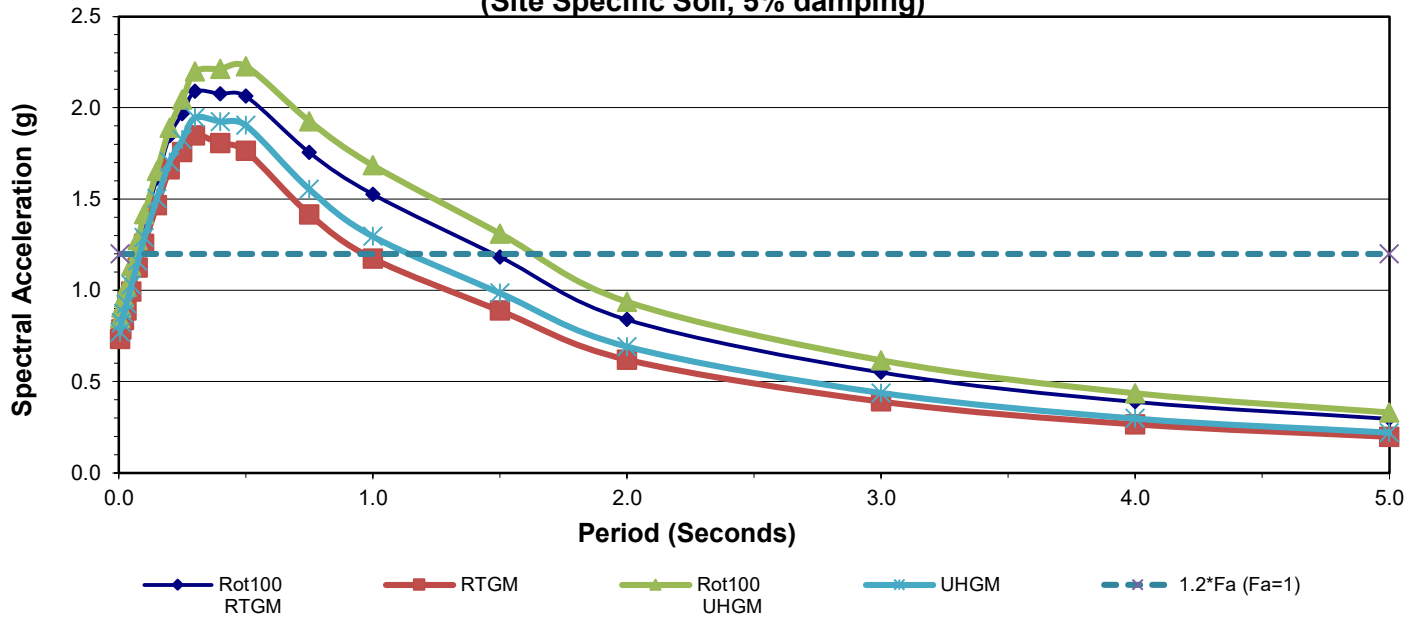
**Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California**

**Figure C-6
Deterministic Response Spectra
BSK Project G2103311B**



RotD50 Horizontal Component of PGA, PGV and IMs									
Input variables		Errors and warnings		Baseline: 5% Damping				User defined: 5% Damping	
				T (s)	PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S _d Median for 5% damping	PSa Median for 5% damping
					PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S _d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5% damping
					PSa Median - 1.σ for 5% damping	S _d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping
					S _d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S _d Median for 5% damping
				PSa (g), S _d (cm)					
				PGA (g)					
				PGV (cm/s)					

**Uniform Hazard Spectra
Risk-Targeted Ground Motion
Spectral Response
Maximum Rotated Horizontal Component
(Site Specific Soil, 5% damping)**



Period (Second)	Rot100 RTGM	RTGM	Rot100 UHGM	UHGM	100Rot Scale Factor
	Sa (g)	Sa (g)	Sa (g)	Sa (g)	
PGA	0.807	0.734	0.848	0.771	1.10
0.01	0.864	0.786	0.905	0.823	1.10
0.02	0.922	0.838	0.962	0.874	1.10
0.03	0.979	0.890	1.019	0.926	1.10
0.05	1.093	0.994	1.133	1.030	1.10
0.075	1.236	1.124	1.275	1.159	1.10
0.1	1.379	1.254	1.417	1.288	1.10
0.15	1.613	1.466	1.654	1.503	1.10
0.2	1.846	1.663	1.890	1.703	1.11
0.25	1.968	1.757	2.044	1.825	1.12
0.3	2.089	1.849	2.199	1.946	1.13
0.4	2.076	1.806	2.213	1.924	1.15
0.5	2.063	1.764	2.228	1.904	1.17
0.75	1.755	1.416	1.926	1.553	1.24
1	1.526	1.174	1.685	1.296	1.30
1.5	1.183	0.890	1.311	0.986	1.33
2	0.840	0.621	0.937	0.692	1.35
3	0.551	0.391	0.617	0.438	1.41
4	0.390	0.267	0.436	0.298	1.46
5	0.297	0.198	0.331	0.221	1.50

Notes:

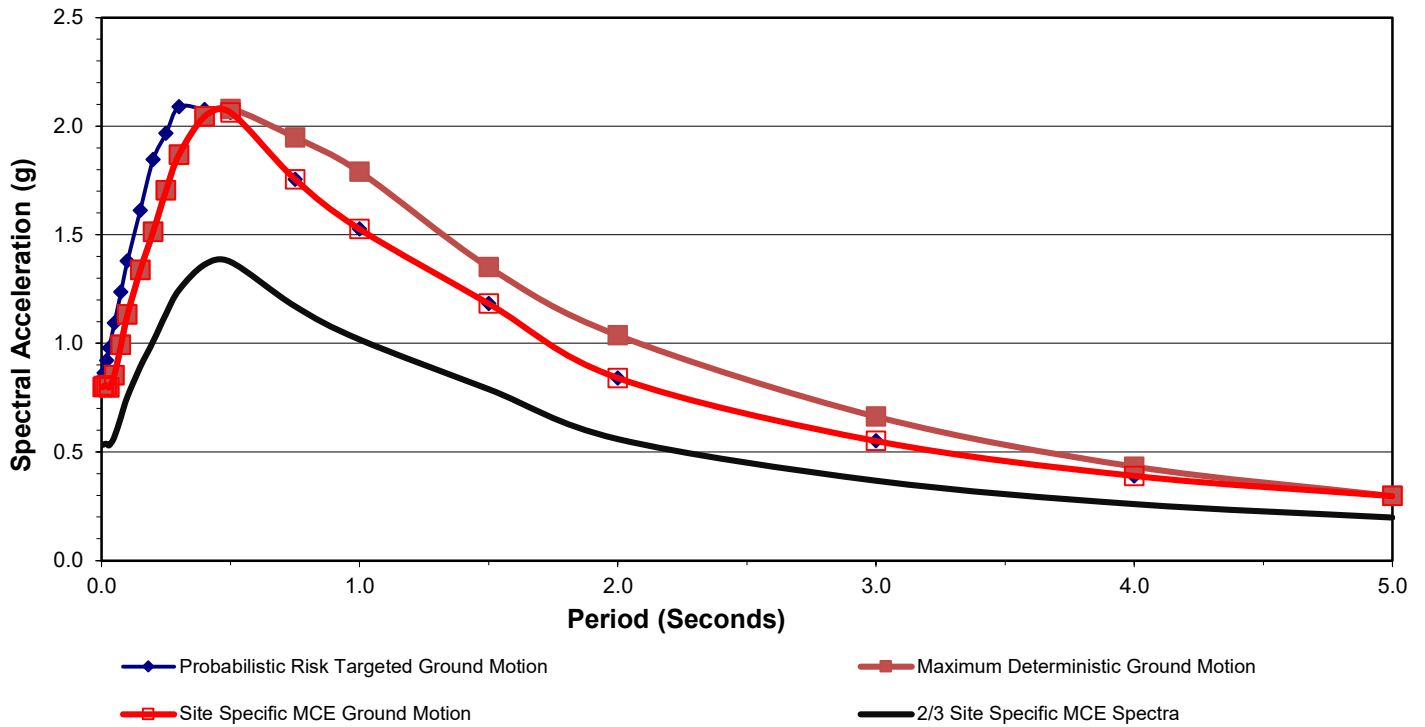
RTGM = Risk-Targeted Ground Motion

UHGM = Uniform Hazard Ground Motion

Rot100 UHGM = Maximum Rotated Uniform Hazard Ground Motion

Rot100 RTGM = Maximum Rotated Risk-Targeted Ground Motion

**Probabilistic - Deterministic Spectra
Maximum Rotated Horizontal Component
(Site Specific Soil, 5% damping)**



Period (Second)	Probabilistic Risk Targeted Ground Motion Sa (g)	Maximum Deterministic Ground Motion Sa (g)	Site Specific MCE Ground Motion Sa (g)	2/3 Site Specific MCE Spectra Sa (g)
PGA	0.807	0.798	0.798	0.532
0.01	0.864	0.804	0.804	0.536
0.02	0.922	0.807	0.807	0.538
0.03	0.979	0.798	0.798	0.532
0.05	1.093	0.854	0.854	0.569
0.075	1.236	0.993	0.993	0.662
0.1	1.379	1.133	1.133	0.755
0.15	1.613	1.338	1.338	0.892
0.2	1.846	1.514	1.514	1.009
0.25	1.968	1.705	1.705	1.137
0.3	2.089	1.869	1.869	1.246
0.4	2.076	2.046	2.046	1.364
0.5	2.063	2.080	2.063	1.376
0.75	1.755	1.948	1.755	1.170
1	1.526	1.790	1.526	1.017
1.5	1.183	1.351	1.183	0.789
2	0.840	1.037	0.840	0.560
3	0.551	0.663	0.551	0.367
4	0.390	0.432	0.390	0.260
5	0.297	0.297	0.297	0.198

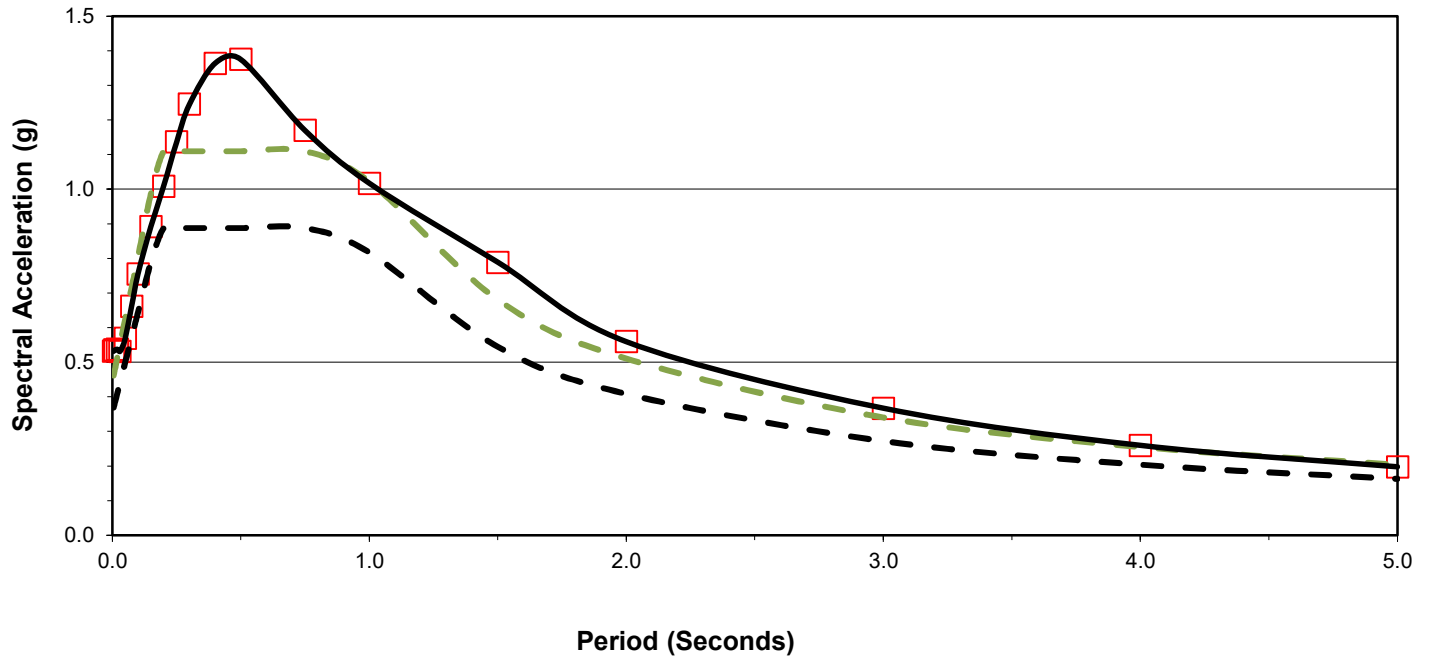
Note: Green Cells Deterministic Controls



Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California

**Figure C-8
Probabilistic -
Deterministic Spectra
BSK Project G2103311B**

Design Response Spectra (Site Specific Soil, 5% damping)



—■— 2/3 Site Specific MCER Spectra
 - - - General Design Spectra
 - - - 80% General Design Spectra
 — Site Specific Design Spectra

Period (Second)	2/3 Site Specific MCER Spectra Sa (g)	General Design Spectra Sa (g)	80% General Design Spectra Sa (g)	Site Specific Design Spectra Sa (g)	Adjusted Site Specific Design Spectra Sa (g)
PGA	0.532	0.462	0.370	0.532	0.532
0.01	0.536	0.480	0.384	0.536	0.536
0.02	0.538	0.516	0.413	0.538	0.538
0.03	0.532	0.553	0.442	0.532	0.532
0.05	0.569	0.625	0.500	0.569	0.569
0.075	0.662	0.715	0.572	0.662	0.662
0.1	0.755	0.806	0.645	0.755	0.755
0.15	0.892	0.987	0.789	0.892	0.892
0.2	1.009	1.110	0.888	1.009	1.238
0.25	1.137	1.110	0.888	1.137	1.137
0.3	1.246	1.110	0.888	1.246	1.246
0.4	1.364	1.110	0.888	1.364	1.364
0.5	1.376	1.110	0.888	1.376	1.376
0.75	1.170	1.110	0.888	1.170	1.170
1	1.017	1.022	0.817	1.017	1.183
1.5	0.789	0.681	0.545	0.789	0.789
2	0.560	0.511	0.409	0.560	0.560
3	0.367	0.341	0.272	0.367	0.367
4	0.260	0.255	0.204	0.260	0.260
5	0.198	0.204	0.163	0.198	0.198

Notes:

Blue Cells Adjusted according to ASCE 7-16, Section 21.4



Ground Motion Hazard Analysis
P&P GAC Treatment
Camrosa WD Project
Ventura County, California

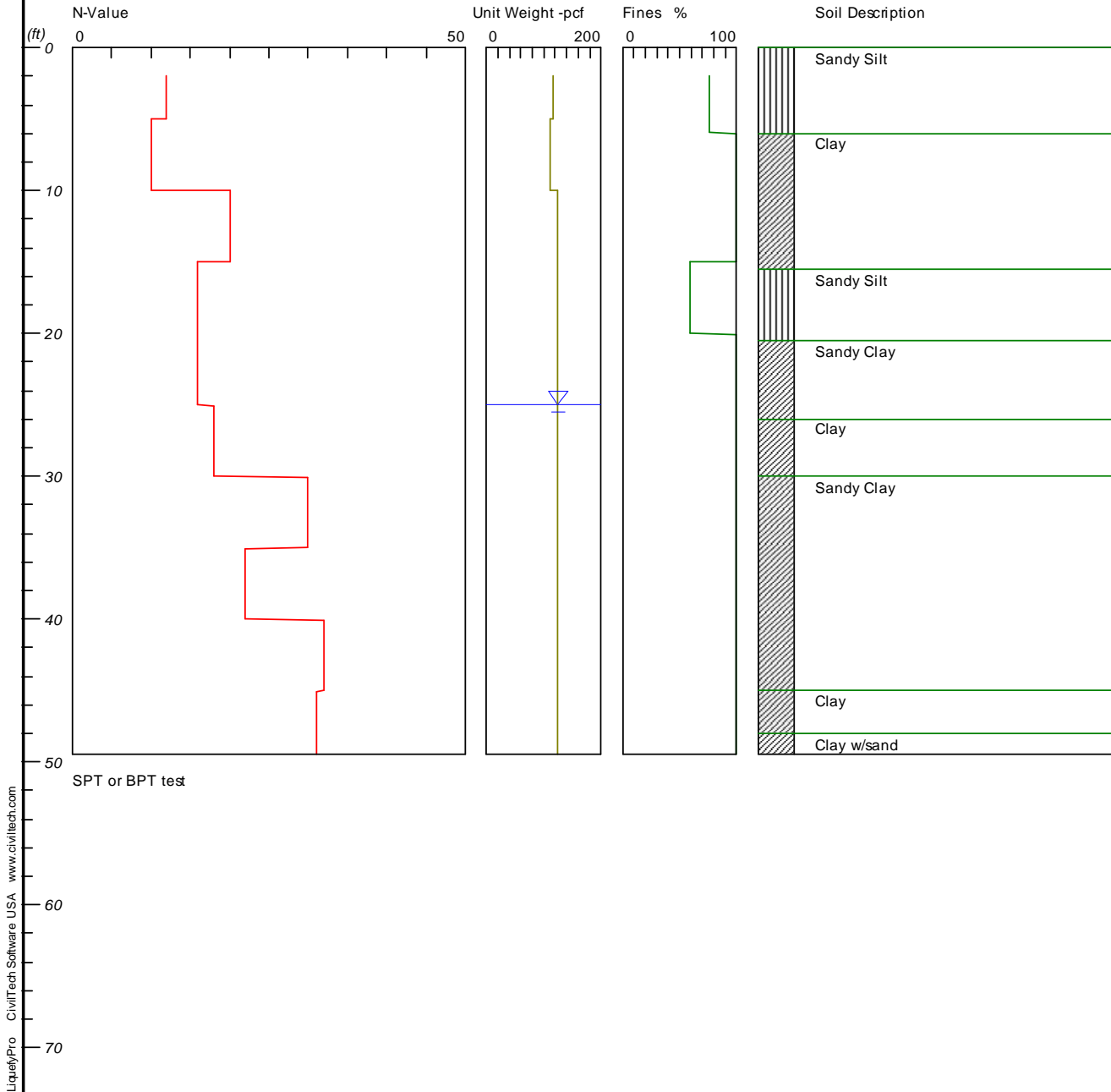
Figure C-9
Design Response Spectra
BSK Project G2103311B

LIQUEFACTION ANALYSIS

GAC Treatment Camrosa WD

Hole No.=B-1 Water Depth=25 ft

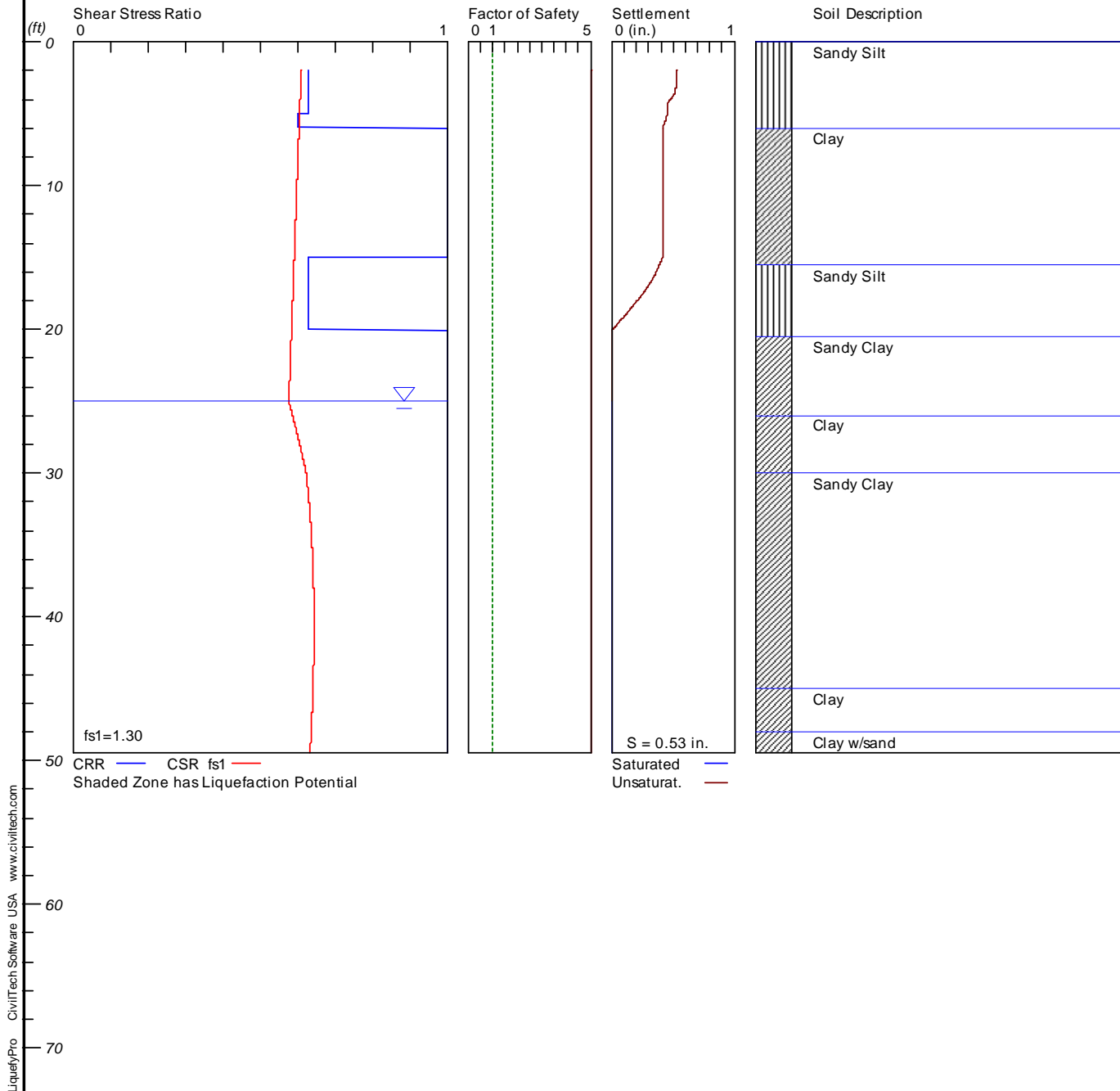
Magnitude=6.86
Acceleration=0.725g



GAC Treatment Camrosa WD

Hole No.=B-1 Water Depth=25 ft

Magnitude=6.86
Acceleration=0.725g



LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: T:\Project Docs\G2103311B - GAC Treatment Camrosa\B-1 general.liq

Title: GAC Treatment Camrosa WD

Subtitle:

Surface Elev.=

Hole No.=B-1

Depth of Hole= 49.50 ft

Water Table during Earthquake= 25.00 ft

Water Table during In-Situ Testing= 60.00 ft

Max. Acceleration= 0.73 g

Earthquake Magnitude= 6.86

Input Data:

Surface Elev.=

Hole No.=B-1

Depth of Hole=49.50 ft

Water Table during Earthquake= 25.00 ft

Water Table during In-Situ Testing= 60.00 ft

Max. Acceleration=0.73 g

Earthquake Magnitude=6.86

No-Liquefiable Soils: Based on Analysis

1. SPT or BPT Calculation.

2. Settlement Analysis Method: Tokimatsu, M-correction

3. Fines Correction for Liquefaction: Stark/Olson et al.*

4. Fine Correction for Settlement: During Liquefaction*

5. Settlement Calculation in: All zones*

6. Hammer Energy Ratio,

Ce = 1.3

7. Borehole Diameter,

Cb= 1.15

8. Sampling Method,

Cs= 1.2

9. User request factor of safety (apply to CSR) , User= 1.3

Plot one CSR curve (fsl=User)

10. Use Curve Smoothing: No

* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
-------------	-----	--------------	------------

2.00	12.00	117.00	76.00
------	-------	--------	-------

5.00	10.00	112.00	76.00
------	-------	--------	-------

6.00	10.00	112.00	NoLiq
------	-------	--------	-------

10.00	20.00	123.00	NoLiq
-------	-------	--------	-------

15.00	16.00	123.00	59.00
-------	-------	--------	-------

20.00	16.00	123.00	NoLiq
-------	-------	--------	-------

25.00	18.00	123.00	NoLiq
-------	-------	--------	-------

30.00	30.00	123.00	NoLiq
-------	-------	--------	-------

35.00	22.00	123.00	NoLiq
-------	-------	--------	-------

40.00	32.00	123.00	NoLiq
-------	-------	--------	-------

45.00	31.00	123.00	NoLiq
-------	-------	--------	-------

49.00	31.00	123.00	NoLiq
-------	-------	--------	-------

Output Results:

Settlement of Saturated Sands=0.00 in.

Settlement of Unsaturated Sands=0.53 in.

Total Settlement of Saturated and Unsaturated Sands=0.53 in.

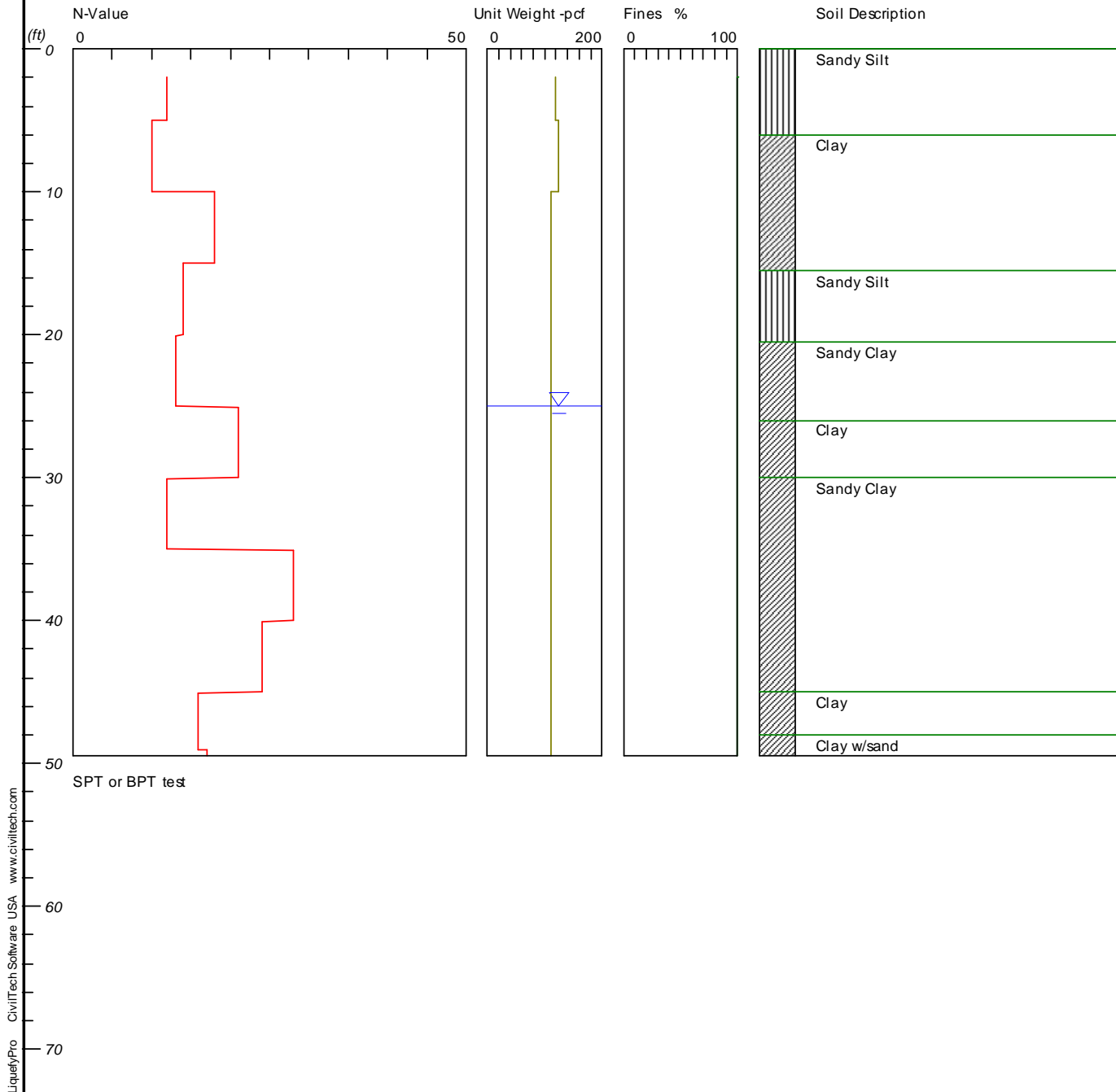
Differential Settlement=0.265 to 0.350 in.

LIQUEFACTION ANALYSIS

GAC Treatment Camrosa WD

Hole No.=B-2 Water Depth=25 ft

Magnitude=6.86
Acceleration=0.725g

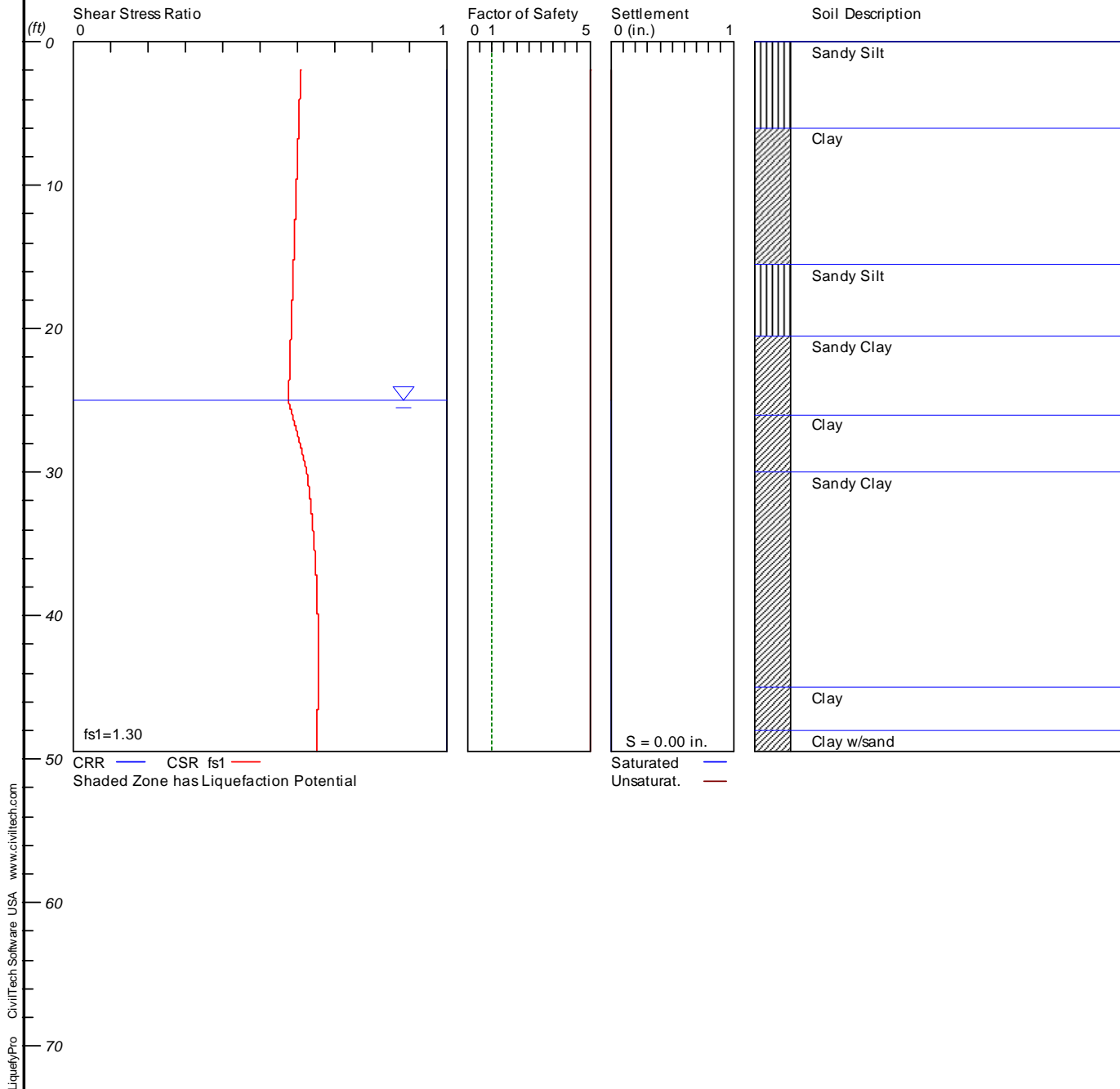


LIQUEFACTION ANALYSIS

GAC Treatment Camrosa WD

Hole No.=B-2 Water Depth=25 ft

Magnitude=6.86
Acceleration=0.725g



LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: T:\Project Docs\G2103311B - GAC Treatment Camrosa\B-2.liq

Title: GAC Treatment Camrosa WD

Subtitle:

Surface Elev.=

Hole No.=B-2

Depth of Hole= 49.50 ft

Water Table during Earthquake= 25.00 ft

Water Table during In-Situ Testing= 60.00 ft

Max. Acceleration= 0.73 g

Earthquake Magnitude= 6.86

Input Data:

Surface Elev.=

Hole No.=B-2

Depth of Hole=49.50 ft

Water Table during Earthquake= 25.00 ft

Water Table during In-Situ Testing= 60.00 ft

Max. Acceleration=0.73 g

Earthquake Magnitude=6.86

No-Liquefiable Soils: Based on Analysis

1. SPT or BPT Calculation.

2. Settlement Analysis Method: Tokimatsu, M-correction

3. Fines Correction for Liquefaction: Stark/Olson et al.*

4. Fine Correction for Settlement: During Liquefaction*

5. Settlement Calculation in: All zones*

6. Hammer Energy Ratio,

Ce = 1.3

7. Borehole Diameter,

Cb= 1.15

8. Sampling Method,

Cs= 1.2

9. User request factor of safety (apply to CSR) , User= 1.3

Plot one CSR curve (fs1=User)

10. Use Curve Smoothing: No

* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
-------------	-----	--------------	------------

2.00	12.00	118.00	NoLiq
------	-------	--------	-------

5.00	10.00	125.00	NoLiq
------	-------	--------	-------

10.00	18.00	110.00	NoLiq
-------	-------	--------	-------

15.00	14.00	110.00	NoLiq
-------	-------	--------	-------

20.00	13.00	110.00	NoLiq
-------	-------	--------	-------

25.00	21.00	110.00	NoLiq
-------	-------	--------	-------

30.00	12.00	110.00	NoLiq
-------	-------	--------	-------

35.00	28.00	110.00	NoLiq
-------	-------	--------	-------

40.00	24.00	110.00	NoLiq
-------	-------	--------	-------

45.00	16.00	110.00	NoLiq
-------	-------	--------	-------

49.00	17.00	110.00	NoLiq
-------	-------	--------	-------

Output Results:

Settlement of Saturated Sands=0.00 in.

Settlement of Unsaturated Sands=0.00 in.

Total Settlement of Saturated and Unsaturated Sands=0.00 in.

Differential Settlement=0.000 to 0.000 in.

INITIAL GAC AND CO2 SUBMITTALS



SUBMITTAL REVIEW FORM

To: Camrosa Water District
7385 Santa Rosa Road
Camarillo, CA 93012

From: Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA 93711

Project No.: 02958-20-002

Reviewer: Kevin Berryhill, P.E.

Project: TCP Removal Project for Conejo Wells

Date: 9/24/2021

Submittal No: AV

Description: GAC Vessel Systems

The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the contract plans and specifications or from departures there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

☐

No Exceptions Taken

☐

Submit Specified Item

☒

Make Corrections Noted

☐

Rejected

☐

Revise & Resubmit

☐

For Information Only

Reviewer Comments:

Item	Description	Mfg/Supplier	Action Taken	Comment

Comments:

1. External color to be selected by the Owner. Provide color chart.
2. All drop pipes and fittings (ARV, manual air release, wash down, etc.) shall be stainless steel, copper, or brass.
3. Provide grounding tabs on both legs at back of vessels
4. District to review submitted air release valve for approval



A SERVICE DISABLED VETERAN OWNED SMALL BUSINESS



SUBMITTAL

Camrosa – 1,2,3 TCP Removal

GAC Treatment System

AV Project No. M-00096

September 7, 2021

AqueoUS[®] VETS
Experienced. Proven. Reliable.

INNOVATIVE WATER AND WASTEWATER SOLUTIONS



September 7, 2021

Becca Bugielski
MKN Associates

Re: Camrosa 1,2,3-TCP Removal GAC Treatment System - Submittal

Ms. Bugielski,

The submittal for the GAC filter system for the Conejo Wellfield GAC System is attached for your review. The package is broken into the following sections, bookmarked in the pdf document.

- Section 1 – System Drawings & Specifications
- Section 2 – Valves
- Section 3 – Instruments
- Section 4 – Additional System Components
- Section 5 – Linings & Coatings

An additional submittal with the detailed drawings and structural calculations will follow in approximately 2 weeks. If there are any questions I can be reached at (530) 913-6792 or cgillespie@aqueousvets.com.

Regards,

Cameron Gillespie

Phone: (530) 913-6792

cgillespie@aqueousvets.com

www.aqueousvets.com



Section 1

System Drawings & Specifications



PF 12-520 LP SYSTEM SPECIFICATION

PF 12-520 Liquid Phase Adsorption Systems are designed to treat a wide range of contaminated process streams. All piping and valves are configured for series, parallel, or vessel isolation flows. System includes GAC inlet and outlet piping, and backwash capabilities. The system consists of two (2) adsorbers, with piping, valves, and gauges assembled operation. Each adsorber is equipped with an underdrain capable of maximum flow rate of 1,100 gpm.

EACH VESSEL:

Vessel Diameter	144"
Side Shell Height	60"
Overall Height (Approx.).....	14'-6"
Working Pressure.....	125 psi @ 150°F
Manway:	
Flanged at side shell	30"
Elliptical type at head.....	14"x18"
Vessel Volume	7,520 gal. / 1,005 ft ³
Maximum Flow Rate (Typical)	1,100 gpm
Design Criteria	ASME
Code Stamping.....	YES
Material.....	Carbon Steel
Supports (4 per vessel).....	Legs
Lifting (2 per vessel)	Lifting Lugs
Seismic	Site Class D, Importance Factor 1.5
Interior Surface Prep	SSPC-SP5
Interior Surface Coating	Plasite 4110, 35 – 45 mil dft
Exterior Surface Primer	Epoxy, 4 – 6 mil dft
Exterior Surface Coating.....	Urethane, 2 – 4 mil dft
Standard Color	Tan (Carboline 9225 Cashew) w/custom colors available

UNDERDRAINS:

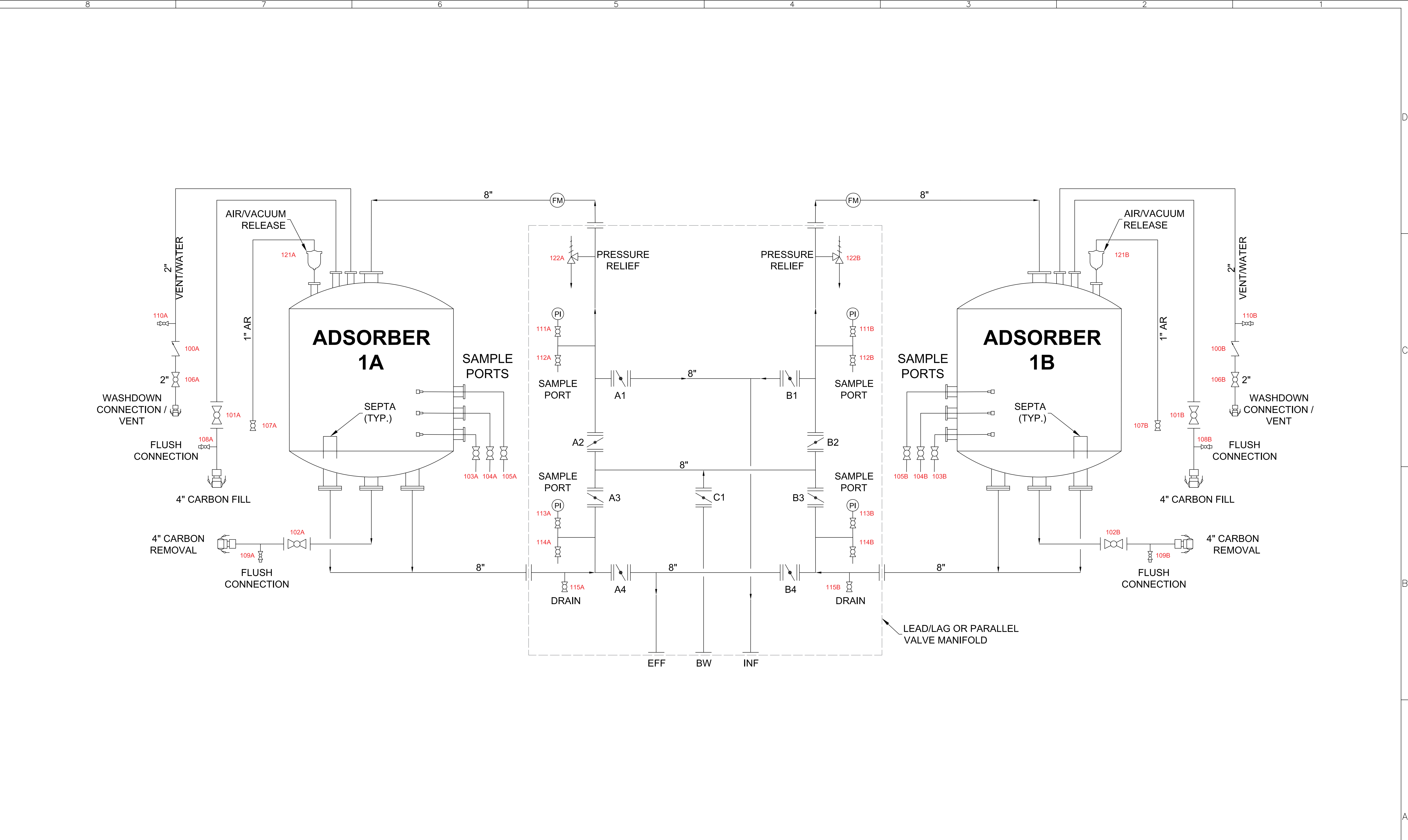
External ring header.....	8" Sch. 40 Carbon Steel
Septa Screens (8 per vessel)	316L Stainless Steel V-Wire Screens 4 ½" Dia x 12" eff.

VALVE ASSEMBLY AND PIPING:

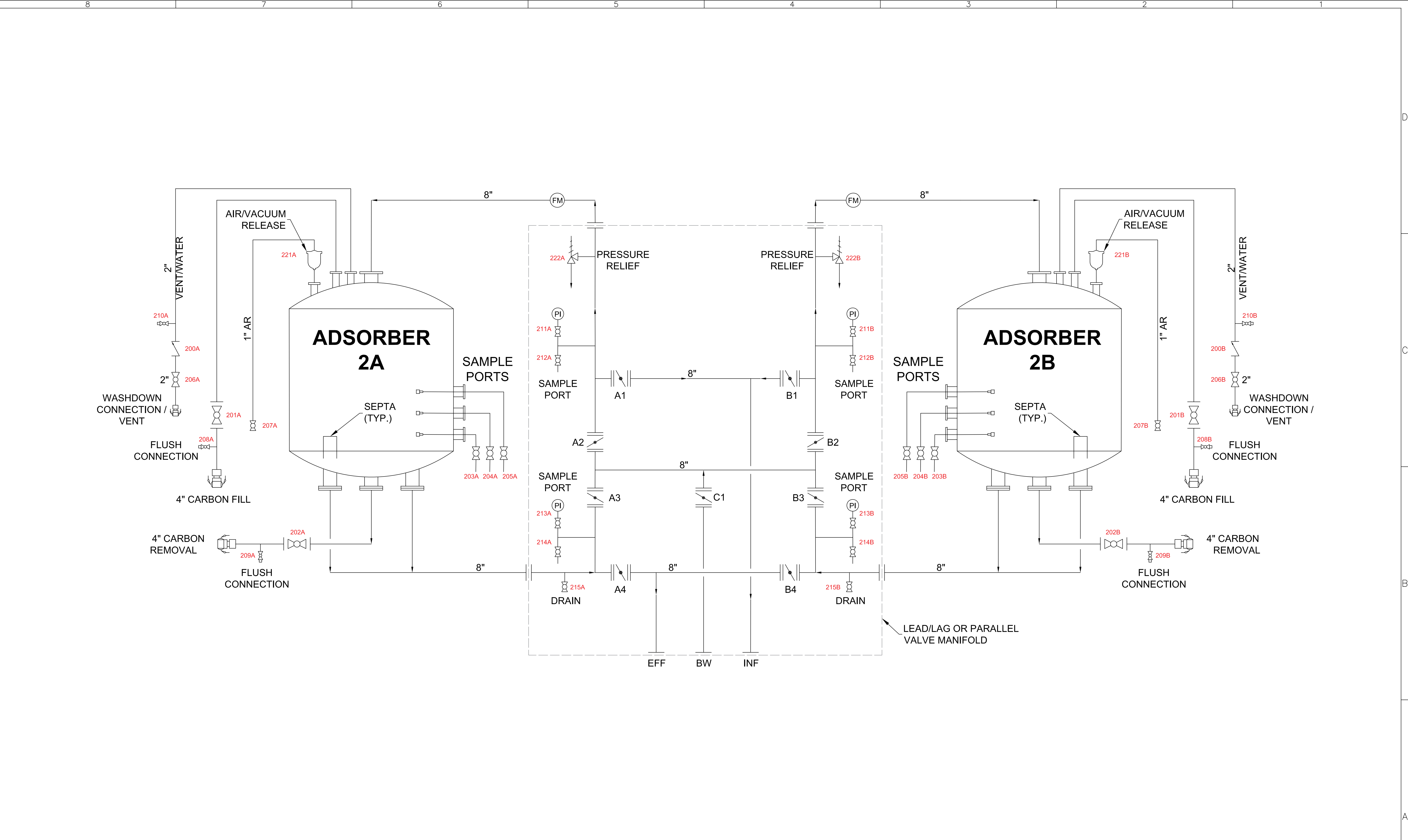
Piping:	
Process Piping	8" Sch 40 Carbon Steel
GAC Transfer Piping.....	4" Sch 40 Lined Carbon Steel
Valves:	
Process	8" Butterfly, Cast Iron Body, DI Disc, Gear Operator
GAC Transfer	4" Flanged 316 Stainless Steel Full Port Ball Valve
Vent/Wash	2" Lead-Free Bronze Ball Valve
Sample Ports (4)	1/2" Lead-Free Bronze Ball Valve
Connection Hardware	Hot-Dip Galvanized

SYSTEM WEIGHT:

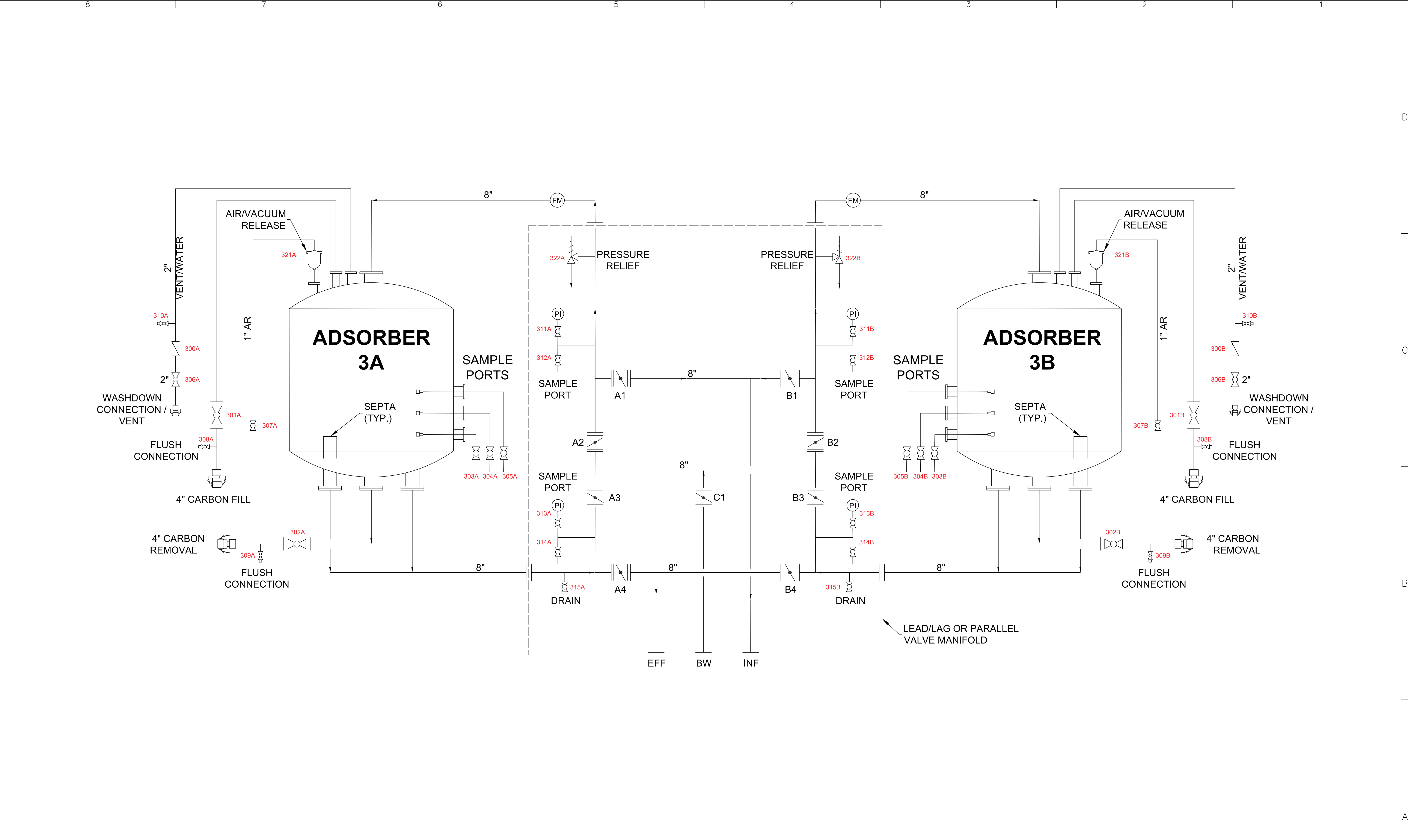
System Shipping weight	35,000 lb
------------------------------	-----------



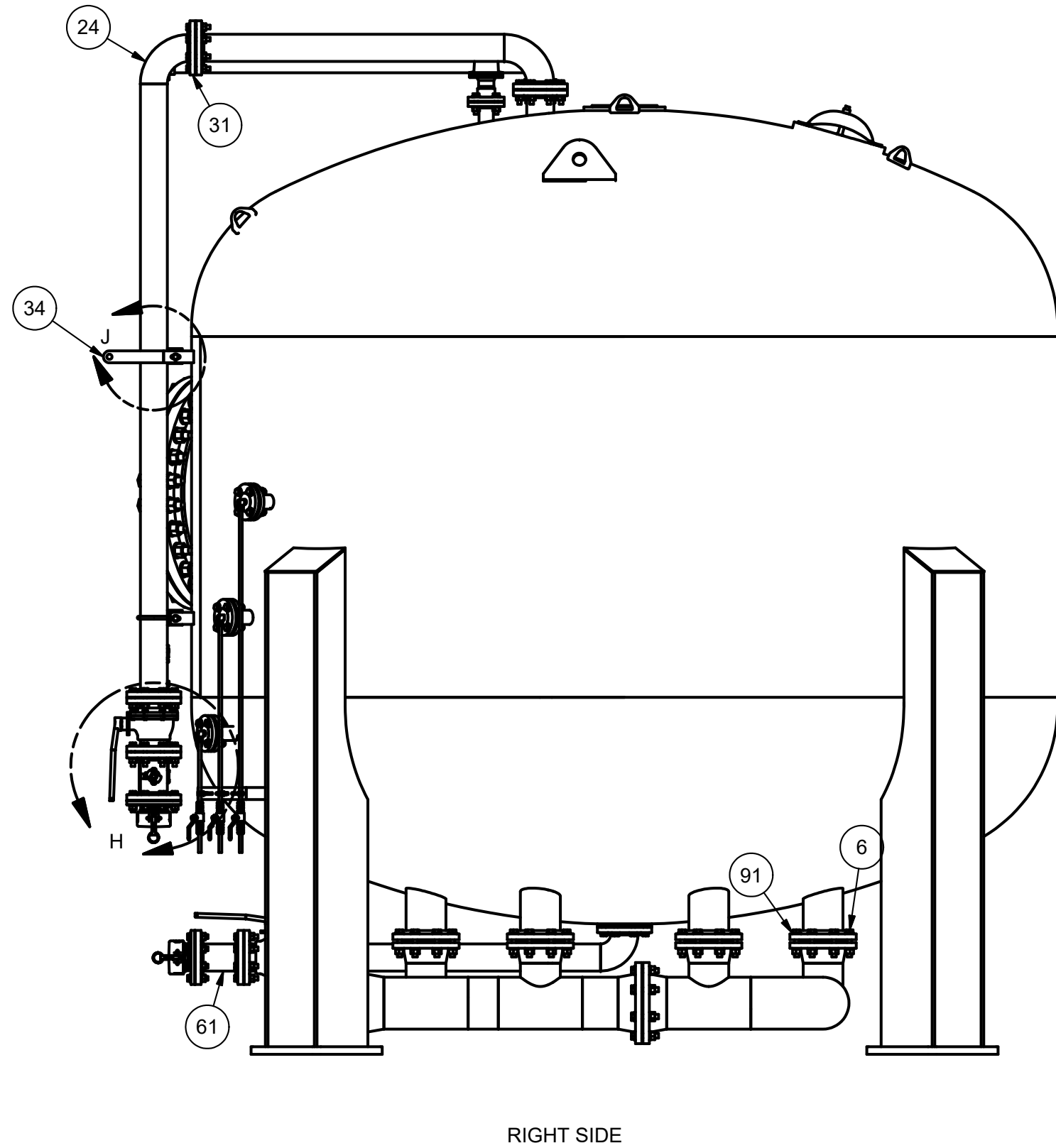
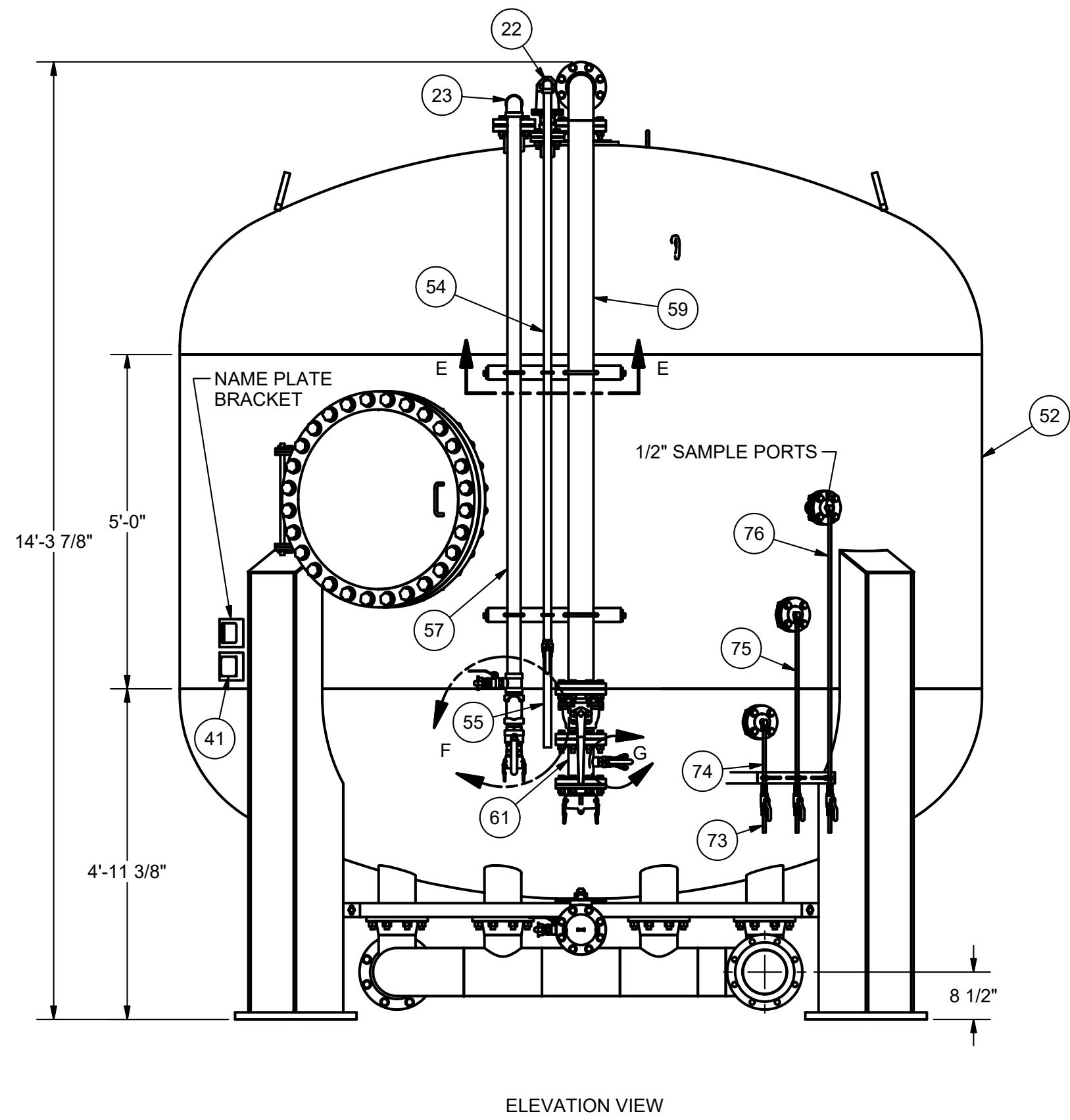
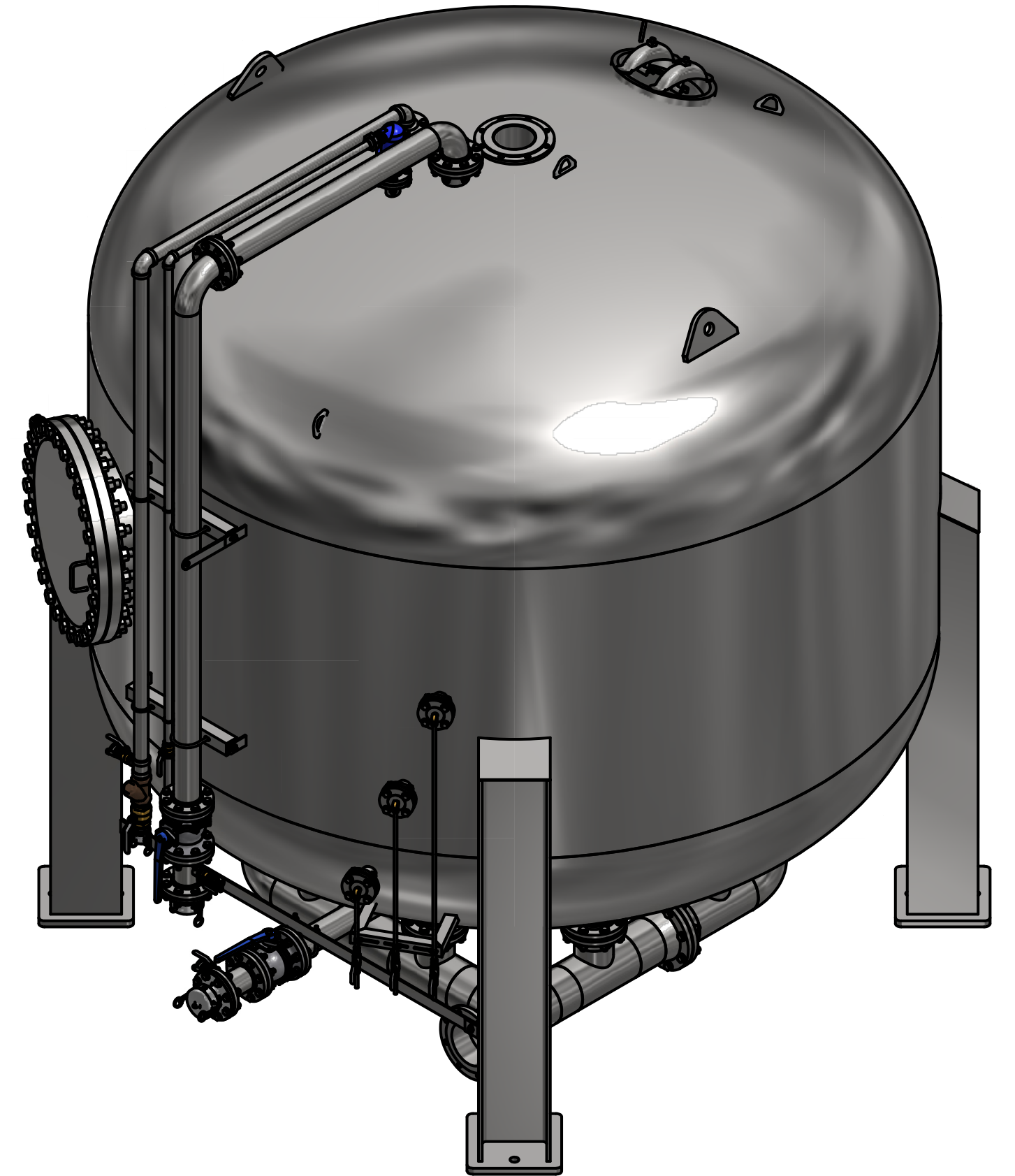
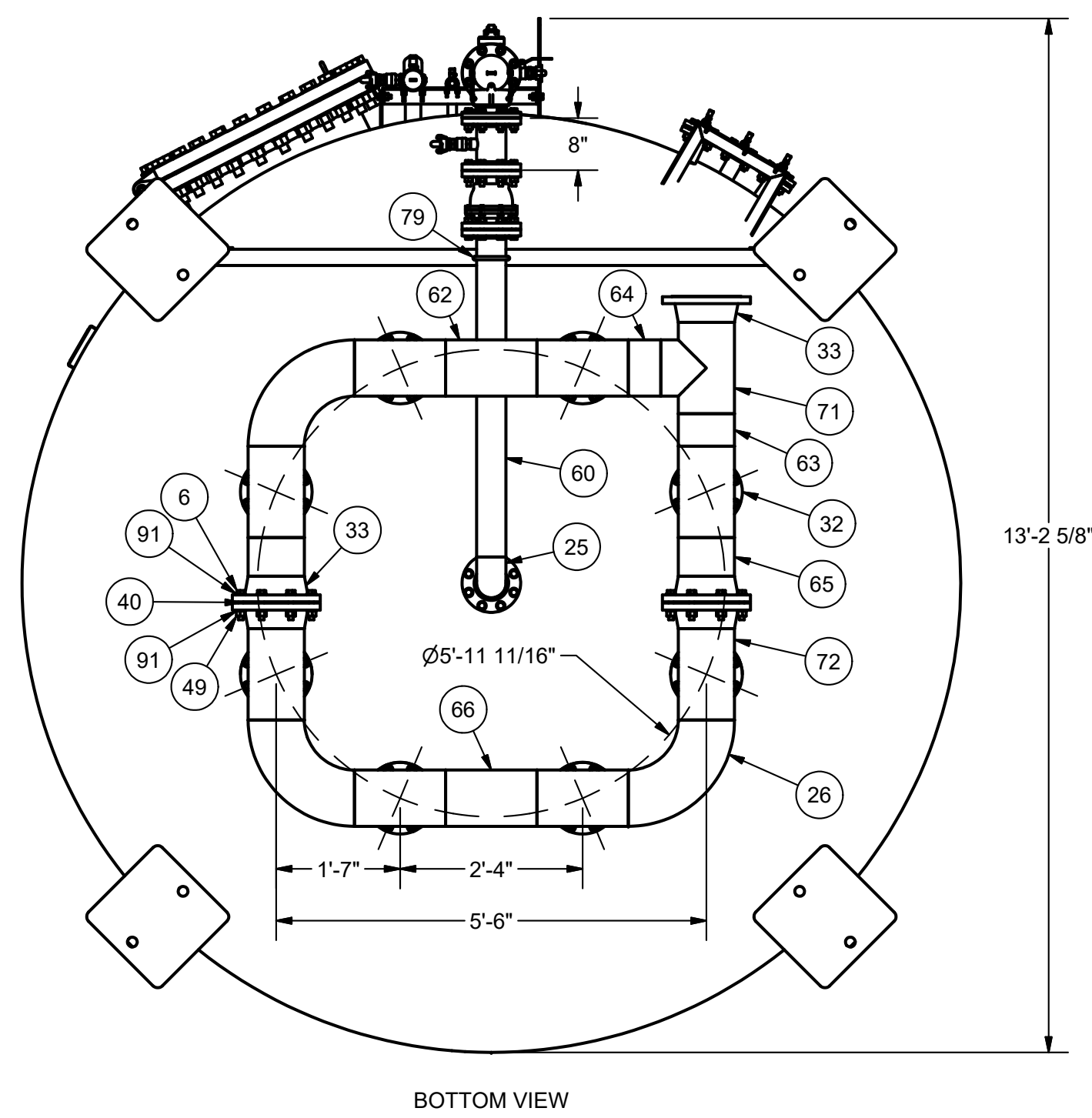
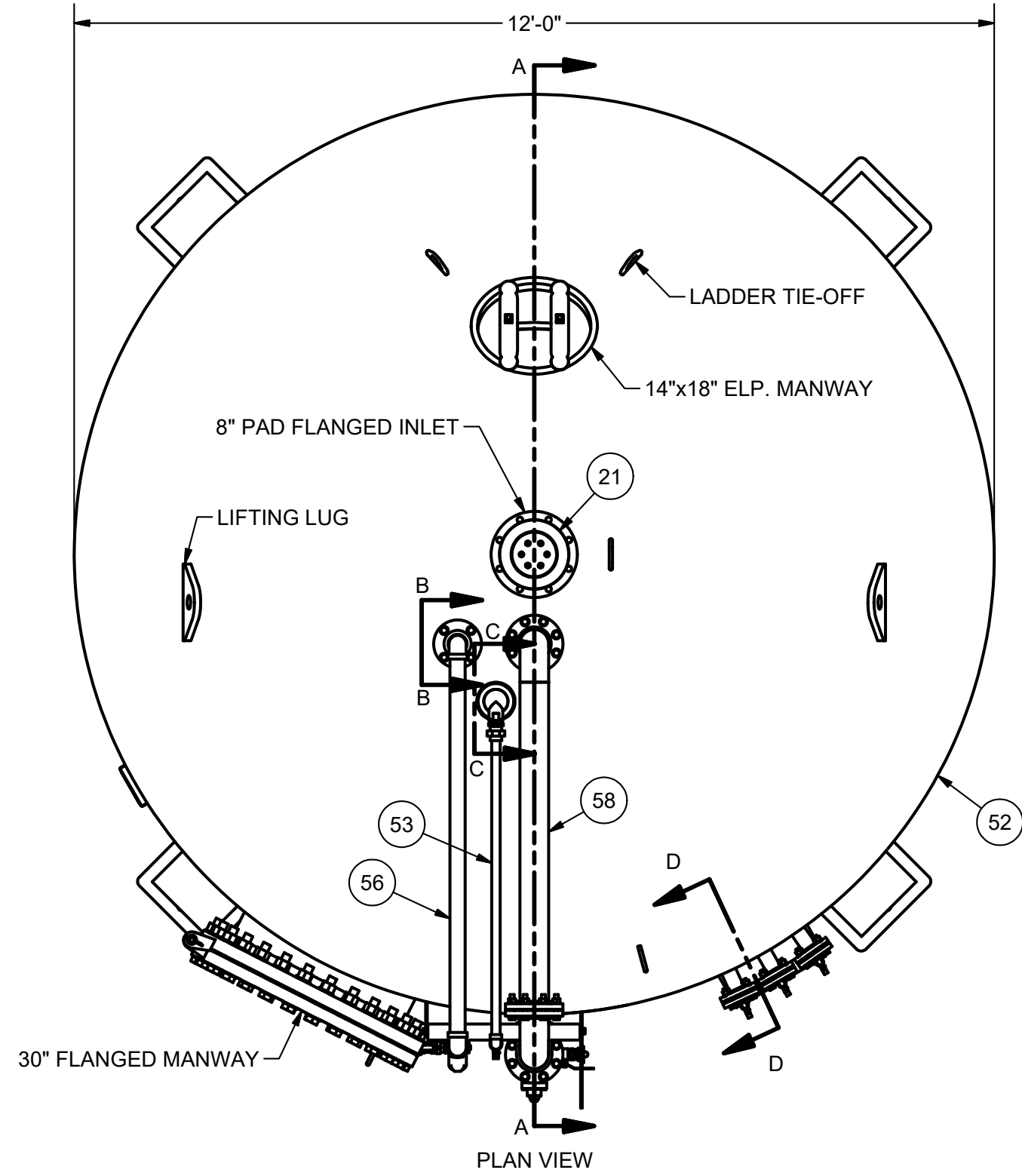
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					ENGINEER	DATE	CLIENT	
					MANAGER	DATE	CAMROSA WATER DISTRICT	
					FILE:		AqueoUS [®] VETS [®]	
					SCALE:		Aqueous Vets Danville, CA	
					PROJECT	CODE	DRAWING	SHEET
					M-00096		PID-00096-A	1 OF 1
					REV	DESCRIPTION	DATE	DWN
							CHKD	APVD
							ECN	REV
								1.0



											DESIGNER	DATE	TITLE PROCESS FLOW DIAGRAM SYSTEM B
											CHECKER	DATE	
											ENGINEER	DATE	
											MANAGER	DATE	
											FILE:		
											SCALE:		
PROJECT	CODE	DRAWING	SHEET	REV									
M-00096		PID-00096-B	1 OF 1	1.0									
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN							

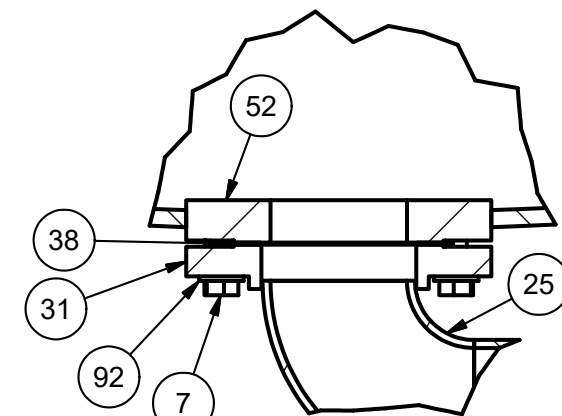
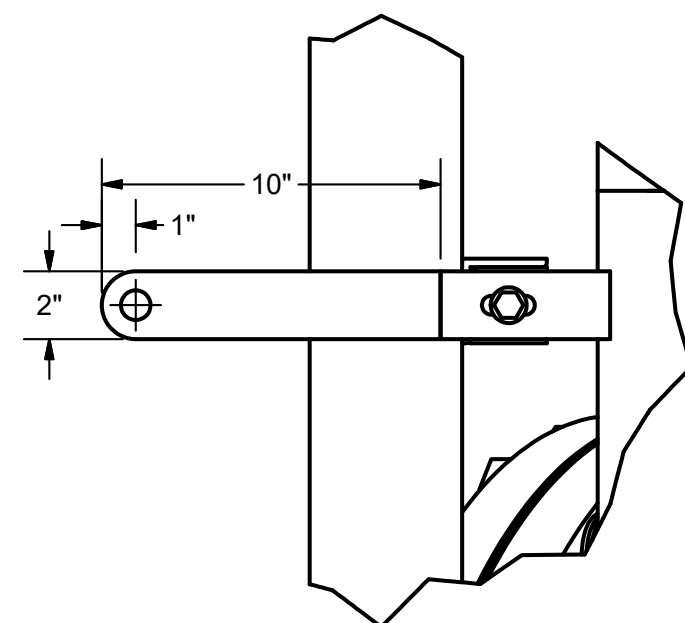
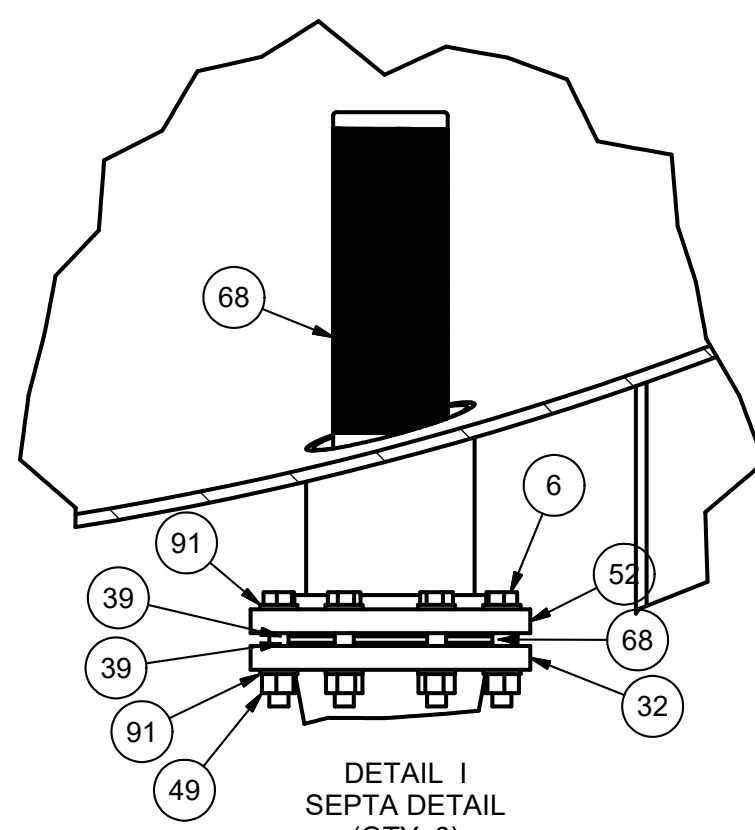
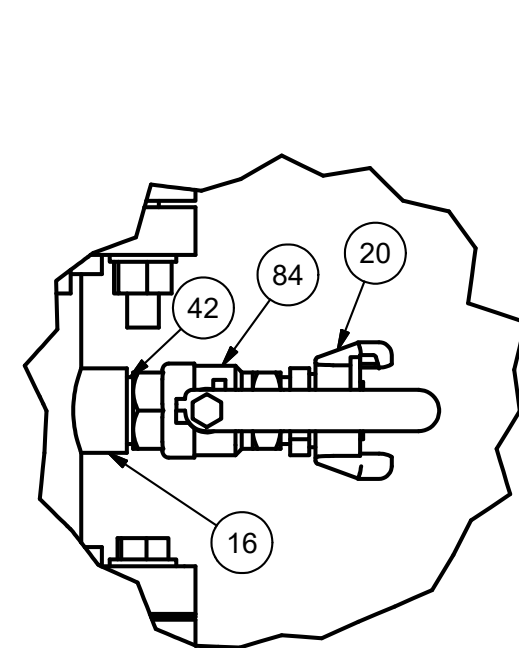
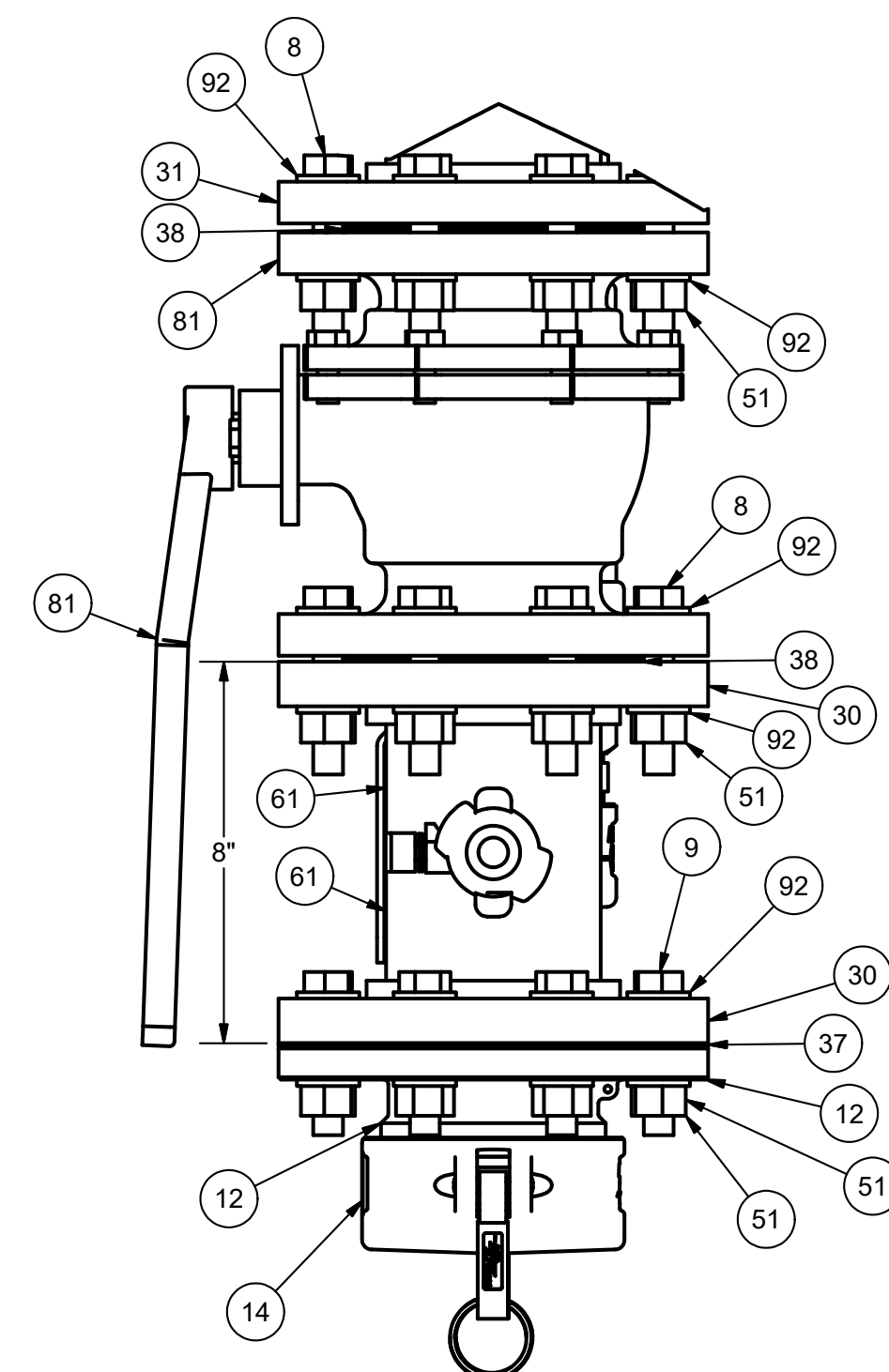
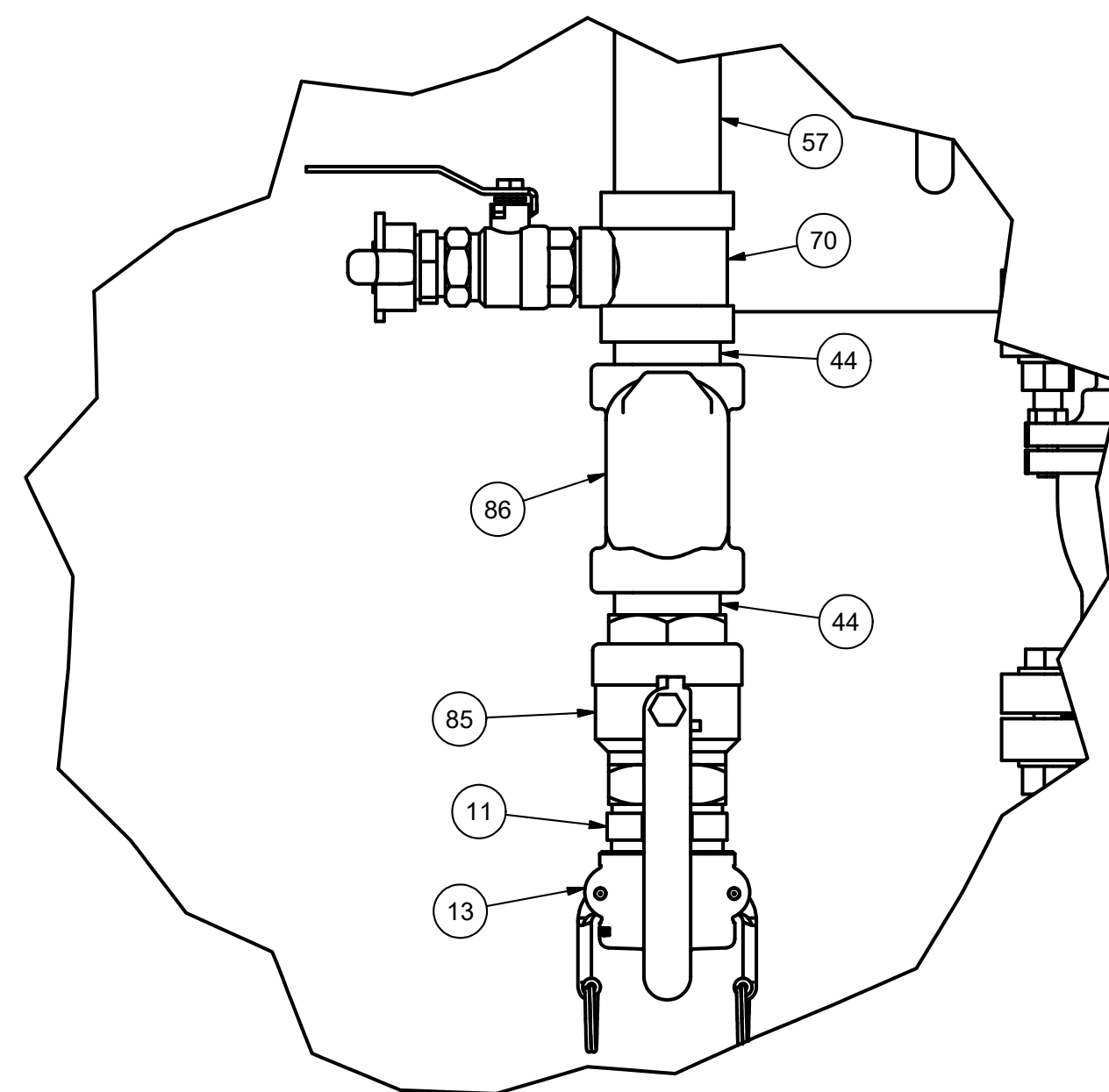
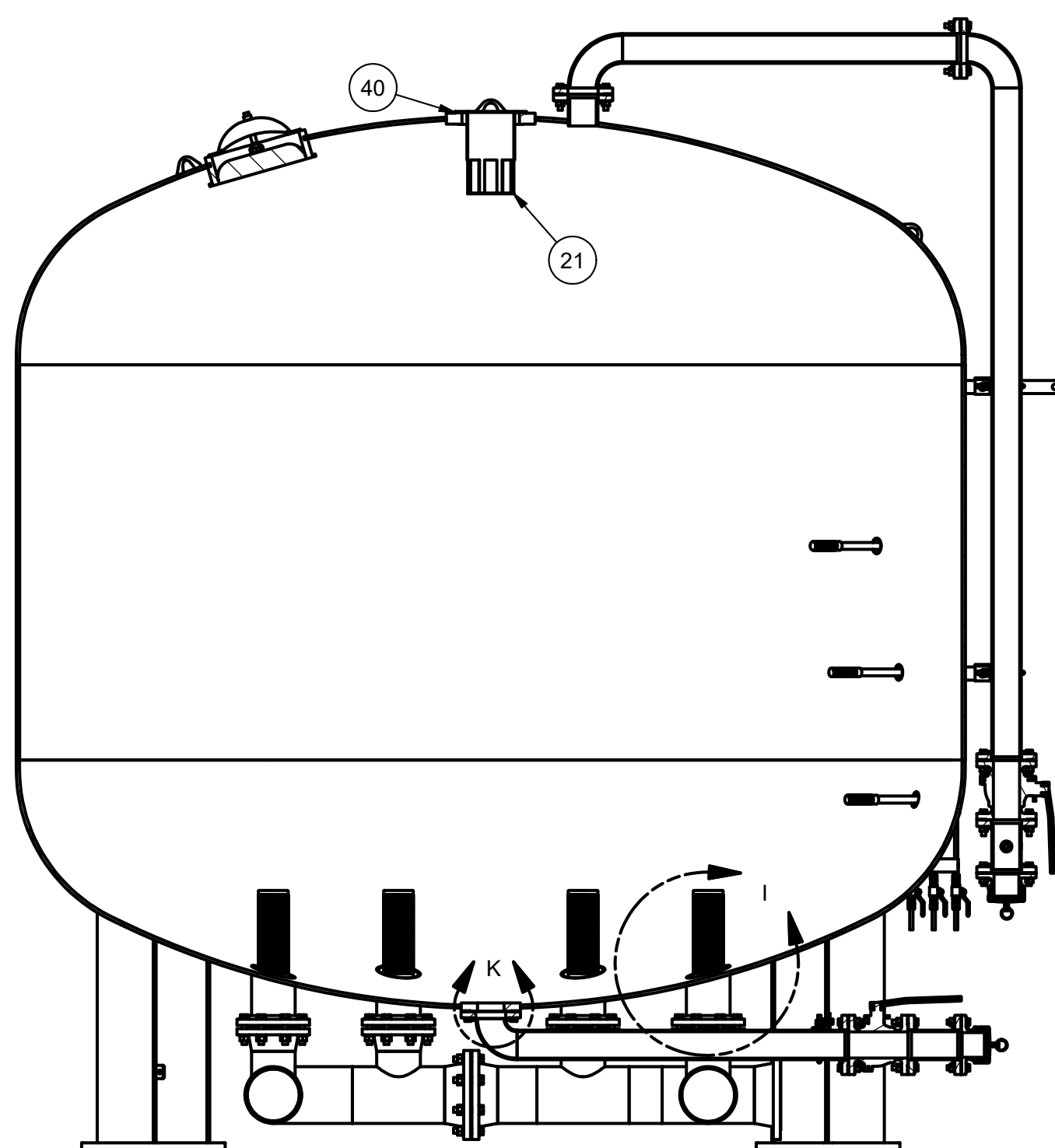
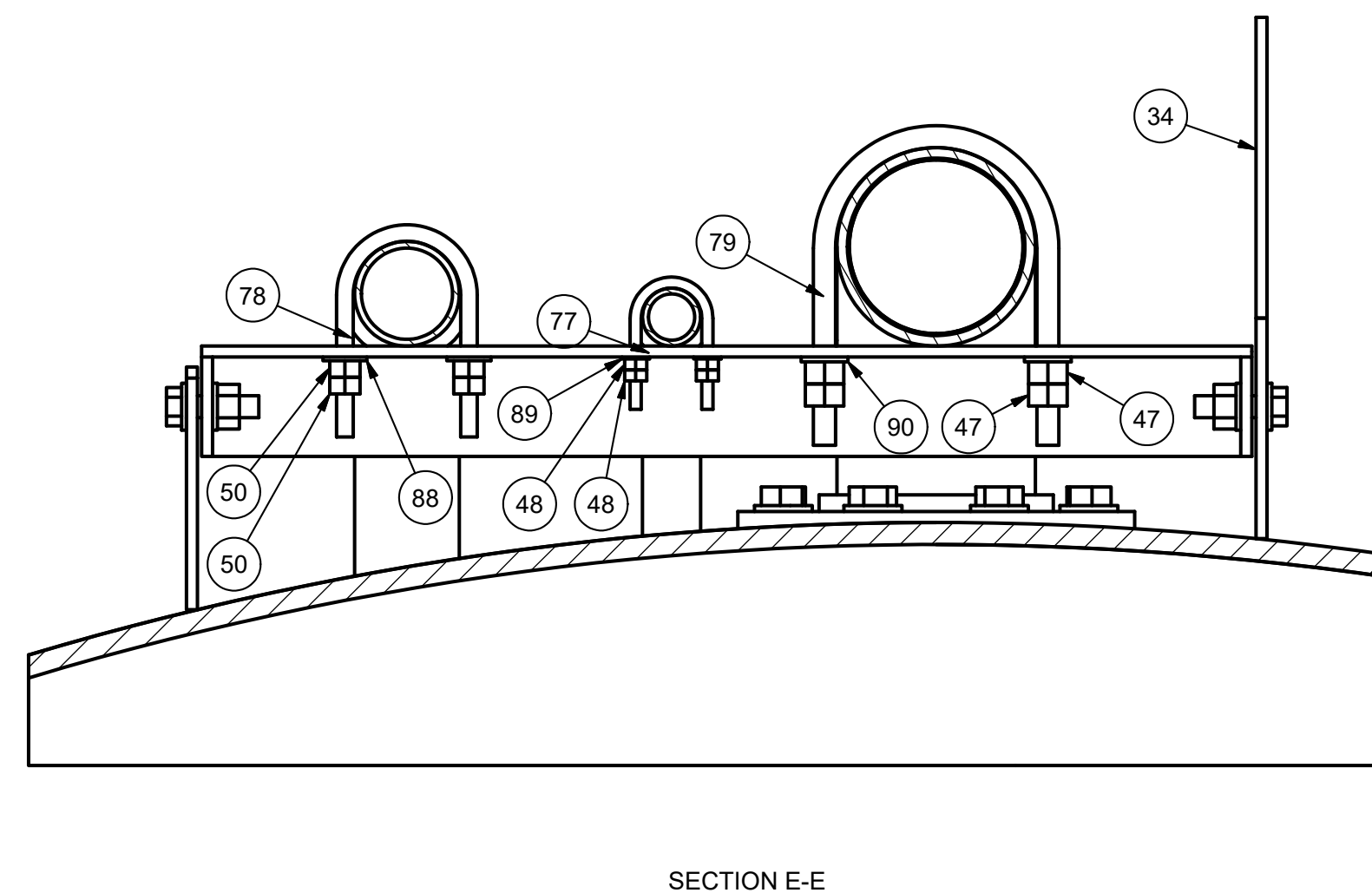
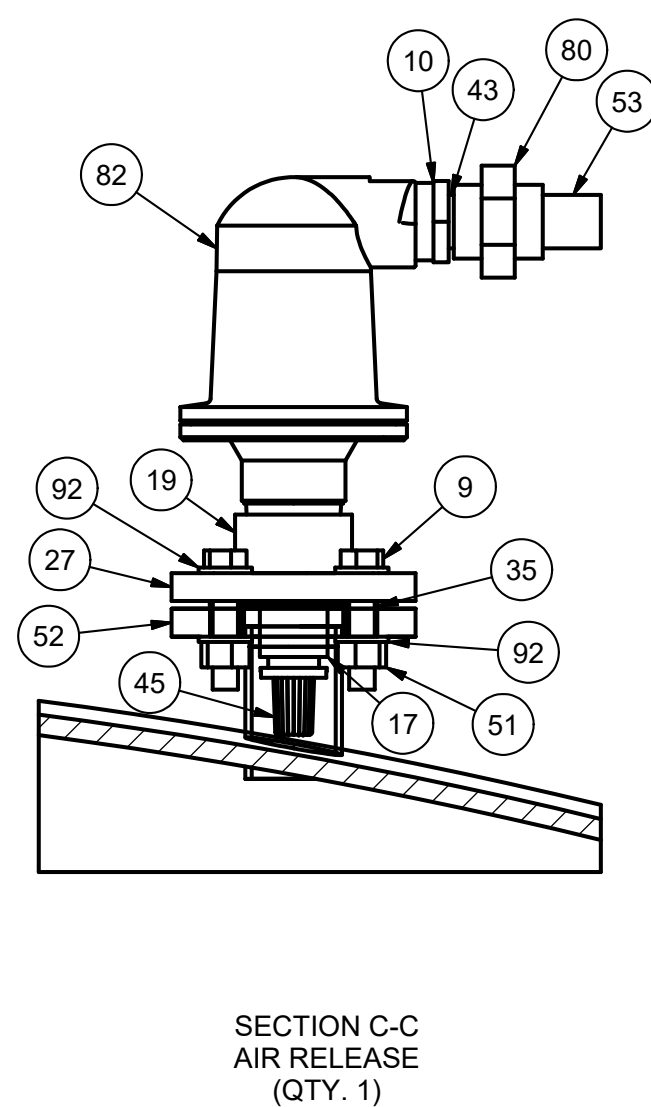


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											ENGINEER	DATE	
											MANAGER	DATE	
											CLIENT CAMROSA WATER DISTRICT		
											FILE:		 Aqueous Vets Danville, CA
SCALE:		PROJECT M-00096	CODE	DRAWING PID-00096-C	SHEET 1 OF 1	REV 1.0							
REV	DESCRIPTION					DATE	DWN	CHKD	APVD	ECN			



- NOTE:
1. THIS DRAWING IS TO SHOW PIPING AND EQUIPMENT FOR CUSTOMER APPROVAL.
 2. PROVIDE STAINLESS STEEL SCREENS AT SEPTA UNDER DRAIN.
 3. VESSELS SHALL BE 125 PSI, ASME CODE.
 4. PIPING MATERIALS SHALL MEET: CS PIPE ASTM A-53 GRADE B (ERW); CS FITTINGS SA-234, ASME B16.9; SS THREADED FITTINGS ASTM A-351; SS PIPE ASTM A-312; SS BW FITTINGS ASTM A-403; MI THREADED FITTINGS ASME B-16.3.
 5. SURFACE PREPARATION: VESSEL: SSPC-SP6 INTERIOR & SSPC-SP6 EXTERIOR. SYSTEM PIPING: SSPC-SP10 INTERIOR & SSPC-SP6 EXTERIOR.
 6. FINISH VESSEL INTERIOR WITH 35-45 MILS OF PLASITE 4110; PREPARE AND APPLY STRICTLY IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS TO MEET NSF STD 61 REQUIREMENTS. LINING TO BE CONTINUOUS TO OD OF THE RAISED FACE ON ALL NOZZLE FLANGES.
 7. FINISH EXTERIOR WITH 2-3 MILS OF CARBOTHANE 134VOC URETHANE, COLOR TO BE DETERMINED, OVER 4-6 MILS OF CARBOGUARD 893 RUST PREVENTATIVE EPOXY PRIMER, APPLIED PER MANUFACTURERS RECOMMENDATIONS.
 8. CS SLURRY/PROCESS PIPE 3" AND LARGER TO BE INTERNALLY LINED WITH 16MILS (MIN.) OF 3M SCOTCHKOTE 134 FUSION BONDED EPOXY.
 9. MANWAY AND SEPTA GASKETS TO BE EPDM. ALL OTHER GASKETS TO BE NAM 37C.
 10. ALL VALVES TO BE TAGGED WITH NUMBER SHOWN ON P&ID.
 11. VESSEL ESTIMATED SHIPPING WEIGHT: 16,000 LBS.
 12. GROUTING AND ANCHORING BY OTHERS IF REQUIRED.


COMPANY CONFIDENTIAL THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREIN ARE THE PROPERTY OF AQUEOUS VETS AND/OR ITS AFFILIATES. THE DESIGN CONCEPTS AND INFORMATION CONTAINED HEREIN ARE PROPRIETARY TO AQUEOUS VETS AND ARE SUBMITTED IN CONFIDENCE. THEY ARE NOT TRANSFERABLE AND MUST BE USED ONLY FOR THE PURPOSE FOR WHICH THE DOCUMENT IS EXPRESSLY LOANED. THEY MUST NOT BE DISCLOSED, REPRODUCED, LOANED, OR USED IN ANY OTHER MANNER WITHOUT THE EXPRESS WRITTEN CONSENT OF AQUEOUS VETS. IN NO EVENT SHALL THEY BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF AQUEOUS VETS. ALL PATENT RIGHTS ARE RESERVED. UPON THE DEMAND OF AQUEOUS VETS, THIS DOCUMENT, ALONG WITH ALL COPIES AND EXTRACTS, AND ALL RELATED NOTES AND ANALYSES, MUST BE RETURNED TO AQUEOUS VETS OR DESTROYED, AS INSTRUCTED BY AQUEOUS VETS. ACCEPTANCE OF THE DELIVERY OF THIS DOCUMENT CONSTITUTES AGREEMENT TO THESE TERMS AND CONDITIONS.			DESIGNER: AJA	DATE 9/1/2021	TITLE PF 12-520LP LOW PRO™ 125 PSI SINGLE TANK ASSEMBLY
			CHECKER: RM	DATE 9/1/2021	CLIENT CAMROSA WATER DISTRICT CONEJO WELLFIELD - GAC TREATMENT SYSTEM (CAMARILLO, CA)
			ENGINEER: JT	DATE 9/1/2021	AqueoUS VETS® 16761 CLEAR CREEK ROAD REDDING, CA 96001 925-331-0573
			MANAGER:	DATE	
			SCALE: 1/2" = 1'	PROJECT M-00096	CODE
				DRAWING NUMBER PF 12-520LP ST 1	SHEET 1 OF 2
					REV 0

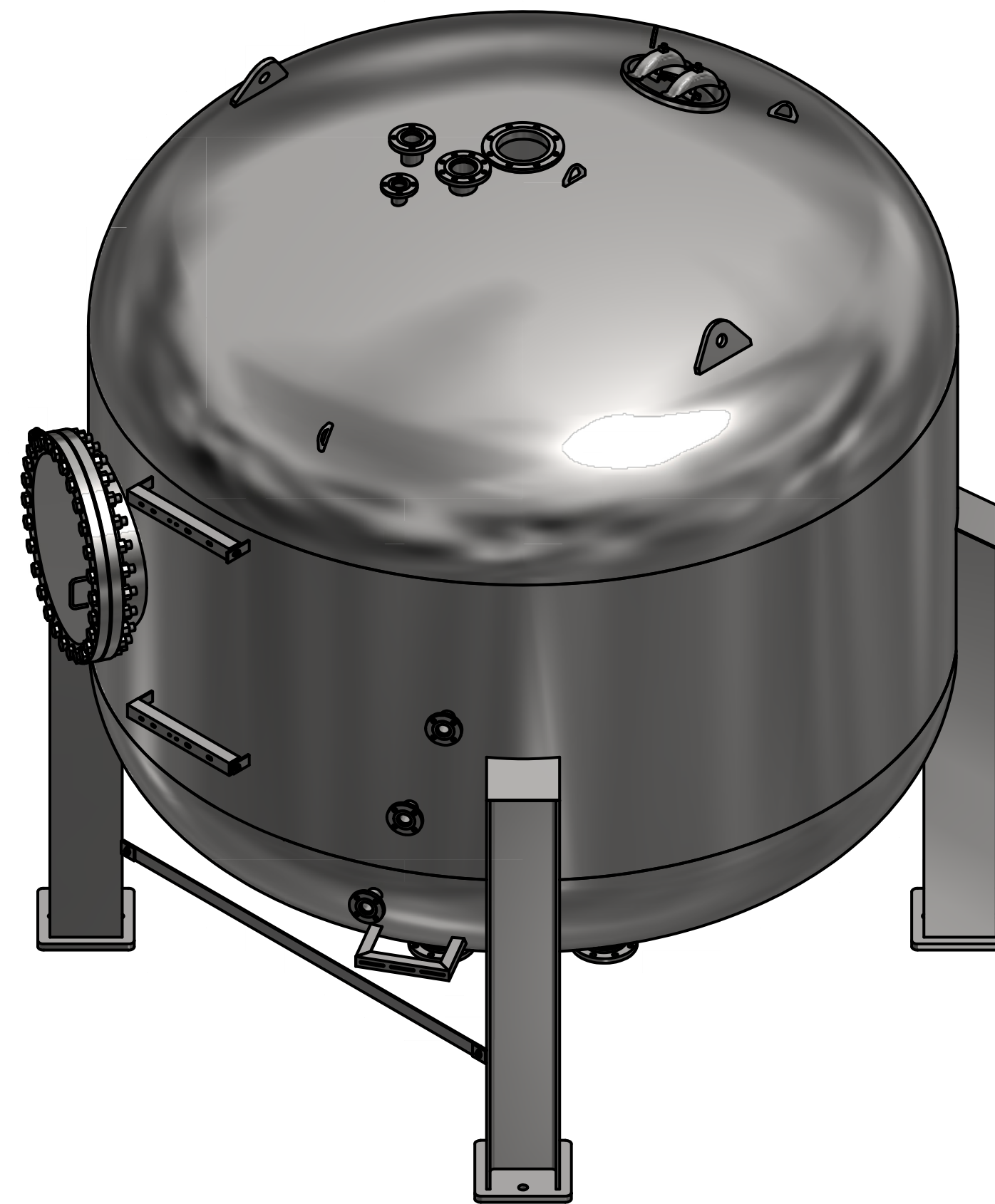
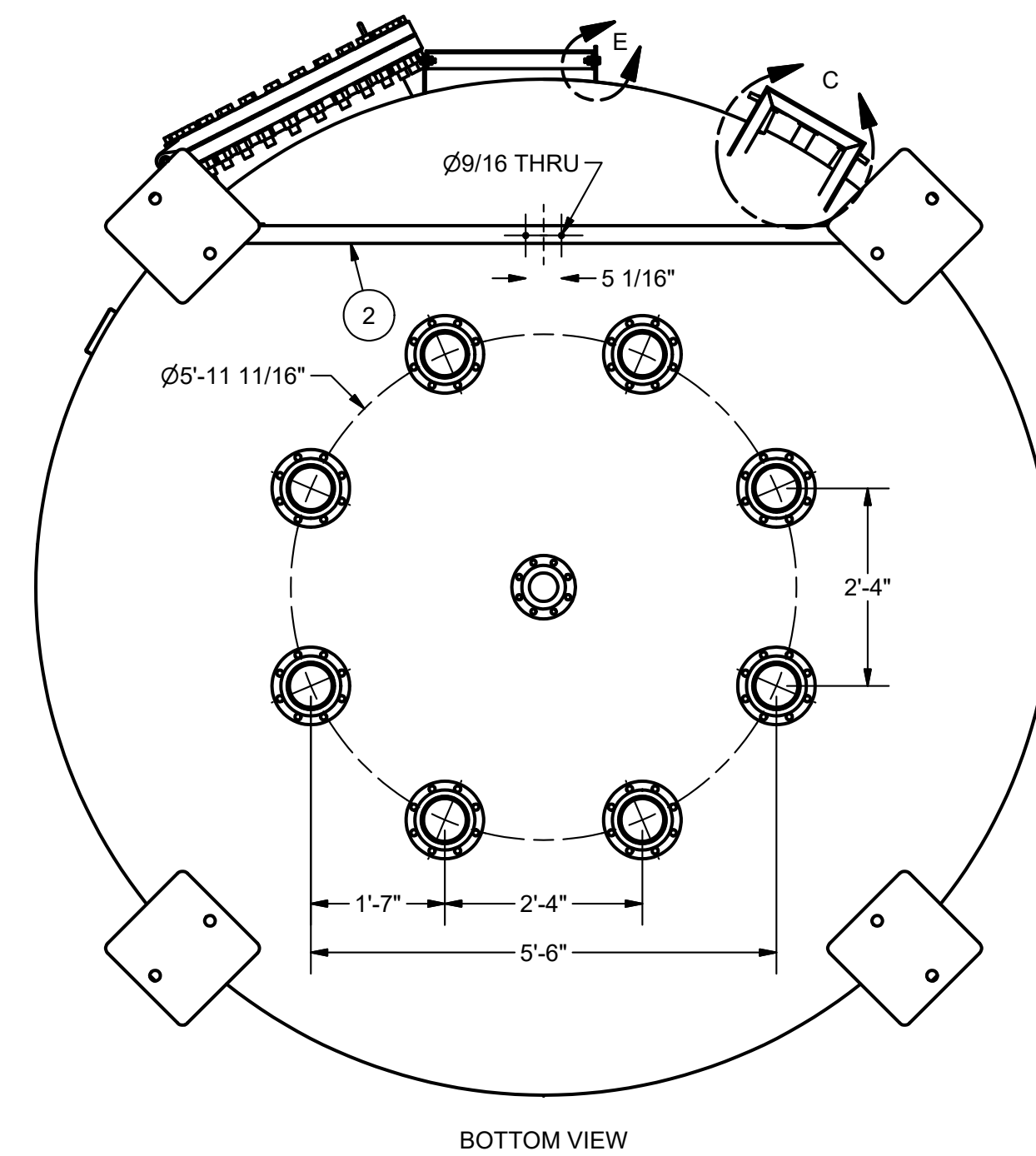


		PARTS LIST				
ITEM	QTY	DESCRIPTION		MATERIAL	LENGTH	WIDTH
1	3	ADAPTER, 0.5" COMP X 0.5" MPT 90° BRASS		Brass, Soft Yellow		
2	3	ADAPTER, SAMPLE PORT WELDMENT 316SS				
3	1	ADAPTER, SPRAY NOZZLE 2" 316SS				
4	6	ADAPTER, STR 0.5" CMP X 0.5" NPT BRASS		BRASS		
5	3	BOLT, HEX 0.25IN D X 1IN L 304SS		Stainless Steel		
6	80	BOLT, HEX 0.75IN D X 4IN L HDG GR A307		Steel, Galvanized		
7	8	BOLT, HEX 0.625IN D X 2IN L HDG GR A307		Steel, Galvanized		
8	52	BOLT, HEX 0.625IN D X 3.5IN L HDG GR A307		Steel, Galvanized		
9	32	BOLT, HEX 0.625IN D X 3IN L HDG GR A307		Steel, Galvanized		
10	1	BUSHING, 1.5IN x 1IN T x T STD WT 316SS		Stainless Steel		
11	1	CAMLOCK, 2" ALUM MALE X MPT		Aluminum-6061		
12	2	CAMLOCK, 4" ALUM FLG X MALE		Aluminum 6061		
13	1	CAP, DUST 2" ALUM CAMLOCK		AL, 6061		
14	2	CAP, DUST 4" ALUM CAMLOCK		Aluminum 6061		
15	3	CLAMP, TUBE CUSHIONED 0.5" SS W/ RUBBER 17/64" HOLE FASTENAL# 0216777		STN STL, 18-8		
16	2	COUPLING, 1IN HALF THD 3000 316SS		Stainless Steel		
17	1	COUPLING, 1IN HALF THD 3000 STL		Steel, Carbon		
18	1	COUPLING, 2IN FULL THD STD WT 316SS		Stainless Steel		
19	1	COUPLING, 2IN HALF THD 3000 STL		Steel, Carbon		
20	3	COUPLING, UNIVERSAL 1" NPT 316SS DIXON RAM12		STN STL, 316L		
21	1	DIFFUSER, SLOTTED 8IN NOM 316SS		Stainless Steel		
22	1	ELBOW, 1IN 90 GALV THD STD WT STD R		Steel, Galvanized		
23	2	ELBOW, 2IN 90 GALV THD STD WT STD R		Steel, Galvanized		
24	2	ELBOW, 4IN 90 STL WELD SCH 40 LR		Steel, Carbon		
25	1	ELBOW, 4IN 90 STL WELD SCH 40 SR		Steel, Carbon		
26	3	ELBOW, 8IN 90 STL WELD SCH 40 LR		Steel, Carbon		
27	1	FLANGE, 2IN BLIND CS 150# RF		Steel, Carbon		
28	3	FLANGE, 2x0.5IN COMPANION CS 150# RF		Steel, Carbon		
29	1	FLANGE, 3x2IN COMPANION CS 150# RF		Steel, Carbon		
30	4	FLANGE, 4IN SLIPON CS 150# FLAT FACE		Steel, Carbon		
31	6	FLANGE, 4IN SLIPON CS 150# RF		Steel, Carbon		
32	8	FLANGE, 6IN WELD NECK CS 150# RF		Steel, Carbon		
33	5	FLANGE, 8IN WELD NECK CS 150# RF		Steel, Carbon		
34	1	FLAT, 2X0.25 IN CS A36		Steel, Carbon	10,000 in	
35	7	GASKET, FLG 2IN NAM 37C RING 0.125IN THK 150#		Composite		
36	2	GASKET, FLG 3IN NAM 37C RING 0.125IN THK 150#		Composite		
37	2	GASKET, FLG 4IN NAM 37C FULL FACE 0.125IN THK 150#		Composite		
38	7	GASKET, FLG 4IN NAM 37C RING 0.125IN THK 150#		Composite		
39	16	GASKET, FLG 6IN EPDM RING 0.125IN THK 150#		EPDM		
40	3	GASKET, FLG 8IN NAM 37C RING 0.125IN THK 150#		Composite		
41	1	ID TAG 5.5X3.5		STN STL, 304		
42	3	NIPPLE, 1IN D X 1.5IN L SCH 40 316SS NPT TBE		Stainless Steel		
43	1	NIPPLE, 1IN D X 1.5IN L SCH 40 GALV NPT TBE		Steel, Galvanized		
44	3	NIPPLE, 2IN D X 2IN L SCH 40 316SS NPT TBE		Stainless Steel		
45	1	NOZZLE, 1" MNPT PP ORTHOS N8		POLYPROPENE		
46	3	NUT, HEX 0.25-20 UNC 304SS		Stainless Steel		
47	12	NUT, HVY HEX 0.5-13 UNC GALV 2H		Steel, Galvanized		
48	8	NUT, HVY HEX 0.25-20 UNC 304SS		Stainless Steel		
49	80	NUT, HVY HEX 0.75-10 UNC GALV 2H		Steel, Galvanized		
50	8	NUT, HVY HEX 0.375-16 UNC GALV 2H		Steel, Galvanized		
51	84	NUT, HVY HEX 0.625-11 UNC GALV 2H		Steel, Galvanized		
52	1	PF 12-520LP LOW PRO™ VESSEL 12 FT DIA 20K LB 125PSI BARE TANK				
53	1	PIPE, 1IN SCH 40 GALV A53-SA53 NSF		Steel, Galvanized	47,4075 in	
54	1	PIPE, 1IN SCH 40 GALV A53-SA53 NSF		Steel, Galvanized	99,6426 in	
55	1	PIPE, 1IN SCH 40 GALV A53-SA53 NSF		Steel, Galvanized	17,000 in	
56	1	PIPE, 2IN SCH 40 GALV A53-SA53 NSF		Steel, Galvanized	59,9375 in	
57	1	PIPE, 2IN SCH 40 GALV A53-SA53 NSF		Steel, Galvanized	101,5075 in	
58	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B		Steel, Carbon	50,7500 in	
59	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B		Steel, Carbon	101,5000 in	
60	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B		Steel, Carbon	49,7246 in	
61	2	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B		Steel, Carbon	7,0000 in	
62	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B		Steel, Carbon	14,000 in	

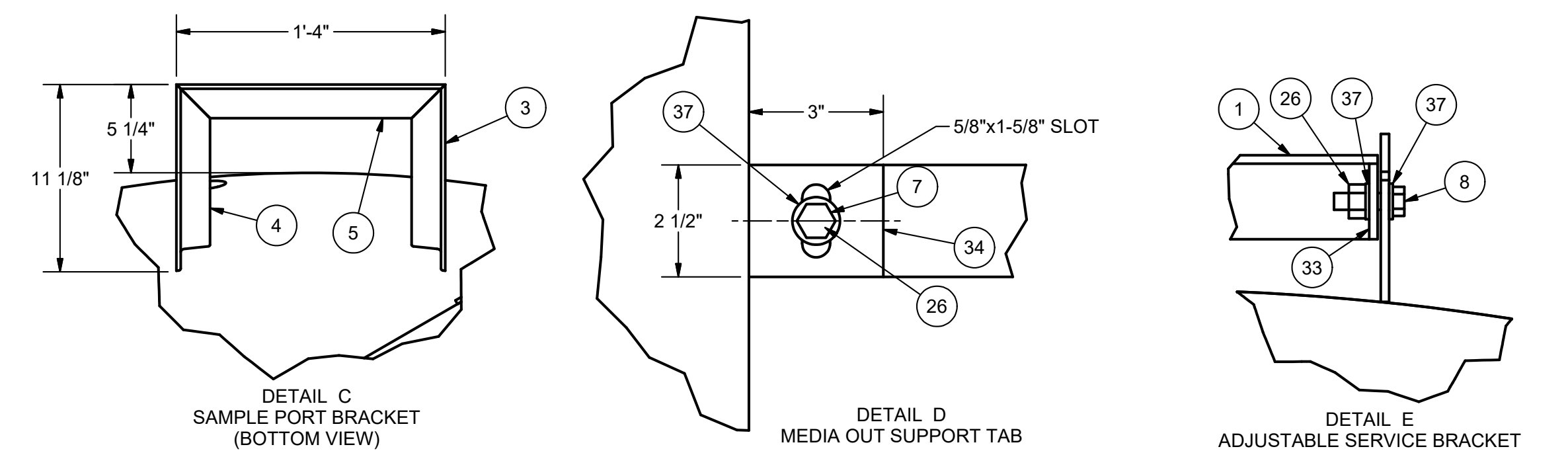
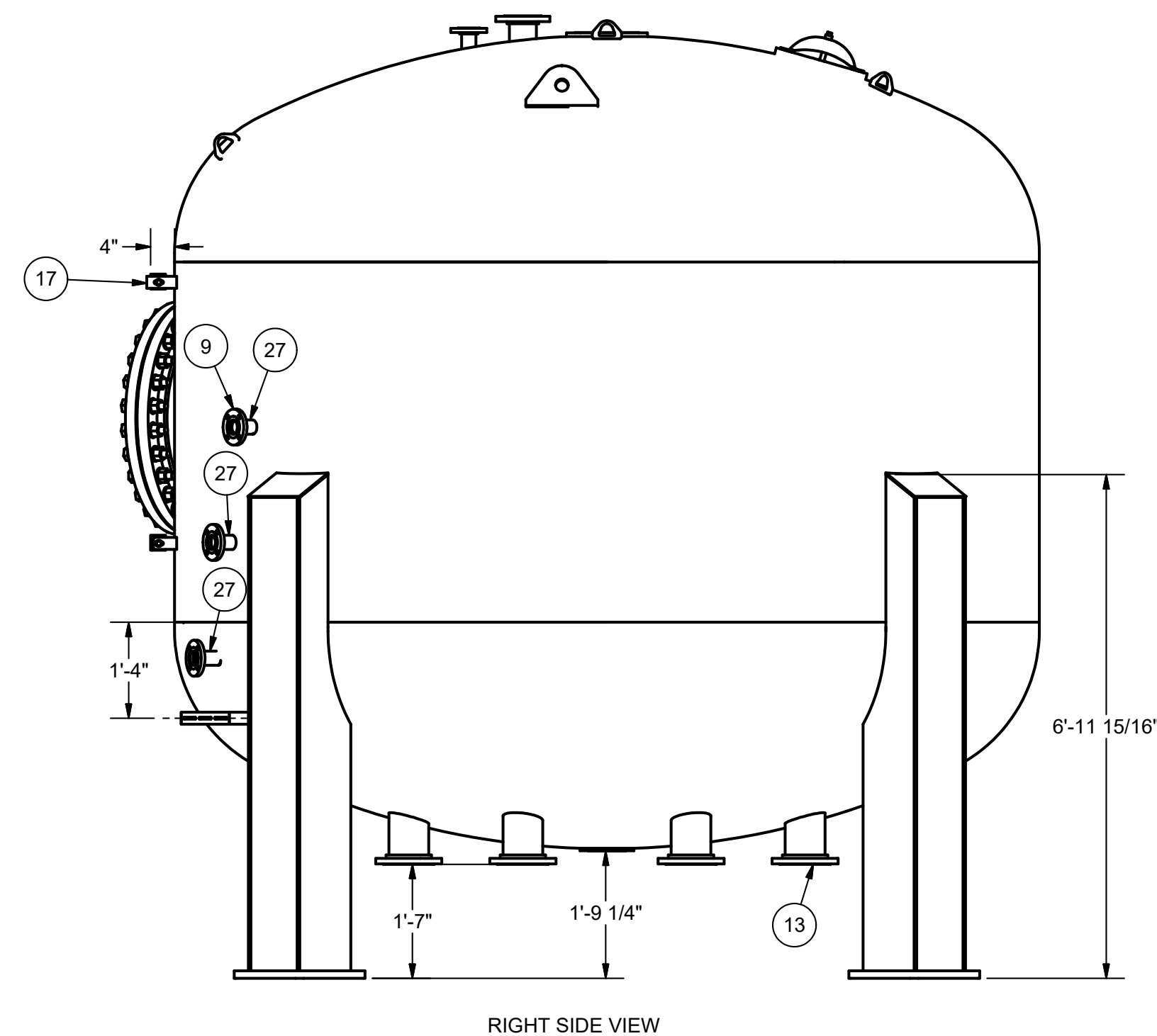
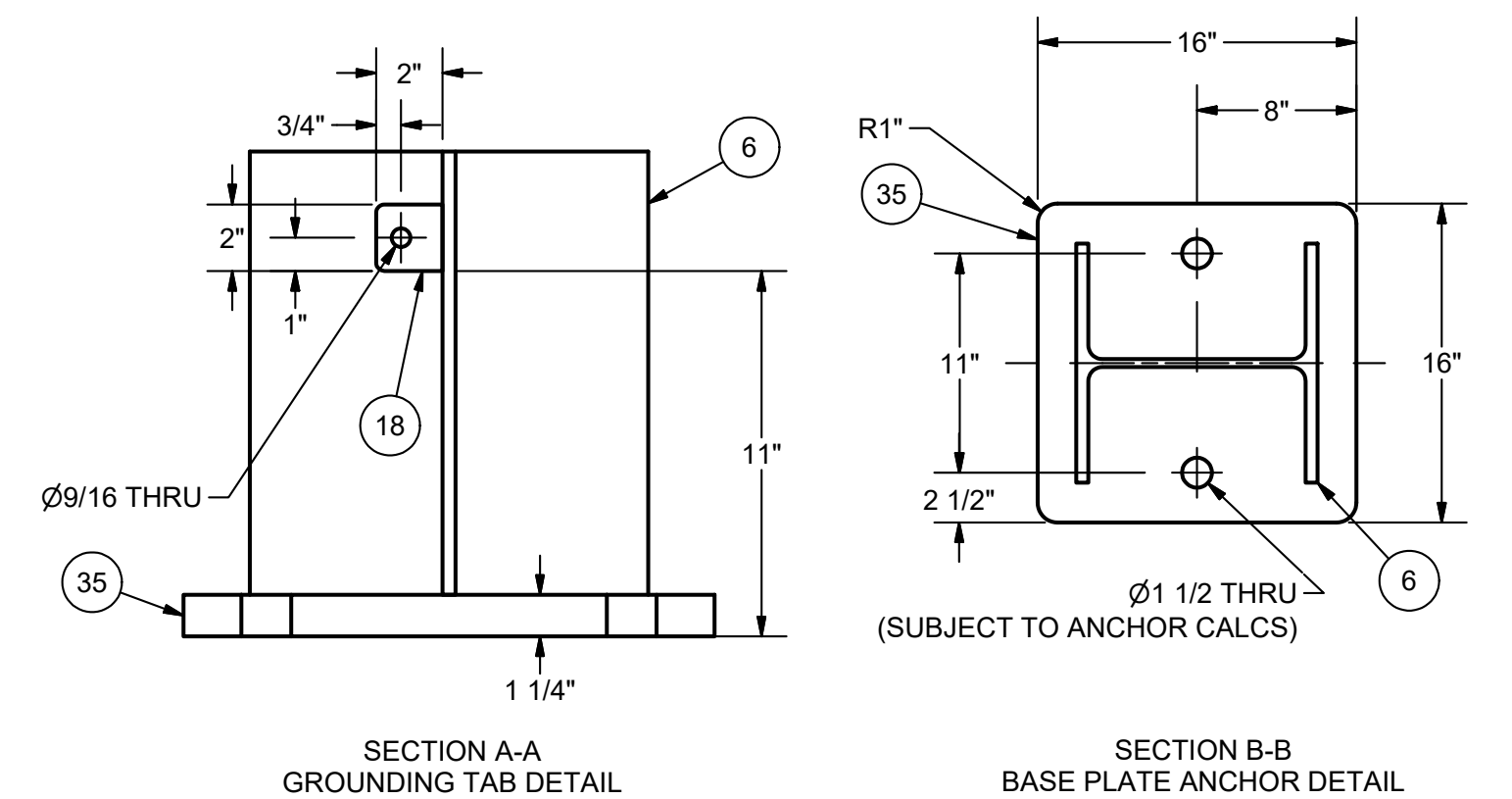
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DESIGNER:	DATE	TITLE				
AJA	9/1/2021	PF 12-520LP LOW PRO™ 125 PSI SINGLE TANK ASSEMBLY				
CHECKER:	DATE	CLIENT	CAMROSA WATER DISTRICT			
RM	9/1/2021		CONEJO WELLFIELD - GAC TREATMENT SYSTEM (CAMARILLO, CA)			
ENGINEER:	DATE		 16761 CLEAR CREEK ROAD REDDING, CA 96001 925-331-0573			
JT	9/1/2021					
MANAGER:	DATE					
SCALE:	1/2" = 1'	PROJECT	CODE	DRAWING NUMBER	SHEET	REV
		M-00096		PF 12-520LP ST 1	2 OF 2	0




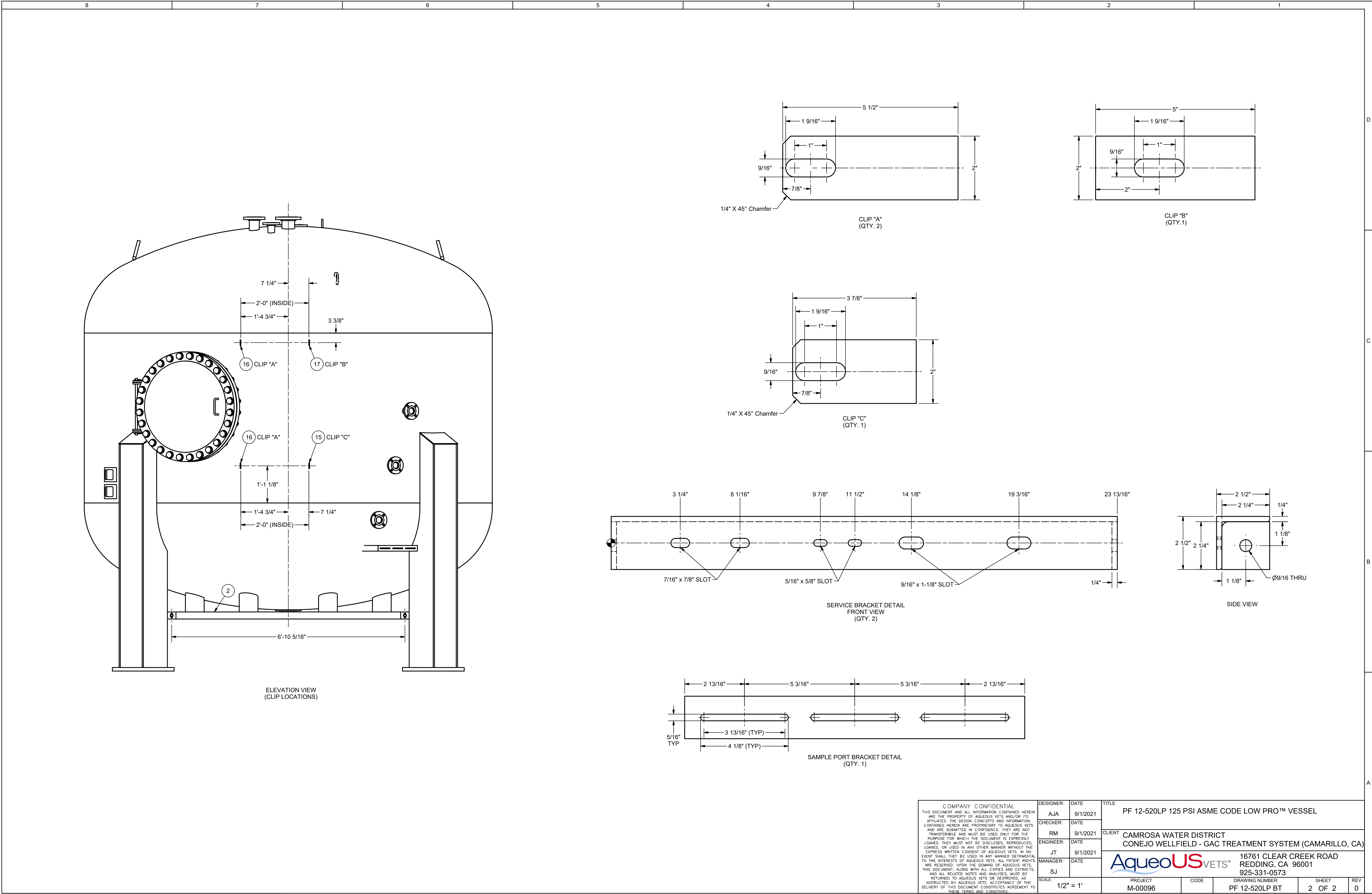
2			1		
PARTS LIST					
ITEM	QTY	DESCRIPTION	MATERIAL	LENGTH	WIDTH
1	2	ANGLE, CS A36 2.5X2.5X0.25 IN	Steel, Carbon	23.8125 in	
2	1	ANGLE, CS A36 2.5X2.5X0.375 IN	Steel, Carbon	85.0589 in	
3	1	ANGLE, CS A36 2X2X0.25 IN	Steel, Carbon	11.2500 in	
4	1	ANGLE, CS A36 2X2X0.25 IN	Steel, Carbon	11.2500 in	
5	1	ANGLE, CS A36 2X2X0.25 IN	Steel, Carbon	16.0000 in	
6	4	BEAM, W12X65# CS A36	Steel, Carbon	82.6875 in	
7	2	BOLT, HEX 0.5IN D X 1.5IN L HDG GR A307	Steel, Galvanized		
8	4	BOLT, HEX 0.5IN D X 1.75IN L HDG GR A307	Steel, Galvanized		
9	4	FLANGE, 2IN SLIPON CS 150# RF	Steel, Carbon		
10	1	FLANGE, 3IN SLIPON CS 150# RF	Steel, Carbon		
11	1	FLANGE, 4IN PAD CS 1.25IN THK 150# RF	Steel, Carbon		
12	1	FLANGE, 4IN SLIPON CS 150# RF	Steel, Carbon		
13	8	FLANGE, 6IN SLIPON CS 150# RF	Steel, Carbon		
14	1	FLANGE, 8IN PAD CS 1.75IN THK 150# RF	Steel, Carbon		
15	1	FLAT, 2X0.25 IN CS A36	Steel, Carbon	3.8750 in	
16	2	FLAT, 2X0.25 IN CS A36	Steel, Carbon	5.5000 in	
17	1	FLAT, 2X0.25 IN CS A36	Steel, Carbon	5.0000 in	
18	1	FLAT, 2X0.25 IN SS 304L	Stainless Steel	2.0000 in	
19	1	HEAD, 144IN OD x 0.5IN THK 1.5IN SF 2 to 1 SE STL SA516-70	Steel, Carbon		
20	1	HEAD, 144IN OD x 0.5IN THK 1.5IN SF 2 to 1 SE STL SA516-70	Steel, Carbon		
21	2	ID BRACKET, 7" x 5" x 1" CS 10 GA.	Steel, Carbon		
22	4	LIFTING LUG SMALL 2 900 LUG	Steel, Carbon		
23	2	LIFTING LUG, 50000# A36	Steel, Carbon		
24	1	MANWAY, 30" ROUND 150# RFSSO HDG NB&W FF EPDM GASKET			
25	1	MANWAY, ELP PRESSURE 14x18x14 SA-106 STL w/ SAFETY CHAIN	Steel, Carbon		
26	6	NUT, HVY HEX 0.5-13 UNC GALV 2H	Steel, Galvanized		
27	3	PIPE, 2IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	4.0000 in	
28	1	PIPE, 2IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	3.7500 in	
29	1	PIPE, 3IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	4.7500 in	
30	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	4.2500 in	
31	8	PIPE, 6IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	8.6250 in	
32	4	PLATE, STL A36/SA36 0.25 IN THK	Steel, Carbon	9.5193 in	12.1200 in
33	4	PLATE, STL A36/SA36 0.25 IN THK	Steel, Carbon	2.2500 in	2.2500 in
34	2	PLATE, STL A36/SA36 0.25 IN THK	Steel, Carbon	3.0000 in	2.5000 in
35	4	PLATE, STL A36/SA36 1.25 IN THK	Steel, Carbon	16.0000 in	16.0000 in
36	1	SHELL 144IN ODX60IN L1X2IN CS SA-516-70			
37	12	WASHER, FLAT STRL 0.5IN GALV	Steel, Galvanized		

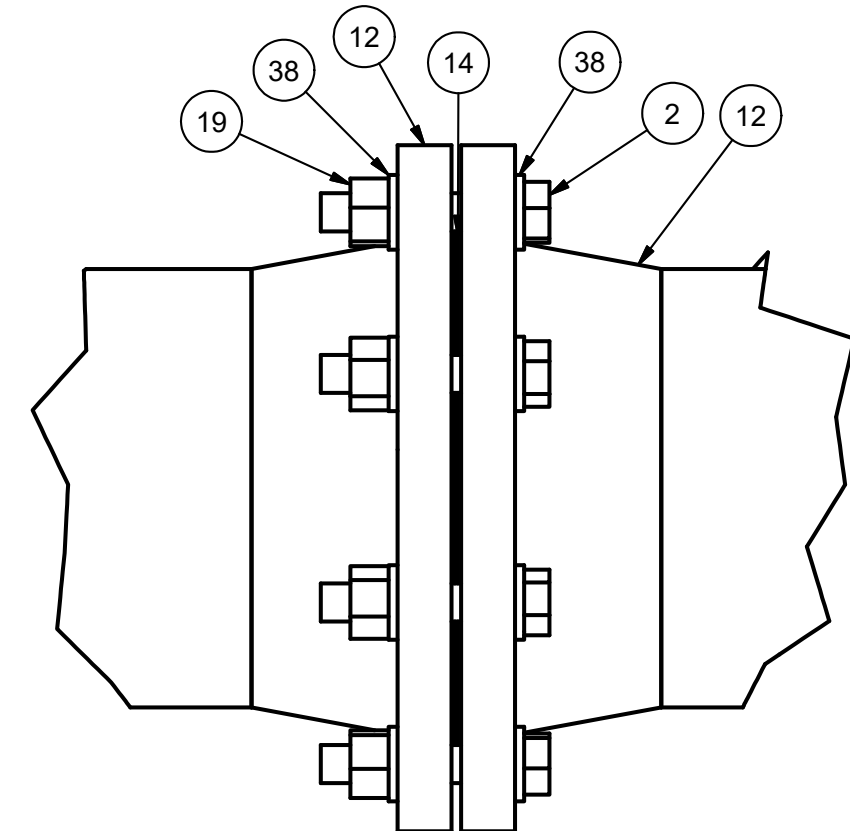


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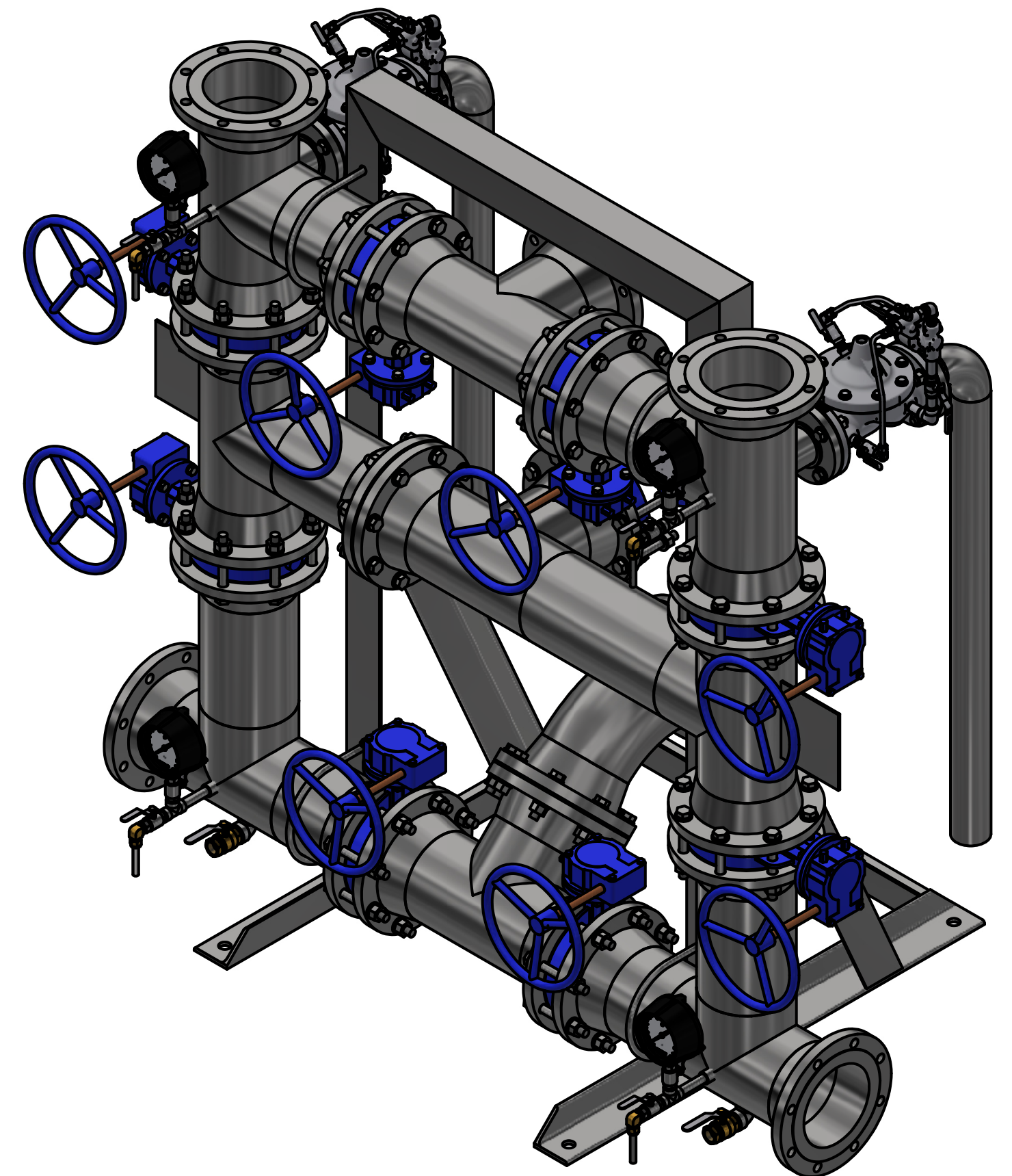
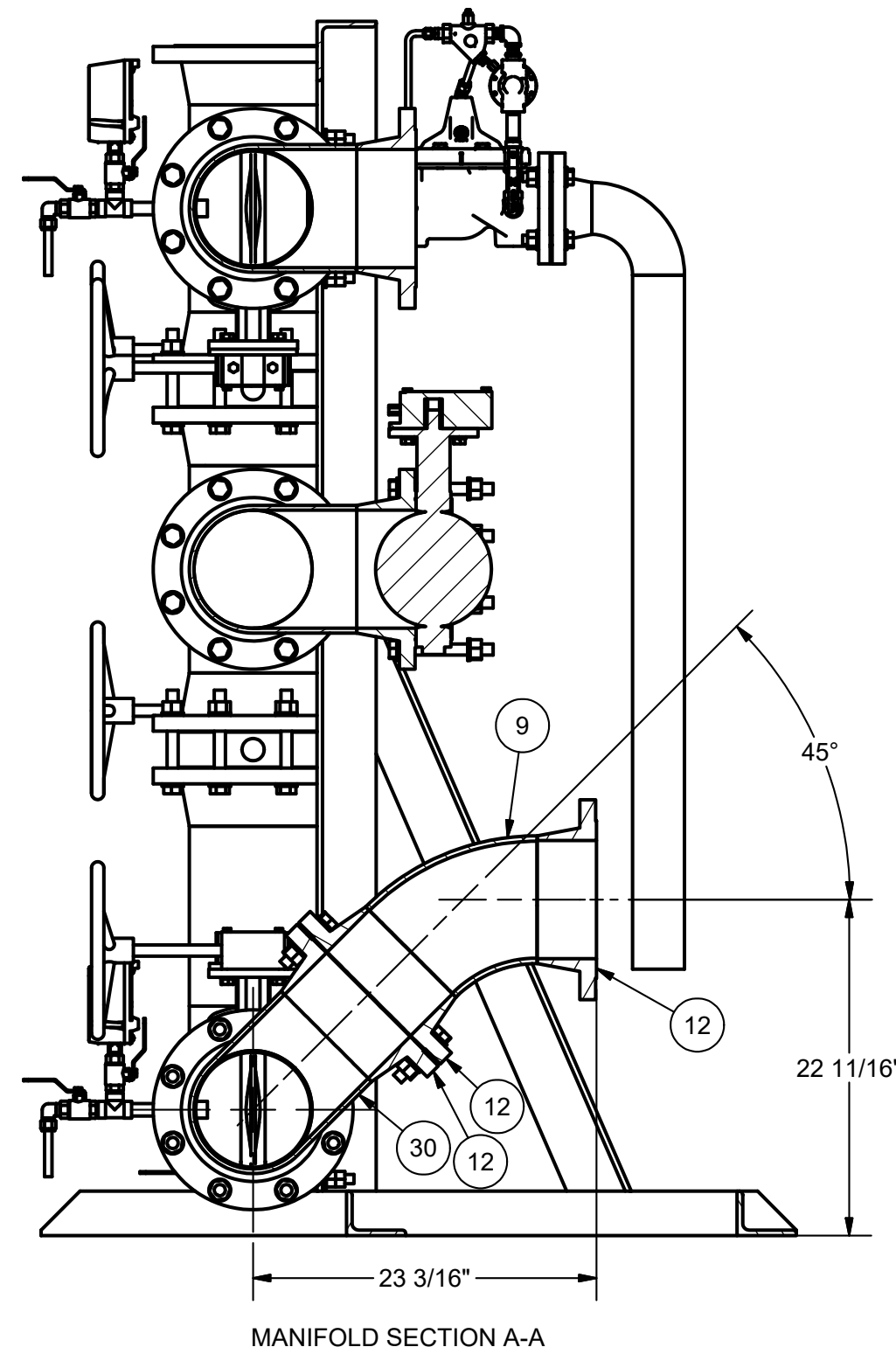
1. ASME STAMPED 125 PSI @ 150° F.
2. MATCH SEPTA RING HEADER TEMPLATE FOR 6" OUTLET NOZZLE FLANGES.
3. PE STAMPED VESSEL AND ANCHORING CALCS PER CURRENT CBC BY VESSEL MANUFACTURER. IP OF 1.5, SEISMIC SITE CLASS D.
4. STANDARD LEG DESIGN SHOW, ACTUAL LEG DESIGN TO FOLLOW PENDING P.E. REVIEW.
5. FLANGED MANWAY TO HAVE FULL FACE NSF-61 EPDM GASKET.
6. ELLIPTICAL MANWAY TO HAVE RING NSF-61 EPDM GASKET AND SAFETY CHAIN.
7. MANWAY FASTENERS (NUTS, BOLTS, WASHERS) TO BE HOT DIPPED GALVANIZED.
8. ANCHOR HOLES TO BE 3/16" LARGER THAN ANCHOR DIAMETER SPECIFIED IN CALCULATIONS.
9. VESSEL SURFACE PREPARATION: SSPC-SP5 INTERIOR & SSPC-SP6 EXTERIOR.
10. FINISH VESSEL INTERIOR WITH 35-45 MILS OF PLASITE 4110, PREPARE AND APPLY STRICTLY IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS TO MEET NSF STD 61 REQUIREMENTS. LINING TO BE CONTINUOUS TO OD OF THE RAISED FACE ON ALL NOZZLE FLANGES.
11. FINISH EXTERIOR WITH 2-3 MILS OF CARBOTHANE 134VOC URETHANE, COLOR TO BE DETERMINED, OVER 4-6 MILS OF CARBOGUARD 893 RUST PREVENTATIVE EPOXY PRIMER, APPLIED PER MANUFACTURERS RECOMMENDATIONS.
12. LEFT VESSEL SHOWN, RIGHT VESSEL MIRRORED.
13. ESTIMATED WEIGHT: 14,500 LBS.

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ITEM		QTY	DESCRIPTION	MATERIAL	LENGTH	WIDTH
1	4	ADAPTER, 0.5" COMP X 0.5" MPT 90° BRASS	Brass, Soft Yellow			
2	16	BOLT, HEX 0.75IN D X 4IN L HDG GR A307	Steel, Galvanized			
3	72	BOLT, HEX 0.75IN D X 6.5IN L HDG GR A307	Steel, Galvanized			
4	16	BOLT, HEX 0.625IN D X 3IN L HDG GR A307	Steel, Galvanized			
5	4	COUPLING, 0.5IN FULL THD 3000 316SS	Stainless Steel			
6	2	COUPLING, 1IN HALF THD 3000 316SS	Stainless Steel			
7	2	ELBOW, 1IN 90 GALV THD STD WT STD R	Steel, Galvanized			
8	2	ELBOW, 3IN 90 STL WELD SCH 40 LR	Steel, Carbon			
9	1	ELBOW, 8IN 45 STL WELD SCH 40 LR	Steel, Carbon			
10	2	FLANGE, 3IN SLIPON CS 150# RF	Steel, Carbon			
11	2	FLANGE, 3IN WELD NECK CS 150# RF	Steel, Carbon			
12	27	FLANGE, 8IN WELD NECK CS 150# RF	Steel, Carbon			
13	4	GASKET, FLG 3IN NAM 37C RING 0.125IN THK 150#	Composite			
14	2	GASKET, FLG 8IN NAM 37C RING 0.125IN THK 150#	Composite			
15	4	GAUGE, PRESSURE 0-60 PSI 4.5" DIA 0.5" NPT ASHCROFT 45 1279SSL 04L XGVSG 60# W/ AV LOGO	Phenolic Resin			
16	8	NIPPLE, 0.5IN D X 1.125IN L SCH 40 316SS NPT TBE	Stainless Steel			
17	4	NIPPLE, 0.5IN D X 4IN L SCH 40 316SS NPT TBE	Stainless Steel			
18	4	NIPPLE, 1IN D X 1.5IN L SCH 40 316SS NPT TBE	Stainless Steel			
19	88	NUT, HVY HEX 0.75-10 UNC GALV 2H	Steel, Galvanized			
20	32	NUT, HVY HEX 0.625-11 UNC GALV 2H	Steel, Galvanized			
21	2	PIPE, 3IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	3.821 in		
22	2	PIPE, 3IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	46.862 in		
23	4	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	6.0000 in		
24	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	16.3622 in		
25	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	8.300 in		
26	2	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B	Steel, Carbon	12.1380 in		
27	2	PLATE, STL A36/SA36 0.1875 in THK	Steel, Carbon	8.0000 in	7.0000 in	
28	1	STAND, MANIFOLD 8" CS LP 15" OUTLET				
29	4	TEE, 0.5IN 304 SS THD 150# STD	Stainless Steel			
30	9	TEE, 8IN STL WELD STD WT STD	Steel, Carbon			
31	4	TUBE RND, 0.5IN 0.035 WALL SST 316L	Stainless Steel	4.0000 in		
32	4	U-BOLT, 8IN PIPE 0.625IN DIA GALV LONG TANGENT	Steel, Galvanized			
33		VALVE TAGS, LABELED PER P&ID				
34	8	VALVE, BALL 0.5IN NPT 316L APOLLO 76F-100 SERIES	Stainless Steel			
35	2	VALVE, BALL 1IN NPT BRASS SCH# 01728155KL	Brass, Soft Yellow			
36	9	VALVE, BFLY WFR HW 8" DI BDB CF8M (316SS) DISC EPDM SEAT PRATT BF1				
37	2	VALVE, PRV 3" FLGD DI/BDBY 125PSI CLA-VAL 50-01BK#; (SEE DATA SHEET)				
38	176	WASHER, FLAT STRL 0.75IN GALV	Steel, Galvanized			
39	40	WASHER, FLAT STRL 0.625IN GALV	Steel, Galvanized			



- NOTES:
1. PIPING MATERIALS SHALL MEET: CS PIPE ASTM A-53 GRADE B (ERW); CS FITTINGS SA-234, ASME B16.9; SS THREADED FITTINGS ASTM A-351; SS PIPE ASTM A-312; SS BW FITTINGS ASTM A-403; MI THREADED FITTINGS ASME B-16.3.
 2. MANIFOLD SURFACE PREPARATION: SSPC-SP10 INTERIOR & SSPC-SP6 EXTERIOR.
 3. FINISH EXTERIOR WITH 2-3 MILS OF CARBOATHANE 134VOC URETHANE, COLOR TO BE DETERMINED. OVER 4-6 MILS OF CARBOGUARD 893 RUST PREVENTATIVE EPOXY PRIMER, APPLIED PER MANUFACTURERS RECOMMENDATIONS.
 4. CS PROCESS PIPE TO BE INTERNALLY LINED WITH 18MIL (MIN.) OF 3M SCOTCHKOTE 134 FUSION BONDED EPOXY.
 5. ALL VALVES TO BE TAGGED WITH NUMBER SHOWN ON P&ID.
 6. ESTIMATED SHIPPING WEIGHT: 3,000 LBS.
 7. GROUTING AND ANCHORING BY OTHERS IF REQUIRED.
 8. ± 1" TOLERANCE ON CONNECTION DIMENSIONS.

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DESIGNER: DATE		TITLE MANIFOLD, 8" CS S40 3 TIER 3" PRV LOW PRO™ 45° OUTLET ASSY				
AJA 9/1/2021						
CHECKER: DATE		CLIENT				
RM 9/1/2021						
ENGINEER: DATE		 16761 CLEAR CREEK ROAD REDDING, CA 96001 925-331-0573				
JT 9/1/2021						
MANAGER: DATE						
SCALE: 1" = 1'		PROJECT	CODE	DRAWING NUMBER	SHEET	REV
				Man 8in CS 3 3in LP 45 ASSY	1 OF 1	0



Section 2

Valves

PRATT®

a MUELLER brand

BF SERIES WAFER / LUG BUTTERFLY VALVES

Engineering Creative Solutions for Fluid Systems Since 1901



MUELLER

CONSTRUCTION SPECIFICATION

Pratt® BF Series Butterfly Valves – 2" - 48"

SIZES	2" - 48"
BODY	Ductile Iron (65-45-12)
DISC	Ductile Iron Nickle Plated Ductile Iron Nylon 11 CF8M Stainless Steel Aluminum Bronze
STEM	416 S.S. Heat Treated
RESILIENT SEAT	EPDM, Buna-N Viton
ACTUATION OPTIONS	Worm Gear Lever Pneumatic Electric
PRESSURE RATINGS	2" – 12" 230 psi 14" – 48" 150 psi

* For installation between ANSI 125/150

** Substitute material may result in pressure rating change.
Contact factory for details.

FEATURES

- Innovative 3 point connection, tongue and groove seat allows for higher pressure rating and full Vacuum service
- Unique secondary shaft seals prevent leakage from shaft.
- Our two piece shaft design provides maximum strength and a high flow characteristic disc.



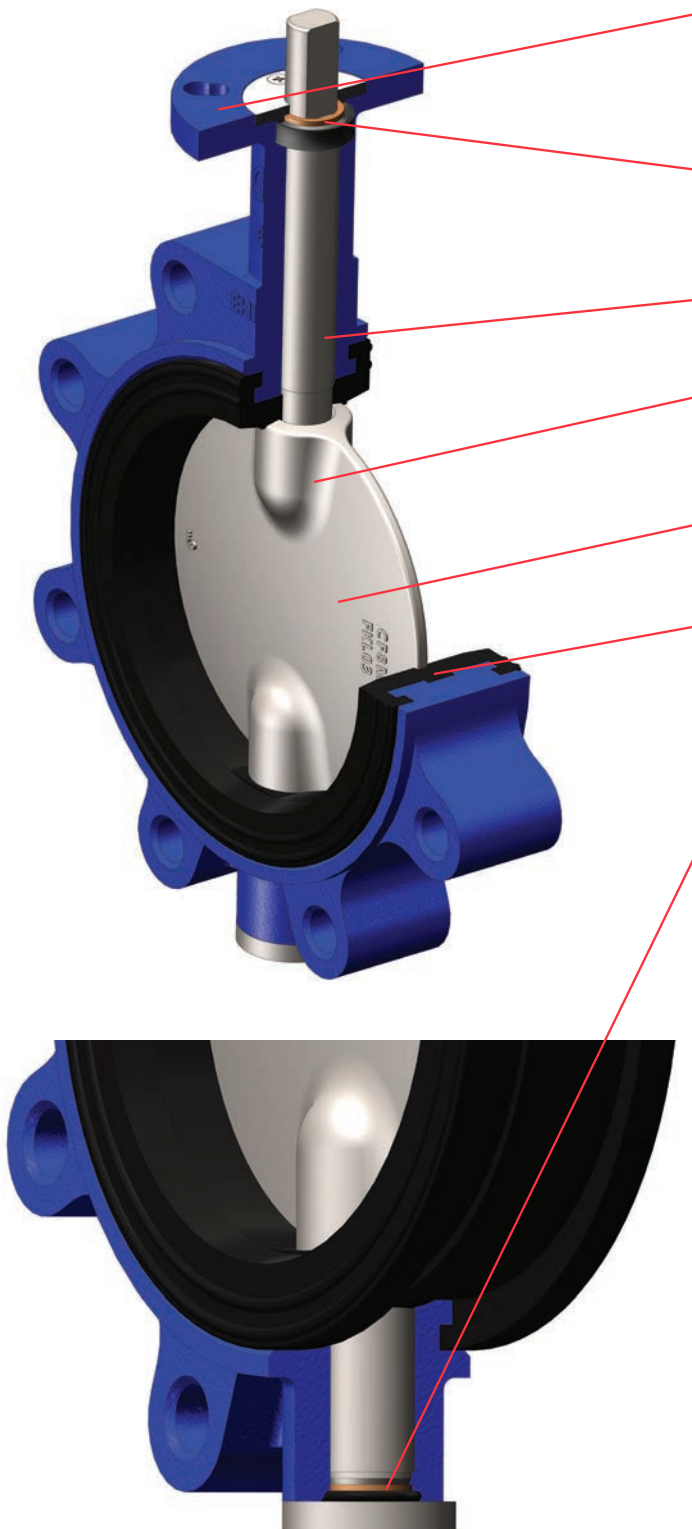
VALVE WITH ELECTRIC OPERATOR



VALVE WITH GEAR OPERATOR

DESIGN DETAILS

Pratt® BF Series Butterfly Valves – 2" - 48", 2"-12" 230 psi, 14"-48" 150 psi



TOP FLANGE

Conforms to ISO 5211 and KV industrial standard allowing a universal mounting pad for automation requirements which is suitable for most actuators in the market.

BLOWOUT PROOF STEM

Meets all API 609 requirements. Our unique design also creates a secondary stem journal seal preventing leakage to atmosphere.

A FULL LENGTH NYLATRON® BUSHING

Reduces stem journal friction and reduces torque.

UTILIZES 2 INTERNALLY DRIVEN SHAFTS

Creating a strong drive connection and allowing for a thin profile disc creating high Cv's.

THIN PROFILE, HIGH TENSIL STRENGTH DISC

Maximizes Cv's and allows for 230 psi pressure rating.

THE PRATT UNIQUE SEAT DESIGN

Utilizes 3 tongue and groove connection points to the valve body. Seats remain secure and stable even under high dead-end pressure and full vacuum services. The center tongue not only locks the seat in place, but allows rubber material to flow into the center body groove when cycling the valve, drastically reducing the operating torque.

THE BF SERIES BOTTOM CAP

Provides lower stem retention and also creates a secondary stem journal seal preventing external leakage to atmosphere. 2"-12" lower shafts ride on a precision wear guide reducing shaft drag.

14" and larger utilizes an axial bearing to support the weight of the shaft and disc, providing a close to friction-free movement.

SUGGESTED SPECIFICATION

Pratt® BF Series Butterfly Valves – 2" - 48", 2"-12" 230 psi, 14"-48" 150 psi

GENERAL

Valves shall be of the Wafer or Lug design for installation between ANSI 125 / 150 flanges. All valves shall be capable of bi-directional, end of line, bubble tight service to rated pressure. Valves are also rated to full vacuum service. Design Standards: API 608 category A.

PRESSURE RATING

2" – 12" – 230psi to fit between ANSI 125 / 150 flanges
14" – 48" – 150psi to fit between ANSI 125 / 250 flanges

BODY

Valve body shall be a 1 piece Ductile Iron ASTM A-536 (65-45-12) construction with a laying length conforming to the latest revision of ISO 5752 and a flange connection B16.1/B16.5.

DISC

Valve disc shall be Ductile iron ASTM A-536 Grade 65-45-12 with ENP plating or Nylon 11 coating, CF8M Stainless Steel, or Aluminum Bronze. Disc shall be designed to accommodate an upper and lower shaft with a thin center profile giving higher Cv values combined with strength.

SHAFT

Valve shaft shall be constructed of Heat Treated 416 Stainless Steel. Valve shall be designed to accommodate (2) shafts (1 upper and 1 lower). The upper shaft shall have a positive engagement in the disc utilizing an internal square drive and shall be retained by the body Top Cap and End Cap.

SEAT

Seat shall be EPDM, Buna-N or Viton. Seat design shall consist of 3 Tongues (2 located on the side walls and 1 located in the center bore) that engage into 3 grooves in the body. These 3 tongue and groove connection points prevent seat movement in a radial and axial direction. Seats shall be field replaceable.

SHAFT SEALS

Upper Shaft Seal shall be self-adjusting V-type and shall be suitable for Pressure or Vacuum service. Packing shall be located above the bushing and shall create a positive seal against the Top Cap. Bottom end cap contains a captive o-ring creating a positive seal against external leakage.

BUSHINGS

Valve shall consist of (2) full length Nylatron® bushings (upper and lower) offering superior protection against friction, corrosion and impacts. Pratt's unique bushings design provide protection against shaft side loading.

TESTING

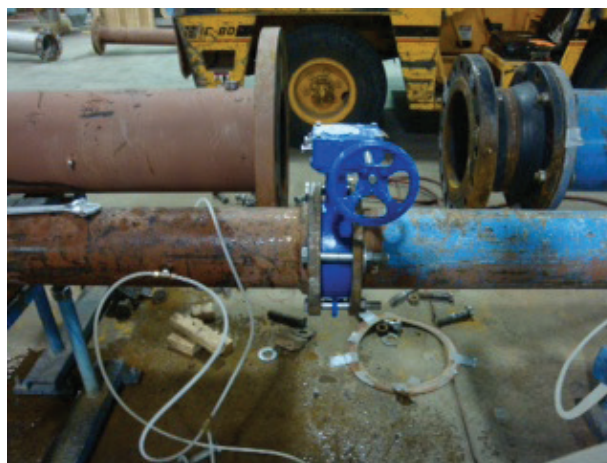
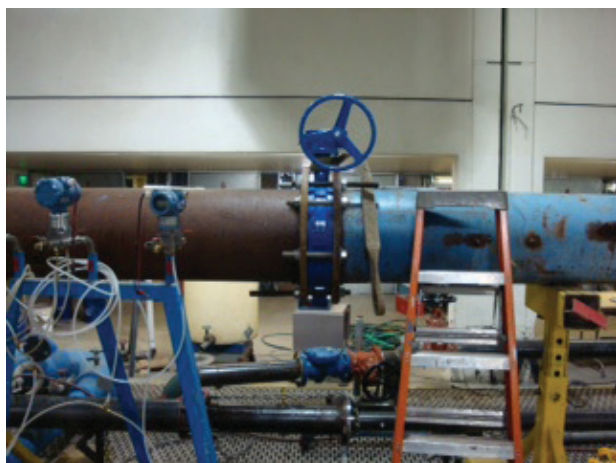
All valves shall be leak tested in the factory at their rated pressure per API 598.

CV FLOW DATA

Pratt® BF Series Butterfly Valves

During its product development phase, the Pratt BF Series Wafer / Lug Butterfly Valve was tested to ensure that it met our own rigorous standards for flow capacity. Throughout testing, the Pratt BF Series valve has consistently produced high Cv values which translates to lower flow resistance, and in turn, lowering system operating costs to the user over the life of the valve. The following Cv chart represents the flow characteristics for all sizes available.

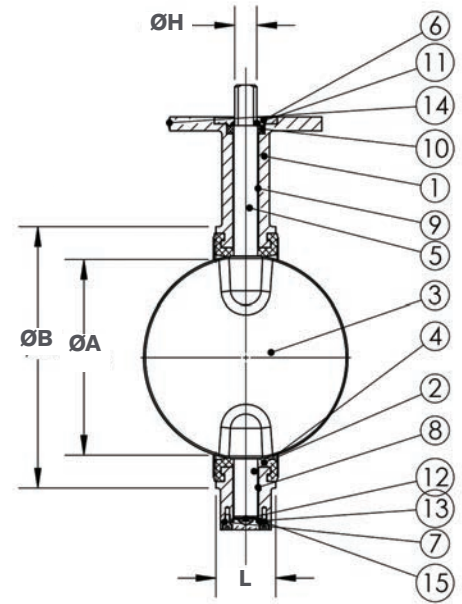
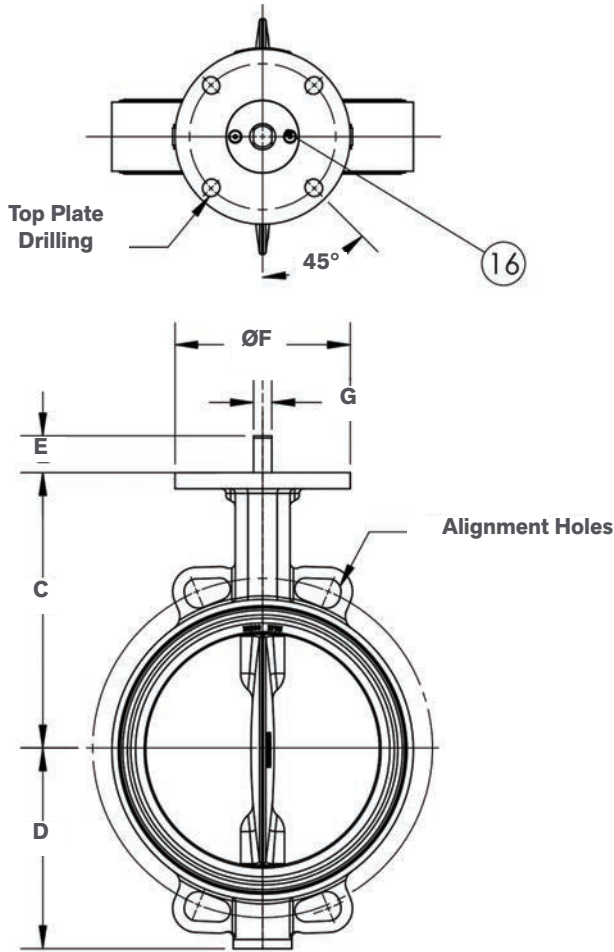
VALVE OPENING (DEG)	CV BY VALVE SIZE													
	2"	2.5"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
10	1	2	3.5	6	8.5	14	18	28.1	40.5	55.1	72	91.1	112.5	162
20	1.8	2.9	4.1	7.4	11.5	16.5	29.4	185.5	267.1	363.6	474.9	601.1	742.1	1069
30	10.8	16.9	24.3	43.2	67.5	97.1	172.7	381.5	549.4	747.8	976.7	1236	1526	2198
40	22.1	34.5	49.7	88.4	138.1	198.8	353.4	683.1	983.6	1339	1749	2213	2732	3935
50	38.5	60.2	86.7	154.2	240.9	346.9	616.8	1161	1671	2275	2971	3761	4643	6685
60	65.3	102	146.9	261.1	408	587.6	1045	1944	2799	3810	4976	6298	7775	11196
70	111	173.5	249.8	444.1	693.9	999.2	1776	3232	4654	6335	8274	10472	12928	18617
80	176.2	275.2	396.3	704.6	1101	1585	2818	6215	8950	12182	15911	20138	24862	35801
90	206.4	322.5	464.4	825.6	1290	1858	3302	6420	9245	12583	16435	20801	25680	36979



Pratt BF Series Wafer / Lug Butterfly Valves being tested at an independent research laboratory

DIMENSIONAL DATA

Pratt® BF Series, Wafer



PART NO.	PART NAME	MATERIAL	QTY.
1	Wafer Body	DI	1
2	Seat	EPDM / NBR / Viton	1
3	Disc	SS316 / DI / C954 / Nylon 11	1
4	Lower Stem	SS416 / SS316 / SS630	1
5	Upper Stem	SS416 / SS316 / SS630	1
6	Top Cap	1020 Steel	1
7	End Cap	1020 Steel	1
8	Lower Bushing	Nylatron®	1
9	Upper Bushing	Nylatron®	1
10	V-packing	NBR	1
11	Washer	SS304	1
12	Wear Shim	SS304	1
13	O-ring	NBR	1
14	Data Plate	SS304	1
15	End Cap Bolt	SS304	2
16	Top Cap Bolt	SS304	2

												PRATT STANDARD TOP PLATE DRILLING			ISO 5211 TOP PLATE DRILLING			ALIGNMENT HOLES		
SIZE	LBS	ØA	ØB	C	D	E	ØF	G	ØH	L	KEY	BOLT CIRCLE	NO. OF HOLES	HOLE DIA.	BOLT CIRCLE	NO. OF HOLES	HOLE DIA.	BOLT CIRCLE	NO. OF HOLES	HOLE DIA.
2"	5.51	1.079	3.500	5.000	2.579	1.260	4.000	0.375	0.563	1.693	-	3.25	4	0.437	2.760	4	0.402	4.75	4	0.75
2.5"	6.39	1.862	4.094	5.500	2.854	1.260	4.000	0.375	0.563	1.811	-	3.25	4	0.437	2.760	4	0.402	5.5	4	0.75
3"	7.49	2.429	4.646	5.709	3.642	1.260	4.000	0.375	0.563	1.811	-	3.25	4	0.437	2.760	4	0.402	6	4	0.75
4"	10.58	3.500	5.827	6.496	4.429	1.260	4.000	0.437	0.625	2.047	-	3.25	4	0.437	2.760	4	0.402	7.5	4	0.75
5"	15.65	4.567	7.205	7.500	4.921	1.260	4.000	0.500	0.750	2.205	-	3.25	4	0.437	2.760	4	0.402	8.5	4	0.88
6"	17.63	5.433	7.992	7.874	5.433	1.260	4.000	0.500	0.750	2.205	-	3.25	4	0.437	2.760	4	0.402	9.5	4	0.88
8"	31.52	7.744	10.315	9.500	6.811	1.260	6.000	0.625	0.875	2.362	-	5	4	0.563	4.921	4	0.563	11.75	4	0.88
10"	50.03	9.646	12.598	10.866	8.110	2.000	6.000	-	1.125	2.677	1/4" * 1/4"	5	4	0.563	4.921	4	0.563	14.25	4	1
12"	67.00	11.339	14.567	12.205	9.713	2.000	6.000	-	1.125	3.071	1/4" * 1/4"	5	4	0.563	4.921	4	0.563	17	4	1

BF SERIES PART NUMBER

Ordering Information

VALVE MODEL		ANSI CLASS		SIZE		BODY		DISC		STEM		SEAT		OPTIONS	
XXX		XXX		XXX		X		X		X		X		XX	
BF1	Wafer	125	Class 125	020	2"	8	Ductile Iron	9	DI/ENP	9	STEEL	9	BUNA	01	UC DISC
BF2	Lug	P10	PN10	025	2 1/2"	7	316SS/CF8M	8	DI/Nylon-11	8	416	8	EPDM	02	SILICONE FREE
		P16	PN16	030	3"			7	Al. Bronze	7	DUPLEX	7	VITON	03	02 CLEANED
				040	4"			6	CF8M	6	316	6	WHITE BUNA	04	SPECIAL PAINTING
				050	5"			4	MONEL	5	MONEL	2	NAT. RUBBER	05	SPECIAL BOLTING
				060	6"			3	HAST C 276	4	HAST C 276	1	NEOPRENE	06	ANTISTATIC
				080	8"			2	17/4 PH	3	17/4			07	SPECIAL PACKING
				100	10"			1	ALLOY 20	2	ALLOY 20			12	NACE
				120	12"			0	DUPLEX 2205					13	GREASE INJECTOR
				140	14"			H	SMO255						
				160	16"										
				180	18"										
				200	20"										
				240	24"										
				300	30"										
				360	36"										
				400	40"										
				420	42"										
				480	48"										
				540	54"										
				600	60"										
				720	72"										
				D05	DN50										
				D06	DN65										
				D08	DN80										
				D10	DN100										
				D12	DN125										
				D15	DN150										
				D20	DN200										
				D25	DN250										
				D30	DN300										
				D35	DN350										
				D40	DN400										
				D45	DN450										
				D50	DN500										
				D60	DN600										

	Standard Product
	Special Order Product
	Options only show in the figure number if there is an option

*Other material and options available upon request

Example Part #: BF1-125-020-8888

Submittal Data Cover Sheet

Date: 02/05/19



Model No.: 50-01BKH

Description: PRESSURE RELIEF VALVE

Job/Project Name: Camrosa Aqueous Vets

Company: J.W. Wood

Contact: Mike Cleveland

Engineering Firm:

Address:

Project Engineer:

City: Redding State: CA Zip:

Fluid To Be Handled: Water

Specific Gravity: 1

Temperature: Ambient

Max. Flow Rate: 1000 GPM

Min. Flow Rate: 0 GPM

Main Valve

Valve Size:

3"

Main Valve Body & Cover:

Ductile Iron ASTM A-536

End Details:

Flanged Ductile Iron ANSI B16.42 Class 150

Base Valve:

100-01 Hytrol

Main Valve Trim:

(Disc Guide, Seat & Cover Bearings)

Optional Stainless Steel

Pressure Rating:

150 Class @ 250 psi Max.

Quantity:

6

Valve Pattern:

Globe

Elastomers: (Max Temperature 180°F)

Buna-N® Synthetic Rubber

Pilot System

Hydraulic Pilot System Adjustment Range(s)

Electronic Pilot Spring Ranges

CRL 20-200 PSI

Tubing & Fittings

Copper & Brass

Pilot System Configuration

Bronze with SST Trim (standard)

Electrical

Electrical - Voltages & Accessories

VC-22D Electronic Valve Controller

VC-22D Power Converter

Features & Options

☒ Strainer:

☒ Pilot System Isolation Valves (B)

☐ Closing Speed Control (C)

☐ Opening Speed Control (S)

☐ Pilot System Check Feature (D)

☐ Independent Operating Pressure (I)

☐ Atmospheric Drain (H)

☒ Fusion Bonded Epoxy Coating 6-8 mil (KC)

☐ X144D e-FlowMeter (M)

☐ Reservoir Gauge with Tester (R)

☐ X145 External Display

Pressure Gauges:

Inlet: 2-1/2" 0 - 200 psi

Outlet:

Cover:

Valve Position Transmitter:

Valve Position Indicator:

Stem Option:

Limit Switch (SPDT):

Differential Pressure Transmitter:

Pressure Transmitter:

Inlet:

Outlet:

Orifice Plate:

Bore: _____

Power Generator:

X43 H-Style Strainer:

X43 H-Style Strainer Flange:
(Ductile Iron ASME B16.42)

Notes:

valve to have "KH" Heavy Spring, VALVE TO BE SET FOR 125 PSI

Cla-Val Contact: JOE PASSALACQUA

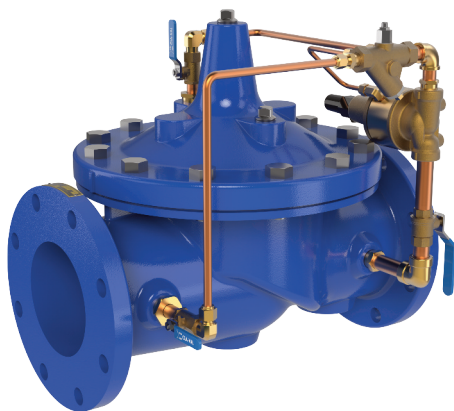
Phone: 925-803-4646

E-Mail: jpassalacqua@cla-val.com



MODEL 50-01

Pressure Relief & Pressure Sustaining Valve



Schematic Diagram

Item Description

- | | |
|---|--------------------------------|
| 1 | 100-01 Hytrol Main Valve |
| 2 | X42N-2 Strainer & Needle Valve |
| 3 | CRL-60 Pressure Relief Control |

Optional Features

Item Description

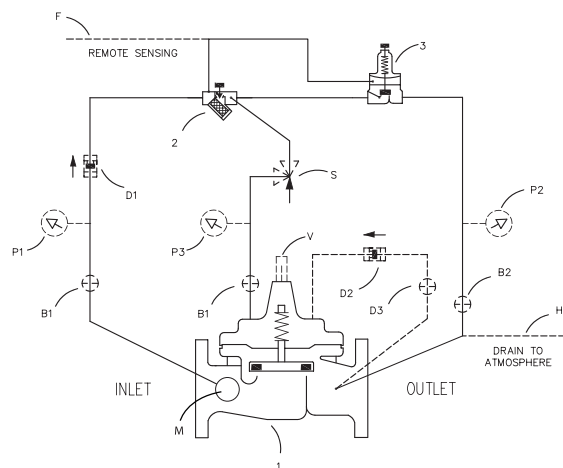
- | | |
|---|-----------------------------------|
| B | CK2 Isolation Valve |
| D | Check Valves with Isolation Valve |
| F | Remote Pilot Sensing |
| H | Drain to Atmosphere |
| M | X144 e-FlowMeter |
| P | X141 Pressure Gauge |
| S | CV Speed Control (Opening) |
| V | X101 Valve Position Indicator |



- Accurate Pressure Control
- Optional Check Feature
- Fast Opening to Maintain Line Pressure
- Slow Closing to Prevents Surges
- Completely Automatic Operation

The Cla-Val Model 50-01 Pressure Relief Valve is actuated by line pressure through a pilot control system, opening fast to maintain steady line pressure but closing gradually to prevent surges. Operation is completely automatic and pressure settings may be easily changed. This valve can be used for pressure relief, pressure sustaining, back pressure, or unloading functions in a bypass system.

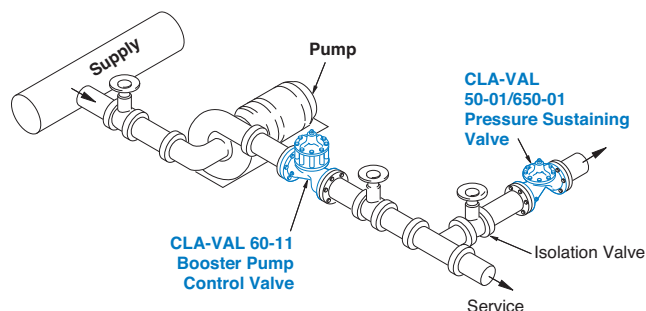
If a check feature is added, and a pressure reversal occurs, the downstream pressure is admitted into the main valve cover chamber, closing the valve to prevent return flow.



Typical Applications

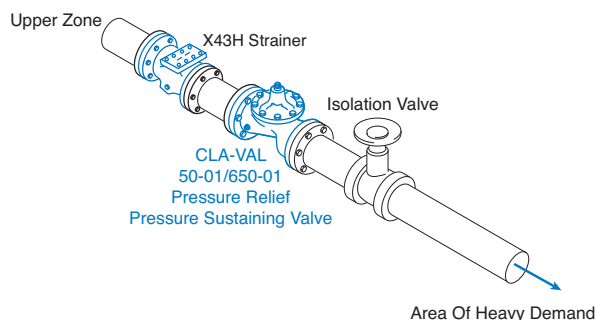
Pressure Relief Service

This fast opening, slow closing relief valve provides system protection against high pressure surges on pump start up and pump shut down by dissipating the excess pressure to a safe location.



Pressure Sustaining Service

When installed in a line between an upper zone and a lower area of heavy demand, the valve acts to maintain desired upstream pressure to prevent "robbing" of the upper zone. Water in excess of pressure setting is allowed to flow to an area of heavy demand, control is smooth, and pressure regulation is positive.



Model 50-01 (Uses 100-01 Hytrol Main Valve)

Pressure Ratings (Recommended Maximum Pressure - psi)

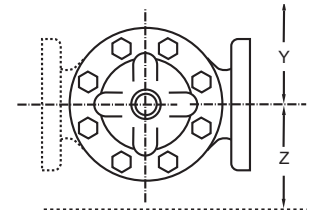
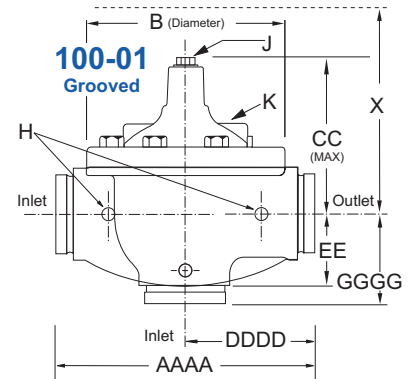
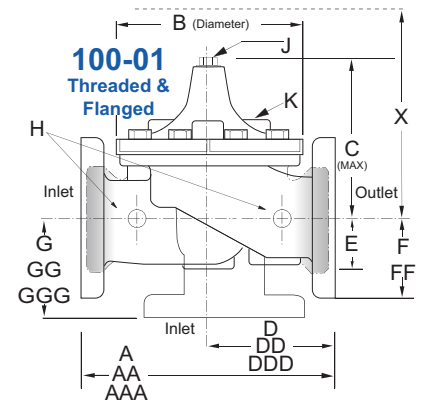
Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End† Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
UNS 87850	Bronze	B16.24	225	400	400	400

Note: * ANSI standards are for flange dimensions only.
 Flanged valves are available faced but not drilled.
 † End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1" - 36" 25 - 900mm	1" - 16" 25 - 400mm	1" - 16" 25 - 400mm
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
 Cla-Val manufactures valves in more than 50 different alloys.

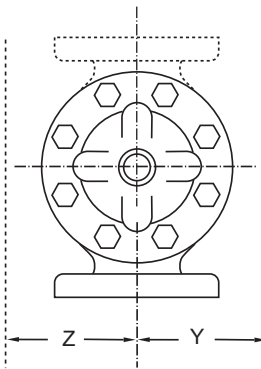
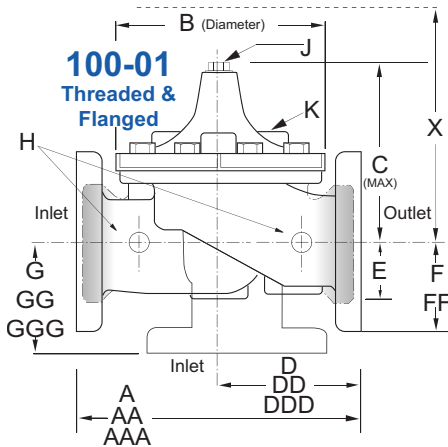


For sizes 18 - 36-inches, use 50-66 E-Sheet

Model 50-01 Dimensions (In Inches)

Valve Size (Inches)	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
A Threaded	7.25	7.25	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	8.50	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	72.75
AAA 300 ANSI	—	—	9.00	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	74.75
AAAA Grooved End	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Diameter	5.62	5.62	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Maximum	5.50	5.50	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	59.00
CC Maximum Grooved End	—	—	4.75	5.75	6.88	7.25	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	3.25	3.25	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	4.00	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	—	—	4.25	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—	—	—	—
E	1.12	1.12	1.12	1.50	1.69	2.06	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	28.50
FF 300 ANSI	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	30.00
G Threaded	1.88	1.88	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	4.00	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	—	—	4.25	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	1.00	1.00	1.25	1.50	2.00	1.00	1.00	1.00	2.00	2.00
K NPT Cover Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	0.40	0.40	0.40	0.60	0.70	0.80	1.10	1.70	2.30	2.80	3.40	4.00	4.50	5.10	5.63	6.75	7.50	8.50
Approx. Ship Weight (lbs)	15	15	15	35	50	70	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
Approx. X Pilot System	11	11	11	13	14	15	17	29	31	33	36	40	40	43	47	68	79	85
Approx. Y Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	40	45
Approx. Z Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	42	47

Model 50-01 Metric Dimensions (Uses 100-01 Hytrol Main Valve)

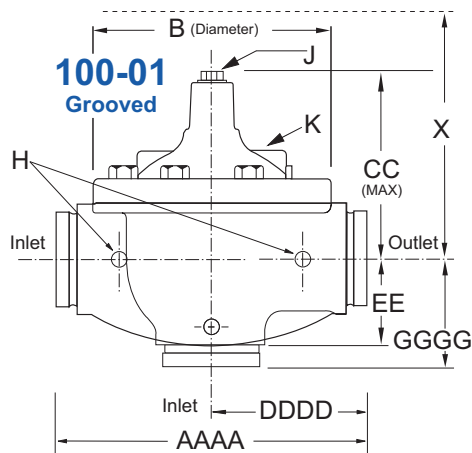


Valve & Pilot Approvals

NSF/ANSI 372: National Lead Free Mandate "Reduction of Lead in Drinking Water Act"

NSF International recognizes Cla-Val as complying with NSF/ANSI 61 and all applicable requirements.

Cla-Val fulfills the requirements described in the American Water Works Association's (AWWA) Standard for Pilot-Operated Control Valves: C530:12



Other 50 Series Products

- 50-01KO - Model 50-01 supplied with with KO Anti-Cavitation Trim
- 50-01H - Model 50-01 supplied with X43H Strainer
- 50-01KOH - Model 50-01 supplied with KO Trim & X43H Strainer
- 650-01 - Reduced Port Pressure Relief Valve
- 650-01KO - Reduced Port Pressure Relief Valve with KO Trim
- 650-01H - Reduced Port Pressure Relief Valve with X43H Strainer
- 650-01KO - Reduced Port Pressure Relief Valve with KO Trim and X43H Strainer

Model 50-01 Dimensions (in mm)

Valve Size (mm)	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
A Threaded	184	184	184	238	279	318	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	216	238	279	305	381	508	645	756	864	991	1051	1168	1321	1562	1600	1848
AAA 300 ANSI	—	—	229	254	295	337	397	533	670	790	902	1029	1105	1210	1326	1606	1638	1899
AAAA Grooved End	—	—	216	228	279	318	381	508	645	—	—	—	—	—	—	—	—	—
B Diameter	143	143	143	168	203	232	292	400	508	600	711	832	902	1054	1143	1350	1422	1676
C Maximum	140	140	140	165	192	208	270	340	406	435	530	614	635	992	1064	1116	1387	1499
CC Maximum Grooved End	—	—	120	146	175	184	236	308	371	—	—	—	—	—	—	—	—	—
D Threaded	83	83	83	121	140	159	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	102	121	140	152	191	254	322	378	432	495	528	—	—	781	—	—
DDD 300 ANSI	—	—	108	127	149	162	200	267	337	395	451	514	549	—	—	803	—	—
DDDD Grooved End	—	—	—	121	—	152	191	—	—	—	—	—	—	—	—	—	—	—
E	29	29	29	38	43	52	81	110	135	235	273	321	394	329	381	451	541	624
EE Grooved End	—	—	52	64	73	79	108	152	192	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	64	76	89	95	114	140	171	203	241	267	298	381	419	489	572	724
FF 300 ANSI	—	—	78	83	95	105	127	159	191	222	260	292	324	381	419	489	610	762
G Threaded	48	48	48	83	102	114	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	102	83	102	102	127	152	203	219	349	378	399	—	—	560	—	—
GGG 300 ANSI	—	—	102	89	110	111	135	165	216	236	368	397	419	—	—	582	—	—
GGGG Grooved End	—	—	—	83	—	108	127	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	1.00	1.00	1.25	1.50	2.00	1.00	1.00	1.00	2.00	2.00
K NPT Cover Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	10	10	10	15	18	20	28	43	58	71	86	102	114	130	143	171	190	216
Approx. Ship Weight (kgs)	7	7	7	16	23	32	64	129	227	354	528	726	1027	1353	1769	2812	3494	5316
Approx. X Pilot System	280	280	280	331	356	381	432	737	788	839	915	1016	1016	1093	1194	1728	2007	2159
Approx. Y Pilot System	229	229	229	229	254	280	305	508	559	610	661	737	762	813	864	991	1016	1143
Approx. Z Pilot System	229	229	229	229	254	280	305	508	559	610	661	737	762	813	864	991	1067	1194

50-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																			
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36	
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900	
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G	
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F	
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4500	7000	8400	11000	14000	17000	25000	42000	50000	
	Maximum Surge	120	210	280	470	670	1000	1800	4000	7000	11000	16000	15000	25000	31000	35000	56500	63000	85000	
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150	
	Maximum Surge	7.6	13	18	30	42	63	113	252	441	693	1008	1197	1577	1956	2461	3560	3975	5360	
100-01 Series is the full internal port Hytrol.																			*Globe Grooved Only	

Notes:

- For sizes 18 through 36-inches / 450mm through 900 mm, use 50-66 E-Sheet
- Many factors should be considered in sizing pressure relief valves including inlet pressure, outlet pressure and flow rates.
- For sizing questions or cavitation analysis, consult Cla-Val with system details.

Pilot System Specifications



Adjustment Ranges

- 0 to 75 psi Max.
- 20 to 105 psi
- 20 to 200 psi *
- 100 to 300 psi

*Supplied unless otherwise specified. Other ranges are available, please consult factory.

Temperature Range
Water: to 180°F

Materials

Standard Pilot System Materials

- Pilot Control: Low Lead Bronze
- Trim: Stainless Steel Type 303
- Rubber: Buna-N® Synthetic Rubber

Optional Pilot System Materials

Pilot Systems are available with optional Aluminum, Stainless Steel or Monel materials.

When Ordering, Specify:

1. Catalog No. 50-01
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded, Flanged, Grooved
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

Main Valve Options

EPDM Rubber Parts

Optional diaphragm, disc and o-ring fabricated with EPDM synthetic rubber

Viton® Rubber Parts - suffix KB

Optional diaphragm, disc and o-ring fabricated with Viton® synthetic rubber

Epoxy Coating - suffix KC

NSF 61 Listed and FDA approved, fusion bonded epoxy coating

Dura-Kleen® Stem - suffix KD

Fluted design prevents dissolved minerals build-up on the stem

LFS Trim

Designed to regulate precisely and smoothly at typical flow rates as well as lower than the industry standard of 1 fps, without decreasing the valve's capacity

Valve Options

X141 Pressure Gauge



X101AR Valve Position Indicator with Air Release



X101 Valve Position Indicator



X144 e-FlowMeter



X43H Strainer



Stainless Steel Pilot

Pilot Approvals



NSF/ANSI 372: National Lead Free Mandate
"Reduction of Lead in Drinking Water Act"

D-040 250 psi

D-040-C 250 psi



Combination Air Valve

Description

The D-040 series Combination Air Valve has the features of both an air release valve and an air & vacuum valve.

The air release component is designed to automatically release small pockets of air to the atmosphere as they accumulate along a pipeline or piping system when it is full and operating under pressure.

The air & vacuum component is designed to automatically discharge or admit large volumes of air during the filling or draining of a pipeline or piping system. This valve will open to relieve negative pressures whenever water column separation occurs.

Applications

- Pump stations: after the pump and after the check valve.
- Downstream (after) and upstream (before) of shut-off valves.
- After deep-well pumps.
- On long constant-sloped pipeline segments.
- At peaks along the pipeline and at peaks relative to hydraulic gradient.
- At end lines.
- Before water meters.
- On strainers and filters.

D-040-C - additional applications

- Water pipelines vulnerable to vandalism and/or water theft.
- Water systems found in remote areas.

Operation

The air & vacuum component, with the large orifice, discharges air at high flow rates during the filling of the system and admits air into the system at high flow rates during its drainage and at water column separation.

High velocity air will not blow the float shut. Water will lift the float, which seals the valve.

At any time during system operation, should internal pressure of the system fall below atmospheric pressure, air will enter the system.

The smooth discharge of air reduces pressure surges and other destructive phenomena.

The intake of air in response to negative pressure protects the system from destructive vacuum conditions and prevents damage caused by water column separation. Air entry is essential to efficiently drain the system. The air release component releases entrapped air in pressurized systems.

Without air valves, pockets of accumulated air may cause the following hydraulic disturbances:

- Restriction of effective flow due to a reduction of the flow area. In extreme cases this will cause complete flow stoppage.
- Obstruction of efficient hydraulic transmission due to air flow disturbances.
- Acceleration of cavitation damages.
- Increase in pressure transients and surges.
- Internal corrosion of pipes, fittings and accessories.
- Dangerous high-energy bursts of compressed air.
- Inaccuracies in flow metering.

As the system fills and is pressurized, the combination air valve functions in the following stages:

1. Air in the pipeline is discharged by the air valve.
2. Liquid enters the air valve, lifting the float which pushes the sealing mechanism to its sealing position.
3. Entrapped air, which accumulates at peaks and along the system, rises to the top of the air valve, which in turn displaces the liquid in the air valve body.
4. The float drops down, unsealing the rolling seal. The air release orifice opens and the accumulated air is released.
5. Liquid enters the air release valve, the float rises pushing the rolling seal to its sealing position.

When internal pressure falls below atmospheric pressure (negative pressure):

1. The float will drop down, immediately opening the air & vacuum and air release orifices.
2. Air will enter into the system

Main Features

- Working pressure range: 3 - 250 psi.
- Testing pressure: 360 psi.
- Maximum working temperature: 140° F.
- Maximum intermittent temperature: 194° F.
- Reliable operation reduces water hammer incidents.
- Dynamic design allows for high capacity air discharge while preventing premature closure.
- Lightweight, small dimensions, simple and reliable structure.
- The discharge outlet enables the connection of a vent/drain pipe.
- The large size of the automatic air release orifice relative to the air valve body:

- Discharges air at high flow rates.
- Lessens the danger of its obstruction by debris.
- Enables the usage of the rolling seal mechanism, making it less sensitive to pressure differential than a direct float seal.
- The body is made of high-strength composite materials and all operating parts are made of specially selected, corrosion-resistant materials.
- Due to its light weight, the valve may be installed on plastic piping systems, as well as other lightweight piping systems.
- D-040-C the body is protected in a metal shell for anti-vandalism/ theft applications.

Valve Selection

- Size range: 1/2", 3/4", 1", 2" threaded male connections, NPT
- Special Order: Optional BSPT connection
- Addition of ball valve tap; NPT male connection.

Options

- The D-040 air valve is available in the following options:
- D-040 1/2", 3/4", 1" & 2" - reinforced nylon body and base.
- **D-040 C 3/4", 1" - ductile iron shell and stainless steel base**
2" - ductile iron shell and base .
- D-040P SSB 3/4", 1" & 2" - reinforced nylon body and stainless steel base.
- D-040 SS 3/4", 1" & 2" - stainless steel body and stainless steel base.
- D-040 LP 3/4", 1" & 2" - designed for very low pressure systems with a working pressure of 0.725 - 87 psi.
- D-040 L 1/2", 3/4", 1", 2" - designed for systems with small suspended solids requiring a low sealing pressure, reinforced nylon/PVDF body and base. The working pressure 0.725 - 150 psi

Note

For best suitability, it is recommended to send the fluid chemical properties along with the valve request.
Upon ordering, please specify: model, size, working pressure, thread and flange standard and type of liquid.

ACCESSORIES

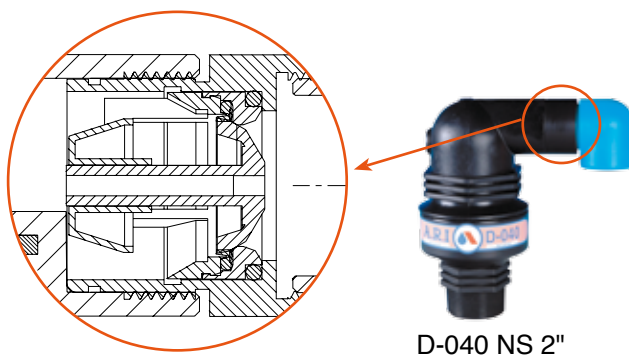
One-way models

D-040 series air valve is available as:

D-040-V -With a one-way, out-only attachment, allows air discharge only, prevents air intake (all models).

D-040-I -With a vacuum breaker, in-only attachment, allows air intake only, not allowing air discharge (D-040 2" only).

D-040-NS -With a non-slam, discharge-throttling attachment, allows full air intake, throttles air discharge (D-040 2" only).



D-040 NS 2"

Screen

Prevents penetration of debris and insects and can be assembled on the valve before or after the Discharge Outlet.

Each strainer has 2 threaded connections 1.5" NPSM/ 2" NPSM.



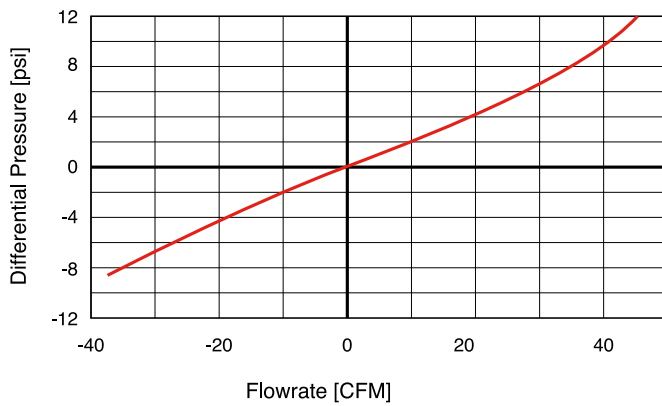
Air Valve Enclosure

A.R.I. air valve enclosure is used to protect air valve, for above surface air valve installations.

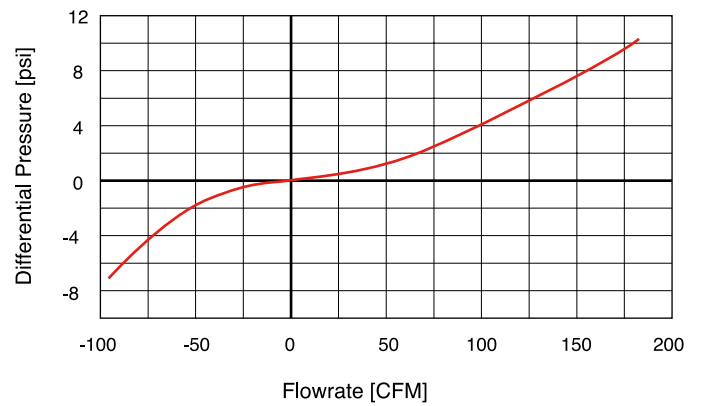
The special enclosure protects and hides the air valves from vandalism and damages.



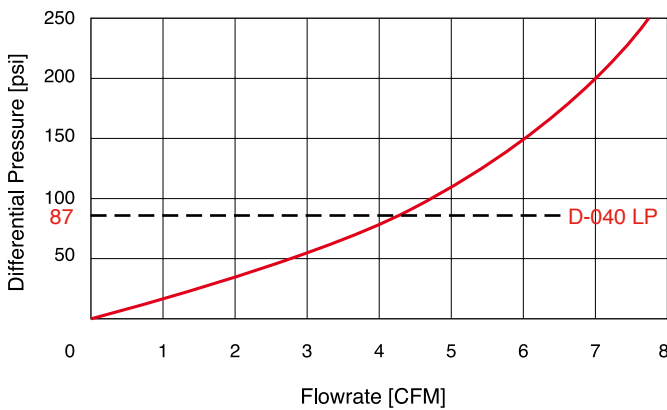
D-040 1/2" 3/4" 1"
AIR & VACUUM FLOWRATE



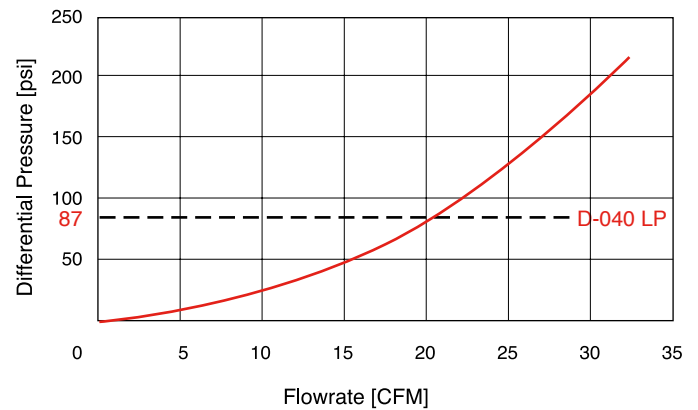
D-040 2"
AIR & VACUUM FLOWRATE



D-040 1/2" 3/4" 1"
AIR RELEASE FLOWRATE



D-040 2"
AIR RELEASE FLOWRATE





D-040-C 2"



D-040-C F 2"



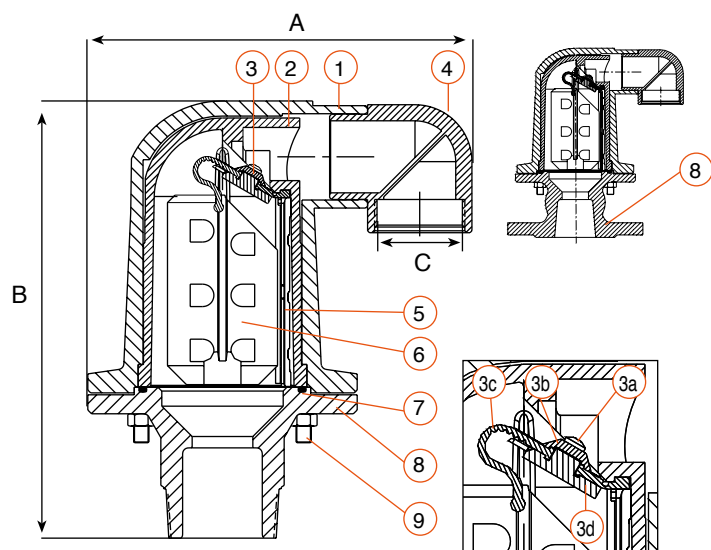
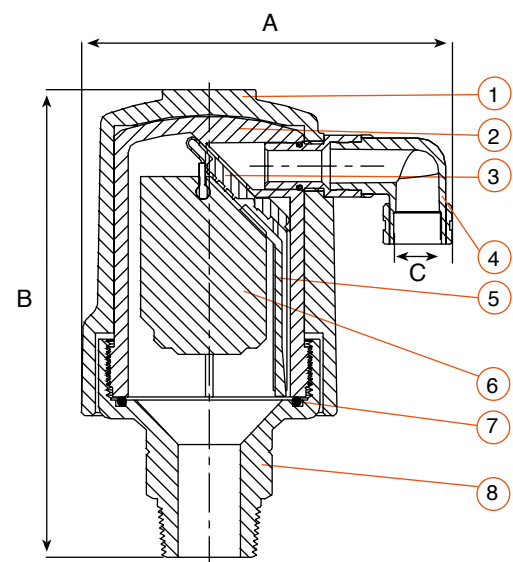
D-040-C 3/4" 1"

DIMENSIONS AND WEIGHT

Nominal Size	Dimensions inch				Weight Lbs.	Orifice Area Sq.in	
	A	B	internal C	external		A / V	Air Release
D-040-C 1"	4.7	5.9	3/8 NPT	0.86	3.75	0.127	0.0077
D-040-C 2"	8	9	1 1/2 NPT	2.16	11.9	1.246	0.0186
D-040-C F 2"	8.4	9.2	1 1/2 NPT	2.16	16	1.246	0.0186
D-040-C F 3"	9.3	9.2	1 1/2 NPT	2.16	16.5	1.246	0.0186

PARTS LIST AND SPECIFICATION

No. Part	Material
1. Shell	Ductile Iron ASTM A-536 60-40-18 / Resicoat RT R4
2. Body	NSF 61 Certified Reinforced Nylon
3. 3/4" 1" Rolling Seal	NSF 61 Certified E.P.D.M.
2" Rolling Seal Assembly:	
3a. Screws	Stainless Steel
3b. Plug Cover	NSF 61 Certified Reinforced Nylon
3c. Rolling Seal	NSF 61 Certified E.P.D.M.
3d. Plug	NSF 61 Certified Reinforced Nylon
4. Discharge Outlet	NSF 61 Certified Polypropylene
5. Clamping Stem	NSF 61 Certified Reinforced Nylon
6. Float	NSF 61 Certified Foamed Polypropylene
7. O - Ring	NSF 61 Certified NBR 70
8. Base 3/4" 1"	Stainless Steel ASTM A744 CF8M
2"	Ductile Iron ASTM A-536 60-40-18 / Resicoat RT R4
9. Bolts & Nuts	Stainless Steel ASTM A744 CF8M



20SSFLD S.S. Flanged Ball Valve • Spec Sheet

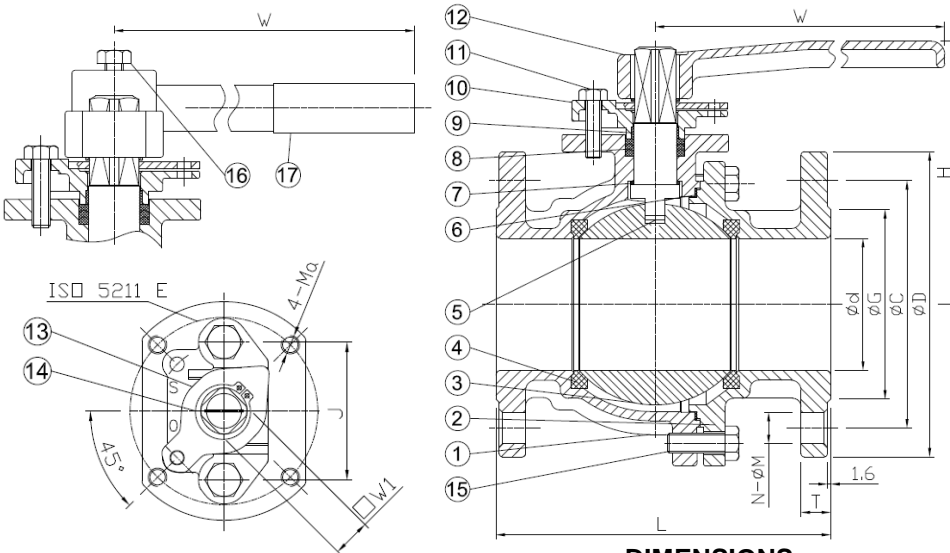


FEATURES & BENEFITS

- Full Port
- Two Piece
- 150 lb. WSP
- W.P. ANSI Class 150
- W.T. -4°F - 392°F
- 316 Stainless Steel Body
- Investment Casting
- Blow-out Proof Stem
- Locking device
- ASME B16.34
- Sizes 1" - 6"

MATERIAL SPECIFICATIONS

No.	Part	Material
1	Body	Stainless Steel 316
2	Cap	Stainless Steel 316
3	Solid Ball	Stainless Steel 316
4	Seat	R.PTFE
5	Stem	Stainless Steel 316
6	Gasket	R.PTFE
7	Thrust Washer	R.PTFE
8	Packing	R.PTFE
9	Stem Packing	R.PTFE
10	Gland	Stainless Steel 304
11	Gland Bolt	Stainless Steel 304
12	Handle	Carbon Steel
13	Stopper	Stainless Steel 304
14	Snap Ring	Stainless Steel 304
15	Bolt	Stainless Steel 304
16	Handle Bolt	Stainless Steel 304
17	Cover	Plastic



DIMENSIONS

Part #	Size	Ød	D	C	G	T	N-ØM	L	H	W	W1	J	ISO 5211	E	Ma	Torque N-M	Weight (lb)
20SSFL03D	1/2"	0.59	3.51	2.38	1.38	0.48	4-Ø0.63	4.26	2.76	6.30	0.47	1.97	F04	1.65	M5	16.1	3.99
20SSFL04D	3/4"	0.79	3.86	2.76	1.69	0.48	4-Ø0.63	4.61	2.88	6.30	0.47	1.97	F04	1.65	M5	20.7	4.76
20SSFL05D	1"	0.99	4.26	3.13	2.01	0.48	4-Ø0.63	5.00	3.03	6.30	0.47	1.97	F04	1.65	M5	25.3	6.22
20SSFL06D	1-1/4"	1.26	4.61	3.53	2.52	0.50	4-Ø0.63	5.52	3.35	6.30	0.47	1.97	F05	1.97	M6	28.8	8.25
20SSFL07D	1-1/2"	1.58	5.00	3.88	2.88	0.56	4-Ø0.63	6.50	4.10	7.33	0.67	2.44	F07	2.76	M8	33.4	12.94
20SSFL08D	2"	1.97	5.99	4.75	3.62	0.63	4-Ø0.75	7.01	4.49	7.33	0.67	2.44	F07	2.76	M8	39.1	19.29
20SSFL09D	2-1/2"	2.56	7.01	5.50	4.14	0.69	4-Ø0.75	7.49	5.59	12.77	0.83	2.96	F07	2.76	M8	57.5	28.88
20SSFL10D	3"	3.15	7.49	6.01	5.00	0.75	4-Ø0.75	8.00	6.03	12.77	0.83	2.96	F10	4.02	M10	86.3	39.02
20SSFL11D	4"	3.94	9.02	7.51	6.19	0.94	8-Ø0.75	9.02	6.54	12.77	0.83	2.96	F10	4.02	M10	115	62.39
20SSFL13D	6"	5.91	10.99	9.52	8.51	1.00	8-Ø0.87	15.52	9.73	29.55	0.95	3.51	F12	4.93	M12	310	144.84



CALIFORNIA 5595 Fresca Dr., La Palma CA 90623
TEXAS 1150 Silber Rd., Houston TX 77055
ILLINOIS 278 Windy Point Dr., Glendale Heights, IL 60139
GEORGIA 113 Industrial Blvd., Americus, Georgia 31709
NEW YORK PO Box 27, Rt.22, Brewster NY 10509
 WEB: www.matco-norca.com

• Phone: 866-532-8306 • Fax: 866-532-8307
 • Phone: 800-935-5456 • Fax: 713-680-2999
 • Phone: 844-412-5068 • Fax: 800-640-2252
 • Phone: 800-433-7526 • Fax: 800-533-5134
 • Phone: 800-431-2082 • Fax: 845-278-9056
 EMAIL: mail@matco-norca.com

76F-100-A SERIES

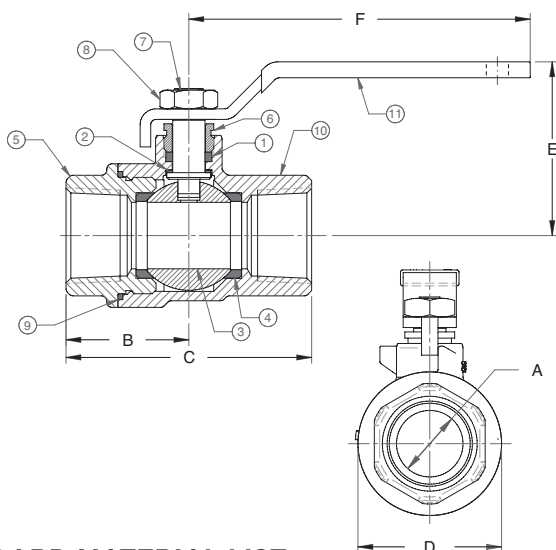
STAINLESS STEEL FULL PORT BALL VALVE



Female NPT Thread, 1/4"-3" 1000 CWP (psig), Cold Non-Shock. (See referenced P/T chart)
 150 psig Saturated Steam.
 Vacuum Service to 29 inches Hg.
 MSS SP-110 Compliant.
 Designed, cast, machined, assembled, and 100% factory tested in USA.

FEATURES

- Investment cast components
- Reinforced seats
- Blowout-proof stem design
- Adjustable packing gland
- Stainless steel lever and nut



STANDARD MATERIAL LIST

	PART	MATERIAL
1	Stem packing	MPTFE
2	Stem bearing	RPTFE
3	Ball	A276-316SS (1/4" to 2", except 1.25") A276-316SS or A351-CF8M stainless (1.25") A351-CF8M stainless (3")
4	Seat (2)	RPTFE (2" & smaller); RTFM (3")
5	Retainer	ASTM A276-316SS (1/4" & 3/8") ASTM A351-CF8M stainless (1/2" to 3")
6	Gland	A276-316 Stainless Steel
7	Stem	A276-316 Stainless Steel
8	Lever nut	304 Stainless Steel
9	Body Seal	RPTFE (1/2" to 3")
10	Body	A351-CF8M
11	Lever and grip	SS w/vinyl

DIMENSIONS

PRODUCT NO.	SIZE	A	B	C	D	E	F	WT.
76F-101-01	1/4"	0.37	0.95	1.91	1.12	1.60	3.85	0.47
76F-102-01	3/8"	0.37	0.95	1.91	1.12	1.60	3.85	0.44
76F-103-01A	1/2"	0.50	1.21	2.35	1.27	1.73	3.85	0.57
76F-104-01A	3/4"	0.81	1.39	2.77	1.62	1.96	3.85	0.91
76F-105-01A	1"	1.00	1.67	3.34	2.00	2.27	4.75	1.38
76F-106-01A	1.25"	1.25	1.96	3.92	2.73	3.21	7.77	4.17
76F-107-01A	1.5"	1.50	2.05	4.10	2.92	3.31	7.77	4.69
76F-108-01A	2"	2.00	2.37	4.74	3.75	3.69	7.77	6.90
76F-100-01A	3"	3.00	3.70	7.40	5.68	5.23	10.00	22.40

- Fire safe to API 607 (requires -24 suffix)
- Meets NACE MR0175 (2000) & MR0103 (2012)
- CSA CGA 3.16-M88 (Requires "GS" suffix)
- **NSF/ANSI 61 Section 8, Annex G (1/4" to 2")**
- NSF/ANSI 372 - Drinking Water System Components - Lead Content

OPTIONS AVAILABLE

(MORE INFORMATION IN SECTION J)

- Minimum quantities apply
- To specify an option, replace the "01" standard suffix with the suffix of the option.
- To specify multiple options, replace the "01" suffix with the desired suffixes in the numerical order shown below. NOTE: Not all suffixes can be combined together.

(SUFFIX)	OPTION	SIZES
-01	Standard Configuration	All
-P -01-	BSPP (Parallel) Thread Connection	1/2" to 2"
-T -01-	BSPT (Tapered) Thread Connection	1/2" to 3"
-02-	Stem Grounded	1/2" to 3"
-04-	2.25" Stem Extension (Carbon Steel, Zinc Plated)	1/2" to 2"
-08-	90° Reversed Stem	1/2" to 2"
-11-	Therma-Seal™ Insulating Tee Handle	1/4" to 2"
-14-	Side Vented Ball (Uni-Directional)	3/8" to 3"
-24-	Graphite packing, PTFE body seal, RPTFE bearing (Fire Safe API 607, 6th edition, ISO 10497:2010)	1/2" to 3"
-27-	SS Latch-Lock Lever & Nut	3/8" to 3"
-30-	Cam-Lock and Grounded	1/2" to 2"
-32-	SS Tee Handle & Nut	1/2" to 2"
-35-	PTFE Trim	3"
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	1/2" to 2"
-40-	Cyl-Loc and Grounded	1/2" to 2"
-44-	Seal Welded	1/4" to 3"
-45-	Less Lever & Nut	1/2" to 3"
-46-	Latch Lock Lever - Lock in Closed Position Only	1/2" to 2"
-47-	SS Latch Lock Oval Handle	1/2" to 2"
-48-	SS Oval Handle (No Latch) & Nut	1/4" to 2"
-49-	No Lubrication. Assembled Dry.	1/2" to 3"
-50-	2.25" CS Locking Stem Extension	1/2" to 2"
-56-	Multifill Seats & Packing	1/2" to 3"
-57-	Oxygen Cleaned	1/4" to 3"
-60-	Static Grounded Ball & Stem	1/2" to 3"
-GS	CSA CGA 3.16 (RTFE Seat - All sizes)	All

Pressure/Temperature Ratings - Page M-12, Graph No. 8

*LEAD FREE: The wetted surfaces of this product shall contain no more than 0.25% lead by weighted average. Complies with Federal Public Law 111-380. ANSI 3rd party approved and listed.
 REV. 14FEB18

The listed C_v "factors" are derived from actual flow testing, at Apollo's Pageland, South Carolina factory. These tests were completed using standard "off the shelf" valves with no special preparation and utilizing standard schedule 40 pipe. It should be understood that these factors are for the valve only and also include the connection configuration. The flow testing is done utilizing water as a fluid media and is a direct statement of the gallons of water flowed per minute with a 1 psig pressure differential across the valve/connection unit. Line pressure is not a factor. Because the C_v is a factor, the formula can be used to estimate flow of most media for valve sizing.

FLOW OF LIQUID

$$Q = C_v \sqrt{\frac{\Delta P}{\text{SpGr}}}$$

$$\text{or } \Delta P = \frac{(Q)^2 (\text{SpGr})}{(C_v)^2}$$

WHERE:

- Q = Flow in US gpm
- ΔP = Pressure drop (psig)
- SpGr = Specific gravity at flowing temperature
- C_v = Valve constant

FLOW OF GAS

$$Q = 1360 C_v \sqrt{\frac{(\Delta P) (P_2)}{(\text{SpGr}) (T)}}$$

$$\text{or } \Delta P = \frac{5.4 \times 10^{-7} (\text{SpGr}) (T) (Q)^2}{(C_v)^2 (P_2)}$$

WHERE:

- Q = Flow in SCFH
- ΔP = Pressure drop (psig)
- SpGr = Specific gravity (based on air = 1.0)
- P2 = Outlet pressure-psia (psig + 14.7)
- T = (temp. °F + 460)
- C_v = Valve constant

CAUTION: The gas equation shown, is valid at very low pressure drop ratios. The gas equation is NOT valid when the ratio of pressure drop (ΔP) to inlet pressure (P1) exceeds 0.02.

NOTE: Only use the gas equation shown if $(P1-P2)/P1$ is less than 0.02.

CV FACTORS FOR APOLLO® VALVES (CONTINUED ON M-4)

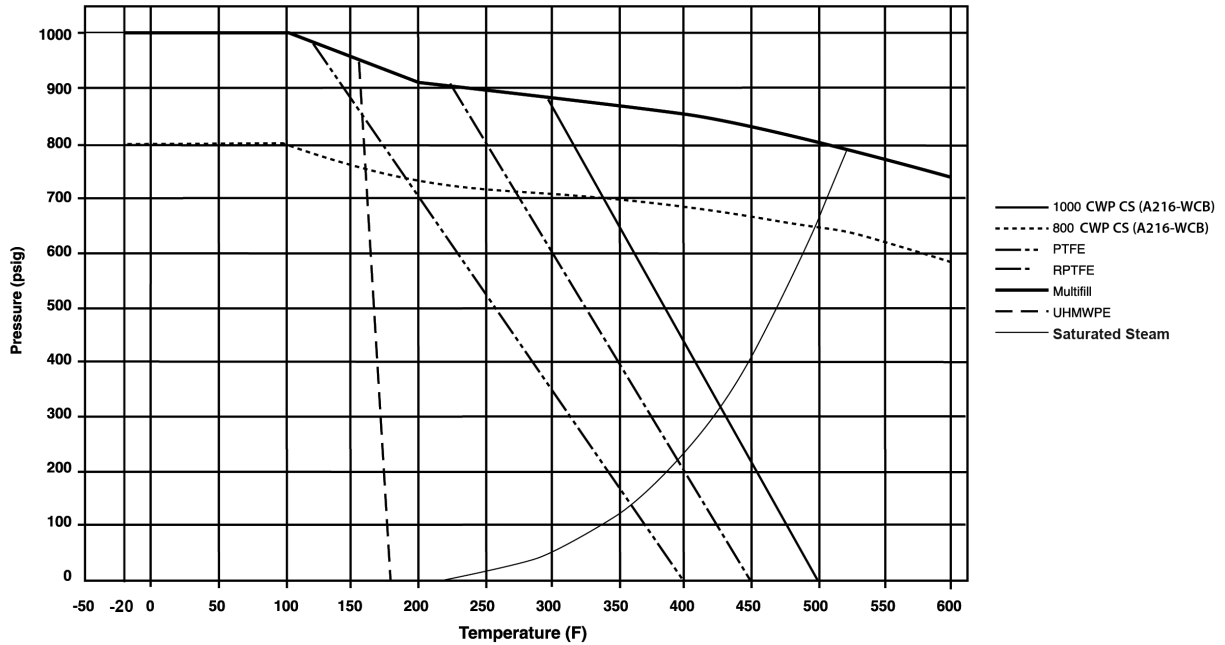
VALVE	SIZE (IN.)														
	1/4	3/8	1/2	3/4	1	1.25	1.5	2	2.5	3	4	6	8	10	12
70B-140 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
70-100/200 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
70-300/400 Series	--	--	15	30	43	48	84	108	--	--	--	--	--	--	--
70-600 Series	2.3	4.5	5.4	12	14	21	34	47	--	--	--	--	--	--	--
70-800 Series	8.4	7.2	15	30	43	48	84	--	--	--	--	--	--	--	--
71-AR Series	--	--	--	30	43	48	84	108	190	370	--	--	--	--	--
71-100/200 Series	--	--	--	30	43	48	84	108	190	370	--	--	--	--	--
72-100/900 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
72-1xx-A/72-9xx-A Series	--	--	26	48	65	125	170	245	--	--	--	--	--	--	--
73A-100 Series	8.4	7.2	15	30	43	48	84	108	--	--	--	--	--	--	--
73-300/400 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
74-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
75-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76-AR Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76F-100 Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
76FJ-100 Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
76FK-100 Series	8.1	15	15	51	68	125	177	389	--	--	--	--	--	--	--
76-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
76-300/400 Series	--	--	26	48	65	125	170	216	--	--	--	--	--	--	--
76-600 Series	2.3	4.5	5.4	12	14	21	34	47	--	--	--	--	--	--	--
76J-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
76J-AR Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
76K-100 Series	8.4	7.2	15	30	43	48	84	108	190	370	--	--	--	--	--
76K-AR Series	8.4	7.2	15	30	43	48	84	108	190	370	670	--	--	--	--
7K-100 Series	--	--	15	51	68	125	177	389	503	--	--	--	--	--	--
77-AR Series	8.1	15	15	51	68	--	177	389	--	--	--	--	--	--	--

REV. 21APR17

1000 CWP

(CS) ASTM A216-WCB

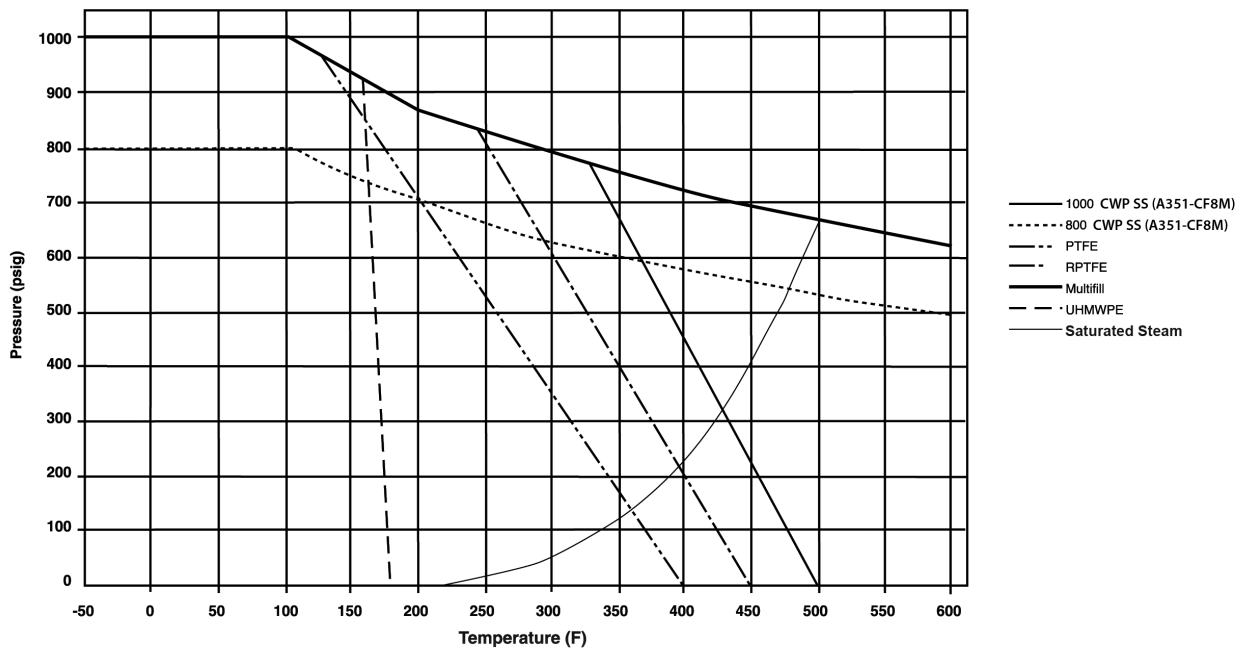
GRAPH 7



1000 CWP

(SS) ASTM A351-CF8M

GRAPH 8





Lead Free Products

**Brass and Stainless Valves, Bronze Fittings, Brass Nipples & Pipe;
Galvanized Malleable Iron Fittings & Steel Pipe Nipples**

**All Smith-Cooper Lead Free Products are fully compliant with
the 2014 Federal Safe Water Drinking Act (SWDA) -
US Senate Bill S 3874 & California AB 1953**

Lead Free Products

- Galvanized malleable iron fittings are certified to; NSF/ANSI 372, SWDA and California AB1953 Lead Free
- Galvanized steel nipples are certified to; NSF/ANSI 372, SWDA and California AB1953 Lead Free
- Red brass seamless nipples and pipe are certified to SWDA and California AB 1953 Lead Free
- Lead free valves are certified to; NSF/ANSI 372, SWDA and California AB1953 Lead Free
- Lead free bronze fittings are certified to; NSF/ANSI 372, SWDA and California AB1953 Lead Free

Lead Free Bronze Fitting Specifications

- Bronze fittings conform to AWWA C800
- Bronze castings conform to ASTM B584, UNS Alloy C89833
- Bronze fitting dimensions conform to ASME B16.15, Class125
- NPT threads on all fittings conform to ASME B1.20.1
- Bronze unions conform to specification A-A-59617
- Manufacturing facilities are ISO 9001:2008
- Thread protectors on all male threads
- Fittings have SCI trademark and are 100% air tested
- Certified to ANSI/NSF 372, SWDA and California AB 1953
- ProPak™ Packaging



Series 8170L & 8171L

Brass Ball Valve

- Certified to SWDA and California AB1953
- Certified to NSF/ANSI 372
- Full port
- Forged brass body
- Blow-out proof stem
- Chrome plated ball
- 600 lb. CWP, 150 lb. WSP up to 2"
- 400 lb. CWP, 150 lb. WSP 2 1/2" - 4"
- UL Listed (1/4" - 2") threaded
- F/M Approved, (1/2" - 2")
- CSA Approved under z21.15a for 1/2 psig (1/2" - 2") - threaded
- CSA Approved under 3-88 for 5 psig (1/2" - 2") - threaded
- Approved under ANSI/ASME B16.33 spec for Gas Piping to 125 psig (1/2" - 2")
- Meets Fed Spec WW-V-35, Type II, Class A, Style 3 (1/2" - 2")
- Conforms to MSS-SP110
- ISO 9001:2008 manufacturer



Size in	Part Number		Packing		Weight lb
	Threaded	Sweat	Inner	Master	
1/4	01728170CL	-	10	160	0.4
3/8	01728170EL	-	10	160	0.3
1/2	01728170GL	01728171GL	10	120	0.5
3/4	01728170IL	01728171IL	6	72	0.7
1	01728170KL	01728171KL	4	48	1.0
1-1/4	01728170LL	01728171LL	4	24	1.7
1-1/2	01728170ML	01728171ML	6	18	2.3
2	01728170NL	01728171NL	4	8	3.5
2-1/2	01728170PL	-	2	6	6.9
3	01728170QL	-	2	4	8.5
4	01728170TL	-	-	2	16.6

Series 8175L & 8176L

Brass Ball Valve with Drain

- Certified to SWDA and California AB1953
- Certified to NSF/ANSI 372
- 600 lb. CWP
- Full port
- Blow-out proof stem
- Forged brass body
- PTFE seats and seals
- Fed. Spec. WW-V-35, Type II, Class A Style 3
- Conforms to MSS SP-110
- ISO 9001:2008 manufacturer



Size in	Part Number		Packing		Weight lb
	Threaded	Sweat	Inner	Master	
1/2	01728175GL	01728176GL	10	100	0.5
3/4	01728175IL	01728176IL	8	48	0.9
1	01728175KL	01728176KL	5	30	1.4

Series 8155L & 8156L

Brass Ball Valve

- Certified to SWDA and California AB1953
- Certified to NSF/ANSI 61-8
- 600 lb. CWP, 150 lb. WSP up to 2"
- 400 lb. CWP, 150 lb. WSP 2 1/2" - 4"
- Full port
- Forged brass body
- Chrome plated ball
- PTFE seats and seals
- Blow-out proof stem
- CSA Approved (1/2" thru 2") - Threaded
- ISO 9001:2008 manufacturer



Size in	Part Number		Packing		Weight lb
	Threaded	Sweat	Inner	Master	
1/4	01728155CL	-	10	160	0.3
3/8	01728155EL	-	10	160	0.3
1/2	01728155GL	01728156GL	10	120	0.5
3/4	01728155IL	01728156IL	10	60	0.7
1	01728155KL	01728156KL	6	60	1.0
1-1/4	01728155LL	01728156LL	4	24	1.7
1-1/2	01728155ML	01728156ML	4	16	2.3
2	01728155NL	01728156NL	2	16	3.5
2-1/2	01728155PL	01728156PL	2	6	6.8
3	01728155QL	01728156QL	2	4	8.5
4	01728155TL	01728156TL	1	2	16.0

Series 8160L

Nickel Plated Brass Ball Valve

- Certified to SWDA and California AB1953
- Certified to NSF/ANSI 61-8
- 600 lb. CWP, 150 lb WSP
- Full port
- Forged brass body, nickel plated
- Chrome plated ball
- Blow-out proof stem
- CSA Approved (1/2" - 2")
- ISO 9001:2008 manufacturer



Size in	Part Number		Packing		Weight lb
	Threaded		Inner	Master	
1/8	01728160AL		10	160	0.3
1/4	01728160CL		10	160	0.3
3/8	01728160EL		10	160	0.3
1/2	01728160GL		10	120	0.5
3/4	01728160IL		10	60	0.7
1	01728160KL		6	60	1.0
1-1/4	01728160LL		4	24	1.7
1-1/2	01728160ML		4	16	2.3
2	01728160NL		2	16	3.5

532 Bronze Swing Check Valve

Specification Sheet

FEATURES & BENEFITS

- 300 WOG - 150 SWP
- Y Pattern
- Threaded Only
- Sizes 1/2" - 2"

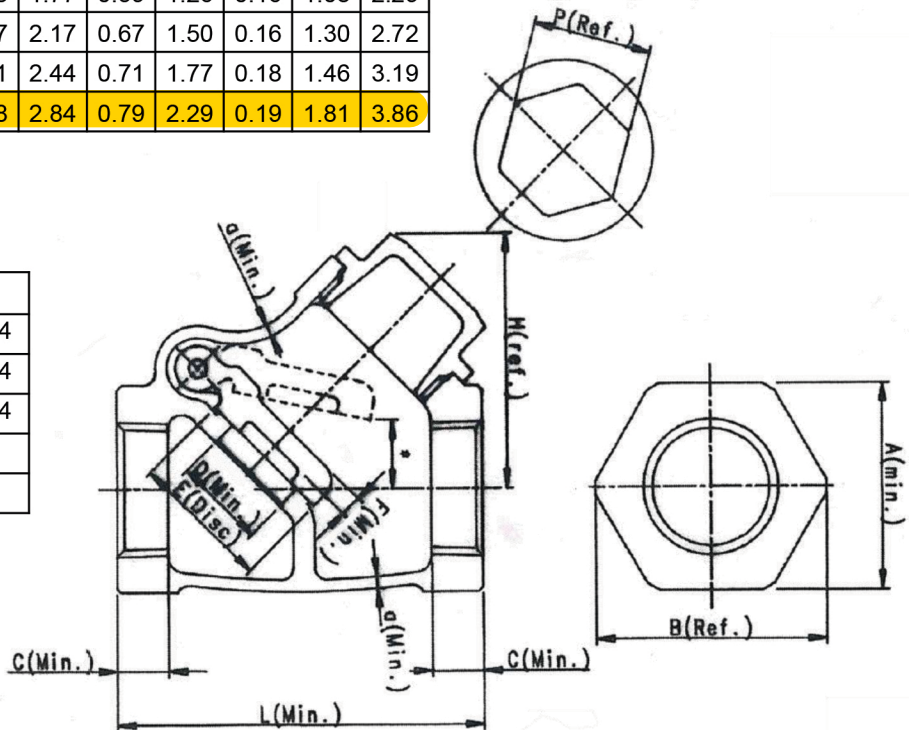


DIMENSIONS

Part #	Size	a	L	D	A	B	C	E	F	P	H
532T03	1/2"	0.09	2.21	0.59	1.10	1.22	0.43	0.79	0.12	0.75	1.65
532T04	3/4"	0.09	2.76	0.75	1.34	1.50	0.51	0.99	0.12	0.93	1.97
532T05	1"	0.10	3.15	0.99	1.58	1.77	0.59	1.26	0.16	1.08	2.29
532T06	1-1/4"	0.11	3.78	1.26	1.97	2.17	0.67	1.50	0.16	1.30	2.72
532T07	1-1/2"	0.12	4.33	1.50	2.21	2.44	0.71	1.77	0.18	1.46	3.19
532T08	2"	0.13	5.04	1.97	2.68	2.84	0.79	2.29	0.19	1.81	3.86

MATERIAL SPECIFICATIONS

No.	Part	Material
1	Body	Cast Bronze ASTM B584
2	Cap	Cast Bronze ASTM B584
3	Disc	Cast Bronze ASTM B584
4	Plug	Brass ASTM B16
5	Pin	Brass ASTM B16





Section 3

Instruments

Data Sheet

1279 Duragauge® Pressure Gauge

45 1279SS 04L XGVSG 60#

FEATURES

- Custom dial printing options
- Micrometer adjustable pointer
- **PLUS™** Performance option dampens vibration, shock and pulsation effects
- Pressure range from Vacuum to 30,000 psi

TYPICAL USES

- Refineries
- Chemical and petrochemical plants
- Offshore oil rigs
- Water and wastewater pressure control
- Pulp and water
- Mining and metals
- Equipment skids
- Specialized OEM equipment
- Cryogenics


1279

4 1/2" dial size



SPECIFICATIONS

Accuracy:	±0.5% of span (ASME B40.100 Grade 2A)
Size:	4 1/2"
Range:	Vacuum, Compound to 30,000 psi
Process Connection Location:	Lower, back, side, top
Process Connection:	1/4 NPT Male, 1/2 NPT Male, 3/8-18 UNF-2B (high pressure connection)
Case Style:	Solid front with pressure relief back
Window:	Glass (STD.), acrylic, shatter proof glass, non-glare glass (OPT.)
Movement:	Rotary, adjustable, 400 SS, Teflon® coated
Movement Materials:	400 SS, Teflon® coated pinion gear and segment
Dial:	Aluminum, white background, black scale
Pointer:	Micrometer, adjustable, aluminum
Weather Protection:	Dry case: Case not sealed, recommended for weather protected environment only Liquid filled or field fillable: IP66 or NEMA 4X (S&P tube and socket), NEMA 4 (A&R tube and socket) Hermetically sealed: IP66
Dampening Options:	Liquid: glycerin, silicone, Halocarbon®, PLUS!™ Performance
Mounting:	Stem, surface (STD.), flush, pipe, remote (OPT.)
Approvals:	CRN

WETTED COMPONENTS

Bourdon Tube	Process Connection Materials	Joints
316L SS	316L SS	Welded
316L SS	Steel	Welded
K-Monel® 500 Tube	Monel® 400	Welded
C510 Phos. Bronze	Brass	Silver brazed

KEY BENEFITS

- Available with a wide variety of accessory and diaphragm seal assemblies
- Available with high process temperature dissipation siphons

MIN/MAX TEMPERATURE LIMITS

Version	Ambient	Process	Storage
Dry	-20°F to 200°F (-29°C to 93°C)	-20°F to 250°F (-29°C to 121°C)	-40°F to 250°F (-40°C to 121°C)
PLUS!™	-40°F to 150°F (-40°C to 66°C)	-40°F to 200°F (-40°C to 93°C)	-40°F to 150°F (-40°C to 66°C)
Glycerin fill	20°F to 150°F (-7°C to 66°C)	20°F to 150°F (-7°C to 66°C)	0°F to 150°F (-18°C to 66°C)
Silicone fill	-40°F to 150°F (-40°C to 66°C)	-40°F to 200°F (-40°C to 93°C)	-40°F to 150°F (-40°C to 66°C)
Halocarbon® fill	-40°F to 150°F (-40°C to 66°C)	-40°F to 200°F (-40°C to 93°C)	-40°F to 150°F (-40°C to 66°C)

NON-WETTED COMPONENTS

Case	Ring	Pressure Relief Back
Phenolic	Threaded, Polycarbonate (Meets UL 94 V-0)	Polycarbonate (Meets UL 94 V-0)

Data Sheet

1279 Duragauge® Pressure Gauge

ORDERING CODE	Example:	451279	S	SH	04	L	XLL	15#
Dial Size/Model Code								
451279 - 4½" solid front		451279						
System (tube and process connection)								
A - Bronze tube, brass process connection, Max. pressure connection 1,000 psi								
P - K-Monel® 500 tube, Monel® 400 process connection, Max. pressure 30,000 psi								
R - 316L SS tube, steel process connection, Max. pressure 30,000 psi								
S - 316 SS tube, 316L SS process connection, Max. pressure 30,000 psi			S					
Case Design								
S - Solid front case, dry								
SH - Solid front case, dry, hermetically sealed				SH				
SL - Solid front case, liquid filled (glycerin STD.)								
Process Connection Sizes								
02 - ¼ NPT Male, N/A for ranges over 20,000 psi								
04 - ½ NPT Male, N/A for ranges over 20,000 psi					04			
09 - ⅝-18 UNF-2B, high pressure fitting, pressures over 20,000 psi (STD.)								
AM - AND 10050-4 (¼ tubing connection)								
RW - SAE 7⁄16-20 Straight thread								
Process Connection Location								
L - Lower						L		
B - Back								
D - Side (3 o'clock)								
E - Side connection (9 o'clock)								
T - Top connection								
Options (If choosing an option(s) must include a "X") (See Table 1 on page 5 for more options)								X__
GV - Silicone case fill								
GX - Halocarbon® case fill								
LL - PLUS! ™ Performance							LL	
NH - SS tag wired to case								
PD - Acrylic window (STD. with liquid filled or hermetically sealed cases)								
C4 - Individual calibration chart (in accordance with ASME B40.100:2013. Accuracy traceable to NIST)								
6B - Cleaned for oxygen service								
Range (coding examples only, see range table on page 3 for all standard ranges)								
Single Scales								
15# - 15 psi								15#
1BR - 1 bar								
1KG - 1 kg/cm²								
100KP - 100 kPa								
Dual Scales								
15#/BR - 15 psi inner scale, 1 bar outer scale								
1BR/# - 1 bar inner scale, 15 psi outer scale								

Data Sheet

1279 Duragauge® Pressure Gauge

STANDARD PRESSURE RANGES					
	psi	bar	kPa	mPa	kg/cm ²
Vacuum	30IMV	N1BR	N100KP	N1MP	N1KG
	-	N1/0.6BR	N100/60KP	0.1/0.06MP	N1/0.6KG
	V/15#	-	-	-	-
Compound	-	N1/1.5BR	N100/150KP	N0.1/0.15MP	N1/1.5KG
	V/30#	-	-	-	-
	-	N1/3BR	N100/300KP	N0.1/0.3MP	N1/3KG
	V/60#	-	-	-	-
	-	N1/5BR	N100/500KP	N0.1/0.5MP	N1/5KG
	V/100#	-	-	-	-
Positive Pressure	-	N1/9BR	N100/900KP	N0.1/0.9MP	N1/9KG
	15#	1BR	100KP	0.1MP	1KG
	20#	-	-	-	-
	-	1.6BR	160KP	0.16MP	1.6KG
	30#	-	-	-	-
	-	2.5BR	250KP	0.25MP	2.5KG
	60#	4BR	400KP	0.4MP	4KG
	-	6BR	600KP	0.6MP	6KG
	100#	-	-	-	-
	120#	-	-	-	-
	-	10BR	1000KP	1MP	10KG
	160#	-	-	-	-
	200#	-	-	-	-
	-	16BR	1600KP	1.6MP	16KG
	300#	-	-	-	-
	-	25BR	2500KP	2.5MP	25KG
	400#	-	-	-	-
	500#	-	-	-	-
	600#	40BR	4000KP	4MP	40KG
	800#	-	-	-	-
	-	60BR	6000KP	6MP	60KG
	1000#	-	-	-	-
	1500#	100BR	10000KP	10MP	100KG
	2000#	-	-	-	-
	-	160BR	16000KP	16MP	160KG
	3000#	-	-	-	-
	-	250BR	25000KP	25MP	250KG
	4000#	-	-	-	-
	5000#	-	-	-	-
	6000#	400BR	40000KP	40MP	400KG
	8000#	-	-	-	-
	-	600BR	60000KP	60MP	600KG
	10000#	-	-	-	-
	15000#	1000BR	100000KP	100MP	1000KG
	20000#	-	-	-	-
	-	1600BR	-	160MP	1600KG
	30000#	-	-	-	-
	-	2500BR	-	250MP	2500KG

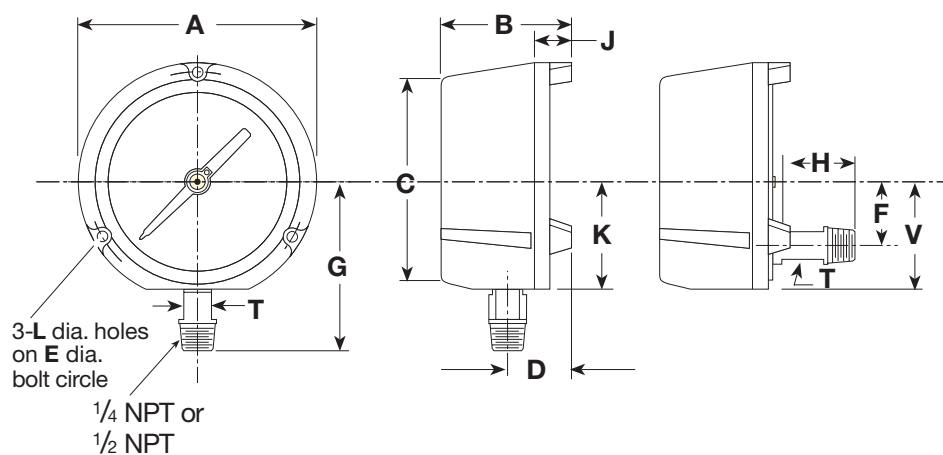
Data Sheet

1279 Duragauge® Pressure Gauge

DIMENSIONS in [] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

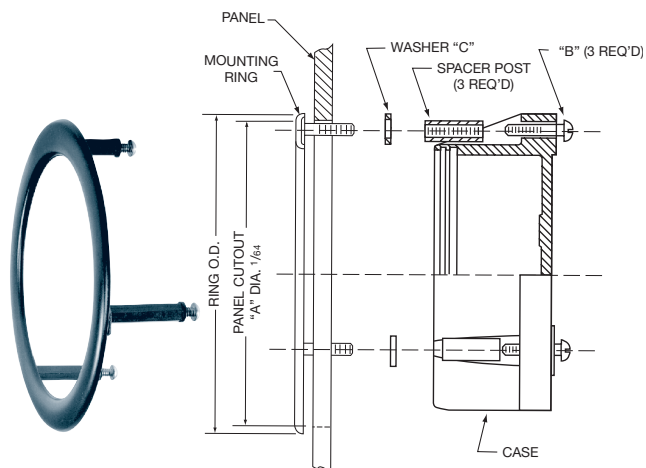
Dial Size Inches	A	B	C	D	E	F	G	H	J	K	T	V	Weight oz / kg
4½	5.81 [147.6]	3.36 [85.3]	5.07 [128.7]	1.06 [40.6]	5.375 [137]	1.62 [41.2]	3.92 [99.6]	0.73 [18.4]	0.22 [5.5]	2.62 [66.7]	0.94 [23.9]	2.625 [67]	2.5 (Dry) 3.5 (L.F.)



1278M Series Flush Mounting Ring

1278M Series Flush Mounting Ring. Used to flush mount gauge case 1279(*)S. Black finish (STD.); Polished SS finish (OPT.)

Gauge Size Inches	Ring O.D.	"A" DIA.	"B" Size of 3 Screws	"C" Size of Washers
4½	6 [152]	5.625 [148]	#10-24 x 1½	7/16 x 17/64 x 5/8



Data Sheet

1279 Duragauge® Pressure Gauge

TABLE 1 - OPTIONS

CODE	OPTION
AB	Gauges calibrated to compensate for absolute pressure
DA	Dial marking (text marking on the dial)
EP	Maximum pointer (adjustable, N/A with liquid filled or hermetically sealed cases)
GV	Silicone case fill
GX	Halocarbon® case fill
HY	Hydrostatic/pneumatic testing (system pressurized to 150% of rated system pressure for 5 minutes. Overload stop STD.)
LL	PLUS!™
NG	Non-glare glass (N/A with liquid fill or hermetically sealed cases)
NH	SS tag wired to case
OS	Overload stop
PD	Acrylic window (STD. with liquid filled or hermetically sealed cases)
SH	Red set hand, stationary
SG	Safety glass
TS	Throttle screw (STD. with liquid filled, hermetically sealed or PLUS!™ Performance)
VS	Underload stop
C4	Individual calibration chart (in accordance with ASME B40.100:2013. Accuracy traceable to NIST)
6B	Cleaned for oxygen service
56	Flush mounting ring

ABB MEASUREMENT & ANALYTICS | DATA SHEET | DS/WM-EN REV. AA

WaterMaster

Electromagnetic flowmeter



Measurement made easy

The perfect fit for all water and waste water applications

State-of-the-art technology

- revolutionary data storage enables transmitter interchange and commissioning without the need for re-configuration
- self-calibrating transmitter with ultra-low temperature coefficient for highest accuracy

Versatile and simple configuration

- 'Through-the-Glass' (TTG) configuration eliminating the need to remove the cover
- smart key based functionality
- 'Easy Setup' function

VeriMaster in situ verification software option

- enables the customer to perform in situ verification of the flowmeter system

Unparalleled service ability

- fault-finding Help texts on the display
- minimized downtime with replaceable electronics cartridges

MID and OIML R49 approved with R49 self-checking

- type-approved to accuracy Class 1 and Class 2 for any pipe orientation and bidirectional flows
- type P-approved continuous self-checking of the sensor and transmitter to ensure the highest accuracy and long-term performance

The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a world leader in process automation technology our worldwide presence, comprehensive service and application-oriented know-how make ABB a leading supplier of flow measurement products.

Introduction

Setting the standard for the Water Industry

The WaterMaster range, available in sizes 10 to 2400 mm (¾ to 96 in.), is designed specifically for use on the many diverse applications encountered in the Water and Waste-water industry. The modular design concept offers flexibility, cost-saving operation and reliability while providing a long service life and exceptionally low maintenance.

Integration into ABB asset management systems and use of the self-monitoring and diagnostic functions increase the plant availability and reduce downtimes.

VeriMaster – the verification tool

An easy-to-use utility, available through the infra red service port. Uses the advanced self-calibration and diagnostic capability of WaterMaster, coupled with fingerprinting technology, to determine the accuracy status of the WaterMaster flowmeter to within $\pm 1\%$ of its original factory calibration. VeriMaster also supports printing of calibration verification records for regulatory compliance.



Diagnostic functions

Using its diagnostic functions, the flowmeter monitors both its own operability and the process. Limit values for the diagnostic parameters can be set locally. When these limits are exceeded, an alarm is tripped. In the event of an error, diagnostic-dependent help text appears on the display. This considerably simplifies and accelerates the troubleshooting procedure.

In accordance with NAMUR NE107, alarms and warnings are classified with the status of 'Maintenance Required', 'Check Function', 'Failure' and 'Out of Specification'.

Flow performance

Utilizing its advanced filtering methods, the WaterMaster improves accuracy even under difficult conditions.

WaterMaster has an operating flow range with $\pm 0.4\%$ accuracy as standard ($\pm 0.2\%$ optional) in both forward and reverse flow directions.

Easy and quick commissioning

'Fit-and-Flow' data storage inside WaterMaster eliminates the need to match sensor and transmitter in the field. On initial installation, the self-configuration sequence automatically replicates into the transmitter all calibration factors, meter size and serial numbers, as well as customer site-specific settings, eliminating the potential for error.

Intuitive, convenient navigation

The 'Easy Setup' function reliably guides unpracticed users through the menu step by step. The smart key based functionality makes handling a breeze – it's just like using a cell phone. During configuration, the permissible range of each parameter is indicated on the display and invalid entries are rejected.

Universal transmitter – powerful and flexible

The backlit display can be rotated easily without the need for tools. The contrast is adjustable and the display fully-configurable. The character size, number of lines and display resolution (number of decimal points) can be set as required. In multiplex mode, several different display options can be pre-configured and invoked one after the other. The smart modular design of the transmitter unit enables easy disassembly without the need to unscrew cables or unplug connectors. HART is used as the standard communications protocol. Optionally, the transmitter is available with PROFIBUS DP or MODBUS communication.

Assured quality

WaterMaster is designed and manufactured in accordance with international quality procedures (ISO 9001) and all flowmeters are calibrated on nationally-traceable calibration rigs to provide the end-user with complete assurance of both quality and performance of the flowmeter.



...Introduction

WaterMaster – always the first choice

WaterMaster sets the standard for the water industry. The specification, features and user benefits offered by this range are based on ABB's worldwide experience in this industry and they are all targeted specifically to the industry's requirements.

Submersible and buriable

WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the Water and Waste Industry. The sensors are, as standard, inherently submersible (IP68, NEMA 6P), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding.

A unique feature of the WaterMaster sensors is that sizes DN40 to DN2400 (1½ to 96 in. NB) are buriable; installation simply involves excavating to the underground pipe, fitting the sensor, cabling back to the transmitter and then backfilling the hole.



The WaterMaster family

Overview of the WaterMaster

A wide range of features and user benefits are built into WaterMaster as standard:

- bi-directional flow
- unique self-calibrating transmitter (patented) for the ultimate in stability and repeatability
- OIML-type continuous self-checking, with alarms, ensures both sensor and transmitter accuracy
- true electrode and coil impedance measurement
- comprehensive simulation mode
- universal switch-mode power supply (options are available for AC and DC supplies)
- comprehensive self-diagnostics compliant with NAMUR NE107
- programmable multiple-alarm capability
- bus options: HART (4 to 20 mA), PROFIBUS DP (RS485), MODBUS (RS485)
- 3 configurable pulse / frequency and alarm outputs
- advanced infrared service port supports remote HMI, HART, cyclic data out and parameter download
- VeriMaster in situ verification software available as option
- read-only switch and ultra-secure service password for total security

OIML / MID approved

WaterMaster has been type tested and Internationally approved to the highest accuracy class 1 and 2 for cold and hot potable water meters – OIML R49-1 (Organisation Internationale de Métrologie Légale). For full details, OIML R49 is available to download from www.oiml.org. Its requirements are very similar to other International standards, such as EN14154 and ISO4064.

WaterMaster has been assessed by type approval at the National Measurement Office (NMO) to OIML R49 and passed to the very highest accuracy designations for sizes DN40 to DN200 (1½ to 8 in. NB).

The approval is for:

- Class 1 and Class 2 accuracy (calibration option)
- Environmental class T50 for water temperatures of 0.1 to 50 °C (32.18 to 122 °F)
- Electromagnetic Environment E2 (10 V/m)
- Any pipe orientation
- 5 Diameters upstream pipe
- 0 Diameters downstream pipe
- Pressure Loss Class <0.25 bar (3.62 psi)
- Integral or remote transmitter (<200 m [<656 ft.] cable)
- DN40 to DN200 (1½ to 8 in. NB), bi-directional flow

A major advance in WaterMaster is the self-checking capabilities that meet and exceed the R49 requirements and is the first electromagnetic flowmeter to be approved to OIML Type P permanent self checking during normal operation (not just at startup) and alarm indication for:

- transmitter and sensor status, with an accuracy alarm
- program ROM and RAM status
- double, independent storage of totalizer values, in both the sensor and transmitter non-volatile memories
- display test

The OIML R49-1 certificate of conformity is available from:

<http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx>

WaterMaster is also approved under the EU Measuring Instruments Directive (MID) 2004/22/EC, that covers putting into use water flowmeters for certain applications. MID WaterMaster is secured against tampering and is available as an option, along with fingerprinting for ABB VeriMaster in situ verification product, with certificate printout to ±1 % accuracy.

WaterMaster certificates of EC type-examination of a measuring instrument are available from:

<http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx>

Superior control through advanced sensor design

The innovative, patented octagonal sensor design improves flow profile and reduces up- and down-stream piping requirements for the most commonly used sizes of 40 to 200 mm (1½ to 8 in.). This optimized full bore meter provides impressive results in the most difficult of installation requirements.

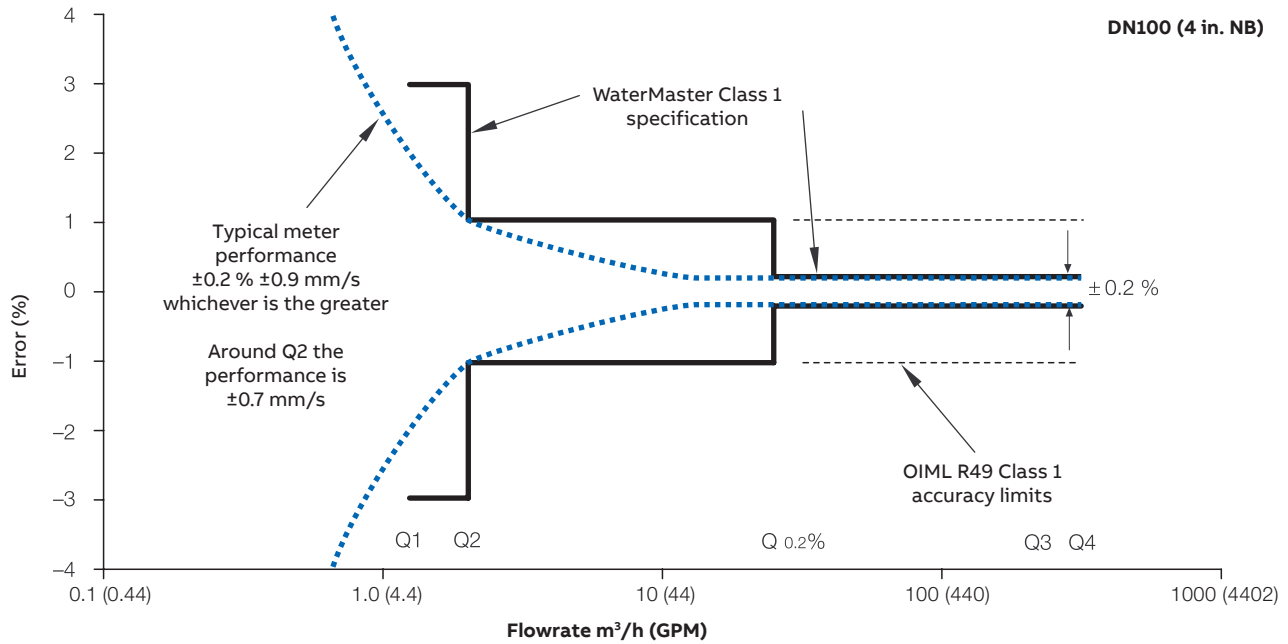


WaterMaster sensors are also available in reduced-bore geometries giving the ultimate in low-flow performance with a very high turn-down range.

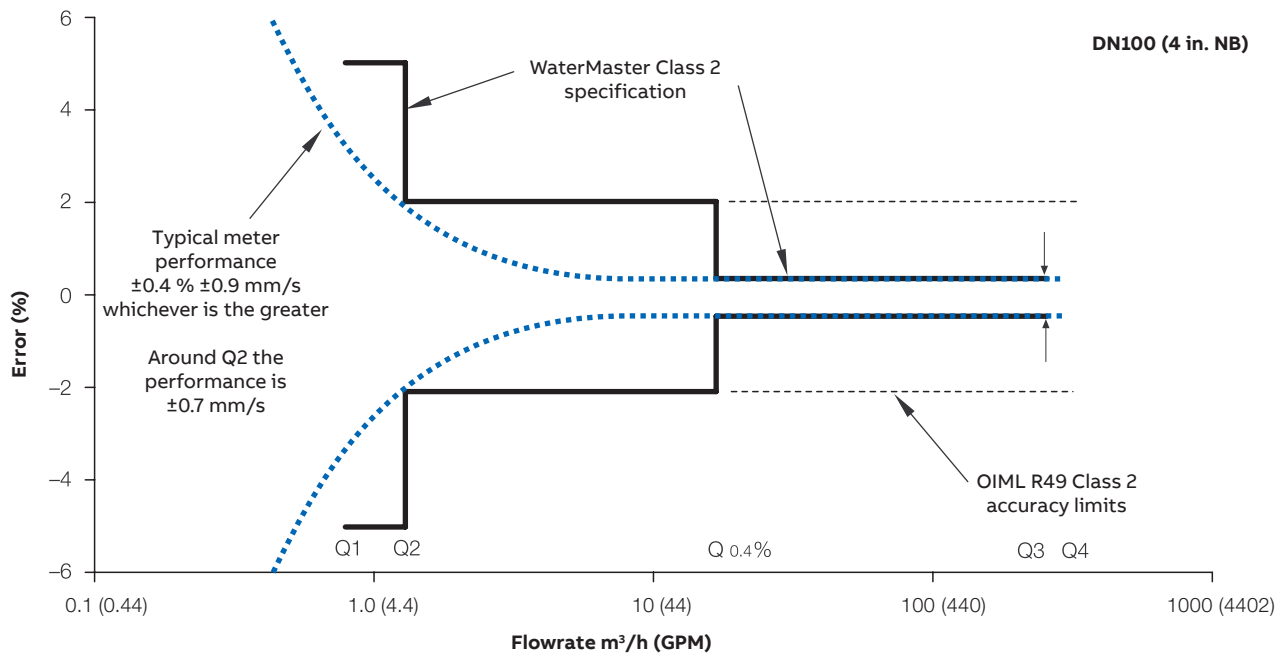
The unique design of the reduced-bore sensor conditions the flow profile in the measuring section so that distortions in the flow profile, either upstream or downstream, are flattened. The result is excellent in situ flowmeter performance, even with very bad hydraulic installation conditions.

Specification

WaterMaster specification to OIML R49 Class 1



WaterMaster specification to OIML R49 Class 2



Although OIML R49 does not define the flow accuracy below Q1, WaterMaster continues to measure flow at lower flow rates down to a cutoff velocity of $\pm 5 \text{ mm/s}$ ($\pm 0.2 \text{ in./s}$). The accuracy between cutoff and Q1 is typically $\pm 0.9 \text{ mm/s}$ ($\pm 0.04 \text{ in./s}$).

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – m³/h

DN	Q4	Q3	Standard Calibration – 0.4 % Class 2			High Accuracy Calibration – 0.2 % Class 1		
			Q _{0.4%}	Q2	Q1	Q _{0.2%}	Q2	Q1
10	3.1	2.5	0.167	0.013	0.008	0.31	0.02	0.012
15	7.88	6.3	0.42	0.032	0.02	0.79	0.05	0.03
20	12.5	10	0.67	0.05	0.032	1.25	0.08	0.05
25	20	16	1.1	0.08	0.05	2	0.13	0.08
32	31.25	25	1.67	0.13	0.08	3	0.20	0.13
40*	50	40	4.2	0.2	0.13	6	0.32	0.2
50*	79	63	4.2	0.32	0.20	7.9	0.5	0.32
65*	125	100	6.7	0.5	0.32	12.5	0.8	0.5
80*	200	160	10.7	0.81	0.51	16	1.3	0.8
100*	313	250	16.7	1.3	0.79	25	2	1.25
125*	313	250	16.7	1.3	0.79	25	2	1.25
150*	788	630	42	3.2	2.0	63	5	3.2
200*	1,250	1,000	67	5.1	3.2	100	8	5
250	2,000	1,600	107	8.1	5.1	160	13	8
300	3,125	2,500	167	12.7	7.9	250	20	12.5
350	5,000	4,000	267	20.3	12.7	400	32	20
400	5,000	4,000	267	20.3	12.7	400	32	20
450	7,875	6,300	420	32	20	630	50	32
500	7,875	6,300	420	32	20	630	50	32
600	12,500	10,000	667	51	32	1000	80	50
700	20,000	16,000	1600	102	64	1600	160	100
750	20,000	16,000	1600	102	64	1600	160	100
30 in. (750)	20,000	16,000	1600	102	64	1600	160	100
800	20,000	16,000	1600	102	64	1600	160	100
900	31,250	25,000	2500	160	100	2500	250	156
1000	31,250	25,000	2500	160	100	2500	250	156
42 in	31,250	25,000	2500	160	100	2500	250	156
1100	31,250	25,000	2500	160	100	2500	250	156
1200	50,000	40,000	4000	256	160	4000	400	250
1350	78,750	63,000	6300	403	252	6300	630	394
1400	78,750	63,000	6300	403	252	6300	630	394
1500	78,750	63,000	6300	403	252	6300	630	394
60 in. (1500)	78,750	63,000	6300	403	252	6300	630	394
1600	78,750	63,000	6300	403	252	6300	630	394
1650	78,750	63,000	6300	403	252	6300	630	394
1800	125,000	100,000	10000	640	400	10000	1000	625
1950	125,000	100,000	10000	640	400	10000	1000	625
2000	125,000	100,000	10000	640	400	10000	1000	625
2200	200,000	160,000	16000	1024	640	16000	1600	1000
2400	200,000	160,000	16000	1024	640	16000	1600	1000

* OIML R49 Certificate of Conformance to Class 1 and Class 2, with OIML R49 and MID versions available.

Q2 = 1.6 * Q1

Q4 = 1.25 * Q3

Note: OIML R49–1 allow Class 1 only for meters with Q3 ³ 100 m³/h. Meters outside this range have been tested and conform to Class 1.

...Specification

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – gal/min

NPS/NB (DN)	Q4	Q3	Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
			Q _{0.4%}	Q2	Q1	Q _{0.2%}	Q2	Q1
3/8 (10)	13.8	11	0.73	0.06	0.035	1.38	0.09	0.053
1/2 (15)	34.7	27.7	1.85	0.14	0.09	3.48	0.22	0.14
3/4 (20)	55	44	2.94	0.22	0.14	5.5	0.35	0.22
1 (25)	88	70.4	4.7	0.35	0.22	8.8	0.57	0.35
1 1/4 (32)	137.6	110	7.3	0.57	0.35	13.2	0.88	0.57
1 1/2 (40)	220	176	18.5	0.89	0.56	26.4	1.41	0.88
2 (50)	347	277	18.5	1.41	0.88	34.7	2.22	1.39
2 1/2 (65)	550	440	29.4	2.24	1.40	55.0	3.52	2.20
3 (80)	881	704	47.0	3.58	2.24	70.4	5.64	3.52
4 (100)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
5 (125)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
6 (150)	3,467	2,774	185	14.1	8.81	277	22.2	13.9
8 (200)	5,504	4,403	294	22.4	14.0	440	35.2	22.0
10 (250)	8,806	7,045	470	35.8	22.4	704	56.4	35.2
12 (300)	13,759	11,007	734	55.9	34.9	1,101	88.1	55.0
14 (350)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
16 (400)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
18 (450)	34,673	27,738	1,849	141	88.1	2,774	222	139
20 (500)	34,673	27,738	1,849	141	88.1	2,774	222	139
24 (600)	55,036	44,029	2,935	224	140	4,403	352	220
27/28* (700)	88,057	70,446	7,045	451	282	7,045	704	440
30 (750)	88,057	70,446	7,045	451	282	7,045	704	440
32 (800)	88,057	70,446	7,045	451	282	7,045	704	440
36 (900)	137,590	110,072	11,007	704	440	11,007	1,100	688
39/40* (1000)	137,590	110,072	11,007	704	440	11,007	1,100	688
42 (1050)	137,590	110,072	11,007	704	440	11,007	1,100	688
44 (1100)	137,590	110,072	11,007	704	440	11,007	1,100	688
48 (1200)	220,143	176,115	17,611	1,127	704	17,611	1,761	1,101
52 (1350)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
54 (1400)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
60 (1500)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
66 (1600)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
68 (1650)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
77 (1800)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
77 (1950)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
84 (2200)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403
96 (2400)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403

*Size is dependent on flange specification

Q2 = 1.6 * Q1

Q4 = 1.25 * Q3

WaterMaster reduced-bore meter (FER) flow performance – m³/h (gal/min)

Size		Class 2 specification						Class 1 specification			
		Q ₄	Q ₃	Q _{0.4%}	Q ₂	Q ₁	R	Q _{0.2%}	Q ₂	Q ₁	R
mm	in.	m ³ / h (Ugal / min)	m ³ / h (Ugal / min)	m ³ / h (Ugal / min)	m ³ / h (Ugal / min)	m ³ / h (Ugal / min)		m ³ / h (Ugal / min)	m ³ / h (Ugal / min)	m ³ / h (Ugal / min)	
40	1½	31 (138)	25 (110)	0.83 (1.05)	0.063 (0.28)	0.04 (0.18)	630	1.7 (7.48)	0.1 (0.44)	0.063 (0.28)	400
50	2	50 (220)	40 (176)	1.0 (4.40)	0.1 (0.44)	0.063 (0.28)	630	2.0 (8.8)	0.16 (0.7)	0.1 (0.44)	400
65	2½	79 (347)	63 (277)	1.6 (7.04)	0.16 (0.7)	0.1 (0.44)	630	3.2 (10.56)	0.25 (1.1)	0.16 (0.7)	400
80	3	125 (550)	100 (440)	2.0 (8.80)	0.25 (1.1)	0.16 (0.7)	630	4.0 (17.6)	0.4 (1.76)	0.25 (1.1)	400
100	4	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400
125	5	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400
150	6	500 (2200)	400 (1760)	8.0 (35.20)	1.0 (4.4)	0.63 (2.77)	630	16 (70.4)	1.6 (7)	1.0 (4.4)	400
200	8	788 (3470)	630 (2770)	13.0 (57.2)	1.6 (7.04)	1.0 (4.4)	630	25 (110)	2.5 (11)	1.6 (7)	400
250	10	1250 (5500)	1000 (4400)	20 (88)	2.5 (11.01)	1.6 (7)	630	40 (176)	4.0 (17.6)	2.5 (11)	400
300	12	2000 (8810)	1600 (7045)	32 (140.8)	4.1 (18.05)	2.5 (11)	630	64 (281.6)	6.4 (28)	4.0 (17.6)	200
350	14	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200
375	15	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200
400	16	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200
450	18	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200
500	20	5000 (22014)	4000 (17610)	80 (352)	16 (70.45)	10 (44)	400	160 (70.4)	32 (141)	20 (88)	200
600	24	7875 (34670)	6300 (27740)	126 (554.4)	25.2 (110.9)	15.8 (70)	400	252 (1108)	50.4 (222)	31.5 (138.7)	200

Q₂ = 1.6 * Q₁**Q₄ = 1.25 * Q₃****Q₃/Q₁ = R**

Specification – Sensor

Functional specification

Temperature limitations

Ambient temperature	
Remote transmitter	–20 to 70 °C (–4 to 158 °F)
Integral transmitter	–20 to 60 °C (–4 to 140 °F)
Process temperature	See table below. 0.1 to 50 °C (32.2 to 122 °F) OIML R49 T50 Approved

Medium temperature °C (°F)				
Code	Lining	Flange material	Minimum	Maximum
FEF, FEW3	Hard rubber	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–10 (14)	80 (176)
FEW1	PTFE	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–25 (–13)	80 (176)
FEW3	PTFE	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–10 (14)	80 (176)
FEW3	Elastomer	Carbon steel	–5 (23)	80 (176)
		Stainless steel	–5 (23)	80 (176)
FEF, FER	Elastomer	Carbon steel	–6 (21)	70 (158)
FEV	Polypropylene		–6 (21)	70 (158)

Pressure limitations

As flange rating
 PN25 Max Process Temp 50 °C (122 °F)
 PN40 Max Process Temp 40 °C (104 °F)
 OIML / MID Approved Meters 16 bar (232 psi)
 UL Fire Service approved meters 285 psi

Pressure equipment directive 97/23/EC

This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt.

IP rating

IP68 (NEMA 6) to 7 m (20 ft.) depth
Note. Not sizes DN10 to DN32 (3/8 – 1 ¼ in. NB)
 IP67 (NEMA 4X) – DN10 to DN32 (3/8 – 1 ¼ in. NB)

Buriable (sensor only)

FEV – DN40 to 200 (1 ½ to 8 in. NB)
 FER – DN40 to 600 (1 ½ to 24 in. NB)
 FEF – DN250 to 600 (10 to 24 in. NB)
 FEW – DN450 to 2400 (18 to 96 in. NB)
 to 5 m (16 ft.) depth

Conductivity

>20 µS cm^{–1}

Transmitter mounting

Integral (not FEF) or remote

Electrical connections

20 mm glands
 ½ in. NPT
 20 mm armored glands

Sensor cable

ABB WaterMaster cable available in two forms –
 standard and armored
 Maximum length 200 m (660 ft.)

Suspended solids

Suspended solids percentage of process medium should
 not exceed 6 % of total volume

Physical specification

Wetted parts

Electrode material

Stainless steel 316 L / 316 Ti
 Super-austenitic steel
 Hastelloy® C-22 and Hastelloy C4
 (other electrode materials available on request)

Potential equalizing rings

Minimum of 1 recommended

Lining material / potable water approvals

Potable Water Approvals						
Code	Size Range	Liner	WRAS	WRAS 60°C	ACS DVGW	NSF-61 AZ/ NZS 4020
FEW1	DN10 to 32 (¾ to 1¼ in. NB)	PTFE	✓			
FEW3	DN10 to 600 (¾ to 24 in. NB)	PTFE				
FEW3	DN40 to 2400 (1½ to 96 in. NB)	Elastomer	✓			✓
FEW3	DN40 to 2400 (1½ to 96 in. NB)	Hard rubber	✓	✓	✓	✓
FEV	DN40 to 200 (1½ to 8 in. NB)	Polypropylene	✓		✓	✓
FEF	DN250 to 600 (10 to 24 in. NB)	Elastomer	✓		✓	✓
FEF	DN250 to 600 (10 to 24 in. NB)	Hard rubber	✓	✓	✓	✓
FER	DN40 to 600 (1½ to 24 in. NB)	Elastomer	✓		✓	✓

*Size is dependent on flange specification

Lining protection plates

Not required

Installation conditions (recommended)

Straight pipe requirements		
	Upstream	Downstream
FEW / FEF	5 x DN	2 x DN
FEV	5 x DN	0 x DN
FER	0 x DN	0 x DN

Pressure loss

Negligible at Q3	All full bore meters
<0.25 bar (<3.62 psi) at Q3	FEV (DN40 to 200 [1½ to 8 in. NB])
<0.63 bar (<9.13 psi) at Q3	FER (DN40 to 600 [1½ to 24 in. NB])

Non-wetted parts**Flange material**

Carbon steel	DN20 to DN2400 ($\frac{3}{4}$ to 96 in. NB)
Stainless steel	DN10 to DN2400 ($\frac{3}{8}$ to 96 in. NB)
SG iron	FEV – DN40 to DN150 [1 $\frac{1}{2}$ to 6 in. NB)
	FER – DN40 to DN150 [1 $\frac{1}{2}$ to 6 in. NB)

Meter tube

Stainless steel	DN10 to DN2400 ($\frac{3}{8}$ to 96 in. NB)
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Housing material

Carbon steel	FEV – DN40 to 200 (1 $\frac{1}{2}$ to 8 in. NB)
	FEW – DN450 to 2400 (18 to 96 in. NB)
Plastic FEF –	DN250 to 600 (10 to 24 in. NB)
Aluminium	FEW – DN10 to 400 ($\frac{3}{8}$ to 16 in. NB)

Terminal box material

Polycarbonate

Cable gland material

Plastic, brass

Paint specification

Zinc-based primed (all sensors), paint coat $\geq 70 \mu\text{m}$ thick
RAL 9002 (light grey)

Specification – transmitter

Functional specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 % / -30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A
Supply voltage fluctuations within the specified range have no effect on accuracy	

Digital Outputs (3)

Rating	30 V @ 220 mA, open collector, galvanically isolated*
Maximum output frequency	5250 Hz
1 off dedicated to Alarm / Logic, programmable function	
2 off configurable to either Pulse / Frequency or Alarm / Logic function	

Current output – HART FEX100 variant

4 to 20 mA or 4 to 12/20 mA, galvanically isolated*	
Maximum loop resistance	750 W
HART protocol	Version 5.7 (HART registered)
Signal levels compliant with NAMUR NE 43	(3.8 to 20.5 mA)
Low alarm	3.6 mA, High alarm 21.8 mA

Additional accuracy

±0.1 % of reading	
Temperature coefficient:	typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP variant

Registered name:	FEX100-DP
RS485 (9.6kbps to 1.5Mbps), galvanically isolated	
DPV0, DPV1	
PA Profile	3.01
Standard idents:	9700, 9740, 9741
FEX100-DP specific ident:	3431
3 Concurrent MS2 master connections	

RS485 Communications – MODBUS FEX100-MB variant

MODBUS RTU protocol	
RS485 (9.6kbps to 115.2kbps), galvanically isolated	

Electrical connections

20 mm glands ½ in. NPT, 20 mm armored glands	
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Temperature limitations

Ambient temperature	-20 to 60 °C (-4 to 140 °F)
Temperature coefficient	Typically <±10 ppm/°C @ Vel ³0.5 m/s

Environmental protection

Humidity:	0 to 100 %
Rating:	IP67 (NEMA 4X) to 1m (3.3 ft.) depth

Tamper-proof security

Write access prevented by internal switch combined with external security seals for MID applications

Languages

English, French, German, Italian, Spanish, Polish

Infrared service port

USB adapter (accessory), USB 1.1. and 2.0 compatible
Driver software for Windows 2000, XP, 7 (32-bit) and Vista

Housing material

Powder-coated aluminium with glass window

Paint specification

Paint coat ³70 µm thick RAL 9002 (light grey)

Transmitter vibration testing

Vibration level:	7 m/s²
Frequency range:	20 to 150 Hz
No. of sweeps in 3 orthogonal planes:	20
Undetectable shift in transmitter span or zero performance	

Hazardous approvals

FM & FMC Class 1 Div 2	
(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG / T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting	
Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32 [3/8 to 11/4 in.NB])	
(FMC listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG / T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting	
Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32 [3/8 to 11/4 in.NB])	
FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84 in. NB) only	

*Size is dependent on flange specification

ATEX/UKEX* Zone 2, 21 & 22

II 3 G Ex nA IIC T5 Gc	
II 2 D Ex tb IIIC T100°C Db	
TA = -20°C to +60°C (integral transmitter)	
TA = -20°C to +70°C (remote sensor)	

IECEx* Zone 2, 21 & 22

Ex tb IIIC T100°C Db	
Ex nA IIC T5 Gc	
TA = -20°C to +60°C (integral transmitter)	
TA = -20°C to +70°C (remote sensor)	

*FEW, FEV, FET and FEF ³700 (27/28 in. NB) only

Declaration of Conformance

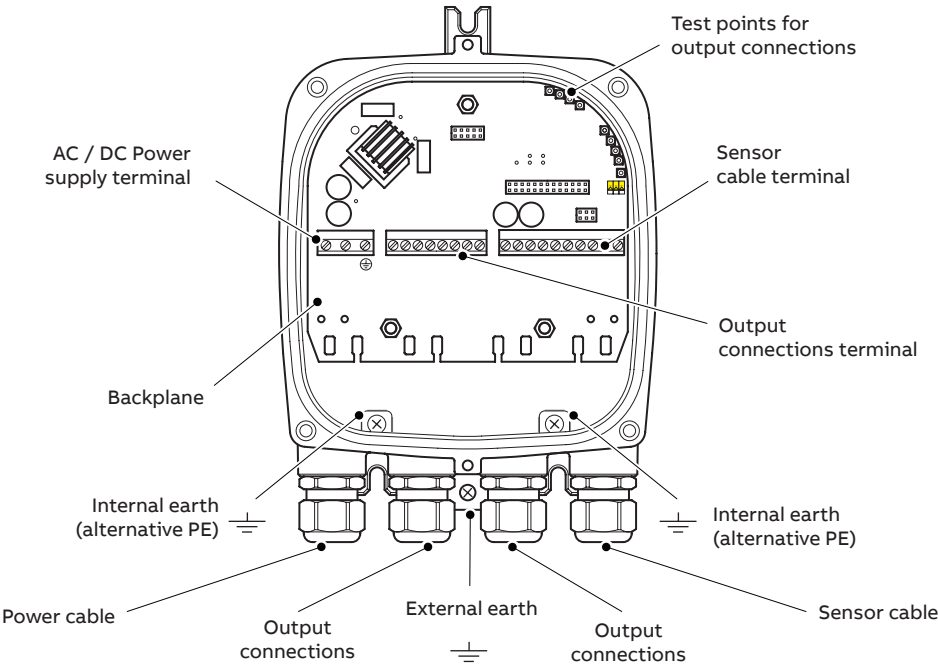
Copies of CE certification will be available on request. WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200 [1½ to 8 in.NB]). Copies of accuracy certification are available on request. WaterMaster (FEV DN40 to 200 [1½ to 8 in.NB]) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

* When installed, do not leave galvanically isolated circuits (pulse and current) floating.

Transmitter connections

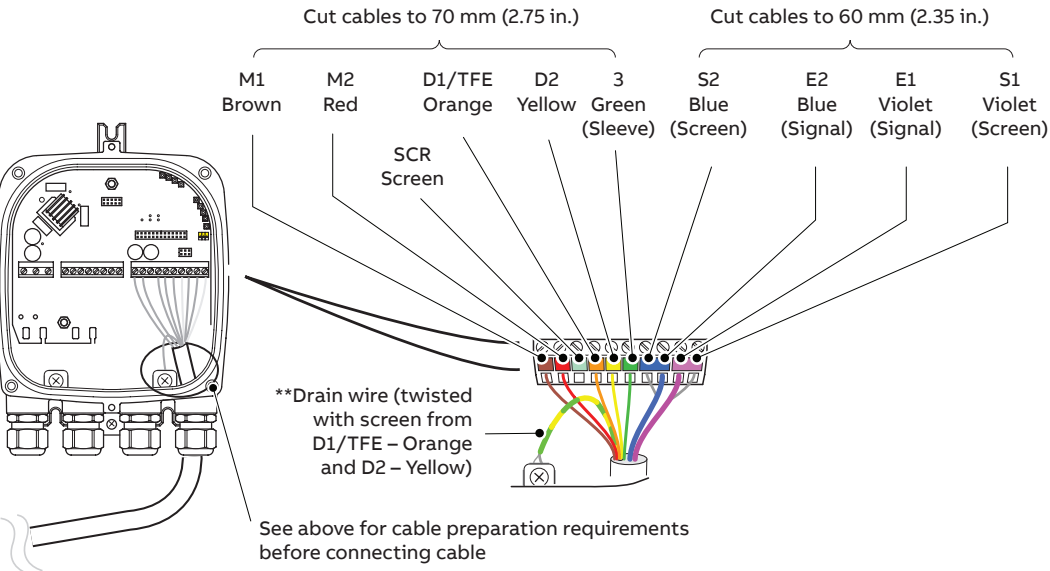
Transmitter terminal connections overview

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and safety precautions – refer to the User Guide OI/FET100–EN.



Cable gland / conduit entry (Remote transmitter shown)

Sensor cable terminal connections and recommended cable lengths



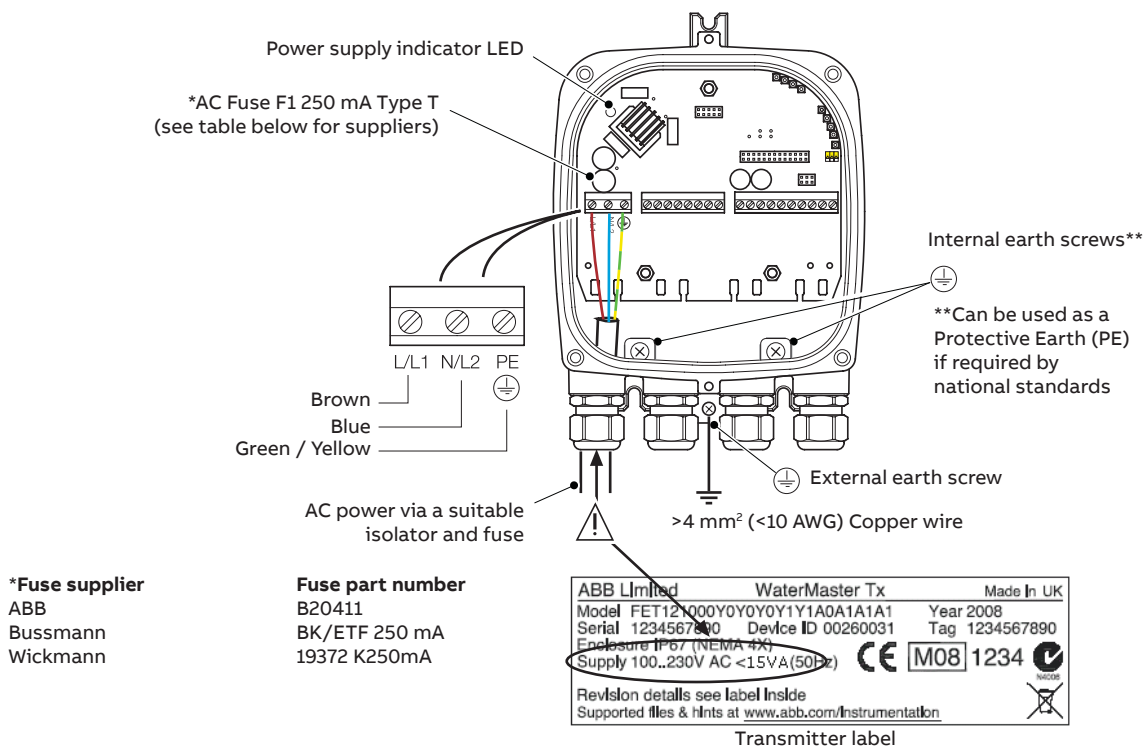
*Inner wire
**For cathodically-protected systems (or if the transmitter enclosure does not have an earth screw) connect the drain wire to terminal SCR.

Sensor cable connections at transmitter terminal block – remote transmitter

...Transmitter connections

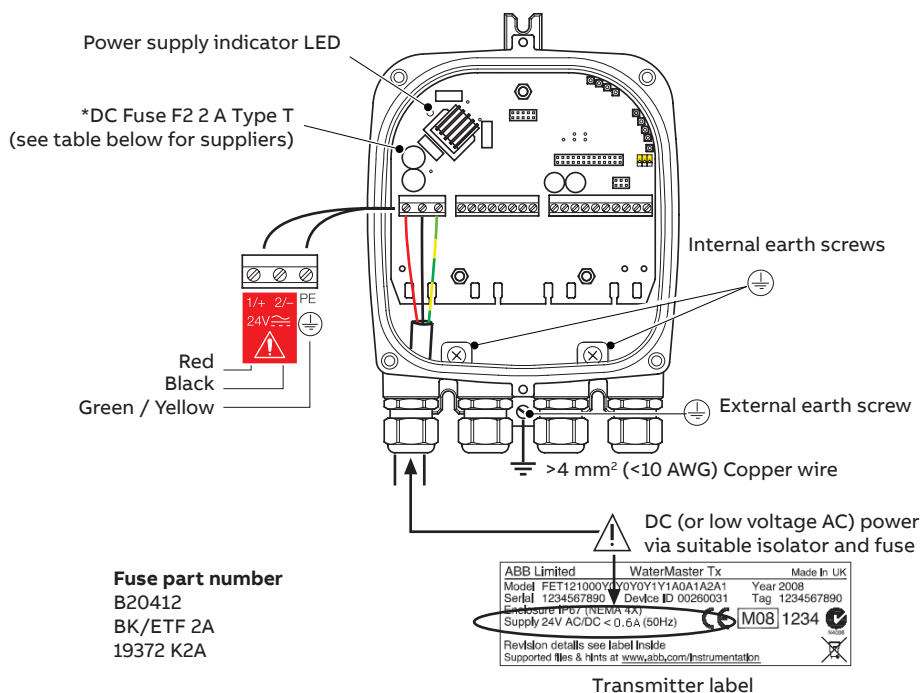
Power supply connections

AC power supply



AC power supply connections

DC (and low voltage AC) power supply



DC (and low voltage AC) power supply connections

Configuration DIP switches

Three configuration DIP switches are mounted on the transmitter backplane board.

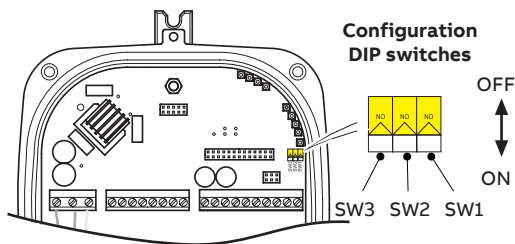
These are factory-set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters the read-only / MID protection switch is set to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.



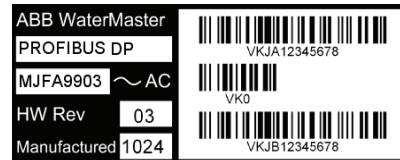
DIP Switch functions

SW1 – Read-only / MID Protection
SW2 – (future product)
SW3 – Internal sensor memory

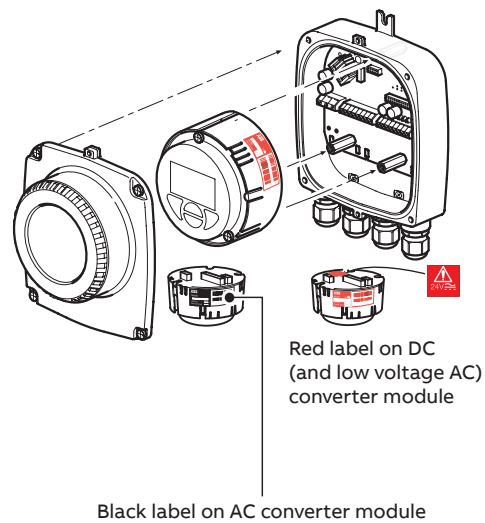
Configuration DIP switches

Transmitter module identification

Note. The communications bus type is HART FEX100 if not specified on the transmitter module label. An example of the PROFIBUS FEX100-DP variant transmitter module label is shown below.



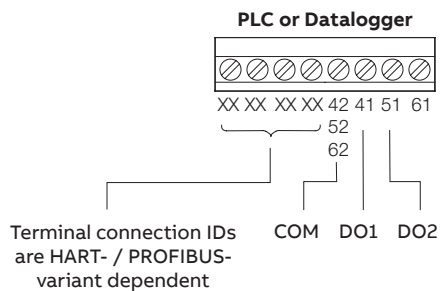
PROFIBUS FEX-100P label



Transmitter module identification

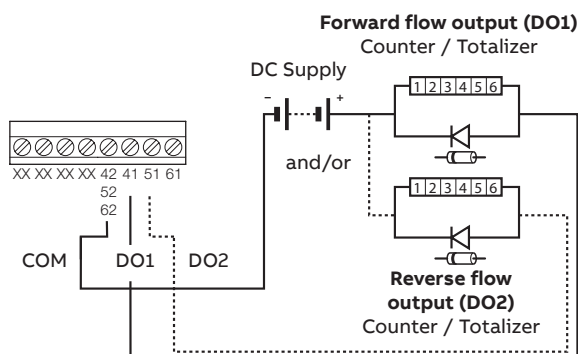
Output connections

Frequency outputs

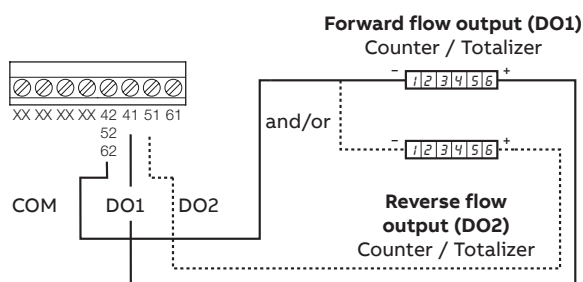


PLC / Datalogger connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

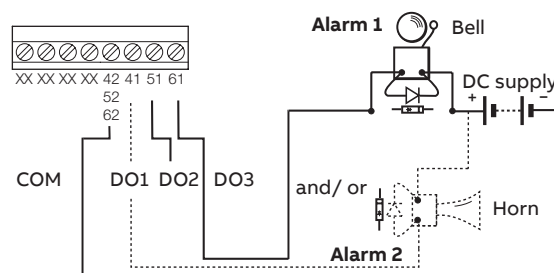
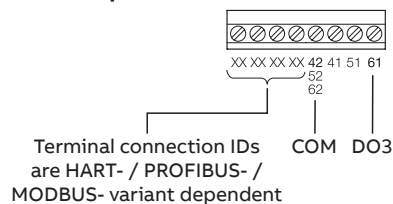


Electromechanical connections



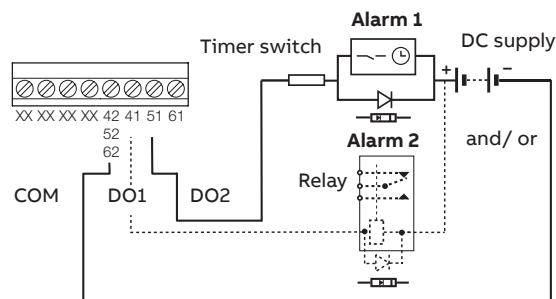
Telemetry / Electronic counters connections

Alarm outputs

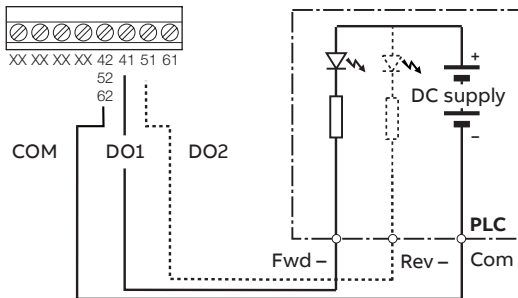
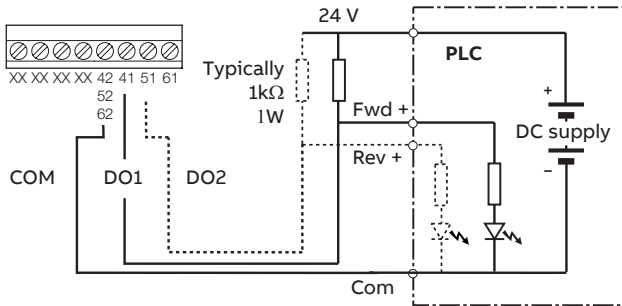


Note.

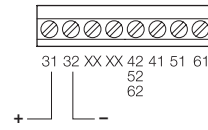
- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in **Electromechanical connections** and **Telemetry / Electronic counters connections**, opposite.
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).



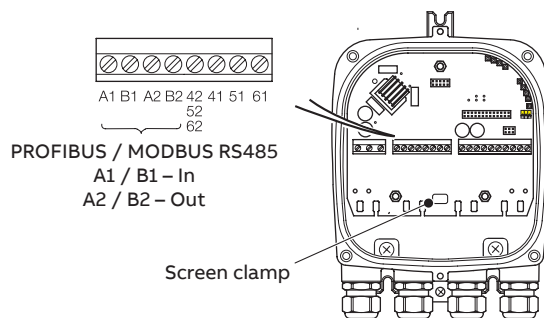
Note. Relay and timer switch shown for example only.

PLC interface**Note.**

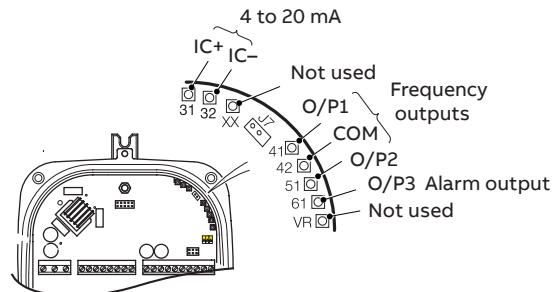
- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA.

Current output (4 to 20 mA) – HART (FEX100) variant

Refer to IM/WMP for HART-Protocol communication details

Current output (4 to 20 mA) – HART (FEX100) variant**RS485 communications – PROFIBUS (FEX100-DP) and MODBUS (FEX100-MB) variants****Test point access**

Note. A typical DVM probe can access (fit) the PCB's test holes.



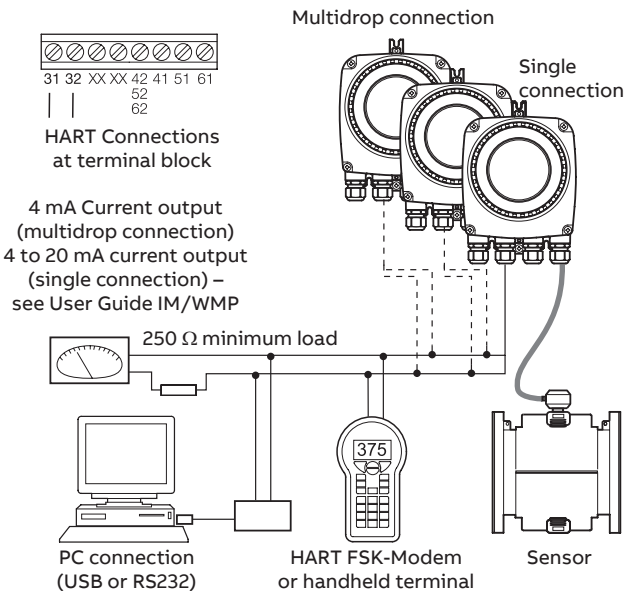
*These 2 test points are connected on the HART FEX100 backplane only (they are present on the PROFIBUS FEX100-DP / MODBUS FEX100-MB backplane but not connected)

Digital communication

The transmitter has the following options for digital communication.

HART protocol

The unit is registered with HART Communication Foundation.



HART protocol	
Configuration	Directly on the Device Software Asset Vision Basic (+ HART – DTM) Install a HART modem (FSK [Frequency Shift Keyed]-Modem) for HART-Communication when connecting to a PC. The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector
Transmission	
Max. signal amplitude	1.2 mA
Current output load	Min. 250W, max. = 560W
Cable	AWG 24 twisted
Max. cable length	1500 m (4921 ft.)
Baud rate	1.200 baud

System integration

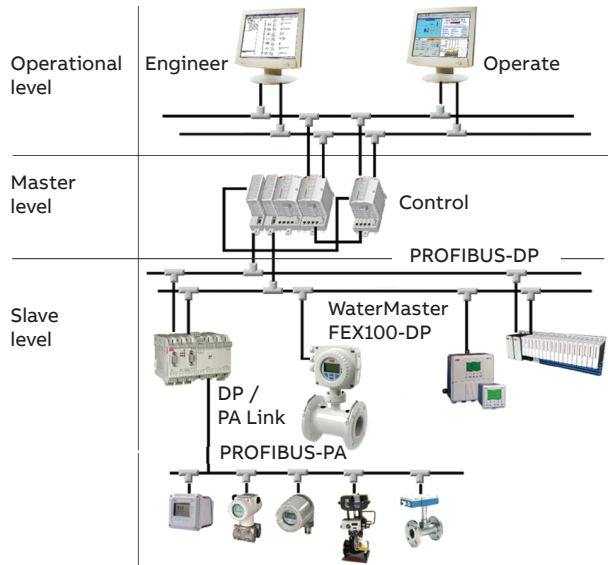
WaterMaster can be integrated into control systems and configuration devices using any Frame application, such as ABB AssetVision or similar third-party applications. ABB Device Type Managers (DTMs) for WaterMaster provide a unified structure for accessing device parameters, configuring and operating the devices and diagnosing problems. FDT (Field Device Tool) technology standardizes the communication and configuration interface between all field devices and host systems.

PROFIBUS DP protocol

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

PROFIBUS DP ID no.	0x3431
Alternative standard ID no.	0x9701 or 0x9741
Configuration	Directly on the device Software Asset Vision Basic (+PROFIBUS DP-DTM)
Transmission signal	Accuracy to IEC 61158-2
Cable	Shielded, twisted cable (accurate to IEC 61158-2, types A or B)

All devices are connected in a bus structure ('line') as shown in below. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment. Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.



System integration

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format.

This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

- General specifications
 - Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.
- DP slave-related specifications
 - Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

MODBUS protocol

MODBUS is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.modbus.org).

Using the MODBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment. WaterMaster FEX100-MB follows the specification for Modbus Over Serial Line V1.02, using 2-wire TIA/EIA-485 (RS485) physical layer.

Cable Properties

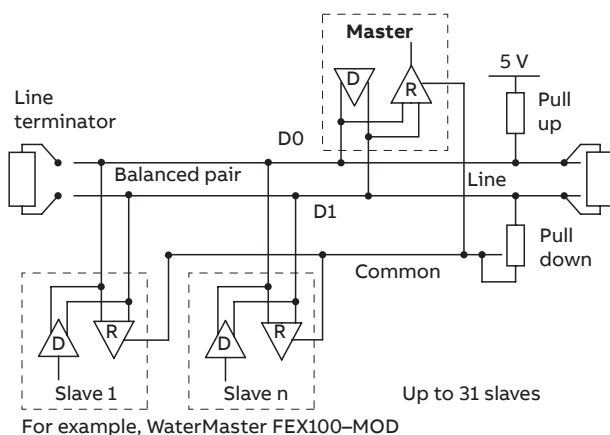
The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).

For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m (3280 ft.). Where 4-wire cabling is used as a 2-wire cabling system the maximum length must be divided by 2. The tap cables must be short, never more than 20 m (65.6 ft.). If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m (131 ft.) divided by n .

The maximum serial data transmission line length for RS485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) – standard screened or twisted pair cable.
- Up to 300 m (984 ft.) – twin twisted pair with overall foil screen and an integral drain wire – for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) – twin twisted pair with separate foil screens and integral drain wires – for example, Belden 9729 or equivalent.

Category 5 cables may be used for RS485-MODBUS to a maximum length of 600 m (1968 ft.). For the balanced pairs used in an RS485-system, a characteristic impedance with value higher than 100Ω is preferred especially for 19200 and higher Baud rates.

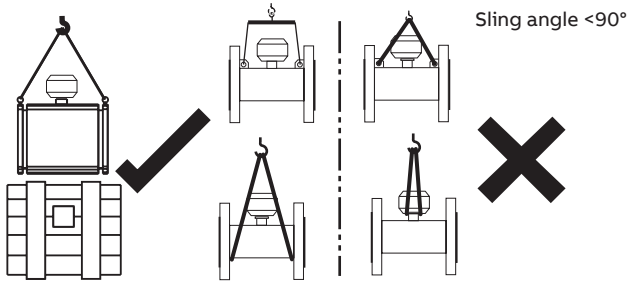


Installation requirements

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and Safety precautions refer to User Guide OI/FEF/FEV/FEW-EN.

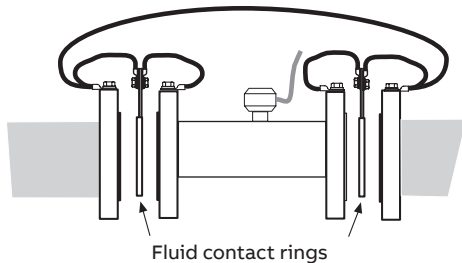
Unpacking the flowmeter

Care must be taken when lifting the flowmeter to use the lifting hooks provided or sling under the body of the meter. Never lift using the terminal connection box of the sensor cable as this will cause damage and invalidate warranty.



Grounding

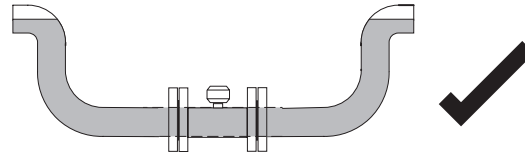
The flowmeter sensor must be cross-bonded to the upstream and downstream pipes. For technical reasons, this potential should be identical to the potential of the metering fluid. The fluid connection is made by installing 2 fluid contact rings (for grounding).



Mounting

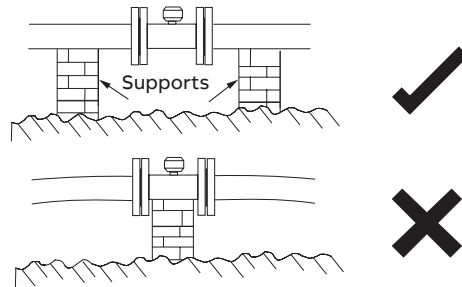
The installation conditions shown below must be observed to achieve the best operational results.

The sensor tube must always be completely full.

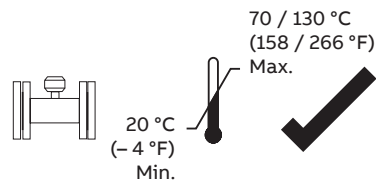


The flow direction must correspond to the identification plate. The device measures the flowrate in both directions. Forward flow is the factory setting.

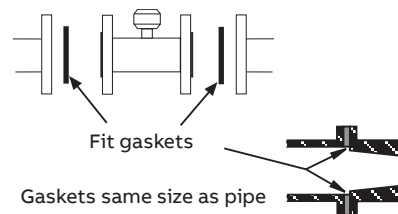
The devices must be installed without mechanical tension (torsion, bending). If required support the pipeline.



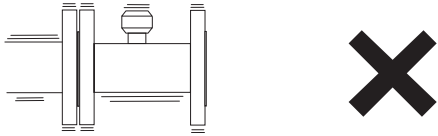
The flange seals must be made from a compatible material for the fluid and fluid temperatures if required.



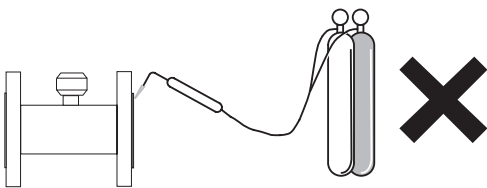
Seals must not extend into the flow area since possible turbulence could influence the device accuracy.



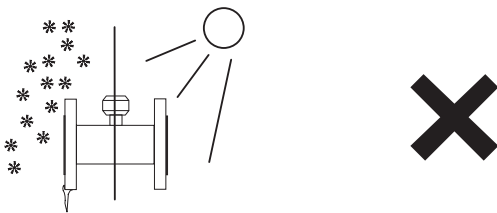
The pipeline may not exert any unallowable forces and torques on the device, such as vibration.



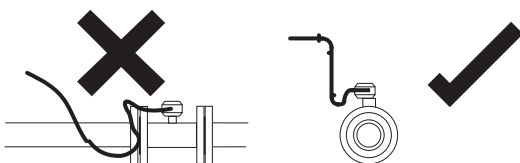
The flowmeter must not be submitted to any localized heat during installation; take care to remember this is a measuring instrument.



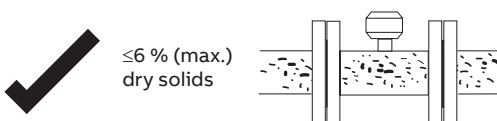
The flowmeter must not be exposed to direct sunlight or provide for appropriate sun protection where necessary.



The cable to the flowmeter should be installed neatly or within a conduit, both loose or conduit should have a u shape below the terminal connection box height to allow any water run off to avoid any capillary action into the flowmeter sensor.

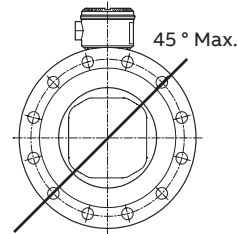


Ensure a maximum 6 % dry solids content flow through pipe – for higher dry solids content, refer to ABB's ProcessMaster range.



Electrode axis

Electrode axis should be horizontal if at all possible or no more than 45° from horizontal.



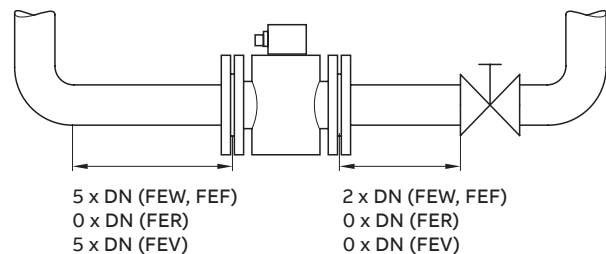
Upstream and Downstream pipe sections

The metering principle is tolerant of the flow profile.

- Wherever possible do not install fittings (for example, manifolds, valves) directly in front of the flowmeter sensor.
- Butterfly valves should be installed so that the valve plate does not extend into the flowmeter sensor.
- Valves or other turn-off components should be installed in the Downstream pipe section.

Experience has shown that, in most installations, straight upstream sections 3 x DN long and straight downstream sections 2 x DN long are normally sufficient. We would recommend conditions of 5 x DN straight upstream and 2 x DN straight downstream where possible.

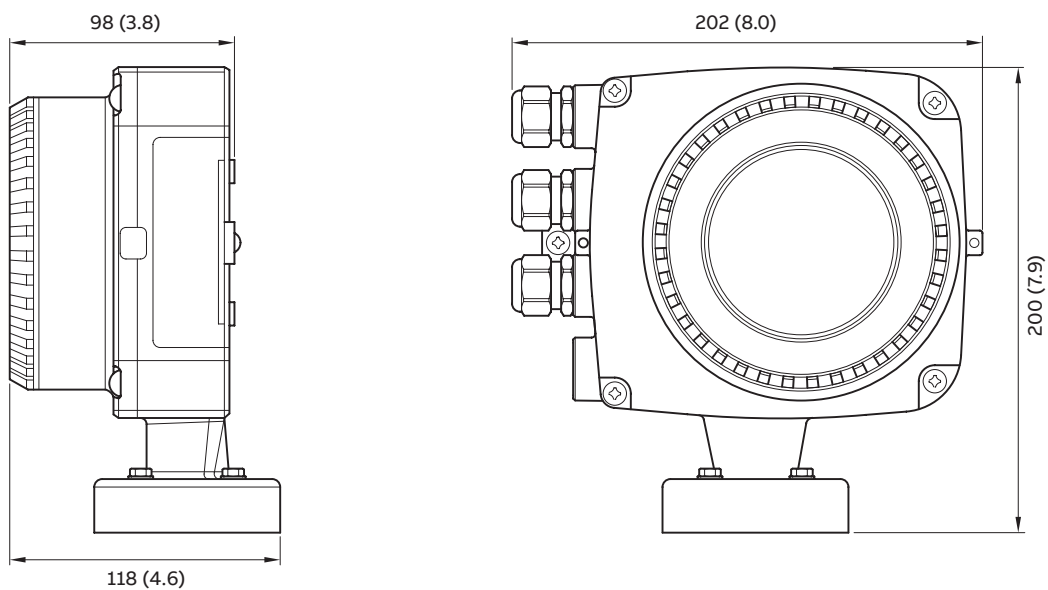
For reduced-bore meters (FER), these straight pipe sections are often not necessary.



Transmitter dimensions

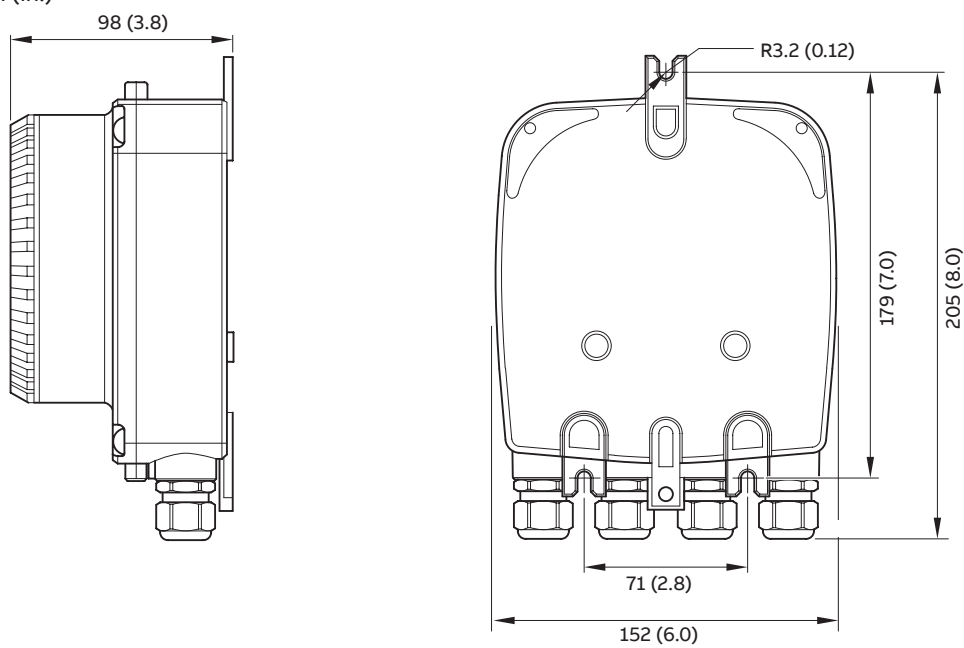
Integral transmitter

Dimensions in mm (in.)



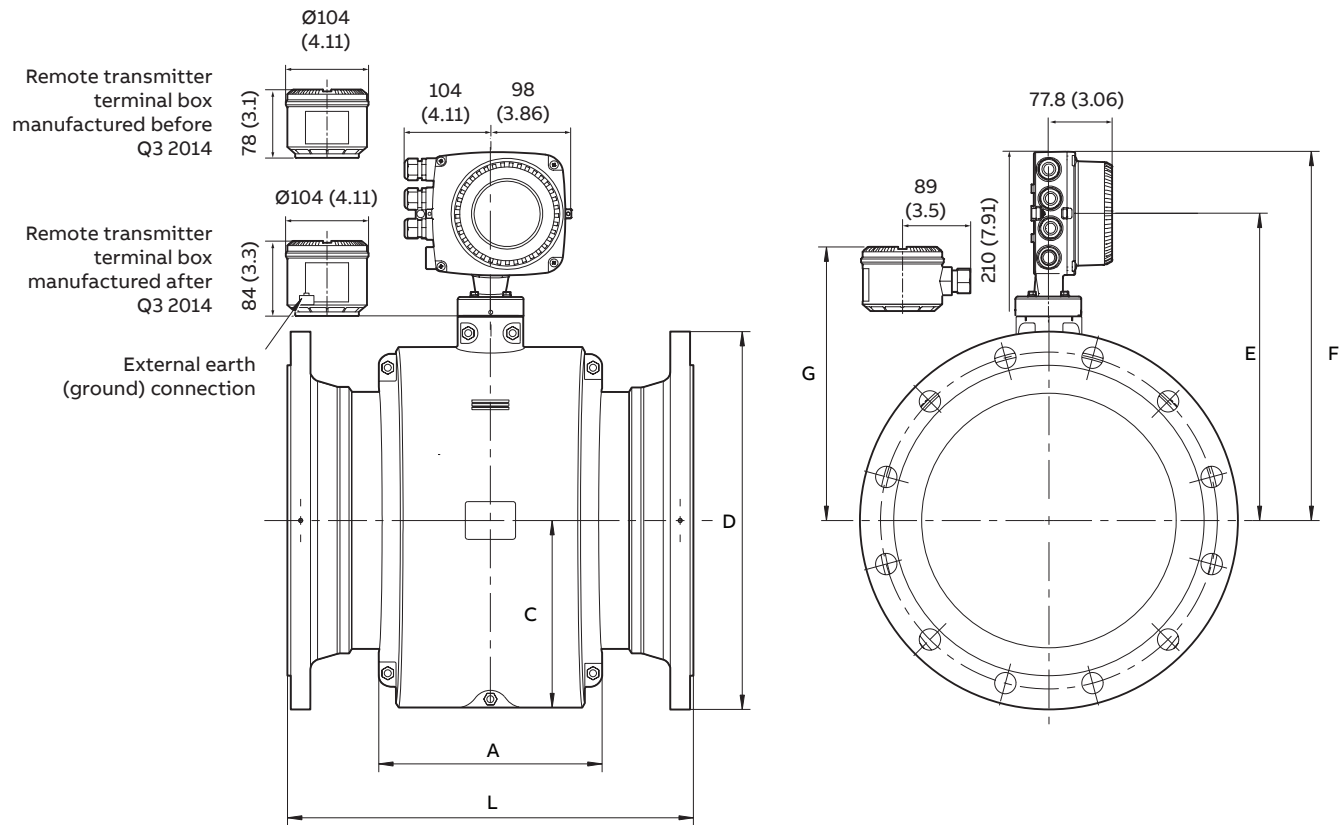
Remote transmitter

Dimensions in mm (in.)



FEW – DN150 to 400 (6 to 16 in. NB)

Dimensions in mm (in.)



DN150 to 400 (6 to 16 in. NB) (FEW)

...Sensor dimensions

DN	Process connection type	Dimensions in mm (in.)							Approx. weight in kg (lb)	
		D	L	F	C	E	G	A	Integral	Remote
DN150 (6 in.)	PN10 to 16	285 (11.22)							33 (73)	31 (68)
	PN25 to 40	300 (11.81)							39 (86)	37 (81)
	JIS5K	265 (10.43)							33 (73)	31 (68)
	JIS10K	280 (11.02)							33 (73)	31 (68)
	AS4087 PN16	280 (11.02)	300 (11.81)	371 (14.61)	146 (9.88)	296 (11.65)	251 (9.88)	166 (6.54)	33 (73)	31 (68)
	AS4087 PN35	305 (11.81)							39 (86)	37 (81)
	ASME B16.5 CL300	320 (12.60)							47 (103)	45 (99)
	ASME B16.5 CL150	279 (10.98)							33 (73)	31 (68)
DN200 (8 in.)	PN10	340 (13.39)							41 (90)	39 (86)
	PN16	340 (13.39)							41 (90)	39 (86)
	PN25	360 (14.17)							55 (121)	53 (117)
	PN40	375 (14.76)							65 (143)	63 (139)
	AS4087 PN16	335 (13.19)	350 (13.78)	411 (16.18)	170 (6.69)	336 (13.23)	291 (11.46)	200 (7.87)	41 (90)	39 (86)
	AS4087 PN35	370 (14.57)							65 (143)	63 (139)
	JIS5K	320 (12.60)							41 (90)	39 (86)
	JIS10K	330 (12.99)							41 (90)	39 (86)
	ASME B16.5 CL300	380 (14.96)							72 (158)	70 (154)
DN250 (10 in.)	ASME B16.5 CL150	345 (13.58)							50 (110)	48 (106)
	PN10	395 (15.55)							61 (134)	59 (130)
	PN16	405 (15.94)							65 (143)	63 (139)
	PN25	425 (16.73)							84 (185)	82 (180)
	PN40	450 (17.72)							95 (209)	93 (205)
	AS4087 PN16	405 (15.94)	450 (17.72)	426 (16.77)	198 (7.80)	351 (13.82)	306 (12.05)	235 (9.62)	65 (143)	63 (139)
	AS4087 PN35	430 (16.93)							95 (209)	93 (205)
	JIS5K	385 (15.16)							65 (143)	63 (139)
	JIS10K	400 (15.75)							65 (143)	63 (139)
DN300 (12 in.)	ASME B16.5 CL300	445 (17.52)							105 (231)	103 (227)
	ASME B16.5 CL150	405 (15.94)							70 (154)	68 (150)
	PN10	445 (17.52)							74 (163)	72 (158)
	PN16	460 (18.11)							80 (176)	78 (172)
	PN25	485 (19.09)							100 (220)	98 (216)
	JIS5K	430 (16.93)							80 (176)	78 (172)
	JIS10K	445 (17.52)	500 (19.69)	449 (17.68)	228 (8.98)	374 (14.72)	329 (12.95)	272 (10.71)	80 (176)	78 (172)
	AS4087 PN16	455 (17.91)							80 (176)	78 (172)
	AS4087 PN35	490 (19.29)							130 (286)	128 (282)
DN350 (14 in.)	ASME B16.5 CL300	520 (20.47)							150 (330)	148 (326)
	ASME B16.5 CL150	485 (19.09)							105 (231)	103 (227)
	PN40	515 (20.28)	600 (23.62)						130 (286)	128 (282)
	PN10	505 (19.88)							95 (209)	93 (205)
	PN16	520 (20.47)							110 (242)	108 (238)
	PN25	555 (21.85)							145 (319)	143 (315)
	JIS5K	480 (18.90)							95 (209)	93 (205)
	JIS10K	490 (19.29)	550 (21.65)	464 (18.27)	265 (10.43)	389 (15.31)	344 (13.54)	322 (12.68)	95 (209)	93 (205)
	AS4087 PN16	525 (20.67)							130 (286)	128 (282)
DN400 (16 in.)	AS4087 PN35	550 (21.65)							185 (407)	183 (403)
	ASME B16.5 CL300	585 (23.03)							140 (308)	138 (304)
	ASME B16.5 CL150	535 (21.06)							105 (231)	103 (227)
	PN40	580 (22.83)	650 (25.59)						195 (429)	193 (425)
	PN10	565 (22.24)							103 (227)	101 (222)
	PN16	580 (22.83)							126 (277)	124 (273)
	PN25	620 (24.41)							170 (374)	168 (370)
	JIS5K	540 (21.26)							103 (227)	101 (223)
	JIS10K	560 (22.05)	600 (23.62)	506 (19.92)	265 (10.43)	431 (16.97)	386 (15.20)	322 (12.68)	116 (255)	114 (251)
	AS4087 PN16	580 (22.83)							154 (339)	152 (335)
	AS4087 PN35	610 (24.02)							302 (664)	300 (660)
	ASME B16.5 CL300	650 (25.59)							265 (583)	263 (578)
	ASME B16.5 CL150	600 (23.62)							175 (385)	173 (381)
	PN40	660 (25.98)	650 (25.59)						258 (568)	256 (564)

DN150 to 400 (6 to 16 in. NB) (FEW) dimensions / weights

Electromagnetic flowmeter WaterMaster – FEW31, FEW32 and FEW38

[illegible]

Continued on next page...

* Standard option for sizes greater than DN600

Electromagnetic flowmeter WaterMaster – FEW31, FEW32 and FEW38

Continued on next page...

Product coding field number	1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	FEW31																				
Flowmeter system – full bore, remote mount	FEW32	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only – for use with WaterMaster transmitter / remote	FEW38																				
Protection class transmitter / protection class sensor																					
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable not fitted and not potted to sensor																1					
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable not fitted and not potted to sensor																2					
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable fitted and potted to sensor																3					
Cable conduits **																					
M20 x 1.5 (plastic)																	A				
NPT ½ in. (blanked when cable not fitted)																	B				
M20 SWA (armored)																	D				
M20 SWA sensor, M20 x 1.5 (plastic) power / output																	F				
Without																	Y				
Power supply																					
Without																		0			
100 to 230 V AC, 50 Hz																		1			
24 V AC or 24 V DC, 50 Hz																		2			
100 to 230 V AC, 60 Hz																		3			
24 V AC or 24 V DC, 60 Hz																		4			
Input and output signal type																					
HART + 20 mA + pulse + contact output																			A		
PROFIBUS DP RS485 physical layer + pulse + contact output																			G		
MODBUS RTU RS485 physical layer + pulse + contact output																			M		
Without																			Y		
Configuration type / diagnostics type																					
Not required																				0	
Factory default / Standard																				1	
Options***																					
Accessories																					
Configuration lead																					AC
Documentation language																					
German M1																					M6
Italian M2																					M7
Spanish M3																					M8
French M4																					MA
English M5 (default)																					MF
																					MN
Lay length																					
ISO length – DN10 to 600 (¾ to 24 in.) and 1.25D DN1800 to 2400 (72 to 96 in.)																					JB
1.3D DN700 to 2400 (28 to 96 in.) – see dimensional pages 28, 29, 30, 31																					JK
1.0D DN700 to 1600 (28 to 64 in.) – see dimensional pages 32, 33, 34, 35																					JH
Verification type																					
Without																					V0
fingerprint																					V3
VeriMaster																					
Potable water approval																					
WRAS cold water approval																					CWA
DVGW																					CWD
WRAS 60 °C (140 °F) water approval																					CWK
NSF material approval																					CWM
Without																					CWY
Power supply frequency (sensor FEW38 only)																					
50 Hz																					F5
60 Hz																					F6
Number of testpoints																					
1 Point																					T1
3 Points																					T3
5 Points																					T5

* FM approval in process. FEF product still available with full FM approval

** The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered. For FM or FMC Approved versions, NPT only permitted.

*** Add codes for options.

ABB Measurement & Analytics

For your local ABB contact, visit:

www.abb.com/contacts

For more product information, visit:

www.abb.com/measurement



Section 4

Additional System Components



NAM 37C Abestos Free Gasket Material

Material Composition and Application

Made from Aramid Fiber, mineral fiber & inorganic fillers bonded with Synthetic NBR Elastomers.

NAM-37C is a premium quality general service gasket material **certified to the standard NSF/ANSI 61** produced specially for the water and waste water treatment and reclamation process where Chlorine content is less than 2500PPM. It is also suitable for steam, oil, mild alkalis and acids, hydrocarbons and solvents.

Available in:

- Sheets - 60" x 60" and 60" x 120"
- Gaskets - **Raised** and Full Face

NAM 37C COMPLIES TO NSF/ANSI 61

Thickness	1/16" to 1/8"
Max. Peak Temp.	572°F (300°C)
Max. Continuous Temp.	428°F (220°C)
Max. Continuous Temp. <i>with steam</i>	320°F (160°C)
Max. Operating Pressure	1137 PSI (80 Kg / cm ²)

ASTM Line Callout
F104F712122A9B4E12M4

PROPERTIES (Test Specimen Thickness 2.0mm)	TEST METHOD	UNIT	SPECIFIED VALUE
Density	---	gm / cm ³	1.70 - 2.10
Tensile Strength	---		
(a) ACC to ASTM F152 (Across Grain)		N / mm ²	8 Min.
(b) ACC to DIN52910 (Across Grain)		N / mm ²	5 Min.
Compressibility	ASTM F36A	%	5 - 15
Recovery	ASTM F36A	%	> 50
Fluid Absorption			
(a) In ASTM Oil No. 3	ASTM F 146		
INCREASE in Mass		%	< 15
INCREASE in Thickness		%	< 10
(b) In Fuel B	ASTM F 146		
INCREASE in Mass		%	< 10
INCREASE in Thickness		%	< 10
(c) In Water/Antifreeze	ASTM F 146		
INCREASE in Mass		%	< 15
INCREASE in Thickness		%	< 15
Ignition Loss	DIN 52911	%	< 30

TRIPAC FASTENERS

475 Klug Circle • Corona, CA 92880
P: 951.280.4488 • F: 951.272.4445

All information and recommendations given in this brochure are based on information obtained from Ferolite Jointings LTD. Since conditions of use are beyond our control, the information provided only serves as a guideline. Users must satisfy themselves that products are suitable for the intended process and uses. We reserve the right to change product design and properties without notice.

MATERIAL PROPERTIES*:

Color:	Black
Composition:	EPDM elastomer – sulfur cure
Durometer, Shore A, (+/- 5):	80
Temperature¹, °F (°C)	
Minimum:	-40 (-40)
Maximum:	+275 (+135)
Pressure¹, (psig (bar)):	
Preferred operating:	150 (10.4)
Maximum:	250 (17.3)
P x T (max.)¹, psig x °F (bar x °C):	30,000 (900)
Finish Available	
Through 1/8"	Cloth
Over 1/8"	Smooth
Meets Specifications:	NSF 61 (Potable Drinking Water), ASTM D-1330 Grade I and II

TYPICAL PHYSICAL PROPERTIES*:

ASTM D412	Tensile Strength, psi (N/mm²):	1500 (10.4)
ASTM D412	Elongation, %:	185
ASTM D395 B	Compression Set, 25% Deflection, Max. %	
	22 hours at 158°F (70°C):	25
ASTM D149	Dielectric Properties, range, volts/mil.	
	Sample conditioning	<2 (1/8")
	None	
ASTM F586	Design Factors	
	"m" factor:	1.0
	"y" factor, psi (N/mm ²):	200 (1.4)
ASTM D2000⁽³⁾	Line Call Out:	4BA815A14B13C12

Notes:

* This is a general guide and should not be the sole means of selecting or rejecting this material. Values do not constitute specification limits.

¹ When approaching maximum pressure and/or temperature, minimum temperature or 50% of maximum P x T, consult Garlock Applications Engineering. Minimum temperature rating is conservative.

³ ASTM D2000 line call out is based on testing performed on slabs made to ASTM D412.

Cam & Groove Couplings and Accessories

A collection of various industrial valves and fittings, including ball valves, gate valves, and flange valves, displayed on a white background. The components are made of different materials, likely brass and steel, and feature various designs for industrial applications. Some have handles, others have flanges, and some are compact and portable. The image shows a variety of sizes and types, illustrating the range of products offered.

Global Cam and Groove

Features:

- interchange with all products produced to A-A-59326D
- made to Dixon specifications and branded Dixon
- Buna seals are standard
- pressure rating for adapters is based on the seal of the mating part



- Dust caps and dust plugs are not to be used in pressure applications for safety and environmental reasons

Global Type A Adapters

Size	A380 Permanent Mold AL Part #	ASTMC38000 Forged Brass Part #	316 Investment Cast SS Part #
1/2"	G50-A-AL ¹	G50-A-BR ¹	G50-A-SS
3/4"	G75-A-AL	G75-A-BR	G75-A-SS
1"	G100-A-AL	G100-A-BR	G100-A-SS
1 1/4"	G125-A-AL	G125-A-BR	G125-A-SS
1 1/2"	G150-A-AL	G150-A-BR	G150-A-SS
2"	G200-A-AL	G200-A-BR	G200-A-SS
2 1/2"	G250-A-AL	G250-A-BR	G250-A-SS
3"	G300-A-AL	G300-A-BR	G300-A-SS
4"	G400-A-AL	G400-A-BR	G400-A-SS
5"	G500-A-AL ¹	G500-A-BR ¹	---
6"	G600-A-AL	---	G600-A-SS
8"	G800-A-AL ¹	---	---

¹ does not interchange in the 1/2", 5", and 8" sizes with Dixon or Boss-Lock style cam and groove

Global Type E Adapters

Size	A380 Permanent Mold AL Part #	ASTMC38000 Forged Brass Part #	316 Investment Cast SS Part #
1/2"	G50-E-AL ¹	G50-E-BR ¹	G50-E-SS
3/4"	G75-E-AL	G75-E-BR	G75-E-SS
1"	G100-E-AL	G100-E-BR	G100-E-SS
1 1/4"	G125-E-AL	G125-E-BR	G125-E-SS
1 1/2"	G150-E-AL	G150-E-BR	G150-E-SS
2"	G200-E-AL	G200-E-BR	G200-E-SS
2 1/2"	G250-E-AL	G250-E-BR	G250-E-SS
3"	G300-E-AL	G300-E-BR	G300-E-SS
4"	G400-E-AL	G400-E-BR	G400-E-SS
5"	G500-E-AL ¹	G500-E-BR ¹	---
6"	G600-E-AL	---	G600-E-SS
8"	G800-E-AL ¹	---	---

¹ does not interchange in the 1/2", 5", and 8" sizes with Dixon or Boss-Lock style cam and groove

Global Type F Adapters

Size	A380 Permanent Mold AL Part #	ASTMC38000 Forged Brass Part #	316 Investment Cast SS Part #
1/2"	G50-F-AL ¹	G50-F-BR ¹	G50-F-SS
3/4"	G75-F-AL	G75-F-BR	G75-F-SS
1"	G100-F-AL	G100-F-BR	G100-F-SS
1 1/4"	G125-F-AL	G125-F-BR	G125-F-SS
1 1/2"	G150-F-AL	G150-F-BR	G150-F-SS
2"	G200-F-AL	G200-F-BR	G200-F-SS
2 1/2"	G250-F-AL	G250-F-BR	G250-F-SS
3"	G300-F-AL	G300-F-BR	G300-F-SS
4"	G400-F-AL	G400-F-BR	G400-F-SS
5"	G500-F-AL ¹	G500-F-BR ¹	---
6"	G600-F-AL	---	G600-F-SS

¹ does not interchange in the 1/2" and 5" sizes with Dixon or Boss-Lock style cam and groove

Global Type D Couplers



Size	A380 Permanent Mold AL with Brass Handles Part #	ASTMC38000 Forged Brass Part #	316 Investment Cast SS Part #	A380 Permanent Mold AL with SS Handles Part #
1/2"	G50-D-AL ^{1,2}	G50-D-BR ¹	G50-D-SS	---
3/4"	G75-D-AL ²	G75-D-BR	G75-D-SS	---
1"	G100-D-AL	G100-D-BR	G100-D-SS	---
1 1/4"	G125-D-AL	G125-D-BR	G125-D-SS	---
1 1/2"	G150-D-AL	G150-D-BR	G150-D-SS	G150-D-ALSI
2"	G200-D-AL	G200-D-BR	G200-D-SS	G200-D-ALSI
2 1/2"	G250-D-AL	G250-D-BR	G250-D-SS	---
3"	G300-D-AL	G300-D-BR	G300-D-SS	G300-D-ALSI
4"	G400-D-AL	G400-D-BR	G400-D-SS	G400-D-ALSI
5"	G500-D-AL ¹	G500-D-BR ¹	---	---
6"	G600-D-AL	---	G600-D-SS	---

¹ does not interchange in the 1/2" and 5" sizes with Dixon or Boss-Lock style cam and groove

² stainless steel handles

Global Type DC Dust Caps



Size	A380 Permanent Mold AL with Brass Handles Part #	ASTMC38000 Forged Brass Part #	316 Investment Cast SS Part #	A380 Permanent Mold AL with SS Handles Part #
1/2"	G50-DC-AL ^{1,2}	G50-DC-BR ¹	G50-DC-SS	---
3/4"	G75-DC-AL ²	G75-DC-BR	G75-DC-SS	---
1"	G100-DC-AL	G100-DC-BR	G100-DC-SS	---
1 1/4"	G125-DC-AL	G125-DC-BR	G125-DC-SS	---
1 1/2"	G150-DC-AL	G150-DC-BR	G150-DC-SS	G150-DC-ALSI
2"	G200-DC-AL	G200-DC-BR	G200-DC-SS	G200-DC-ALSI
2 1/2"	G250-DC-AL	G250-DC-BR	G250-DC-SS	---
3"	G300-DC-AL	G300-DC-BR	G300-DC-SS	G300-DC-ALSI
4"	G400-DC-AL	G400-DC-BR	G400-DC-SS	G400-DC-ALSI
5"	G500-DC-AL ¹	G500-DC-BR ¹	---	---
6"	G600-DC-AL	---	G600-DC-SS	---

¹ does not interchange in the 1/2" and 5" sizes with Dixon or Boss-Lock style cam and groove

² stainless steel handles

Replacement Handle Assemblies for Global Couplers

For Aluminum and Brass Global Couplers

Feature:

- supplied complete with ring and pin



Fits on sizes	Investment Stainless Part #
3/4"	G75HRP
1"	G100HRP
1 1/2" and 2"	G152HRPSI
3" and 4"	G34HRPSI
6"	G600HRPSI



Fits on sizes	Forged Brass Part #
1 1/4" - 2 1/2"	G152HRP
3" and 4"	G34HRP
6" and 8"	G600HRP

For Stainless Steel
Global Couplers

Fits on sizes	Investment Stainless Part #
3/4"	G75HRPSS
1"	G100HRPSS
1 1/4" - 2 1/2"	G125250HRPSS
3" and 4"	G300400HRPSS
6"	G600HRPSS

Safety Clip for Global Couplers

Zinc Plated Carbon Steel
Part #

GSAFETYCLIP



Adapters and Couplers x 150# Flanged Drilling

Features:

- aluminum and unplated iron flanges are flat faced
- stainless steel flanges are raised face



Dixon adapter x 150# flange

Size	356T6 Aluminum Part #	Flange Thick.	Unplated Malleable Iron Part #	Flange Thick.	316 Stainless Steel Part #	Flange Thick.
1"	---	---	---	---	100-AL-SS	9/16"
1½"	---	---	---	---	150-AL-SS	11/16"
2"	200-AL-AL	3/4"	---	---	200-AL-SS	7/16"
3"	300-AL-AL	5/8"	300-AL-MI	5/8"	300-AL-SS	7/16"
4"	400-AL-AL	5/8"	---	---	400-AL-SS	7/16"
6"	600-AL-AL	5/8"	---	---	600-AL-SS	5/8"
8"	800-AL-AL ¹	1-1/8"	---	---	---	---

¹ part is produced as a welded fabrication

Feature:

- supplied standard with a Buna-N gasket, other gaskets available on pages 49-50



Dixon coupler x 150# flange

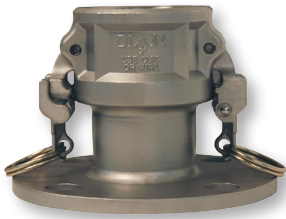
Size	356T6 Aluminum Part #	Flange Thickness	316 Stainless Steel Part #	Flange Thickness
1"	---	---	100-DL-SS	21/32"
1½"	---	---	150-DL-SS	25/32"
2"	200-DL-AL	3/4"	200-DL-SS	7/16"
3"	300-DL-AL	15/16"	300-DL-SS	7/16"
4"	400-DL-AL	15/16"	400-DL-SS	7/16"
6"	600-DL-AL	1"	600-DL-SS	5/8"
8"	800-DL-AL ¹	1-1/8"	---	---

¹ part is produced as a welded fabrication

Feature:

- supplied standard with a Buna-N gasket, other gaskets available on pages 49-50

EZ Boss-Lock coupler x 150# flange



Size	316 Stainless Steel Part #	Flange Thickness
1"	RDL100EZ ¹	9/16"
1½"	RDL150EZ ¹	11/16"
2"	RDL200EZ	7/16"
3"	RDL300EZ ¹	7/16"
4"	RDL400EZ ¹	7/16"
6"	RDL600EZ ¹	1"

¹ part is produced as a welded fabrication

In-Line Sight Glass for Bulk Transfer

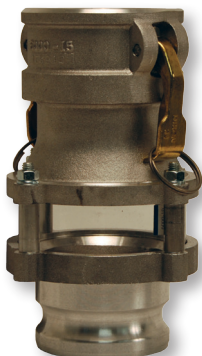
Application:

- designed for dry bulk transfer hose
- not intended for liquid service, for dry bulk transfer *only*



Features:

- aluminum body, Buna seals, acrylic sight glasses, stainless steel hardware and bronze cam arms (where applicable)



	coupler x adapter	adapter x adapter	coupler x coupler
Size	Part #	Part #	Part #
3" x 3"	3533CA	3533AA	3533CC
3" x 4"	3534CA	3534AA	---
4" x 3"	3543CA	---	3543CC
4" x 4"	3544CA	3544AA	3544CC

Air King™

⚠ WARNING

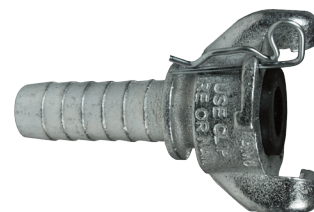
- The use of an Air King™ safety clip or wire type retainer is necessary to ensure Air King™ universal couplings will not become accidentally disconnected. This guarantees the fittings are properly connected because the safety pin will not go through the holes in mating flanges until couplings are locked in place. Only one Air King™ safety clip or wire type retainer is required for each Air King™ universal coupling.

Features:

- can be used with Air King™ ferrules
- supplied with safety clip
- pressure rating: **150 PSI** at ambient temperature **70°F (21°C)**
- supplied with rubber washers, part # **AWR4**
- meets pressure requirements as specified in A-A-59553 commercial item description superseding Mil Spec.WWC-633D

2-Lug Hose Ends

Size	Iron Part #	Optional Qty	Brass Part #	Optional Qty	316 Stainless Steel Part #
3/8"	AMH ¹	25	ABH	25	RAMH
1/2"	AM1	50	AB1 ¹	50	RAM1
5/8"	AM5	50	AB5	50	---
3/4"	AM6	50	AB6 ¹	50	RAM6
1"	AM11	50	AB11 ¹	50	RAM11

**2-Lug Male NPT Ends**

Size	Iron Part #	Optional Qty	Brass Part #	Optional Qty	316 Stainless Steel Part #
1/4"	AMB1	25	ABB1	25	---
3/8"	AMB	25	ABB	25	RAMB
1/2"	AM2	50	AB2 ¹	50	RAM2
3/4"	AM7	50	AB7 ¹	50	RAM7
1"	AM12	50	AB12 ¹	50	RAM12

**2-Lug Female NPT Ends**

Size	Iron Part #	Optional Qty	Brass Part #	Optional Qty	316 Stainless Steel Part #
1/4"	AMC1	25	ABC1	25	---
3/8"	AMC	25	ABC	25	RAMC
1/2"	AM3	50	AB3 ¹	50	RAM3
3/4"	AM8	50	AB8 ¹	50	RAM8
1"	AM13	50	AB13 ¹	50	RAM13

¹ global investment cast

Air King™ is for air and water service only Warning: Never use any Air King™ coupling for steam service! None of Dixon®'s catalog information is to be interpreted to mean that this type of coupling is suitable for use on steam hose.



Dixon, founded in 1916, is a premier manufacturer and supplier of hose couplings, valves, dry-disconnects, swivels, and other fluid transfer and control products. The company's global reach includes a wide range of products for numerous industries including petroleum exploration, refining, transportation, chemical processing, food & beverage, steel, fire protection, construction, mining and manufacturing. Dixon's strategic objective is to create solutions that make products safer, leak-free, longer lasting, and always available.

dixonvalve.com • Customer Service: 877.963.4966

Dixon Valve

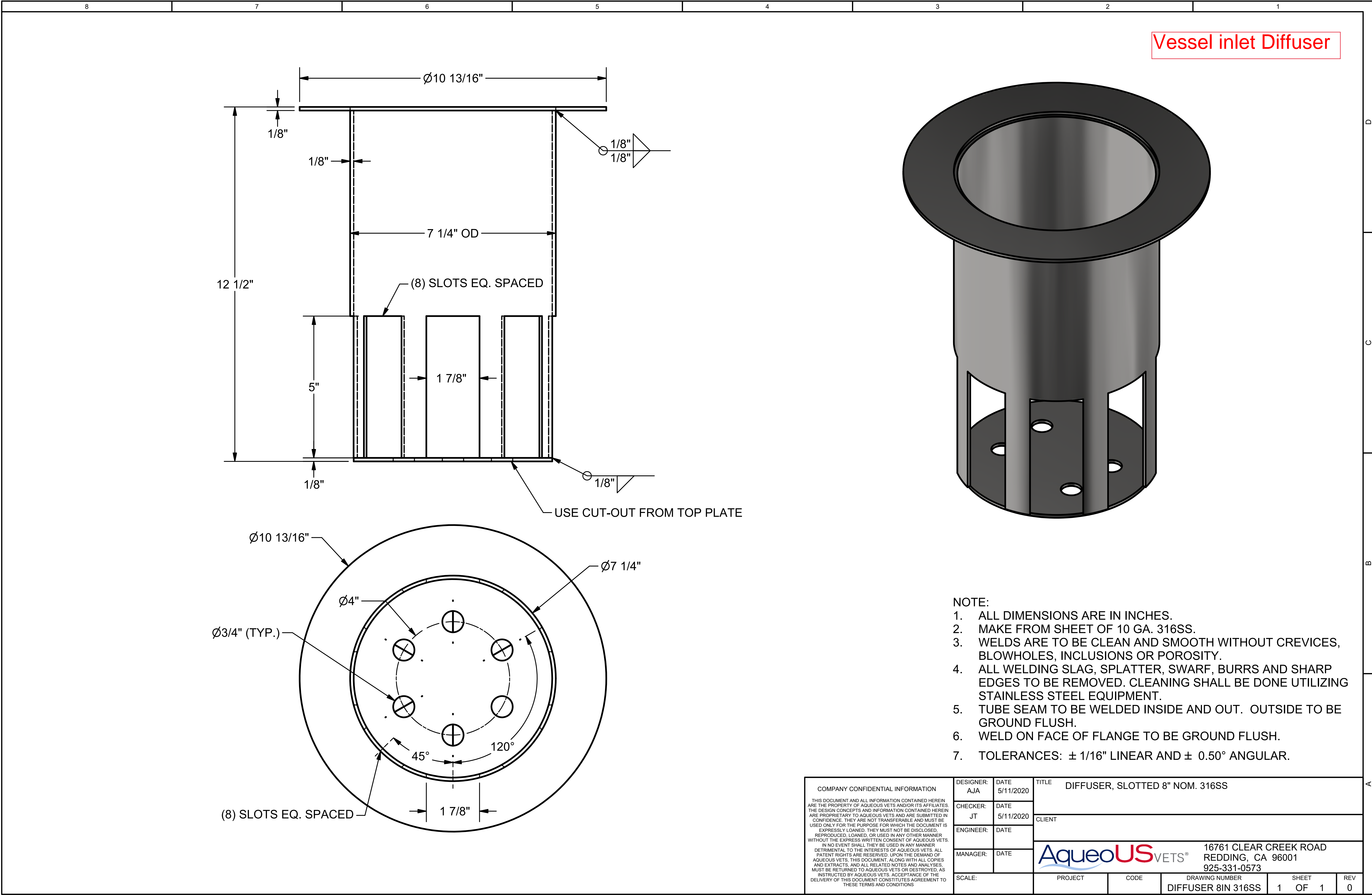
800 High Street, Chestertown, MD 21620
Fax: 800.283.4966



You **Tube**™



Dixon
Customer Service



BILL OF MATERIALS						
ITEM	NAME	DWG. NO	MATERIAL	DESCRIPTION	QTY	NOTES
1	HALF COUPLING	—	316 SS	3/4" 150#	1	
2	WEDGE-FLOW	—	316 SS	1.315" OD, 60/L-93Q CONST., .010" SLOT	1	
3	WELD RING	—	316 SS	1" SCH 40 PIPE	2	
4	END DISC	—	316 SS	1 1/8" DIA	1	

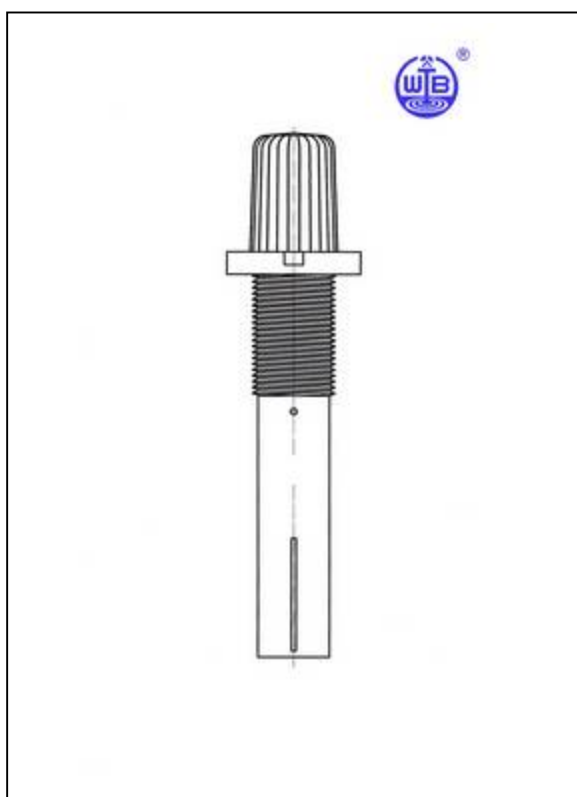
Technical drawing of a vertical assembly, likely a wellhead or valve component, showing dimensions and callouts:

- Top dimension: $3/4"$ FNPT
- Overall height dimension: $5 \frac{3}{8}"$ OAL
- Internal height dimension: $4"$ W/F
- Bottom dimension: $1.315"$ OD
- Callouts: 1, 2, 3, 4

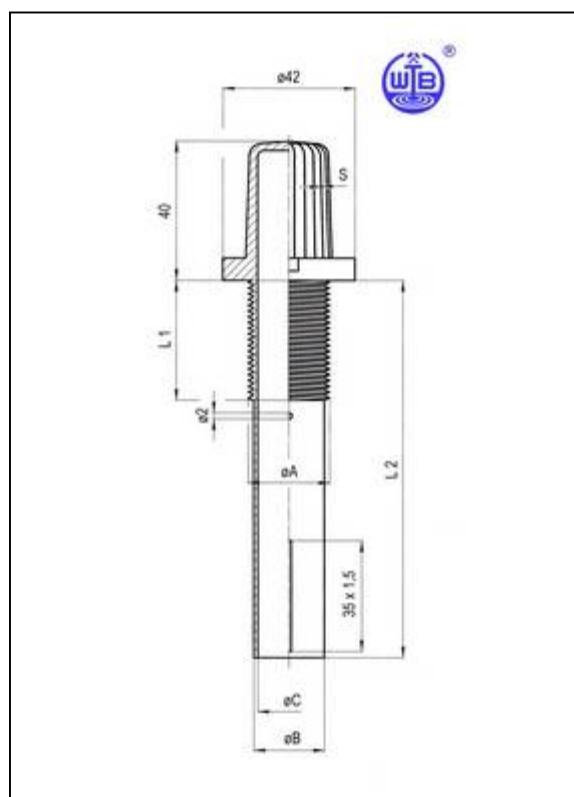
Sheet: 1 OF 1

FILTER NOZZLE TYPE N

ARV Media Retention Nozzle



L2 = Standard 120 mm inkl. Gewinde
= Standard 120 mm incl. thread
= Standard 120 mm incl. filetage
= Standard 120 mm incl. rosca



B = 26 mm / 23 mm / 21 mm
C = 23 mm / 20 mm / 18 mm

Type N Options



Slots

#of slots	Width	Length	
20	0,1	35	= 0,70 cm ²
20	0,2	35	= 1,40 cm ²
24	0,25	35	= 2,10 cm ²
10	0,7	35	= 2,45 cm ²
10	1,2	35	= 4,20 cm ²
20	0,7	35	= 4,90 cm ²
22	0,7	35	= 5,39 cm ²
4	5,0	35	= 7,00 cm ²
10	2,5	35	= 8,75 cm ²
3	9,0	35	= 9,45 cm ²
12	2,5	35	= 10,5 cm ²

Only R 3/4"

Only with tube dia. 26mm

Thread

TYP		A (mm)	L1 (mm)											
	METRIC		14	15	18	20	25	30	40	50	60	65	70	80
N 2 f	M 27 x 2,0	27									✓			
N 2 g	M 27 x 2,5	27						✓	✓	✓	✓			
N 3	M 30	30						✓			✓			
	WITHWORTH													
N 10	1"	25,4				✓	✓	✓	✓	✓	✓			
N 19	1 1/8"	28,6		✓										
N 4	1 1/4"	31,8				✓	✓	✓	✓	✓	✓			✓
N 9	1 3/8"	34,9		✓				✓						
N 14	1 3/4"	44,5						✓						
	BSP GAZ													
N 5	R 3/4"	26,4				✓		✓	✓	✓	✓			
N 17	R 7/8"	30,2							✓					
N 8	R 1"	33,2	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
N 18	R 1 1/4"	41,9								✓				

Tailpipe

L2	Upon request
----	--------------

Material Options

PPN

PPH

PVDF

SpiralJet® SPRAY NOZZLES, STANDARD AND EXTRA LARGE FREE PASSAGE SPRAY



FEATURES AND BENEFITS

- Solid cone-shaped spray pattern with round impact area.
- Maximum liquid throughput for a given pipe size.
- Maximum free passage design minimizes clogging on HHSJX.
- Compact size enables easy installation or retrofit on most pipe systems.

HHSJ



Threaded/hex
Brass or 316 Stainless Steel
1/4" to 2" NPT or BSPT (M)

HHSJ



Threaded/flats
Cast 316 Stainless Steel
1/4" to 4" NPT or BSPT (M)

HHSJ



Threaded/round
PVC or PTFE
1/4" to 4" NPT or BSPT (M)

HHSJX



Threaded/hex
Brass
3/8" to 2" NPT or BSPT (M)

HHSJX



Threaded/flats
Cast 316 Stainless Steel
3/8" to 2" NPT or BSPT (M)

HHSJX



Threaded/round
PVC or Polypropylene
3/8" to 2" NPT or BSPT (M)

OPTIMIZATION TIPS

- See page B2 for optimization tips.

APPLICATIONS

- Aerating
- Chemical processing
- Fire suppression/prevention
- Gas scrubbing, cooling
- Washing/rinsing

SEE ALSO

- Accessories
 - Adjustable ball fittings
 - Check valves
 - Pressure gauges
 - Pressure regulators
 - Pressure relief valves
 - Solenoid valves
 - Split-eyelet connectors
 - Strainers



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SpiralJet® SPRAY NOZZLES, STANDARD AND EXTRA LARGE FREE PASSAGE SPRAY

B

PERFORMANCE DATA

HHSJ

*At the stated pressure in bar.

Inlet Conn. (in.)	Spray Angle at 0.7 bar (°)					Capacity Size	Orifice Dia. Nom. (mm)	Max. Free Passage Dia. (mm)	Capacity (liters per minute)*				
	60	90	120	150	170				0.7	1.5	3	7	25
1/4	●	●	●			07	2.4	2.4	2.7	3.9	5.5	8.4	16.0
	●	●	●	●	●	13	3.2	3.2	5.0	7.3	10.3	15.7	30
	●	●	●	●	●	20	4.0	3.2	7.6	11.2	15.8	24	46
3/8	●					07	2.4	2.4	2.7	3.9	5.5	8.4	16.0
	●					13	3.2	3.2	5.0	7.3	10.3	15.7	30
	●					20	4.0	3.2	7.6	11.2	15.8	24	46
	●	●	●	●	●	30	4.8	3.2	11.4	16.8	24	36	68
	●	●	●	●	●	40	5.6	3.2	15.3	22	32	48	91
	●	●	●	●	●	53	6.4	3.2	20	30	42	64	121
	●	●	●	●	●	82	7.9	3.2	31	46	65	99	187
1/2	●	●	●	●	●	120	9.5	4.8	46	67	95	145	274
	●	●	●	●	●	164	11.1	4.8	63	92	129	198	374
					●	210	12.7	4.8	80	117	166	253	479
3/4	●	●	●	●	●	210	12.7	4.8	80	117	166	253	479
1	●	●	●	●	●	340	15.9	6.4	130	190	268	410	775
	●	●	●	●	●	470	19.1	6.4	179	262	371	567	1071
1-1/2	●	●	●	●	●	640	22.2	7.9	244	357	505	772	1459
	●	●	●	●	●	820	25.4	7.9	313	458	647	989	1869
	●	●	●	●	●	960	28.6	7.9	366	536	758	1158	2188
2	●	●	●	●	●	1400	34.9	11.1	534	782	1105	1689	3191
	●	●	●	●	●	1780	38.1	11.1	679	994	1406	2147	4057
3	●	●	●			2560	44.5	14.3	976	1429	2021	3088	5835
	●	●	●			3360	50.8	14.3	1282	1876	2653	4053	7659
4	●	●	●			5250	63.5	15.9	2002	2931	4145	6332	11967

HHSJX

*At the stated pressure in bar.

Inlet Conn. (in.)	Spray Angle at 0.7 bar (°)		Capacity Size	Orifice Dia. Nom. (mm)	Max. Free Passage Dia. (mm)	Capacity (liters per minute)*				
	90	120				0.7	1.5	3	7	25
3/8	●	●	30	4.8	4.8	11.4	16.8	24	36	68
	●	●	40	5.6	5.6	15.3	22	32	48	91
	●	●	53	6.4	6.4	20	30	42	64	121
	●	●	82	7.9	7.9	31	46	65	99	187
1/2	●	●	120	9.5	9.5	46	67	95	145	274
	●	●	164	11.1	11.1	63	92	129	198	374
3/4	●	●	210	12.7	12.7	80	117	166	253	479
1	●	●	340	15.9	15.9	130	190	268	410	775
	●	●	470	19.1	19.1	179	262	371	567	1071
1-1/2	●	●	640	22.2	22.2	244	357	505	772	1459
	●	●	820	25.4	25.4	313	458	647	989	1869
	●	●	960	28.6	28.6	366	536	758	1158	2188
2	●	●	1400	34.9	34.9	534	782	1105	1689	3191
	●	●	1780	38.1	38.1	679	994	1406	2147	4057

Maximum Free Passage Diameter is the maximum diameter as listed of foreign matter that can pass through the nozzle without clogging.



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SpiralJet® SPRAY NOZZLES, STANDARD AND EXTRA LARGE FREE PASSAGE SPRAY



DIMENSIONS AND WEIGHTS

Standard	Nozzle Type	Inlet Conn. (in.)	Length (mm)	Hex. (mm)	Net Weight (kg)
	HHSJ (M)	1/4	53.9	14.3	.03
		3/8	60.3	17.5	.05
		1/2	79.4	22.2	.10
		3/4	87.3	27	.15
		1	116	34.9	.29
		1-1/2	171	50.8	.77
		2	175	63.5	.99
		3	302	95.3	2.6
		4	229	114.3	4.6
	HHSJX (M)	3/8	69	22.2	.09
		1/2	85	26.9	.18
		3/4	117	34.9	.23
		1	130	44.5	.51
		1-1/2	171	50.8	.85
		2	279	76.2	2.5

Based on largest/heaviest version of each type.

MATERIALS

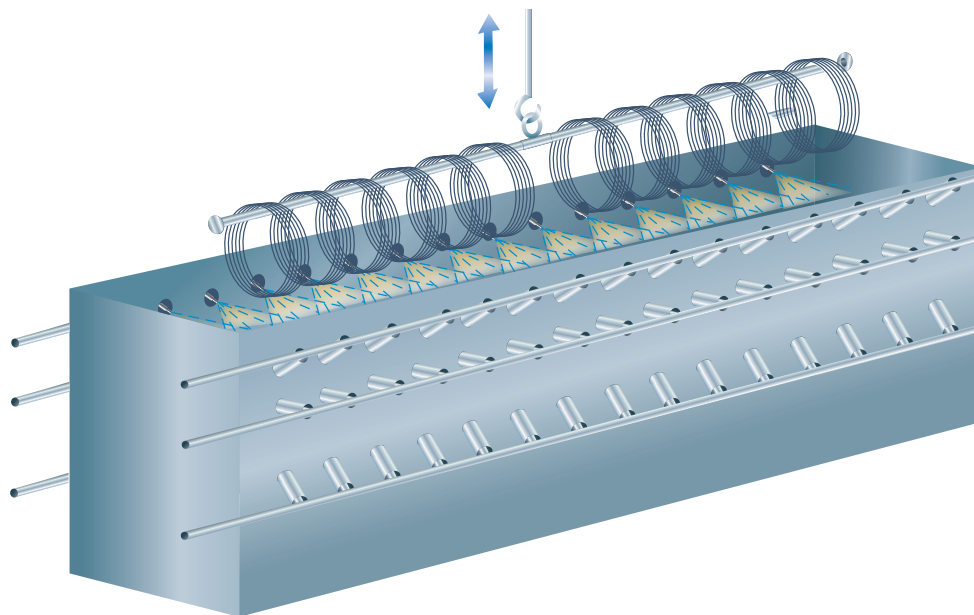
Material	Material Code	Nozzle Type	
		HHSJ	HHSJX
Bar Stock:			
Brass	(none)	●	●
Polypropylene	PP		●
Polyvinyl Chloride	PVC	●	●
PTFE	TEF	●	
Cast:			
316 Stainless Steel	SS	●	●

Other materials available upon request.

ORDERING INFO

STANDARD SPRAY NOZZLE				
1/4	HHSJ	- SS	120	07
Inlet Conn.	Nozzle Type	Material Code	Spray Angle	Capacity Size
3/8	HHSJX	- SS	120	30
Inlet Conn.	Nozzle Type	Material Code	Spray Angle	Capacity Size

BSPT connections require the addition of a "B" prior to the inlet connection.



SpiralJet spray nozzles used to rinse wire coils in pickling line.



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Section 5
Linings & Coatings



Linings & Coatings Summary

Description	Lining	Coating
Vessels	Plasite 4110 to DFT of 35-45 mils	Carboguard 893 primer, 4 – 6 mils Carbothane 134 VOC topcoat, 2 – 3 mils (Color: TBD)
Process Pipe	Scotchkote 134, 16 mils	Carboguard 893 primer, 4 – 6 mils Carbothane 134 VOC topcoat, 2 – 3 mils (Color: TBD)



SELECTION & SPECIFICATION DATA

Generic Type	Vinyl ester
Description	Vinyl ester resin combined with special curing system and inert flake pigment to provide outstanding chemical and physical properties. Specially formulated for excellent abrasion resistance. PLASITE 4110 meets the FDA requirements for 21 CFR, 175.300 and 177.2420. Uses: As a high chemical abrasion-resistant thick film for tank lining service and as a maintenance coating for severe exposure.
Color	Charcoal gray
Finish	N/A
Primer	For steel surfaces, coating is considered to be a "self-priming" system. Do not apply PLASITE 4110 directly to concrete. See reference to fillers and sealers in CONCRETE section.
Dry Film Thickness	35 - 45 mils (889 - 1143 microns) total thickness Consult Carboline Technical Service Department for any deviation to this film thickness. Refer to APPLICATION section.
Coverage Rate	Plasite 4110 will cover approximately 960 mil ft. ² /gal. or 86.4 sq. m. per 25 microns/gal. This is a coverage obtained from field use on small jobs and includes loss in can, spray loss, small amount of shrinkage, etc. Application by conventional spray equipment may affect coverage.
VOC Values	As Supplied : 0.50 lbs/gal (60 g/L) Plasite Thinner #20 : Thinned 5% by volume 0.78 lbs/gal (93 g/L)
Dry Temp. Resistance	Continuous: 380°F (193°C) Non-Continuous: 460°F (238°C) Limited short excursions to 460 °F (238 °C) acceptable. Wet temperature resistance depends upon concentration and reagent exposure.
Topcoats	Not Applicable
Density	79.1 lbs/ft ³ (0.26384 lbs/ft ² at 40 mils)

SUBSTRATES & SURFACE PREPARATION

General	Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.
Steel	Cleanliness: Abrasive blast to SSPC-SP10 (minimum) Profile: Minimum 4 mil (100 micron) dense, sharp anchor profile free of peening, as measured by ASTM D 4417. Defects exposed by blasting must be repaired.
Aluminum	Surface shall be clean and grease-free with a blast produced anchor pattern or "tooth" as described earlier under "Steel". In addition, the blasted surface shall be given a chemical treatment such as: Alodine 1200S available from Henkel Surface Tech, Iridite 14-2 produced by MacDermid Incorporated, Oakite Cryscat 747 LTS and Oakite Cryscat Ultraseal produced by Oakite Products.

SUBSTRATES & SURFACE PREPARATION

Concrete or CMU	Concrete shall be designed, placed, cured, and prepared per NACE No. 6/SSPC-SP 13, latest edition. Abrade to remove all laitance, loose concrete, etc. and to create surface profile in accordance with the appropriate ICRI CSP 5-7.
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PERFORMANCE DATA

Test Method	System	Results
Abrasion Resistance	Plasite 4110	11 milligrams average loss per 1000 cycles Taber CS-17 Wheel, 1000 gram weight
Elongation	Plasite 4110	1.7% using Method ASTM D638
Film Density	Plasite 4110	79.1 lbs/ft ³ 0.26384 lbs/ft ² at 40 mils
Pigments	Plasite 4110	Inert fillers and flake
Surface Hardness	Plasite 4110	Konig Pendulum Hardness of 134 seconds (Glass Standard = 250 seconds); ASTM Method D4366-84.
Thermal Shock	Plasite 4110	Unaffected by minus 70 °F to plus 200 °F in 5 cycles, or 40 to 380 °F in 10 cycles

MIXING & THINNING

Mixing Mix Part B into Part A using a mechanical high speed agitator, making sure all Part B is completely mixed with Part A. Maintain a good vortex while mixing until a smooth liquid, free of any unmixed particles of pigment, is obtained (approximately 15-30 minutes). After the pigments and liquid are thoroughly mixed, add the entire amount of the measured liquid promoter (Part D). Mix completely. (no color streaking or residue of part D should remain on the container sidewalls). Allow to cool if material temperature increases, then add Part C and necessary amount of Plasite Thinner 20. Mix an additional three to five minutes.

WARNING! The promoter (Part D) and the catalyst (Part C) must be separately mixed into the coating (Parts A&B). Any contact of unmixed Part C with Part D may lead to a fire or an explosion! Continuous mixing during use is required. Part A, Part B and Part D may be premixed up to 72 hours prior to adding Part C. Operator should wear face mask during high speed mixing of the coating components. Avoid breathing dust.

Thinning Use 2 to 10% thinning with PLASITE Thinner #20 as needed to adjust coating for higher temperatures and various application conditions. Topcoating of previously coated films will require the addition of 2 to 20% thinner. Consult Carboline laboratory for unusual thinning requirements. See RECOATING TIME SECTION.

Pot Life 1.5-3 hours in one gallon cans and 1.5-2 hours in five gallon cans at 70 to 90 °F (21-32 °C) MATERIAL temperature. MATERIAL temperatures in excess of 90 °F will significantly reduce pot life.
CAUTION! Do not attempt to extend pot life by mixing newly catalyzed coating into coating near the end of its pot life.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Conventional Spray	<p>59ASS Fluid Nozzle 251 Air Cap 559SS Needle Pot pressure of approximately 50 psi Atomizing pressure of approximately 60 psi Use standard production type pressure pot with air motor drive agitator. Heavy-duty trigger spring recommended.</p> <p>Note: Application by conventional spray equipment may affect maximum film building capabilities and coverage rates. Applicators may prefer to apply additional coats to achieve the 40 mil nominal DFT.</p>
Airless Spray	<p>GPM Output 3.0 (minimum) Material hose 3/8" I.D. (minimum) Fluid nozzle 0.025" or larger Output PSI 1800-2200 12" minimum spray width All screens should be removed from pump and gun. CONTINUOUS MIXING DURING USE IS REQUIRED.</p> <p>Note: Conventional spray equipment is preferred. Expect higher wear rates to airless spray equipment lower units and spray tips.</p>
Brush	<p>Brush application is not recommended, but may be used for repairs or touch-up. Continuous mixing during use is required.</p>

APPLICATION PROCEDURES

General

A minimum surface temperature of 70 °F (21 °C) is required to obtain polymerization of the coating system. Coating can be applied at a surface temperature as low as 60 °F (16 °C) but polymerization will be inhibited. Succeeding coats cannot be applied without damaging the system until the surface temperature rises sufficiently to obtain partial polymerization. This will require raising to the minimum surface temperature of 70 °F (21 °C) within 12 hours of application. Refer to CURING section. When surface temperatures are over 100 °F (38 °C), consult Carboline Technical Service for special instructions.

The mixed coating shall be applied utilizing a multi-pass spray system. Apply horizontal and vertical passes with 50% overlap. Special precautions are required at overlaps and welds to eliminate excessive film build. Spray gun should be perpendicular to surface at all times, approximately 14 in/36 cm from surface. For non-NSF applications, coating may be overcoated after initial "set" which will occur normally in 3 to 6 hours at 70 °F (21 °C) with proper ventilation. Initial "set" time will decrease as surface temperature increases. Refer to RECOATING TIME section.

When physical contact (foot traffic, scaffolding, etc.) with the previously applied coating, or for NSF applications is needed, a minimum of 10 hours at 70 °F (21 °C) substrate and air temperature with ventilation is required before proceeding. Previously applied coats must have reached a "non-tacky" state before being exposed to physical contact. This condition will occur in less time as surface temperature increases. Overcoating shall be performed as soon as possible to prevent contamination.

LINING REPAIR

Clean damaged area, removing all contaminants and loose coating. Abrasive blast substrate to original specification where coating has been exposed to environment and where oxidation is evident. Feather the original coating not less than 2 in/5 cm from damaged area.

If new coating is physically damaged and has not been in service, repair as shown above. For repairing holidays, sand surface and brush apply proper thickness of coating. Apply coating by brush or spray. Do not apply by brush on areas larger than 1 sq. ft./0.93 sq.m.

RECOATING TIME

May be recoated after initial 10 hour cure. Following coating must be applied within 30 days. Each following coat should be diluted approximately 2 to 20% with PLASITE Thinner 20. Note: Previously applied coating exposed to an accumulation of 24 hours of sunlight or surface temperatures in excess of 130 °F may result in intercoat disbondment. An applied coating film must be topcoated before an accumulation of 24 hours exposure has occurred or special procedures (such as shading with tarps) must be used.

Warning: Contamination of previously exposed coating film may be detrimental to adhesion of the repair and may affect life expectancy.

CURING SCHEDULE

Surface Temp.	Cure Time
70°F (21°C)	10 Days
90°F (32°C)	7 Days

Although coating may be applied at substrate temperatures as low as 60 °F (16 °C), the substrate temperature must be raised to at least 70 °F (21 °C) within 12 hours and held until coating surface is tack-free (approximately 10 hours) to avoid possible loss of cure. A minimum of 70 °F (21 °C) surface temperature is required to obtain polymerization of this coating.

CURING SCHEDULE

Surface Temp.	Cure Time
110°F (43°C)	72 Hours
120°F (49°C)	36 Hours
130°F (54°C)	18 Hours
140°F (60°C)	10 Hours
150°F (66°C)	6 Hours
160°F (71°C)	4.5 Hours
170°F (77°C)	3.5 Hours
180°F (82°C)	2.5 Hours
190°F (88°C)	2 Hours
200°F (93°C)	1.75 Hours

Listed are a few curing schedules that may be used for time and work planning. Prior to raising the metal to the force curing temperature, it is necessary that an air dry time of 2 to 5 hours at temperatures from 70 °F (21 °C) to 100 °F (38 °C) be allowed. After the air dry time has elapsed, the temperature should be raised in increments of approximately 30 °F (17 °C) every 30 minutes until the desired force curing metal temperatures are reached. Any moisture from condensation of any source will kill the cure on freshly applied coating before it reaches a “non-tacky” stage. A force cure at 200 °F (93 °C) metal temperature for 4 hours is necessary to comply with NSF Standard 61 requirements.

CLEANUP & SAFETY

Cleanup	Clean with PLASITE Thinner 20. In case of spillage, absorb and dispose of in accordance with local applicable regulations.
Safety	Read and follow all caution statements on this product data sheet and on the SDS for this product. Employ normal workmanlike safety precautions. Keep container closed when not in use.
Ventilation	When used in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to insure all personnel are below guidelines. If not sure, use MSHA/NIOSH approved respirator.
Caution	This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

TESTING / CERTIFICATION / LISTING

NSF	<ul style="list-style-type: none"> • PLASITE 4110 is certified to NSF/ANSI Standard 61 for ambient potable water when the following requirements are met: The tank is 3,000 gallons/11,100 liters or larger. • PLASITE Thinner #20, up to maximum of 20% by volume, may be used for thinning purposes. • The coating must be applied in 2 to 3 coats to a maximum DFT of 45 mils/1125 microns. • Prior to placing the lining in service, it must be force cured at 200 °F/93 °C metal temperature for 4 hours.
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PACKAGING, HANDLING & STORAGE

Shelf Life	Approximately 4 months at 75 °F (24 °C). Cooler storage temperatures will increase shelf life. Storage at higher temperatures can result in substantially shorter shelf life.
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Plasite[®] 4110

PRODUCT DATA SHEET



PACKAGING, HANDLING & STORAGE

Shipping Weight (Approximate)	12 lbs. per gallon kit.
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WARRANTY

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.

3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134

Data Sheet and Application Guide

February 2016

Handling and Safety Precautions: Read all Health Hazard, Precautionary and First Aid, Material Safety Data Sheet, and product label prior to handling or use.

Product Description

3M Scotchkote Fusion-Bonded Epoxy Coating 134 is a one-part, heat curable, thermosetting epoxy coating designed for corrosion protection of metal. The epoxy is applied to preheated steel as a dry powder which melts and cures to a uniform coating thickness when properly applied. This bonding process provides excellent adhesion and coverage on applications such as valves, pumps, pipe drains, hydrants, pipes, tanks and porous castings. Scotchkote coating 134 is NSF/ANSI 61 certified for potable water applications and is also resistant to wastewater, corrosive soils, hydrocarbons, harsh chemicals, and sea water. Powder properties allow easy manual or automatic application by electrostatic or air-spray equipment.

Product Features

- No primer required for most applications.
- For electrostatic or air-spray application on preheated metal articles.
- Can be electrostatically applied to unheated metal parts and subsequently cured by baking.
- Long gel time allows application on large or complex articles, minimizing fear of runs, sags, laminations, or unsightly overspray.
- Especially useful for coating the inside of pipe or other fabrications where a smooth, corrosion resistant coating is required.
- Can be machined by grinding or cutting to meet close tolerance requirements.
- Allows easy visual inspection of coated articles.
- Can be painted with alkyd paint, acrylic lacquer, polyurethane, or acrylic enamel for color coding.
- Applied coating will not sag cold flow.
- Lightweight for lower shipping costs.
- Protects over wide temperature range.
- Resists direct burial soil stress.
- Resists cavitation and cathodic disbondment.
- Can be used for elevated temperature service in presence of H₂S, CO₂, CH₄, crude oil and brine when applied over phenolic primer such as 3M Scotchkote Liquid Phenolic Primer 345.
- Long-term performance history in water, sewage, and other service environments.
- Scotchkote coating 134 has been tested and certified to NSF /ANSI Standard 61, Drinking Water System Components. For NSF certified applications, the max approved thickness is 60 mil (1.5 mm) and the maximum approved operating temperature is 140°F/60°C. Primers may not be used for potable water applications.
- Scotchkote coating 134 meets the requirements of AWWA Standard C213 and C550.



3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134

Temperature Operating Range For non-potable water applications Scotchkote coating 134, when properly applied to a nominal thickness of 15 mils, should perform on pipelines operating between -100°F/-73°C to 203°F/95°C. For temperatures reaching 230°F/110°C thicker coatings, greater than 30 mils, may improve the service capability. However, it is difficult to accurately predict field performance from the laboratory data due to the wide variations in actual field conditions. Soil types, moisture content, temperatures, coating thickness, and other factors specific to the area all influence the coating performance and upper temperature operating limits.

General Application Information

1. Remove oil, grease and loosely adhering deposits.
2. Abrasive blast clean the surface to NACE No. 2/SSPC-SP10 ISO 8501:1, Grade SA 2 ½ near-white metal.
3. Apply mechanical masks or mask with materials such as 3M Scotch® Glass Cloth Tape 361 or 3M Aluminum Foil Tape 425 as required.
4. Preheat article to the desired application temperature per cure specifications.
5. Deposit Scotchkote coating 134 by powder spray to the specified thickness.
6. Cure according to cure specifications.
7. Visually and electrically inspect for coating flaws after the coating has cooled.
8. Repair all defects.

Cure Specifications Scotchkote coating 134 may be applied to metal articles which have been preheated to a temperature of 300°F/149°C to 475°F/246°C. After application, Scotchkote coating 134 must be cured according to the cure guide to achieve maximum performance properties.

If Scotchkote coating 134 is electrostatically applied to unheated parts, the cure time should be measured from the time the coated part reaches the cure temperature. After cure, the coating may be force cooled using air or water to facilitate inspection and handling.

3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134

Product - Physical and Chemical Properties

3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134 Cure Guide

Temperature of Article at Time of Powder Application	Typical Gel Time	Cure Time
475°F/246°C	40 seconds	7 minutes
450°F/232°C	60 seconds	10 minutes
400°F/204°C	120 seconds	15 minutes
350°F/177°C	330 seconds	25 minutes
425°F/218°C	90 seconds	25 minutes for NSF/ANSI 61 approved applications

Typical Properties

Property	Value
Color Forest Green	Color Forest Green
Specific Gravity – Powder (Air Pycnometer)	1.51
Coverage	127 ft ² /lb/mil (066 m ² /kg/mm)
Fluid Bed Density 33 lbs/ft ³ (530 kg/m ³)	33 lbs/ft ³ (530 kg/m ³)
Shelf Life at 80°F/27°C 18 months	Shelf Life at 80°F/27°C 18 months
Average Gel Time (400°F/204°C)	120 seconds
Edge Coverage	12% to 18%
Minimum Explosive Concentration	0.03 oz/ft ³ (30,6 g/m ³)
Ignition Temperature	986°F/530°C
V.O.C. (As Supplied)	0 g/L, as calculated

Chemical/Pressure/Temperature Resistance

Test Conditions	Gas Phase	Results
Autoclave, 120°F/49°C 48 hours, 1500 psi/10.3 MPa	99.5% CO ₂ 0.5% H ₂ S	Excellent adhesion, no coating loss or blisters in aqueous, hydrocarbon, or gas phase
Autoclave, 150°F/66°C 48 hours, 2200 psi/15.2 MPa	80% CH ₄ 12% CO ₂ 8% H ₂ S	Excellent adhesion, no coating loss or blisters in aqueous, hydrocarbon, or gas phase
Autoclave, 200°F/93°C 24 hours, 3300 psi/22.8 MPa	86% CH ₄ 8% CO ₂ 6% H ₂ S	Excellent adhesion, no coating loss or blisters in aqueous, hydrocarbon, or gas phase
Autoclave, 300°F/149°C 24 hours, 3000 psi/20.7 MPa	90% CH ₄ 10% CO ₂ Trace H ₂ S	Excellent adhesion, no coating loss or blisters in aqueous, hydrocarbon, or gas phase

All tests performed on 3M™ Scotchkote™ Fusion Bonded Epoxy Coating 134 applied over a 1 mil/25,4 µm phenolic primer. Liquid phase for all test conditions: 33% kerosene, 33% toluene, 34% brine solution of 5% NaCl.

3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134

Continued Product - Physical and Chemical Properties

Chemical Resistance Testing

ASTM G20-10 Immersion Testing at 20°C

Solution	30 days	60 days	90 days
Acetic Acid (5%)	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Acetone	No blistering or disbondment, coating is slightly rubbery	No blistering or disbondment, coating is slightly rubbery	No blistering or disbondment, coating is slightly rubbery
Carbon Disulfide	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Gasoline	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Hydrochloric Acid (10%)	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Kerosene	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Lime Water, Saturated	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Methyl Alcohol	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Methyl Ethyl Ketone	No blistering or disbondment, coating is slightly rubbery	No blistering or disbondment, coating is slightly rubbery	No blistering or disbondment, coating is slightly rubbery
Nitric Acid (10%)	Discoloration; No blistering or disbondment	Discoloration; No blistering or disbondment	Discoloration; No blistering or disbondment
Sodium Carbonate Solution (20%)	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Sodium Chloride Solution (10%)	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Sodium Hydroxide Solution (10%)	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Sulfuric Acid (30%)	No blistering or disbondment	No blistering or disbondment	Slight discoloration; No blistering or disbondment
Toluene	No blistering or disbondment	No blistering or disbondment	No blistering or disbondment
Trichloroethylene	No blistering or disbondment, coating is slightly rubbery	No blistering or disbondment, coating is slightly rubbery	No blistering or disbondment, coating is slightly rubbery

3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134

Continued Product - Physical and Chemical Properties

3M internal – Historical Chemical Resistance testing based on similar, but not identical products.**

Testing Temperature 73°F (23°C*)

Acetic Acid up to 25%	Ferric Nitrate	Potassium Borate
	Ferric Sulfate	Potassium Carbonate
Aluminum Chloride	Ferrous Nitrate	Potassium Chloride
Aluminum Hydroxide	Ferrous Sulfate	Potassium Dichromate up to 10%
Aluminum Nitrate	Formaldehyde up to 100%	Potassium Hydroxide
Aluminum Sulfate	Formic Acid up to 10%	Potassium Nitrate
Ammonium Carbonate	Freon; gas and liquid	Potassium Sulfate
Ammonium Chloride	Gas (Mfg)	Propylene Glycol
Ammonium Hydroxide up to 100%	Gas (Natural)	Sewage
Ammonium Nitrate	Gasoline Leaded	Silver Nitrate
Ammonium Phosphate	Gasoline Unleaded	Soap Solution
Ammonium Sulfate	Glycerine	Soaps
Amyl Alcohol	Heptane	Sodium Bicarbonate
Barium Carbonate	Hexane	Sodium Bisulfate
Barium Chloride	Hexylene Glycol	Sodium Carbonate
Barium Hydroxide	Hydrochloric Acid up to 25%	Sodium Chlorate
Barium Nitrate	Hydrofluoric Acid up to 40%	Sodium Chloride
Barium Sulfate	Hydrogen Sulfide	Sodium Hydroxide
Benzene	Isopropyl Alcohol	Sodium Meta Silicate up to 5%
Boric Acid	Jet Fuel	Sodium Nitrate
Borax		Sodium Sulfate
Butyl Alcohol	Linseed Oil	Sodium Thiosulfate up to 5%
Cadmium Chloride	Lubricating Oil	Stannic Chloride
Cadmium Nitrate	Magnesium Carbonate	Sulfur
Cadmium Sulfate	Magnesium Chloride	Sulfuric Acid up to 60%
Calcium Carbonate	Magnesium Hydroxide	Synthetic Sea Fuel (60% Naphtha,
Calcium Chloride	Magnesium Nitrate	20% Toluene, 15% Xylene,
Calcium Hydroxide	Magnesium Sulfate	5% Benzene)
Calcium Nitrate		Synthetic Silage
Calcium Sulfate	Mercuric Chloride	Tetrapropylene
Calcium Disulfide	Methanol (softened)	Toluene
Carbon Tetrachloride	MIBK (Methyl Isobutyl Ketone)	
Caustic Potash	Mineral Oil	Triethylene Glycol
Caustic Soda	Mineral Spirits	Trisodium Phosphate
Chlorine 2%	Molasses	Turpentine
Citric Acid up to 25%	Motor Oil	Undecanol
Copper Chloride	Muriatic Acid	Urea
Copper Nitrate	Naphtha	Urine
Copper Sulfate	Nickel Chloride	Vinegar
Crude Oil	Nickel Nitrate	Water
Cyclohexane	Nickel Sulfate	Chlorinated
Cyclohexene	Nitric Acid up to 30%	Demineralized
Cyclopentane	Nonane	Distilled
Detergent	Octane	Salt
Diesel Fuel	Oxalic Acid	Sea
Diethylene Glycol	Pentane	Xylol
Dipropylene Glycol	Perchloroethylene	Zinc Chloride
Ethanol (softened)	Phosphoric Acid up to 50%	Zinc Nitrate
Ethylbenzene	Phosphorous Trichloride	Zinc Sulfate
Ethylene Glycol	Potassium Aluminum Sulfate	10-10-10 Fertilizer, Saturated
Ferric Chloride up to 50%	Potassium Bicarbonate	

**Tests conducted for two years. No effect unless otherwise stated.

3M™ Scotchkote™ Fusion-Bonded Epoxy Coating 134

Storage	In a cool dry location less than 80°F (27°C)
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Shelf-Life	18 months from date of manufacture
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Availability	For ordering, technical, product information, or the Safety Data Sheet, call: Phone: 800-722-6721 Fax: 877-601-1305
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Important Notice	All statements, technical information, and recommendations related to 3M's products are based on information believed to be reliable, but the accuracy or completeness is not guaranteed. Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use. Any statements related to the product, which are not contained in 3M's current publications, or any contrary statements contained on your purchase order, shall have no force or effect unless expressly agreed upon, in writing, by an authorized officer of 3M.
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Warranty; Limited Remedy; Limited Liability	Because conditions of product use are outside of our control and vary widely, the following is made in lieu of all express or implied warranties: This product will conform to 3M's published product specifications and be free from defects in material and manufacture on the date of your purchase. 3M MAKES NO OTHER WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. If this product is defective upon your receipt, your exclusive remedy shall be, at 3M's option, to replace the 3M product or refund the purchase price of the 3M product. Except where prohibited by law, 3M will not be liable for any direct, indirect, special, incidental or consequential loss or damage arising from this 3M product, regardless of the legal theory asserted.
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Electrical Markets Division
6801 River Place Blvd.
Austin, TX 78726-9000
800.722.6721
www.3M.com/corrosion

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78-8141-8528-2 Rev A

SELECTION & SPECIFICATION DATA

Generic Type	Cycloaliphatic Amine Epoxy
Description	High solids corrosion resistant primer and intermediate. Used either as a primer or an intermediate coat over steel and inorganic zinc primers. Can be topcoated with a broad variety of high performance finish coats.
Features	<ul style="list-style-type: none"> • Excellent corrosion protection • Excellent film build and edge protection • Used as a primer or an intermediate coating • Good abrasion resistance • Cures down to 40°F (4°C) • VOC compliant to current AIM regulations
Color	Red (0500); Gray (0700); Yellow (0600); White (0800)
Finish	Eggshell
Primer	Self-priming. May be applied over organic and inorganic zinc rich primers. A mist coat may be required to minimize bubbling over zinc rich primers.
Dry Film Thickness	3 mils (76 microns) per coat 4 - 6 mils (102 - 152 microns) per coat 3 - 6 mils (76 - 150 microns) for mild environments and as an intermediate coat over zinc rich primers. 4-6 mils (102-152 microns) for more severe environments. Do not exceed 10.0 mils (250 microns) in a single coat. Excessive film thickness over inorganic zincs may increase damage during shipping or erection.
Solids Content	By Volume 77% +/- 2%
Theoretical Coverage Rate	1235 ft ² /gal at 1.0 mils (30.3 m ² /l at 25 microns) 412 ft ² /gal at 3.0 mils (10.1 m ² /l at 75 microns) 206 ft ² /gal at 6.0 mils (5.1 m ² /l at 150 microns) Allow for loss in mixing and application.
VOC Values	As Supplied : 1.6 lbs/gal (195 g/l) Thinner 2 : 16 oz/gal = 2.2 lbs/gal (261 g/l) Thinner 230 : 13 oz/gal = 2.1 lbs/gal (252 g/l) Thinner 33 : 32 oz/gal = 2.7 lbs/gal (329 g/l) These are nominal values and may vary slightly with color. *Maximum thinning for 250 g/l restricted areas is 12 oz/gal with Thinner 2, and 11 oz/gal with Thinner 33 or 230. Use Thinner 76 where non-photochemically reactive solvents are required (up to 11 oz/gal)
Dry Temp. Resistance	Continuous: 200°F (93°C) Non-Continuous: 250°F (121°C) Discoloration and loss of gloss is observed above 200°F (93°C).
Limitations	Not recommended for immersion service
Topcoats	May be coated with Acrylics, Epoxies, Alkyds, or Polyurethanes depending on exposure and need.

SUBSTRATES & SURFACE PREPARATION

General	Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.
Steel	SSPC-SP6 with a 1.0-2.0 mil (25-50 microns) surface profile. When using under fireproofing products, defer to the primer surface preparation requirements in the product data sheet of the fireproofing product.
Galvanized Steel	Prime with specific Carboline primers as recommended by your Carboline Sales Representative. Refer to the specific primer's Product Data Sheet for substrate preparation requirements. When using under fireproofing products, defer to the primer surface preparation requirements in the product data sheet of the fireproofing product.
Concrete or CMU	Concrete must be cured 28 days at 75°F (24°C) and 50% relative humidity or equivalent. Prepare surfaces in accordance with ASTM D42582 Surface Cleaning of Concrete and ASTM D4259 Abrading Concrete. Voids in concrete may require surfacing.

PERFORMANCE DATA

All test data was generated under laboratory conditions. Field testing results may vary.

Test Method	System	Results
ASTM B117 Salt Fog	Blasted Steel 1ct. IOZ 1 ct. 893	No blistering, rusting and no creepage at scribe after 4000 hours
ASTM D 1735 Water Fog	Blasted Steel 1ct. IOZ 1 ct. 893	No blistering softening or rusting after 5000 hours
ASTM D2583 Hardness	Blasted Steel 1 ct. 893	73, Barcol Test, 1 week cure, 5 mils DFT
ASTM D4060 Abrasion	Blasted Steel 1ct. 893	88 mg. loss after 1000 cycles, CS17 wheel, 1000 gm. load
ASTM G26 Weatherometer	Blasted Steel 1ct. IOZ 1 ct. 893	No blistering softening or rusting after 4000 hours

Test reports and additional data available upon written request.

MIXING & THINNING

Mixing	Power mix separately, then combine and power mix. DO NOT MIX PARTIAL KITS. A 30-minute "sweat-in" time is highly recommended for applications below 50°F (10°C) and will improve cure response.
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MIXING & THINNING

Thinning	<p>Spray: Up to 16 oz/gal (131.5 g/l) (12%) w/ Thinner 2 or up to 13 oz/gal (106.8 g/l) (10%) w/ Thinner 230</p> <p>Brush: Up to 32 oz/gal (263 g/l) (25%) w/ Thinner 33</p> <p>Roller: Up to 32 oz/gal (263 g/l) (25%) w/ Thinner 33</p> <p>Mist coating: Thin up to 32 oz/gal (263 g/l) with Thinner 2 or 33 in VOC restricted (2.8lb/gal) areas. May thin up to 48 oz/gal where VOC restricted levels are at 3.5 lb/gal (0.42 kg/l) for mist coat only. If necessary, use Thinner 230 only in hot (above 100°F/38°C) and windy conditions, to slow down the evaporation rate.</p> <p>Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied. *See VOC values for thinning limits. Carboline Thinner 236E or 225E (up to 10% or 13 oz/gal) may also be used to thin this product to minimize HAP and VOC emissions. Consult Carboline Technical Service for guidance.</p>
Ratio	1:1 Ratio (A to B)
Pot Life	4 Hours at 75°F (24°C) Pot life ends when coating loses body and begins to sag. Pot life times will be less at higher temperatures. Thinning rates above 16 oz/gal will shorten the working time to 2 hours.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Spray Application (General)	This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco.
Conventional Spray	Pressure pot equipped with dual regulators, 3/8" (0.95 cm) I.D. minimum material hose, 0.070" (0.18 cm) I.D. fluid tip and appropriate air cap.
Airless Spray	<p>Pump Ratio: 30:1 (min.)</p> <p>GPM Output: 3.0 (min.)</p> <p>Material Hose: 3/8" (0.38 cm) I.D. (min.)</p> <p>Tip Size: 0.017-0.021" (0.043-0.053 cm)</p> <p>Output PSI: 2100-2300</p> <p>Filter Size: 60 mesh</p> <p>PTFE packings are recommended and available from the pump manufacturer.</p>
Brush & Roller (General)	Multiple coats may be required to obtain desired appearance, recommended dry film thickness and adequate hiding. Avoid excessive re-brushing or re-rolling. For best results, tie-in within 10 minutes at 75°F (24°C).
Brush	Use a medium bristle brush.
Roller	Use a short-nap synthetic roller cover with phenolic core.

APPLICATION CONDITIONS

Condition	Material	Surface	Ambient	Humidity
Minimum	40°F (4°C)	40°F (4°C)	40°F (4°C)	0%
Maximum	90°F (32°C)	135°F (57°C)	110°F (43°C)	90%

This product simply requires the substrate temperature to be above the dew point. Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions.

CURING SCHEDULE

Surface Temp.	Dry to Handle	Dry to Topcoat	Dry to Touch	Maximum Recoat Time w/ Acrylics	Maximum Recoat Time w/ Epoxies	Maximum Recoat Time w/ Polyurethanes
40°F (4°C)	24 Hours	72 Hours	6 Hours	14 Days	30 Days	90 Days
50°F (10°C)	16 Hours	24 Hours	5 Hours	14 Days	30 Days	90 Days
60°F (16°C)	12 Hours	16 Hours	4 Hours	14 Days	30 Days	90 Days
75°F (24°C)	6 Hours	8 Hours	3 Hours	14 Days	30 Days	90 Days
90°F (32°C)	3 Hours	4 Hours	2 Hours	14 Days	15 Days	30 Days

These times are based on a 4.0 mil (100 microns) dry film thickness. Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times and could result in solvent entrapment and premature failure. Excessive humidity or condensation on the surface during curing can interfere with the cure, can cause discoloration and may result in a surface haze. Any haze or blush must be removed by water washing before recoating. During high humidity conditions, it is recommended that the application be done while temperatures are increasing. Recoat intervals may vary from those listed above when using under intumescent fireproofing products. Consult Carboline Technical Service for recommended cure times before applying Carboline intumescent products. If the maximum recoat time is exceeded, the surface must be abraded by sweep blasting or sanding before the application of additional coats. When cured below 50°F (10°C) a slight softening is typically observed as the temperature rises above 50°F (10°C) and is considered normal.

CLEANUP & SAFETY

Cleanup	Use Thinner 2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.
Safety	Read and follow all caution statements on this product data sheet and on the SDS for this product. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.
Ventilation	When used in enclosed areas and product is thinned, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to insure all personnel are below guidelines. If not sure or if not able to monitor levels, Use MSHA/NIOSH approved supplied air respirator.

PACKAGING, HANDLING & STORAGE

Shelf Life	Part A: Min. 36 months at 75°F (24°C) Part B: Min. 24 months at 75°F (24°C) *Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.
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PACKAGING, HANDLING & STORAGE

Storage Temperature & Humidity	40° - 110°F (4°-43°C) 0-90% Relative Humidity
Storage	Store Indoors. This product is solvent based and not affected by excursions below these published storage temperatures, down to 10°F, for a duration of no more than 14 days. Always inspect the product prior to use to make sure it is smooth and homogeneous when properly mixed.
Shipping Weight (Approximate)	2 Gallon Kit - 29 lbs (13 kg) 10 Gallon Kit - 143 lbs (65 kg)
Flash Point (Setflash)	Carboguard 893 Part A: 61°F (16°C) Carboguard 893 Part B: 59°F (15°C)

WARRANTY

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.

SELECTION & SPECIFICATION DATA

Generic Type	Aliphatic Acrylic Polyurethane
Description	High gloss finish with exceptional weathering performance characteristics. Used extensively in virtually all industrial markets, provides a smooth, durable finish that has superior resistance to corrosion and chemical exposure.
Features	<ul style="list-style-type: none"> • High solids, low VOC content • Excellent weatherability • Exceeds SSPC Paint 36 specification for a Level 3 urethane • Excellent flow characteristics allow for application by spray or roller • Superior impact and abrasion resistance • Indefinite recoatability • VOC compliant to current AIM regulations • Suitable for use in USDA inspected facilities
Color	<p>Refer to Carboline Color Guide. Certain colors, particularly in non-lead safety oranges, reds and yellows may require multiple coats for adequate hiding. Check color suitability before use.</p> <p>The alignment of aluminum flakes in aluminum-filled finishes is very dependent on application conditions and techniques. Care must be taken to keep conditions as constant as possible to reduce variations in final appearance. It is also advisable to work from a single batch of material since variations can occur from batch to batch. For more information consult Carboline Technical Service Department.</p>
Finish	Gloss
Primer	Refer to Substrates & Surface Preparation.
Dry Film Thickness	2 - 2.5 mils (51 - 64 microns) per coat
Solids Content	By Volume 70% +/- 2%
Theoretical Coverage Rate	<p>1123 ft²/gal at 1.0 mils (27.6 m²/l at 25 microns) 561 ft²/gal at 2.0 mils (13.8 m²/l at 50 microns) 449 ft²/gal at 2.5 mils (11.0 m²/l at 62 microns) Allow for loss in mixing and application.</p>
VOC Value(s)	<p>Per EPA Method 24: 1.58 lbs./gal (190 g/l) 11 oz/gal of Thinner 214: 2.06 lbs./gal (247 g/l) 10 oz/gal of Thinner 215: 2.06 lbs./gal (247 g/l) 10 oz/gal of Thinner 25: 2.05 lbs./gal (245 g/l)</p> <p>These are nominal values and may vary slightly with color. This product contains US EPA VOC-exempt solvent(s).</p>
Dry Temp. Resistance	<p>Continuous: 200°F (93°C) Non-Continuous: 250°F (121°C)</p> <p>Discoloration and loss of gloss is observed above 200°F (93°C).</p>
Topcoats	Carbothane Clear Coat when required

Carbothane[®] 134 VOC

PRODUCT DATA SHEET



SUBSTRATES & SURFACE PREPARATION

General | Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating. For all surfaces prime with specific Carboline primers as recommended by your Carboline sales representative. Refer to the specific primer's Product Data Sheet for detailed requirements of the specified primer.

Previously Painted Surfaces | Lightly sand to roughen and de-gloss the surface. Existing paint must attain a minimum 3A rating in accordance with ASTM D3359 "X-Scribe" adhesion test.

PERFORMANCE DATA

Test Method	System	Results
ASTM B117 Salt Fog	Blasted Steel 1 ct. Org Zinc 1 ct Epoxy 1 ct 134 HG	No rusting, blistering loss of bond or any measurable creepage from the scribe after 3000 hours
ASTM D2794 Impact Resistance	Blasted Steel 1ct. 134 HG	155 inch-pounds; no visible cracking. Gardner Impact Tester
ASTM D3359 Adhesion	Blasted Steel 1 ct Epoxy 1 ct 134 HG	5A
ASTM D3363 Hardness	Blasted Steel 1 ct Epoxy 1 ct 134 HG	H
ASTM D4060 Abrasion	Blasted Steel 1 ct 134 HG	70 mg. loss after 1000 cycles, CS17 wheel, 1000 gm. load
ASTM D4541 Adhesion	Blasted Steel 1 ct. Epoxy 1 ct 134 HG	2562 psi Pneumatic
ASTM D870 Immersion Resistance	Blasted Steel 1 ct Org. Zinc 1 ct Epoxy 1 ct 134 HG	No rusting in the scribe, no blistering, softening or discoloration after either 30 days of freshwater or saltwater immersion at 75°F.
ASTM G26 Weatherometer	Blasted Steel 1 ct. Epoxy 1 ct 134 HG	No blistering, rusting or cracking; gloss retention of 85% color change of 1 Macadam unit after 2000 hours
ASTM G53 ASTM D4587 Accelerated Weathering	Blasted Steel 1 ct. Org. Zinc 1 ct Epoxy 1 ct 134 HG	No rusting, blistering or loss of adhesion; less than 5% gloss loss after 3000 hours

Test reports and additional data available upon written request.

MIXING & THINNING

Mixing | Power mix Part A separately, then combine and power mix. DO NOT MIX PARTIAL KITS.

Thinning | Spray: Up to 11 oz/gal (9%) w/Thinner 214 or 10 oz/gal (8%) w/Thinner 25
Brush and/or Roller: Up to 10 oz/gal (8%) w/Thinner 215
The solvents listed above contain VOC. These maximum amounts listed will result in VOC at or below 250 g/l, 2.09 lbs/gal. Carboline Thinner 236E is VOC exempt and HAP free. It is also acceptable for all methods listed above. *Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.

MIXING & THINNING

Ratio | 4:1 Ratio (A to B)

Pot Life | 4 Hours at 75°F (24°C) and less at higher temperatures. Pot life ends when coating becomes too viscous to use. MOISTURE CONTAMINATION WILL SHORTEN POT LIFE AND CAUSE GELLATION.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Spray Application (General) | This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. Spray equipment has been found suitable and available from manufacturers such as Binks, DeVilbiss and Graco.

Conventional Spray | Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip and appropriate air cap.

Airless Spray | Pump Ratio: 30:1 (min.)*
GPM Output: 3.0 (min.)
Material Hose: 3/8" I.D. (min.)
Tip Size: .015-.017"
Output PSI: 2100-2400
Filter Size: 60 mesh
*Teflon packings are recommended and available from the pump manufacturer.

Brush & Roller (General) | Multiple coats may be required to obtain desired appearance and recommended dry film thickness. Avoid excessive re-brushing or re-rolling. For best results, tie-in within 10 minutes at 75°F (24°C).

Brush | Recommended for touch-up only. Use a medium, natural bristle brush.

Roller | Use a short-nap mohair roller cover with phenolic core.

APPLICATION CONDITIONS

Condition	Material	Surface	Ambient	Humidity
Minimum	50°F (10°C)	35°F (2°C)	35°F (2°C)	0%
Maximum	100°F (38°C)	120°F (49°C)	95°F (35°C)	80%

Industry standards are for substrate temperatures to be above 5°F (3°C) the dew point.

Caution: This Product is moisture sensitive in the liquid stage and until fully cured. Protect from high humidity, dew and direct moisture contact until fully cured. Application and/or curing in humidities above maximum, or exposure to moisture may result in a loss of gloss and/or micro bubbling of the product.

Carbothane[®] 134 VOC

PRODUCT DATA SHEET



CURING SCHEDULE

Surface Temp.	Dry to Handle	Dry to Recoat	Final Cure General
35°F (2°C)	36 Hours	36 Hours	14 Days
50°F (10°C)	16 Hours	16 Hours	10 Days
75°F (24°C)	8 Hours	8 Hours	7 Days
90°F (32°C)	4 Hours	4 Hours	5 Days

These times are based on a 2.0 mil (50 micron) dry film thickness. Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times and could result in solvent entrapment and premature failure.

Caution: This product is moisture sensitive in the liquid stage and until fully cured. Protect from high humidity, dew and direct moisture contact until fully cured. Application and/or curing in humidities above maximum, or exposure to moisture may result in a loss of gloss and/or micro bubbling of the product.

CLEANUP & SAFETY

Cleanup	Use Thinner 2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.
Safety	Read and follow all caution statements on this product data sheet and on the SDS for this product. Wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.
Ventilation	When used in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to insure all personnel are below guidelines. If not sure, use MSHA / NIOSH approved respirator.
Caution	This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

PACKAGING, HANDLING & STORAGE

Shelf Life	Part A: Min. 36 months at 75°F (24°C) Part B: Min. 24 months at 75°F (24°C) *Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.
Storage Temperature & Humidity	40°-110°F (4°-43°C) 0-80% Relative Humidity
Storage	Store Indoors.
Shipping Weight (Approximate)	1 Gallon Kit - 14 lbs (6kg) 5 Gallon Kit - 60 lbs. (27 kg)
Flash Point (Setaflash)	Part A: 74° F (23° C) Urethane Converter 811 Part B: 127°F (53 °C)

WARRANTY

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.



SUBMITTAL REVIEW FORM

To: Camrosa Water District
7385 Santa Rosa Road
Camarillo, CA 93012

From: Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA 93711

Project No.: 02958-20-002

Reviewer: Kevin Berryhill, P.E.

Project: TCP Removal Project for Conejo Wells

Date: 10/13/2021

Submittal No: AV - R1

Description: GAC Vessel Systems

The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the contract plans and specifications or from departures there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

☒

No Exceptions Taken

☐

Submit Specified Item

☐

Make Corrections Noted

☐

Rejected

☐

Revise & Resubmit

☐

For Information Only

Reviewer Comments:

Item	Description	Mfg/Supplier	Action Taken	Comment

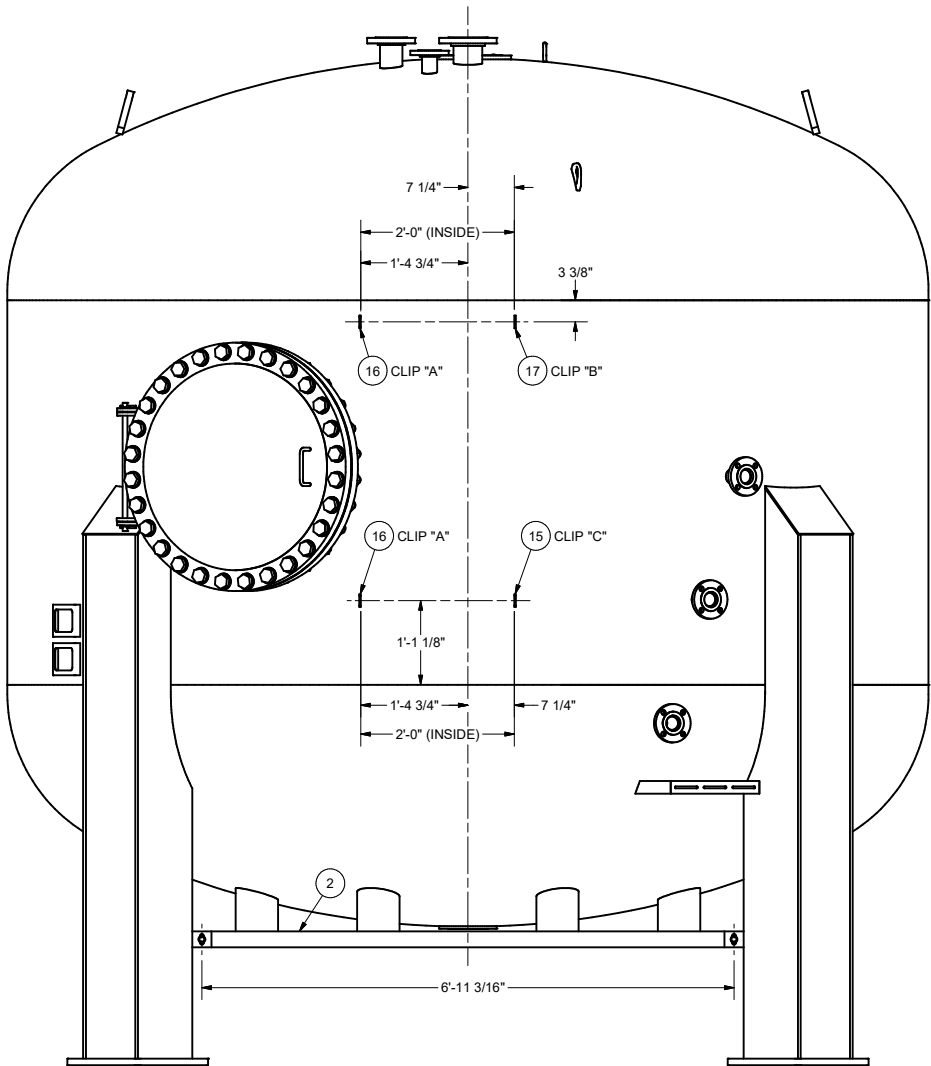
Comments:

No exceptions taken.

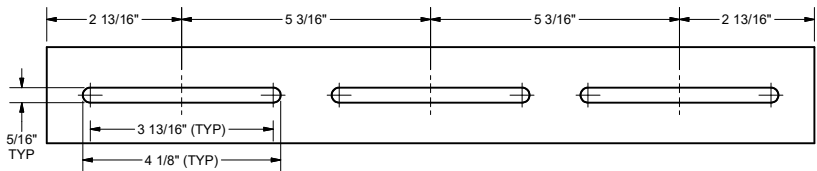
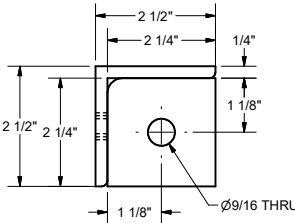
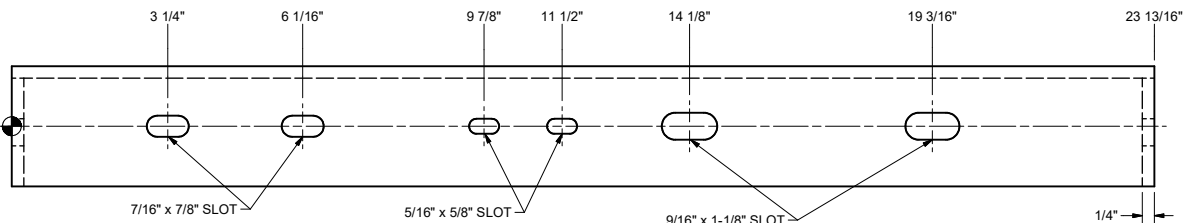
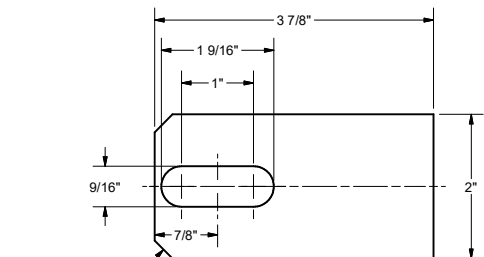
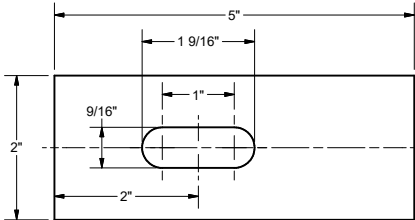
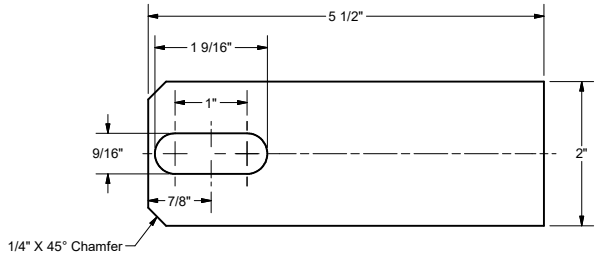
The District has selected 9225 "Cashew" as the exterior coating color.

The District will accept the A.R.I. combination air valves with metal bodies

8 7 6 5 4 3 2 1



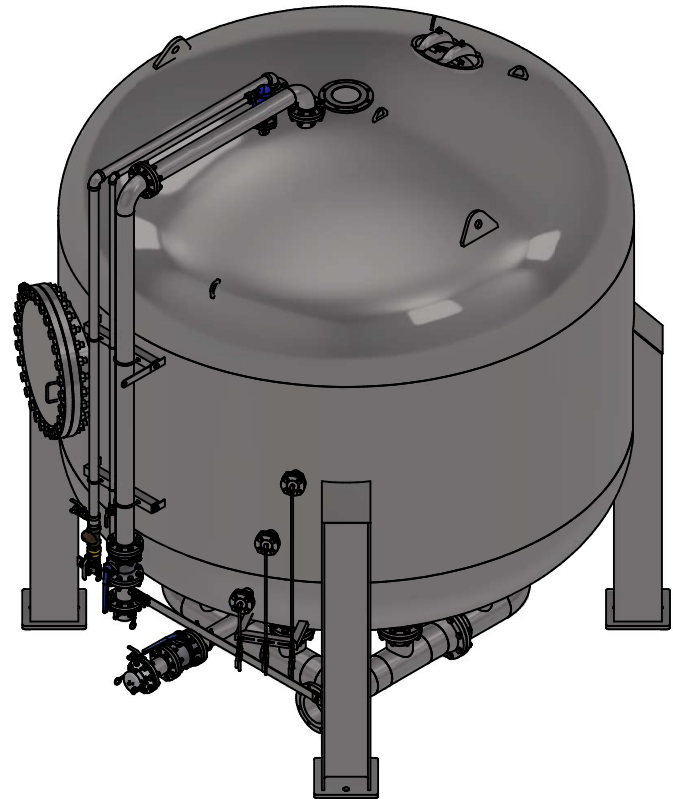
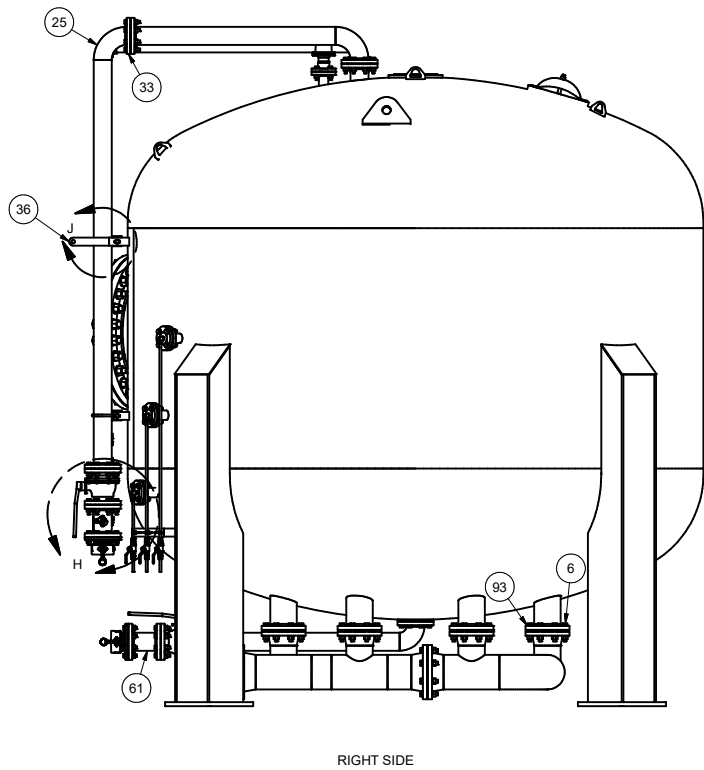
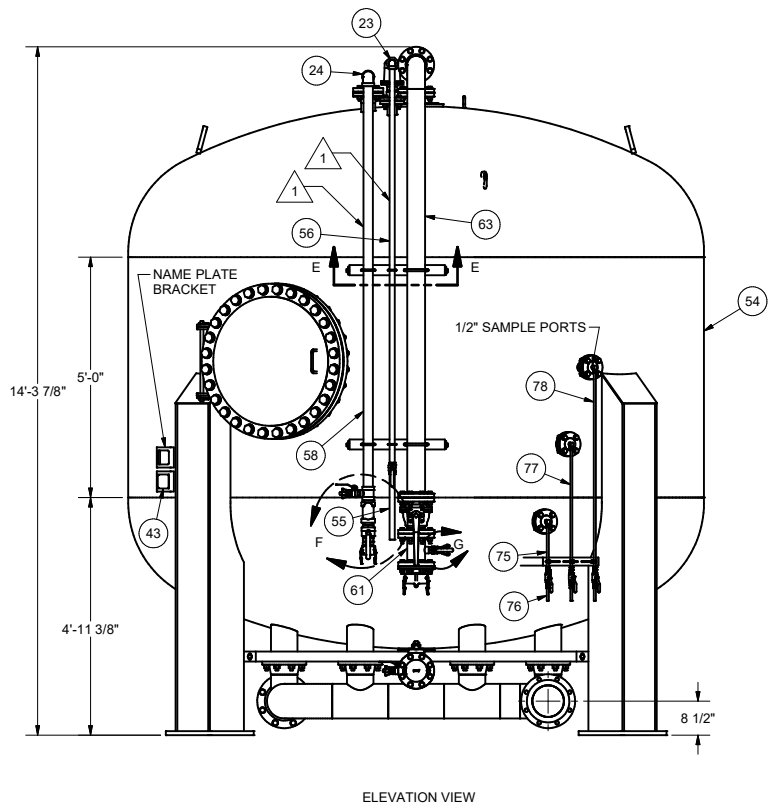
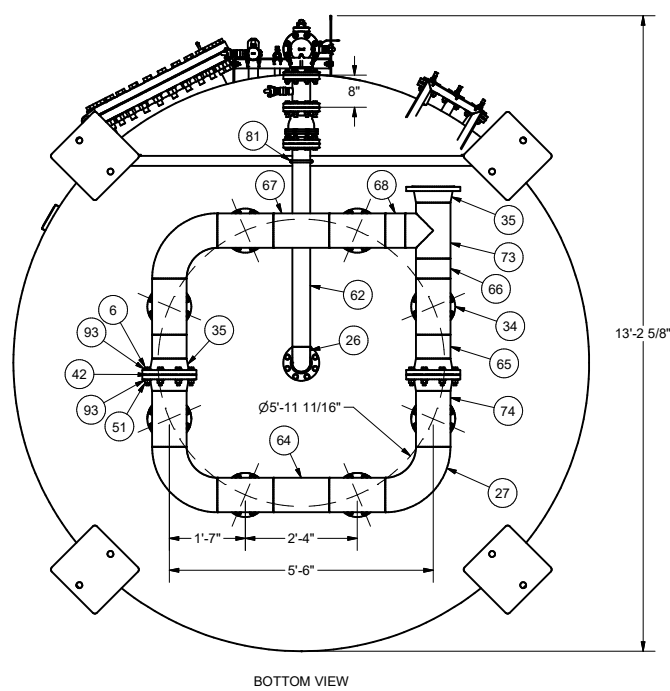
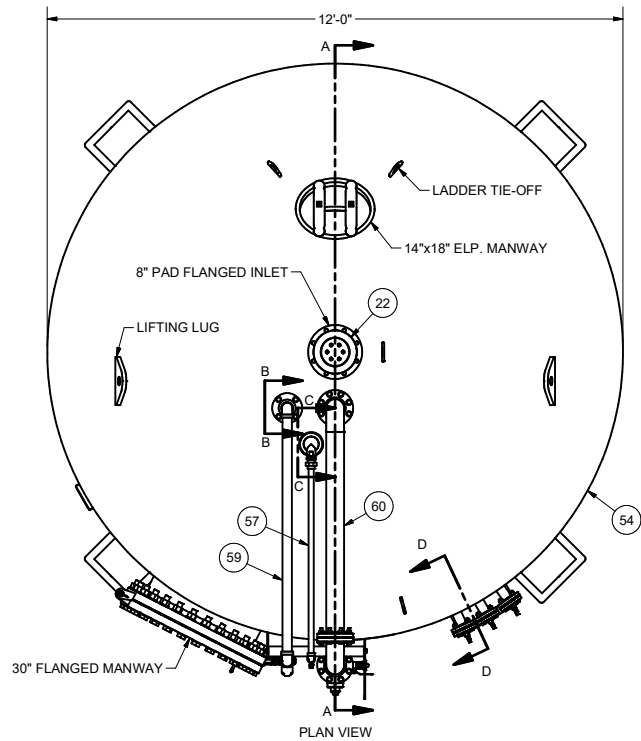
ELEVATION VIEW
(CLIP LOCATIONS)



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DESIGNER: AJA
CHECKER: RM
ENGINEER: JT
MANAGER: SJ
DATE: 9/1/2021
DATE: 9/1/2021
DATE: 9/1/2021
DATE: 9/1/2021
SCALE: 1/2" = 1'

TITLE: PF 12-520LP 125 PSI ASME CODE LOW PRO™ VESSEL
CLIENT: CAMROSA WATER DISTRICT
CONEJO WELLFIELD - GAC TREATMENT SYSTEM (CAMARILLO, CA)
AqueoUS VETS® 16761 CLEAR CREEK ROAD
REDDING, CA 96001
925-331-0573
PROJECT: M-00096
CODE:
DRAWING NUMBER: PF 12-520LP BT
SHEET: 2 OF 2
REV: 2

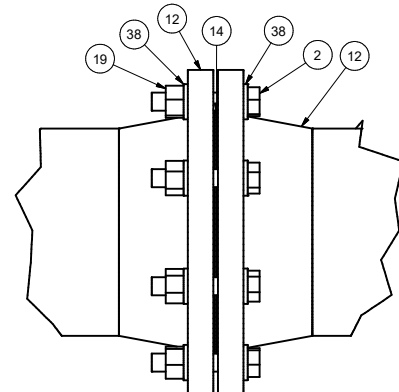


- NOTE:
1. THIS DRAWING IS TO SHOW PIPING AND EQUIPMENT FOR CUSTOMER APPROVAL.
 2. PROVIDE STAINLESS STEEL SCREENS AT SEPTA UNDER DRAIN.
 3. VESSELS SHALL BE 125 PSI, ASME CODE.
 4. PIPING MATERIALS SHALL MEET: CS PIPE ASTM A-53 GRADE B (ERW); CS FITTINGS SA-234, ASME B16.9; SS THREADED FITTINGS ASTM A-351; SS PIPE ASTM A-312; SS BW FITTINGS ASTM A-403; MI THREADED FITTINGS ASME B-16.3.
 5. SURFACE PREPARATION: VESSEL: SSPC-SP5 INTERIOR & SSPC-SP6 EXTERIOR. SYSTEM PIPING: SSPC-SP10 INTERIOR & SSPC-SP6 EXTERIOR.
 6. FINISH VESSEL INTERIOR WITH 35-45 MILS OF PLASITE 4110, PREPARE AND APPLY STRICTLY IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS TO MEET NSF STD 61 REQUIREMENTS. LINING TO BE CONTINUOUS TO OD OF THE RAISED FACE ON ALL NOZZLE FLANGES.
 7. FINISH EXTERIOR WITH 2-3 MILS OF CARBOTHANE 134VOC URETHANE, COLOR TO BE 9225 CASHEW, OVER 4-6 MILS OF CARBOGUARD 893 RUST PREVENTATIVE EPOXY PRIMER, APPLIED PER MANUFACTURERS RECOMMENDATIONS.
 8. CS SLURRY/PROCESS PIPE 3" AND LARGER TO BE INTERNALLY LINED WITH 16MILS (MIN.) OF 3M SCOTCHKOTE 134 FUSION BONDED EPOXY.
 9. MANWAY AND SEPTA GASKETS TO BE EPDM. ALL OTHER GASKETS TO BE NAM 37C.
 10. ALL VALVES TO BE TAGGED WITH NUMBER SHOWN ON P&ID.
 11. VESSEL ESTIMATED SHIPPING WEIGHT: 16,000 LBS.
 12. GROUTING AND ANCHORING BY OTHERS IF REQUIRED.

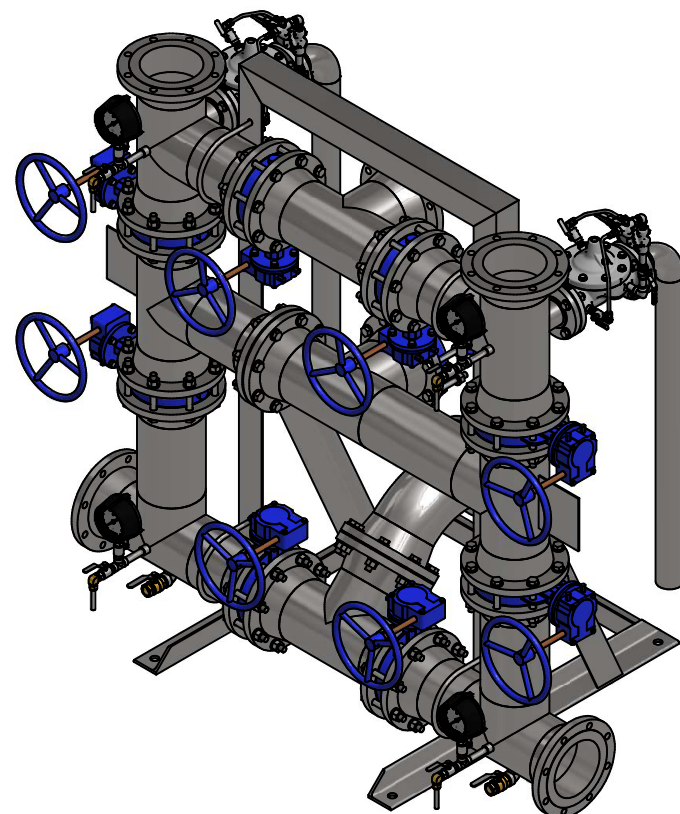
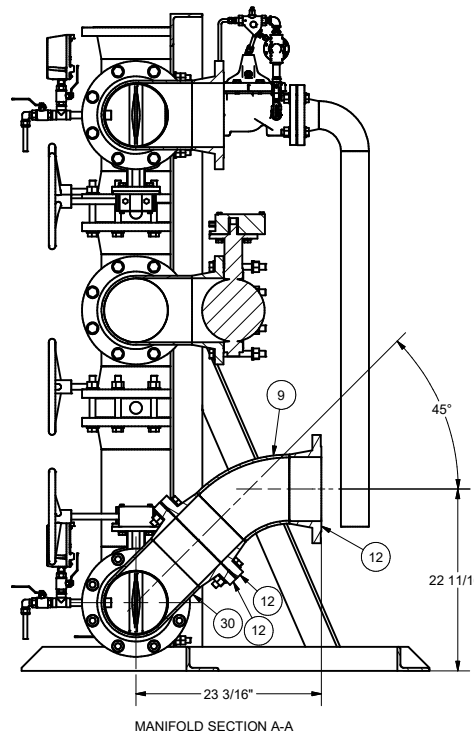
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		AJA 9/1/2021	PF 12-520LP LOW PRO™ 125 PSI SINGLE TANK ASSEMBLY	
		CHECKER: DATE	CLIENT	
		RM 9/1/2021		
		ENGINEER: DATE	16761 CLEAR CREEK ROAD REDDING, CA 96001 925-331-0573	
		JT 9/1/2021		
		MANAGER: DATE	PROJECT	CODE
			M-00096	
		SCALE: 1/2" = 1'	DRAWING NUMBER	SHEET
			PF 12-520LP ST 1	1 OF 2
				REV 1

REVISION HISTORY						
REV	DESCRIPTION	DATE	DWN	CHK	APPD	ECN
1	UPDATED 1" & 2" PIPE & FITTINGS FROM GALVANIZED TO SS, AND COLOR UPDATE	10/4/2021	AMN	AJA		

			PARTS LIST		7			
ITEM	QTY	DESCRIPTION			MATERIAL	LENGTH	WIDTH	
1	3	ADAPTER, 0.5" COMP X 0.5" MPT 90° BRASS			Brass, Soft Yellow			
2	3	ADAPTER, SAMPLE PORT WELDMENT 316SS						
3	1	ADAPTER, SPRAY NOZZLE 2" 316SS						
4	6	ADAPTER, STR 0.5" CMP X 0.5" NPT BRASS			BRASS			
5	3	BOLT, HEX 0.25IN D X 1 IN L 304SS			Stainless Steel			
6	80	BOLT, HEX 0.75IN D X 4 IN L HDG GR A307			Steel, Galvanized			
7	8	BOLT, HEX 0.625IN D X 2 IN L HDG GR A307			Steel, Galvanized			
8	48	BOLT, HEX 0.625IN D X 3.5IN L HDG GR A307			Steel, Galvanized			
9	4	BOLT, HEX 0.625IN D X 3.25IN L HDG GR A307			Steel, Galvanized			
10	32	BOLT, HEX 0.625IN D X 3 IN L HDG GR A307			Steel, Galvanized			
11	1	BUSHING, 1.5IN x 1IN T x T STD WT 316SS			Stainless Steel			
12	1	CAMLOCK, 2" ALUM MALE X MPT			Aluminum-6061			
13	2	CAMLOCK, 4" ALUM FLG X MALE			Aluminum 6061			
14	1	CAP, DUST 2" ALUM CAMLOCK			AL, 6061			
15	2	CAP, DUST 4" ALUM CAMLOCK			Aluminum 6061			
16	3	CLAMP, TUBE CUSHIONED 0.5" SS W/ RUBBER 17/64" HOLE FASTENAL# 0216777			STN STL, 18-8			
17	2	COUPLING, 1IN HALF THD 3000 316SS			Stainless Steel			
18	1	COUPLING, 1IN HALF THD 3000 STL			Steel, Carbon			
19	1	COUPLING, 2IN FULL THD STD WT 316SS			Stainless Steel			
20	1	COUPLING, 2IN HALF THD 3000 STL			Steel, Carbon			
21	3	COUPLING, UNIVERSAL 1" NPT 316SS DIXON RAM12			STN STL, 316L			
22	1	DIFFUSER, SLOTTED 8IN NOM 316SS			Stainless Steel			
23	1	ELBOW, 1IN 90 304L SS THD STD WT STD R			Stainless Steel			
24	2	ELBOW, 2IN 90 304L SS THD STD WT STD R			Stainless Steel			
25	2	ELBOW, 4IN 90 STL WELD SCH 40 LR			Steel, Carbon			
26	1	ELBOW, 4IN 90 STL WELD SCH 40 SR			Steel, Carbon			
27	3	ELBOW, 8IN 90 STL WELD SCH 40 LR			Steel, Carbon			
28	1	FLANGE, 2IN BLIND CS 150# RF			Steel, Carbon			
29	3	FLANGE, 2x0.5IN COMPANION CS 150# RF			Steel, Carbon			
30	1	FLANGE, 3IN WELD NECK CS 150# RF			Steel, Carbon			
31	1	FLANGE, 3x2IN COMPANION CS 150# RF			Steel, Carbon			
32	4	FLANGE, 4IN SLIPON CS 150# FLAT FACE			Steel, Carbon			
33	6	FLANGE, 4IN SLIPON CS 150# RF			Steel, Carbon			
34	8	FLANGE, 6IN WELD NECK CS 150# RF			Steel, Carbon			
35	5	FLANGE, 8IN WELD NECK CS 150# RF			Steel, Carbon			
36	1	FLAT, 2X0.25 IN CS A36			Steel, Carbon	10.0000 in		
37	7	GASKET, FLG 2IN NAM 37C RING 0.125IN THK 150#			COMPOSITE			
38	3	GASKET, FLG 3IN NAM 37C RING 0.125IN THK 150#			COMPOSITE			
39	2	GASKET, FLG 4IN NAM 37C FULL FACE 0.125IN THK 150#			COMPOSITE			
40	7	GASKET, FLG 4IN NAM 37C RING 0.125IN THK 150#			COMPOSITE			
41	16	GASKET, FLG 6IN EPDM RING 0.125IN THK 150#			EPDM			
42	3	GASKET, FLG 8IN NAM 37C RING 0.125IN THK 150#			COMPOSITE			
43	1	ID TAG 5.5X3.5			STN STL, 304			
44	1	NIPPLE, 1IN D X 1.5IN L SCH 40 304SS NPT TBE			Stainless Steel			
45	3	NIPPLE, 1IN D X 1.5IN L SCH 40 316SS NPT TBE			Stainless Steel			
46	3	NIPPLE, 2IN D X 2IN L SCH 40 316SS NPT TBE			Stainless Steel			
47	1	NOZZLE, 1" MNPT PP ORTHOS NB			POLYPROPENE			
48	3	NUT, HEX 0.25-20 UNC 304SS			Stainless Steel			
49	12	NUT, HVY HEX 0.5-13 UNC GALV 2H			Steel, Galvanized			
50	8	NUT, HVY HEX 0.25-20 UNC 304SS			Stainless Steel			
51	80	NUT, HVY HEX 0.75-10 UNC GALV 2H			Steel, Galvanized			
52	8	NUT, HVY HEX 0.375-16 UNC 304SS			Stainless Steel			
53	84	NUT, HVY HEX 0.625-11 UNC GALV 2H			Steel, Galvanized			
54	1	PF 12-520LP LOW PRO™ VESSEL 12 FT DIA 20K LB 125PSI BARE TANK						
55	1	PIPE, 1IN SCH 40 SST 304L			Stainless Steel	17.0000 in		
56	1	PIPE, 1IN SCH 40 SST 304L			Stainless Steel	99.6426 in		
57	1	PIPE, 1IN SCH 40 SST 304L			Stainless Steel	47.4075 in		
58	1	PIPE, 2IN SCH 40 SST 304L			Stainless Steel	101.5075 in		
59	1	PIPE, 2IN SCH 40 SST 304L			Stainless Steel	59.9375 in		
60	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	50.7500 in		
61	2	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	7.0000 in		
62	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	50.1612 in		
63	1	PIPE, 4IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	101.5000 in		
64	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	14.0000 in		
65	2	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	5.937 in		
66	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	5.000 in		
67	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	14.000 in		
68	1	PIPE, 8IN SCH 40 STL A53-SA53 GRADE B			Steel, Carbon	5.000 in		
69	3	SCREEN, 1.313IN OD X 4IN EFF X 0.75 FNPT CONN, 0.01IN SLOT 316LSS			Stainless Steel			
70	8	SEPTA, 4.5IN OD X 12IN EFF 0.012 SLOT 316SS			Stainless Steel			
71	1	SPRAY NOZZLE, 2" PVC NPT PN# 2HHSJ-PVC1701400			PVC			
72	1	TEE, 2x2x1IN 316SS THD 150# RED			Stainless Steel			
73	1	TEE, 8IN STL WELD STD WT STD			Steel, Carbon			
74	8	TEE, 8x8x6IN STL WELD STD WT STD			Steel, Carbon			
75	1	TUBE RND, 0.5IN 0.035 WALL SST 316L			Stainless Steel	11.7050 in		
76	3	TUBE RND, 0.5IN 0.035 WALL SST 316L			Stainless Steel	4.0000 in		
77	1	TUBE RND, 0.5IN 0.035 WALL SST 316L			Stainless Steel	31.0050 in		
78	1	TUBE RND, 0.5IN 0.035 WALL SST 316L			Stainless Steel	50.2050 in		
79	2	U-BOLT, 1IN PIPE 0.25IN DIA 304SS			Stainless Steel			
80	2	U-BOLT, 2IN PIPE 0.375IN DIA 304SS LONG TANGENT			Stainless Steel			
81	3	U-BOLT, 4IN PIPE 0.5IN DIA GALV LONG TANGENT			Steel, Galvanized			
82	1	UNION, 1IN 304 T150#			STN STL, 304			
83	2	VALVE 4IN 316SS FULL PORT BALL VALVE			STN STL, 316			
84	1	VALVE, AIR/COMBO 2" NPT X 1.5" NPT CI BODY AIR-D 040-C			Iron, Ductile			
85	3	VALVE, BALL 0.5IN NPT 316L APOLLO 76F-100 Series			Stainless Steel			
86	4	VALVE, BALL 1IN NPT BRASS SCH# 01728155KL			Brass			
87	1	VALVE, BALL 2IN NPT BRASS SCH# 01728155NL			Brass			
88	1	VALVE, SWING CHECK Y 2" BRONZE BODY NPT MATCO #532			BRONZE			
89	6	WASHER, FLAT 0.25IN 304SS			Stainless Steel			
90	4	WASHER, FLAT SMALL OD 0.25IN 304SS			Stainless Steel			
91	4	WASHER, FLAT SMALL OD 0.375IN 304SS			Stainless Steel			
92	6	WASHER, FLAT STRL 0.5IN GALV			Steel, Galvanized			
93	160	WASHER, FLAT STRL 0.5IN GALV			Steel, Galvanized			
94	176	WASHER, FLAT STRL 0.625IN GALV			Steel, Galvanized			
95	3	WASHER, LOCK 0.25IN 304SS			Stainless Steel			



		PARTS LIST			
ITEM	QTY	DESCRIPTION	MATERIAL	LENGTH	WIDTH
1	4	ADAPTER, 0.5" COMP X 0.5" MPT 90° BRASS	Brass, Soft Yellow		
2	16	BOLT, HEX 0.75IN D X 4IN L HDG GR A307	Steel, Galvanized		
3	72	BOLT, HEX 0.75IN D X 6.5IN L HDG GR A307	Steel, Galvanized		
4	16	BOLT, HEX 0.625IN D X 3IN L HDG GR A307	Steel, Galvanized		
5	4	COUPLING, 0.5IN FULL THD 3000 316SS	Stainless Steel		
6	2	COUPLING, 1IN HALF THD 3000 316SS	Stainless Steel		
7	2	ELBOW, 1IN 90 GALV THD STD WT STD R	Steel, Galvanized		
8	2	ELBOW, 3IN 90 STL WELD SCH 40 LR	Steel, Carbon		
9	1	ELBOW, 8IN 45 STL WELD SCH 40 LR	Steel, Carbon		
10	2	FLANGE, 3IN SLIPON CS 150# RF	Steel, Carbon		
11	2	FLANGE, 3IN WELD NECK CS 150# RF	Steel, Carbon		
12	27	FLANGE, 8IN WELD NECK CS 150# RF	Steel, Carbon		
13	4	GASKET, FLG 3IN NAM 37C RING 0.125IN THK 150#	Composite		
14	2	GASKET, FLG 8IN NAM 37C RING 0.125IN THK 150#	Composite		
15	4	GAUGE, PRESSURE 0-60 PSI 4.5"DIA 0.5"L NPT ASHCROFT 45 1279SSL 04L XGVSG 60# W/ AV LOGO	Phenolic Resin		
16	8	NIPPLE, 0.5IN D X 1.125IN L SCH 40 316SS NPT TBE	Stainless Steel		
17	4	NIPPLE, 0.5IN D X 4IN L SCH 40 316SS NPT TBE	Stainless Steel		
18	4	NIPPLE, 1IN D X 1.5IN L SCH 40 316SS NPT TBE	Stainless Steel		
19	88	NUT, HVY HEX 0.75-10 UNC GALV 2H	Steel, Galvanized		
20	32	NUT, HVY HEX 0.625-11 UNC GALV 2H	Steel, Galvanized		
21	2	PIPE, 3IN SCH 40 STL A53-A53 GRADE B	Steel, Carbon	3.821 in	
22	2	PIPE, 3IN SCH 40 STL A53-A53 GRADE B	Steel, Carbon	46.862 in	
23	4	PIPE, 8IN SCH 40 STL A53-A53 GRADE B	Steel, Carbon	6.000 in	
24	1	PIPE, 8IN SCH 40 STL A53-A53 GRADE B	Steel, Carbon	16.3622 in	
25	1	PIPE, 8IN SCH 40 STL A53-A53 GRADE B	Steel, Carbon	8.300 in	
26	2	PIPE, 8IN SCH 40 STL A53-A53 GRADE B	Steel, Carbon	12.1380 in	
27	2	PLATE, STL A36/SA36 0.1875 in THK	Steel, Carbon	8.000 in	7.000 in
28	1	STAND, MANIFOLD 8" CS LP™ 45° OUTLET			
29	4	TEE, 0.5IN 304 SS THD 150# STD	Stainless Steel		
30	9	TEE, 8IN STL WELD STD WT STD	Steel, Carbon		
31	4	TUBE RND, 0.5IN 0.035 WALL STD 316L	Stainless Steel	4.000 in	
32	4	U-BOLT, 8IN PIPE 0.625IN DIA GALV LONG TANGENT	Steel, Galvanized		
33		VALVE TAGS, LABELED PER P&ID			
34	8	VALVE, BALL 0.5IN NPT 316L APOLLO 76F-100 SERIES	Stainless Steel		
35	2	VALVE, BALL 1IN NPT BRASS SC# 01728155KL	Brass, Soft Yellow		
36	9	VALVE, BFLY WFR HW 8" DI BDY CF8M (316SS) DISC EPDM SEAT PRATT BF1			
37	2	VALVE, PRV 3" FLGD DI/BDY 12SPSI CALA-VAL 50-01BKH; (SEE DATA SHEET)			
38	176	WASHER, FLAT STRL 0.75IN GALV	Steel, Galvanized		
39	40	WASHER, FLAT STRL 0.625IN GALV	Steel, Galvanized		



- NOTES:
1. PIPING MATERIALS SHALL MEET: CS PIPE ASTM A-53 GRADE B (ERW); CS FITTINGS SA-234, ASME B16.9; SS THREADED FITTINGS ASTM A-351; SS PIPE ASTM A-312; SS BW FITTINGS ASTM A-403; MI THREADED FITTINGS ASME B-16.3
 2. MANIFOLD SURFACE PREPARATION: SSPC-SP10 INTERIOR & SSPC-SP6 EXTERIOR
 3. FINISH EXTERIOR WITH 2-3 MILS OF CARBOETHANE 134VOC URETHANE, COLOR TO BE 9225 CASHEW. OVER 4-6 MILS OF CARBOGUARD 893 RUST PREVENTATIVE EPOXY PRIMER, APPLIED PER MANUFACTURERS RECOMMENDATIONS.
 4. CS PROCESS PIPE TO BE EXTERNALLY LINED WITH 16MILS (MIN.) OF 3M SCOTCHKOTE 134 FIBRE BONDED EPOXY.
 5. ALL VALVES TO BE TAGGED WITH NUMBER SHOWN ON P&ID.
 6. ESTIMATED SHIPPING WEIGHT: 3,000 LBS.
 7. GROUTING AND ANCHORING BY OTHERS IF REQUIRED.
 8. ± 1" TOLERANCE ON CONNECTION DIMENSIONS.

REVISION HISTORY						
REV	DESCRIPTION	DATE	DWN	CHK	APPD	ECN
1	UPDATED VESSEL COLOR TO 9225 CASHEW	10/4/2021	AMN	AJA		

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DESIGNER: AJA	DATE 9/1/2021	TITLE MANIFOLD, 8" CS S40 3 TIER 3" PRV LOW PRO™ 45° OUTLET ASSY				
CHECKER: RM	DATE 9/1/2021					
ENGINEER: JT	DATE 9/1/2021					
MANAGER:	DATE					
		CLIENT				
		<div>AqueoUS VETS®</div> <div>16761 CLEAR CREEK ROAD REDDING, CA 96001 925-331-0573</div>				
SCALE: 1" = 1'		PROJECT	CODE	DRAWING NUMBER Man 8in CS 3 3in LP 45 ASSY	SHEET 1 OF 1	REV 1



SUBMITTAL REVIEW FORM

To: Camrosa Water District
7385 Santa Rosa Road
Camarillo, CA 93012

From: Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA 93711

Project No.: 02958-20-002

Reviewer: Kevin Berryhill, P.E.

Project: TCP Removal Project for Conejo Wells

Date: 10/19/2021

Submittal No: BIG

Description: Carbon Dioxide System

The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the contract plans and specifications or from departures there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

☐

No Exceptions Taken

☐

Submit Specified Item

☐

Make Corrections Noted

☐

Rejected

☒

Revise & Resubmit

☐

For Information Only

Reviewer Comments:

Item	Description	Mfg/Supplier	Action Taken	Comment

Comments:

1. Include storage tank in next submittal
2. Confirm 10-inch insertion length for injection quill is for 18" manifold pipe diameter
3. Drawing N0002 (PDF page 23) indicates indoor service condition. All equipment will be installed outdoors uncovered
4. Electrical panels to be deadfront, with a 3-point locking out door with a handle that accepts a padlock. Indicators and controls shall be located on the inner door.

September 30, 2021

Project: Camrosa Water District - Camarillo, CA
Specification: Section 46 31 43 Carbon Dioxide Storage and Feed System

Submittal 1

Ms. Becca Bugielski:

Please find enclosed with this letter Submittal 1 for CO2 Feed Equipment for the referenced project. This is a complete shop drawing submittal containing information for the CO2 feed system.

Please don't hesitate to contact us if you have any questions or if we can help in any way.

Sincerely,



Dylan Pearson
Project Engineer
479.228.7002



INDEX

[illegible]



CONTRACTOR'S INSTALLATION CHECKLIST

Contractor: TBD
Location: 7385 Santa Rosa Rd. Camarillo, CA 93012
System: (1) StreamlineCO2 100 DX
Scheduled Commissioning: TBD

Following is a checklist of installation tasks to be completed prior to the agreed upon commissioning date. Any time required by BlueInGreen's representative, in addition to the contract amount, for commissioning and/or training due to items below not being completed prior to the agreed upon commissioning date shall be billed to the party under contract with BlueInGreen for the supply of commissioning services. The billing rate shall be \$3,000 per day plus expenses at the federal per diem rate.

(Initial When Complete)

	Suction piping has been constructed, secured, cleaned of all debris, and connected to the system inlet
	Discharge piping has been constructed, secured, cleaned of all debris, and connected to the system outlet (Cleaning must occur prior to installing orifice assembly)
	The orifice assemblies have been installed and secured on the end of the discharge piping at the injection points
	Suction and Discharge piping have passed a leak test to the Owner's satisfaction
	Gas supply lines have been constructed, secured, cleaned of all debris, and connected to the fully vaporized, heated gas supply and the systems' gas inlets
	Heated gas supply pressure has been set and verified to be 125 psig and 60-80 °F at the skid
	Gas outlet vent piping has been constructed, secured, connected to the gas vent outlets, and routed out of the building
	Gas supply and vent piping have passed a leak test to the Owner's satisfaction
	480/3/60 power with adequate amperage has been properly connected into the system control panel
	Hardwire cables for discrete communications have been routed, connected to the systems' control panels, and tested to be functional
	pH probes have been installed downstream and signal has been routed and connected to the system control panel and tested to be functional

I, the undersigned, certify that all installation tasks above, and any other tasks necessary for commissioning of the equipment, have been completed and verified to be correct.

Printed Name: _____ (Contractor's Representative)

Signature: _____ Date: _____



P.O. Box 9024
Fayetteville, AR 72703
479.527.6378 | blueingreen.com

SHOP DRAWING SUBMITTAL

STREAMLINE CO2 DISSOLUTION SYSTEM

FOR: CAMROSA WATER DISTRICT

CONTRACTOR PROJECT NO. XXXX

SYSTEM DESIGN DETAILS

GAS TYPE: CARBON DIOXIDE

MAX. FLOW RATE: 20 gpm

GAS DELIVERY: 43 (max) LBS/HR

MAX. OPERATING PRESSURE: 80 psi

OPERATION METHOD: PH, DOSING, DELIVERY

ESTIMATED SYSTEM WEIGHT: 1000 lb

SYSTEM FOOTPRINT: 72"L X 37"W X 84"H

ELECTRICAL DETAIL: FEED SYS:120V / 1 ph /60Hz
PUMPS: 480V/ 3ph /60Hz

LIFT METHOD: PALLET JACK

INFORMATION CONTAINED HEREIN IS PROTECTED BY PATENTS 7,255,332, 8,276,888, 8,919,743, AND PATENTS PENDING. NOT ALL WIRING OR COMPONENTS NECESSARILY SHOWN, SEE SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS.

REVISION SUMMARY

STREAMLINE 100 DX
COVER SHEET

BlueInGreen
A Chart Industries Company

MECHANICAL BOM

Item	Make/Model	Quantity	Part Number	BIG Tag
Gas Line Components				
Gas Piping	--	--	1" Schedule 40 304 SS	P10, P20
Wye Strainer	Keckley	1	5SWY-34M100L36-GTI-SSB7	--
Gas Inlet Solenoid	ASCO RedHat	1	8210P004MO 12-24VDC	10SO01
Gas Mass Flow Meter	Sage Prime	1	SIP - 100 - S150FLG100 - DC24 - CO2, 0-60 lb/hr @ 80 psig	10FT01
Gas Flow Control Valve	Badger RCV with EVA	1	1004-GC-F-36-SV-OE-GLN-36 / 24 VDC EVA 1 with Fdbk	10FV01
Check Valve	Check-All U3 Series	1	U3HSSKZ.500SS	--
Pressure Gauge	Trerice D80 Series	1	D83LFSS2502BA060	--
Pressure Transmitter	IFM PT Series	1	PT2494 with EVC002 Cable (5m)	20PT01
Needle Valve	Swagelok GU Series	1	SS-4GUF8	--
Ball Valves (Isolation)	Sharpe 50M76 Series	1	1/4" - 50M76	--
Ball Valves (Isolation)	Sharpe 3903 Series	2	1" - 3903 - 6 - SW	--
Water Line Components				
Water Piping	--	--	1" Schedule 40 304 SS	P30, P40, P50
Pump/Motor	Goulds eSV / Baldor	2	5SV6FE4F60	30CP01, 30CP02
Check Valve	Sharpe 25116 Swing Check	3	1" - 25116	--
Ball Valves (Isolation)	Sharpe 50M76 Series	2	1/4" - 50M76	--
Pressure Gauge	Trerice D80 Series	3	D83LFSS2502BA060	--
Pressure Transmitter	IFM PT Series	2	PT2494 with EVC002 Cable (5m)	30PT01, 30PT02
Ball Valves (Isolation)	Sharpe 3903 Series	5	1" - 3903 -6- SW	--
Orifice Assembly	Saf-T-Flo	1	FL-200-1-200-S-S-10-DH-06	--
Water Flow Meter	ABB Watermaster	1	FEW311025H1S4A1D1A1A1A1Y2A1	40FT01
Tank Components				
Pressure Vessel	Custom	1	6" dia ASME, 304 SS, rated for 215 psig MAWP @ 130 °F	50TK01
Safety Relief Valve	Apollo 500 Series	1	523EEBKZAA0145 (145 psig set pressure)	20SV01
Skids & Racks				
Feed Skid	Custom	1	Powder Coated Carbon Steel	--
Pump Skid	Custom	1	Powder Coated Carbon Steel	--
Control Panel Support Rack	Custom	1	Powder Coated Carbon Steel	--
Gas Piping Support Rack	Custom	1	Powder Coated Carbon Steel	--
Drain Lines				
Drain Piping	--	--	1" Schedule 40 304 SS	--
Drain Valves	Sharpe 50M76	4	1" - 50M76	--

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STREAMLINE 100

BILL OF MATERIAL

REVISION SUMMARY

DESIGN

DRAWN dmb

APRV TBD

DATE 8/30/2021

JOB

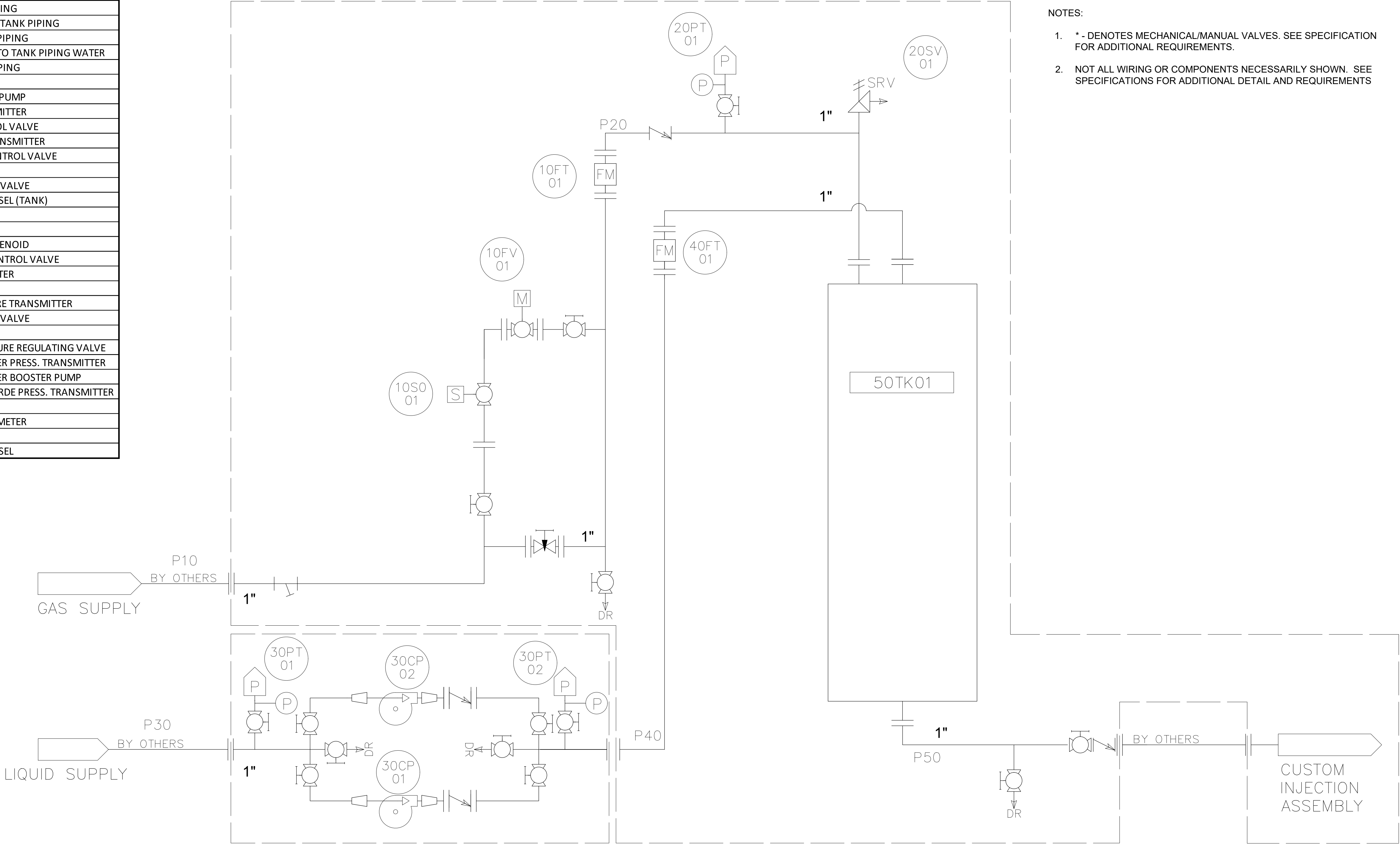
DWG

SHEET 4 OF 16

TAG EXAMPLES

10 - SO - 01
LOCATION COMPONENT TYPE ITEM NUMBER

TAG	DESCRIPTION
P10	GAS TRAIN PIPING
P20	GAS TRAIN TO TANK PIPING
P30	WATER INLET PIPING
P40	WATER INLET TO TANK PIPING WATER
P50	DISCHARGE PIPING
CP	CENTRIFUGAL PUMP
FT	FLOW TRANSMITTER
FV	FLOW CONTROL VALVE
PT	PRESSURE TRANSMITTER
PV	PRESSURE CONTROL VALVE
S0	SOLENOID
SRV	SAFETY RELIEF VALVE
TK	PRESSURE VESSEL (TANK)
DR	DRAIN
10SO01	GAS INLET SOLENOID
10FV01	GAS FLOW CONTROL VALVE
10FT01	GAS FLOW METER
20PT01	TANK PRESSURE TRANSMITTER
20SV01	SAFETY RELIEF VALVE
30PV01	WATER PRESSURE REGULATING VALVE
20PT01	CARRIER WATER PRESS. TRANSMITTER
30CP01	CARRIER WATER BOOSTER PUMP
30PT02	PUMP DISCHARDE PRESS. TRANSMITTER
40FT01	LIQUID FLOW METER
50TK01	PRESSURE VESSEL



- NOTES:
- * - DENOTES MECHANICAL/MANUAL VALVES. SEE SPECIFICATION FOR ADDITIONAL REQUIREMENTS.
 - NOT ALL WIRING OR COMPONENTS NECESSARILY SHOWN. SEE SPECIFICATIONS FOR ADDITIONAL DETAIL AND REQUIREMENTS

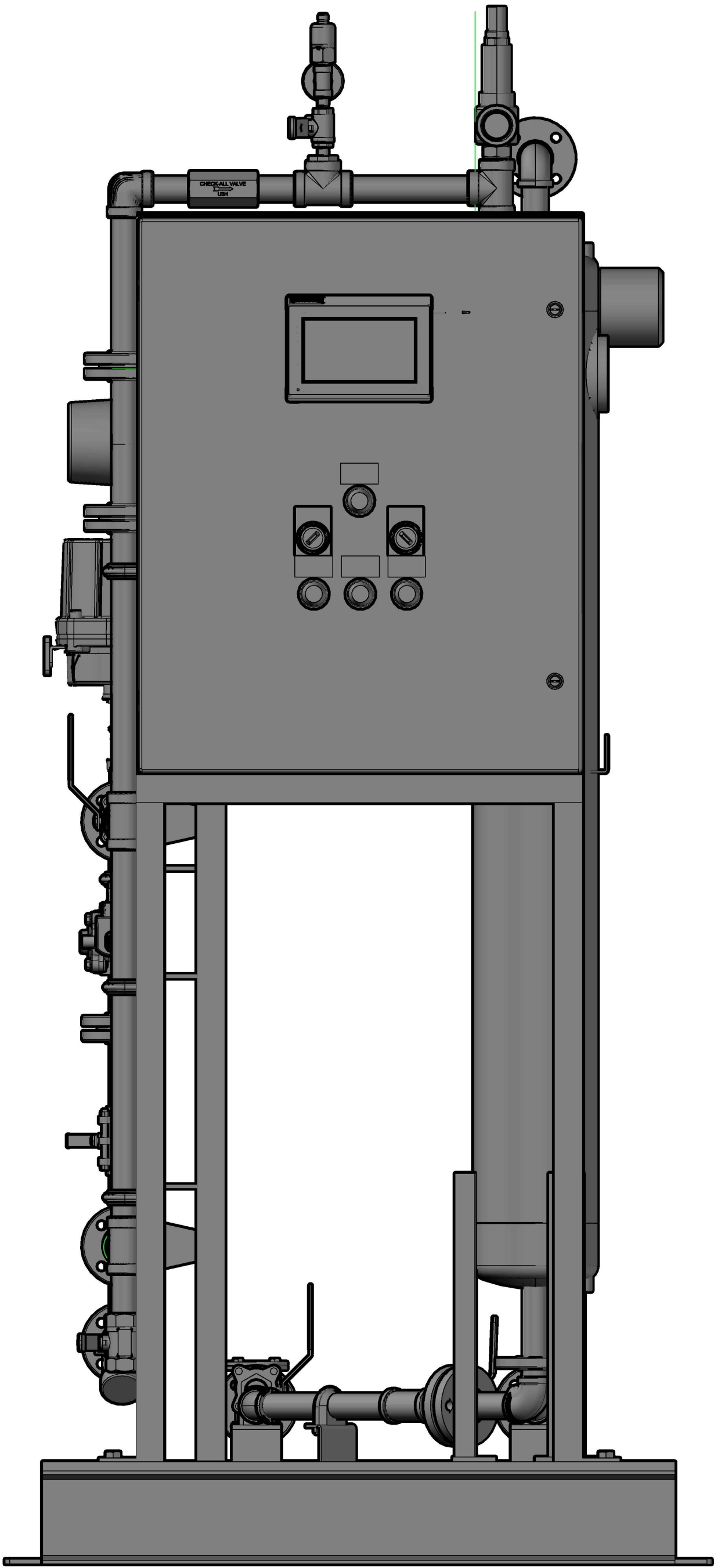
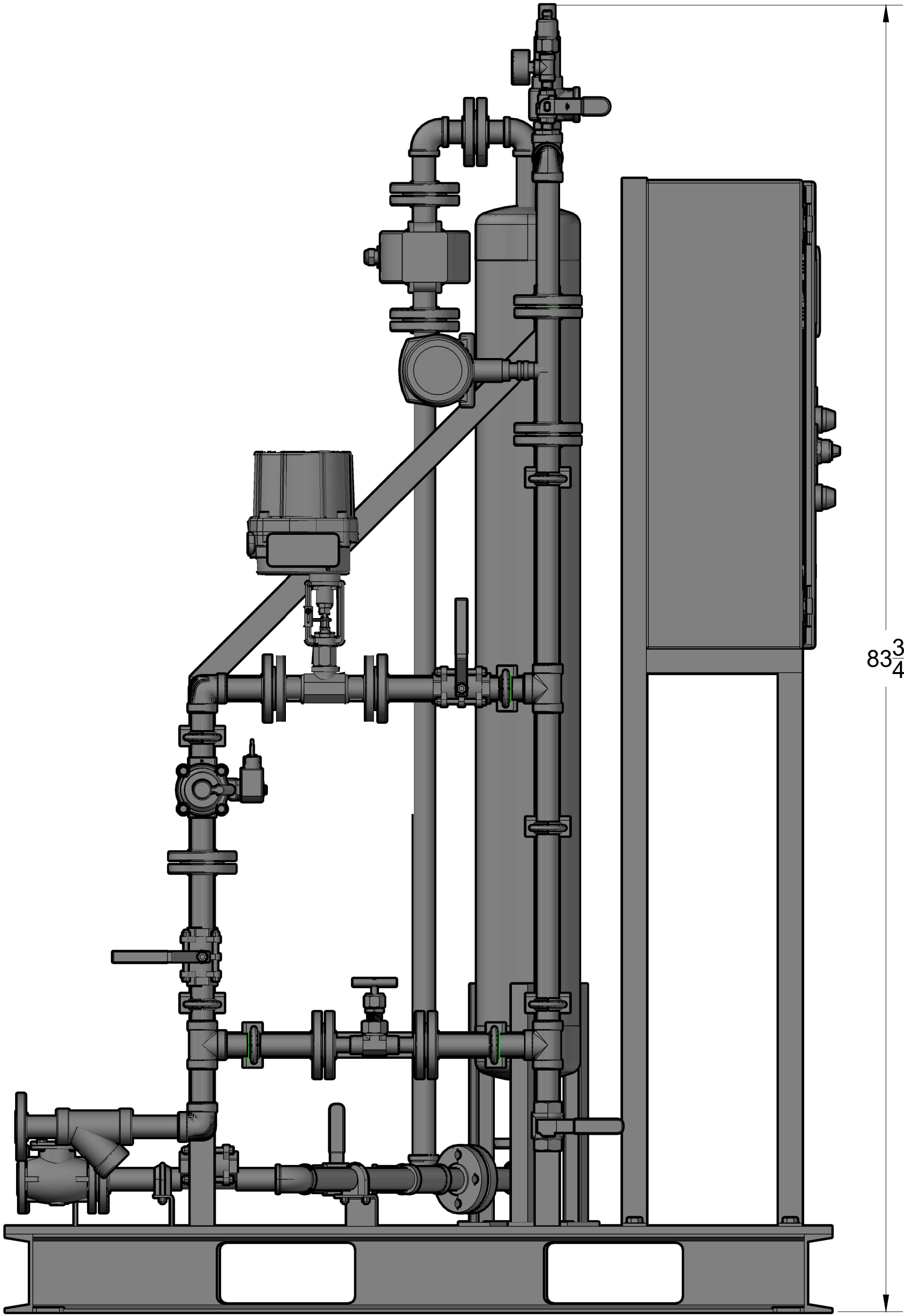
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REVISION SUMMARY

DESIGN	
DRAWN	dmb
APRV	TBD
DATE	9/23/2021
JOB	
DWG	
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STREAMLINE 100 DX

P & I D



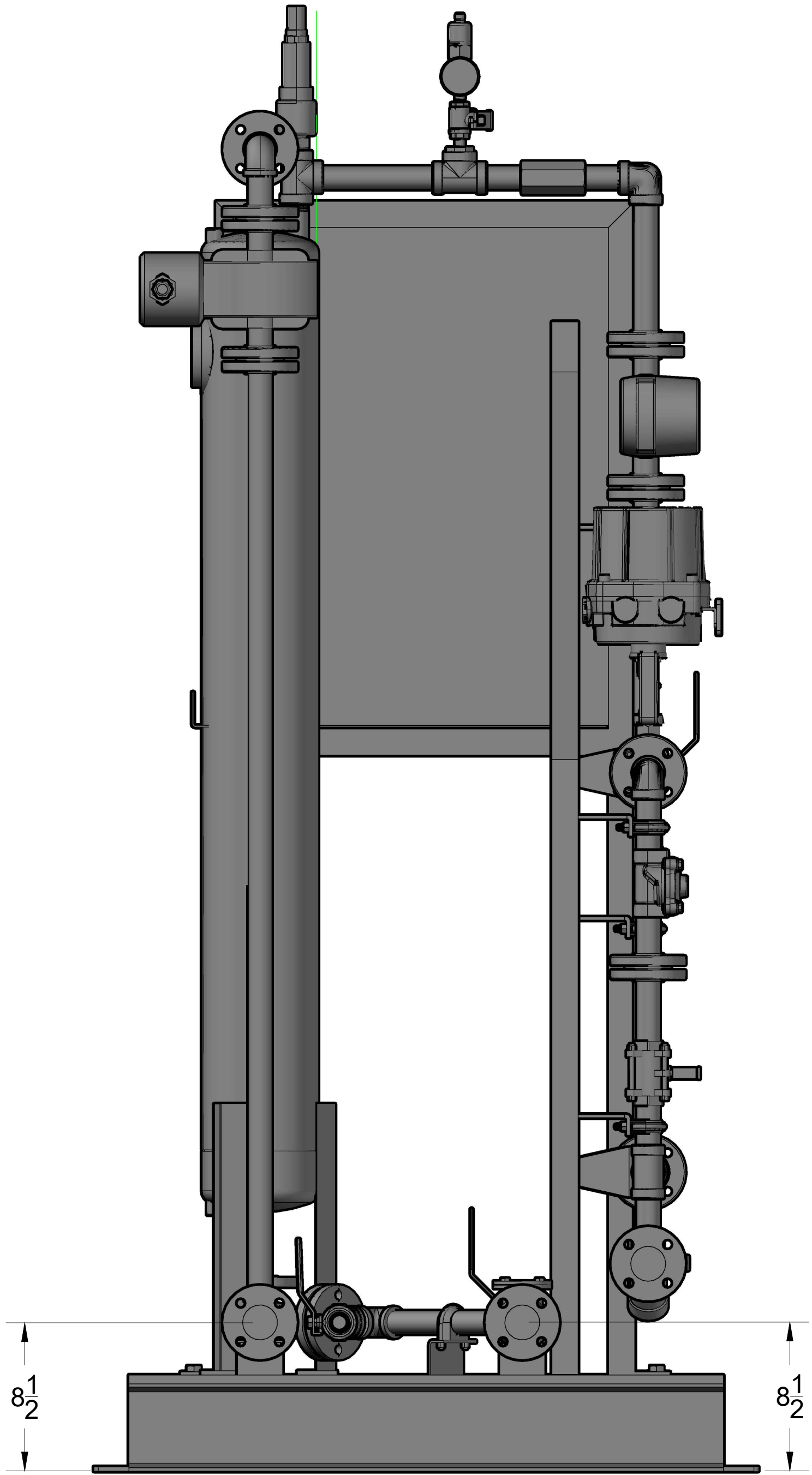
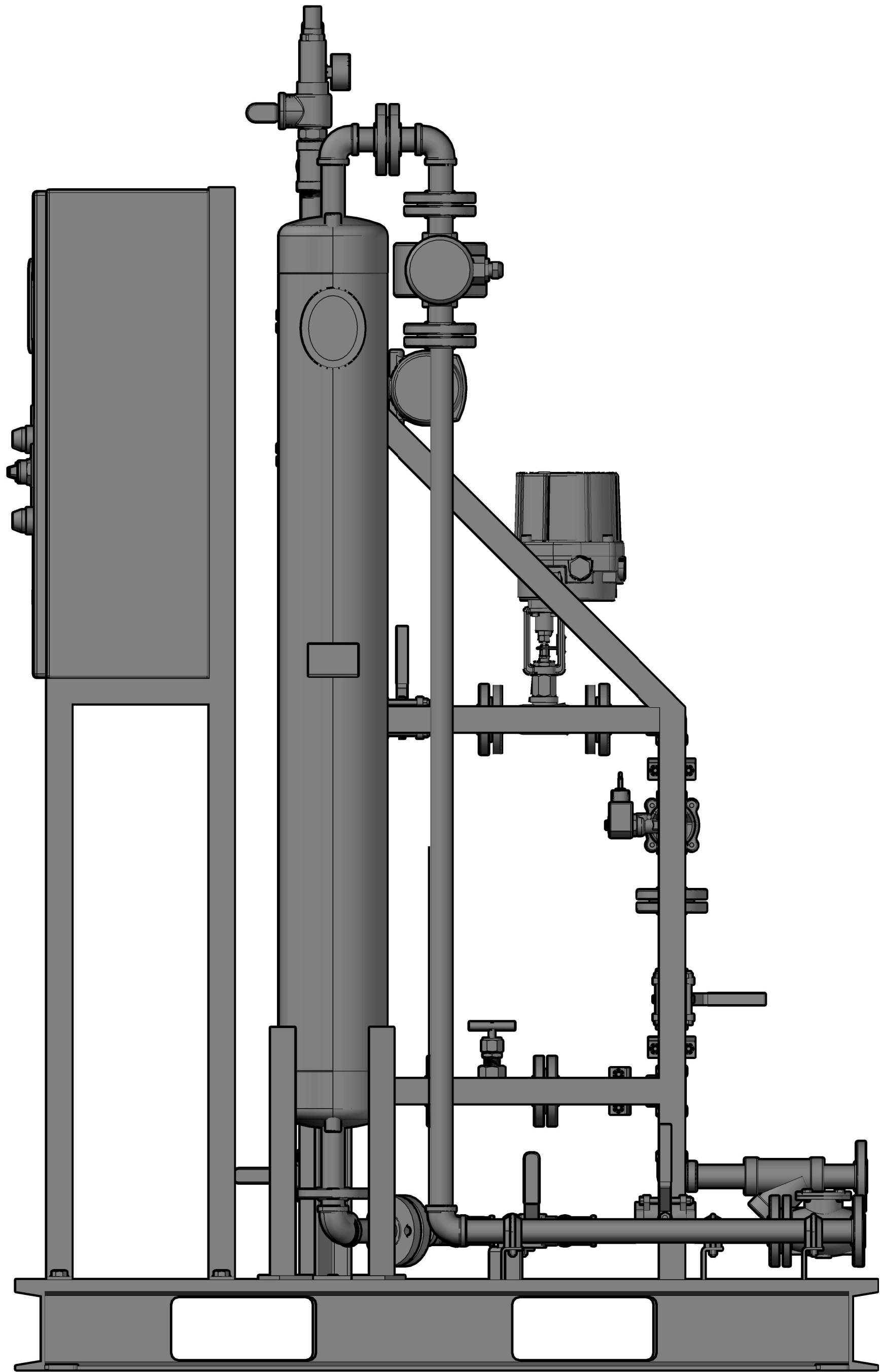
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REVISION SUMMARY			

STREAMLINE 100 DX

PROFILE VIEWS

DESIGN	
DRAWN	dmb
APRV	TBD
DATE	9/23/2021
JOB	
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SHEET	3 OF 10

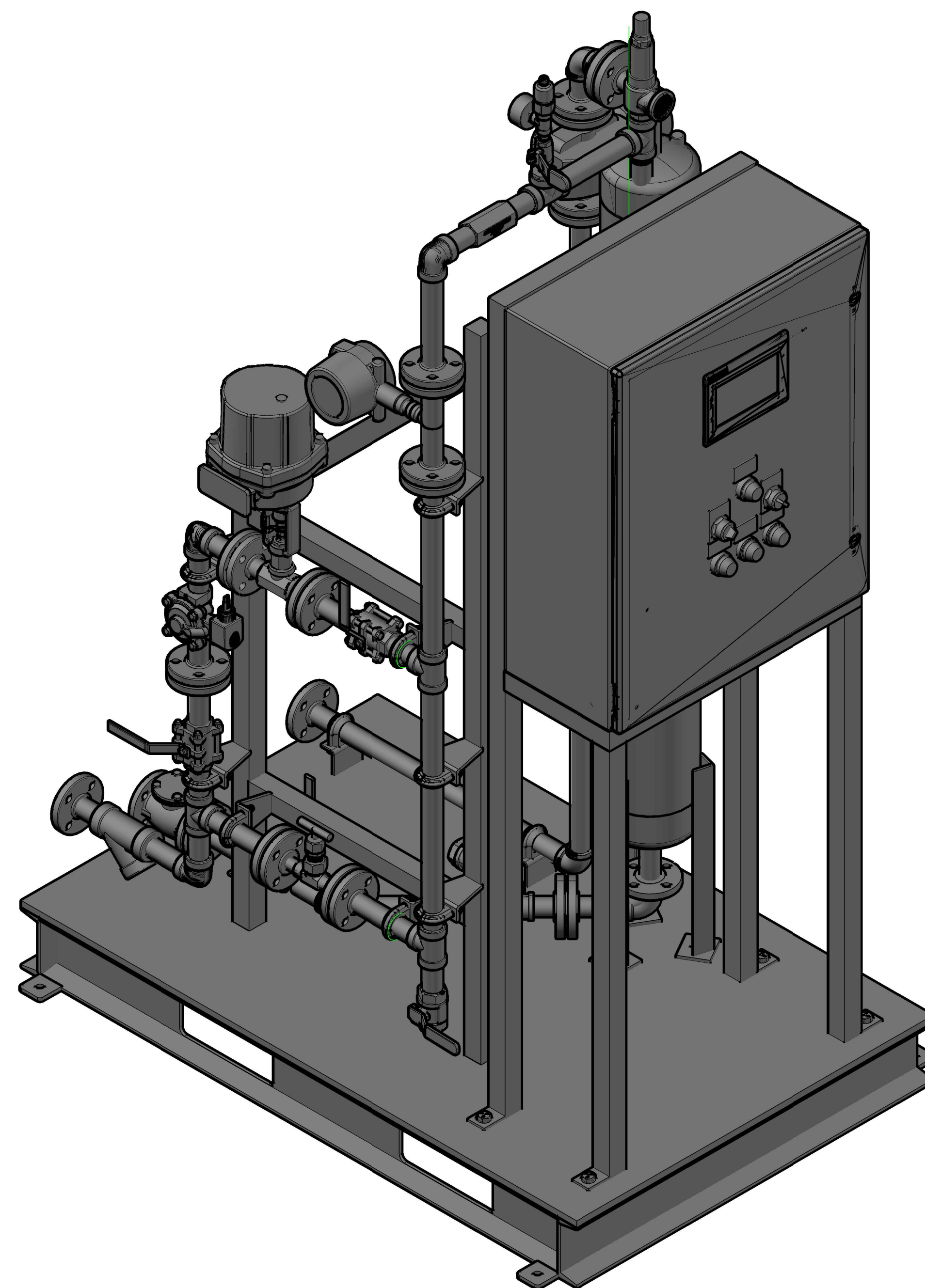
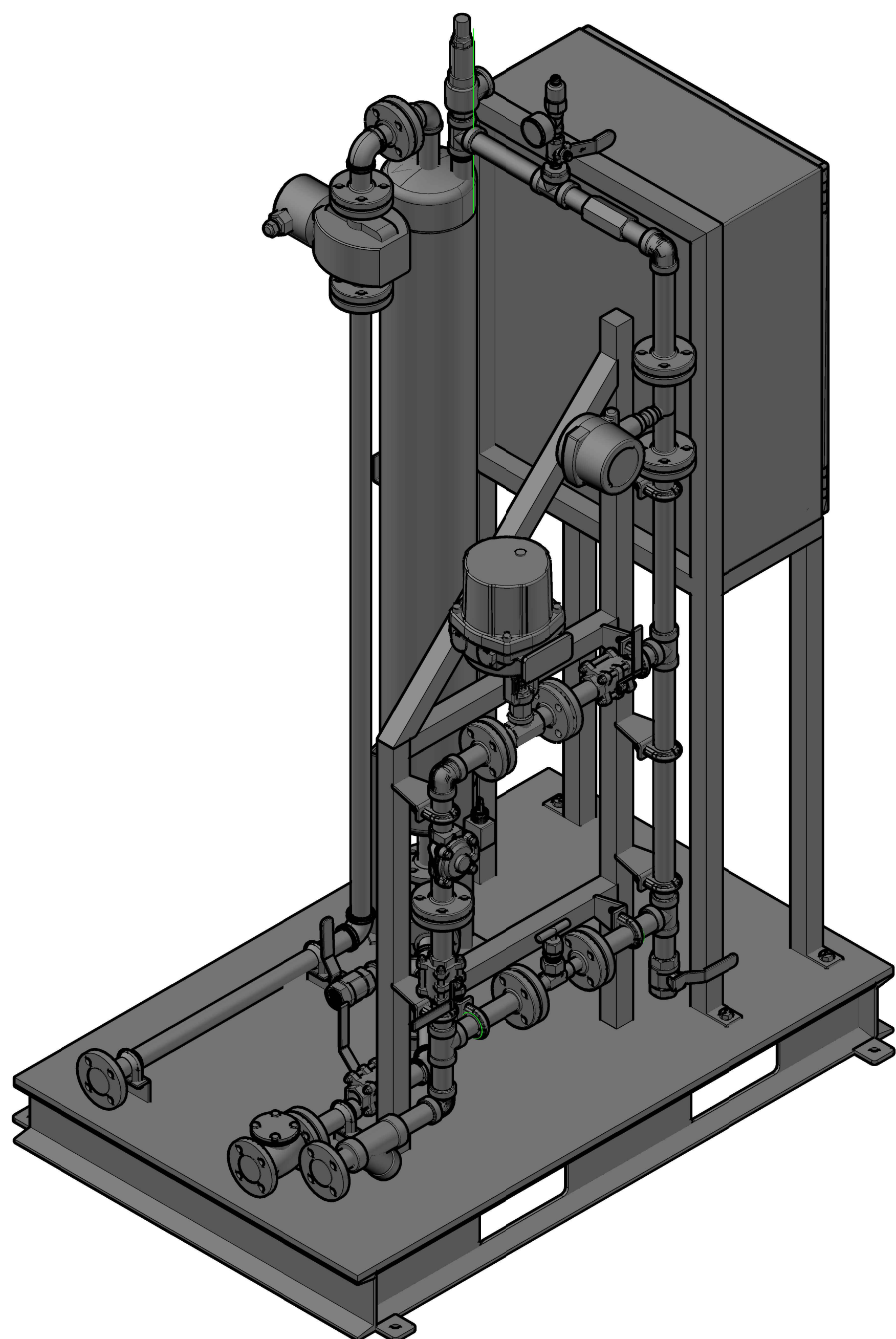


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REVISION SUMMARY			

STREAMLINE 100 DX	
PROFILE VIEWS	

DESIGN	
DRAWN	dmb
APRV	TBD
DATE	9/23/2021
JOB	
DWG	
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REVISION SUMMARY

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DESIGN

DRAWN	dmb
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APRV	TBD
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DATE	9/23/2021
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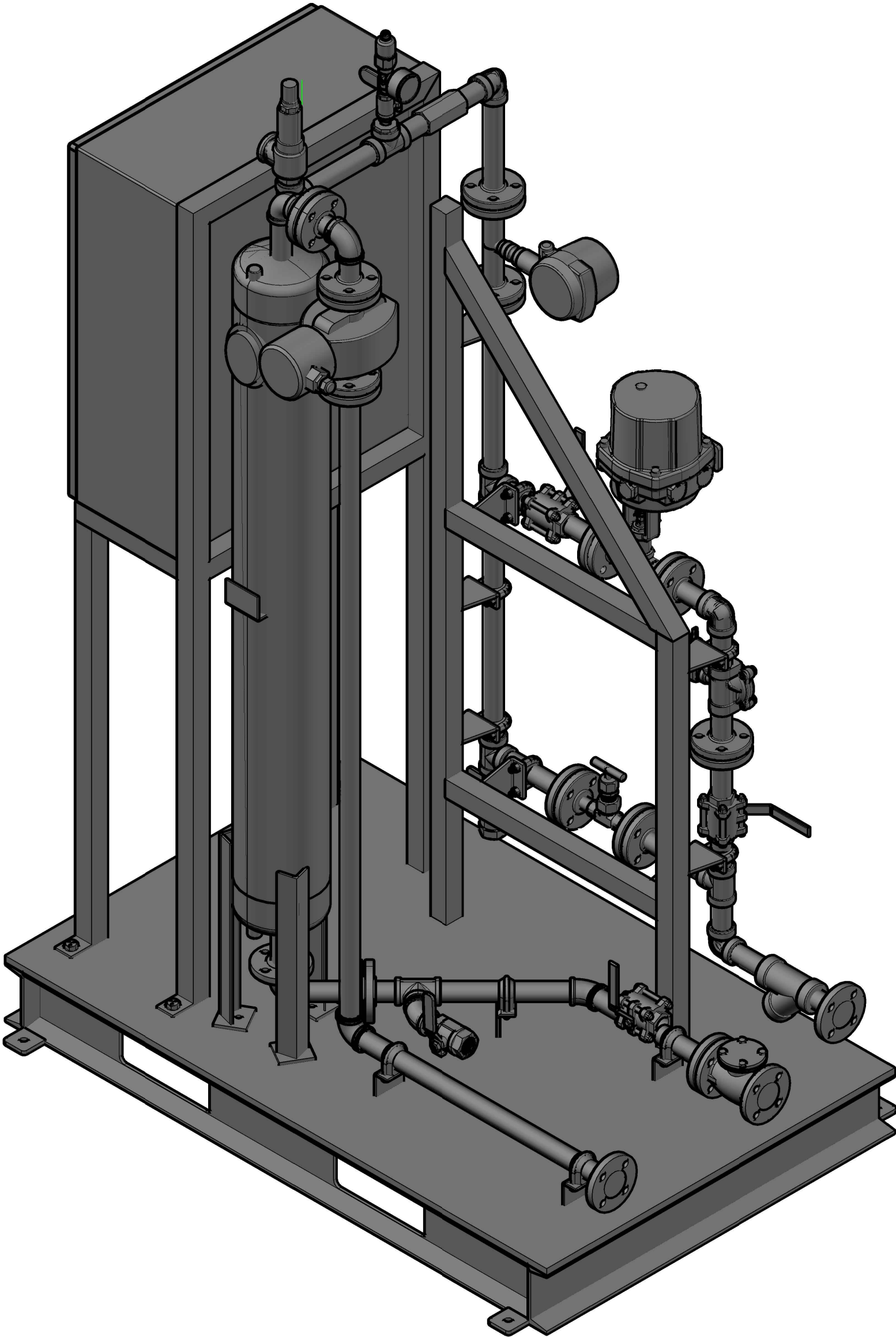
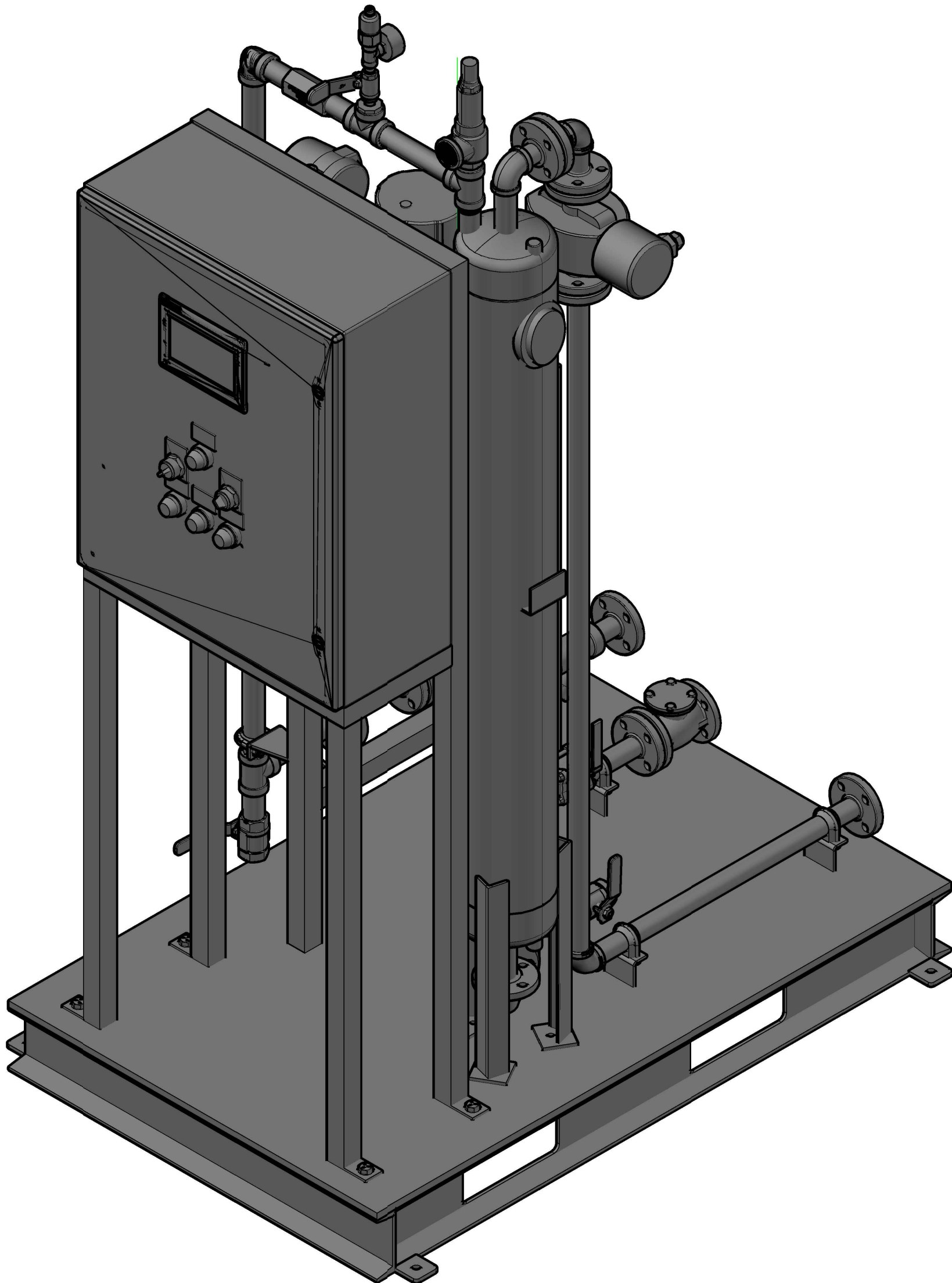
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SHEET 5 OF 10

STREAMLINE 100 DX

ISOMETRIC VIEWS

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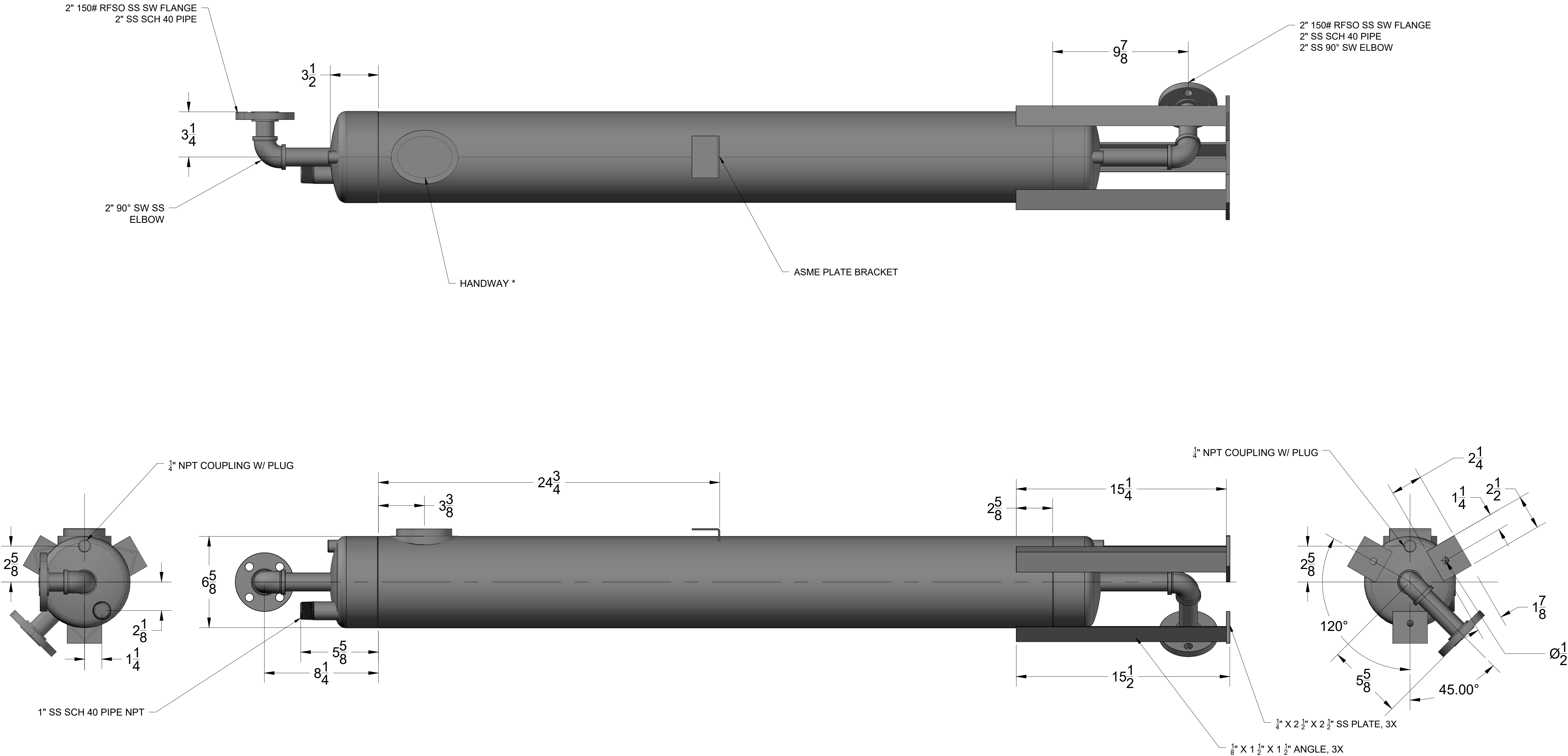
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REVISION SUMMARY

DESIGN	
DRAWN	dmb
APRV	TBD
DATE	9/23/2021
JOB	
DWG	
SHEET	6 OF 10

STREAMLINE 100 DX
ISOMETRIC VIEWS

NOTE: ASME SECTION VIII, DIV III RATED FOR 215 PSI MAWP @ 100F



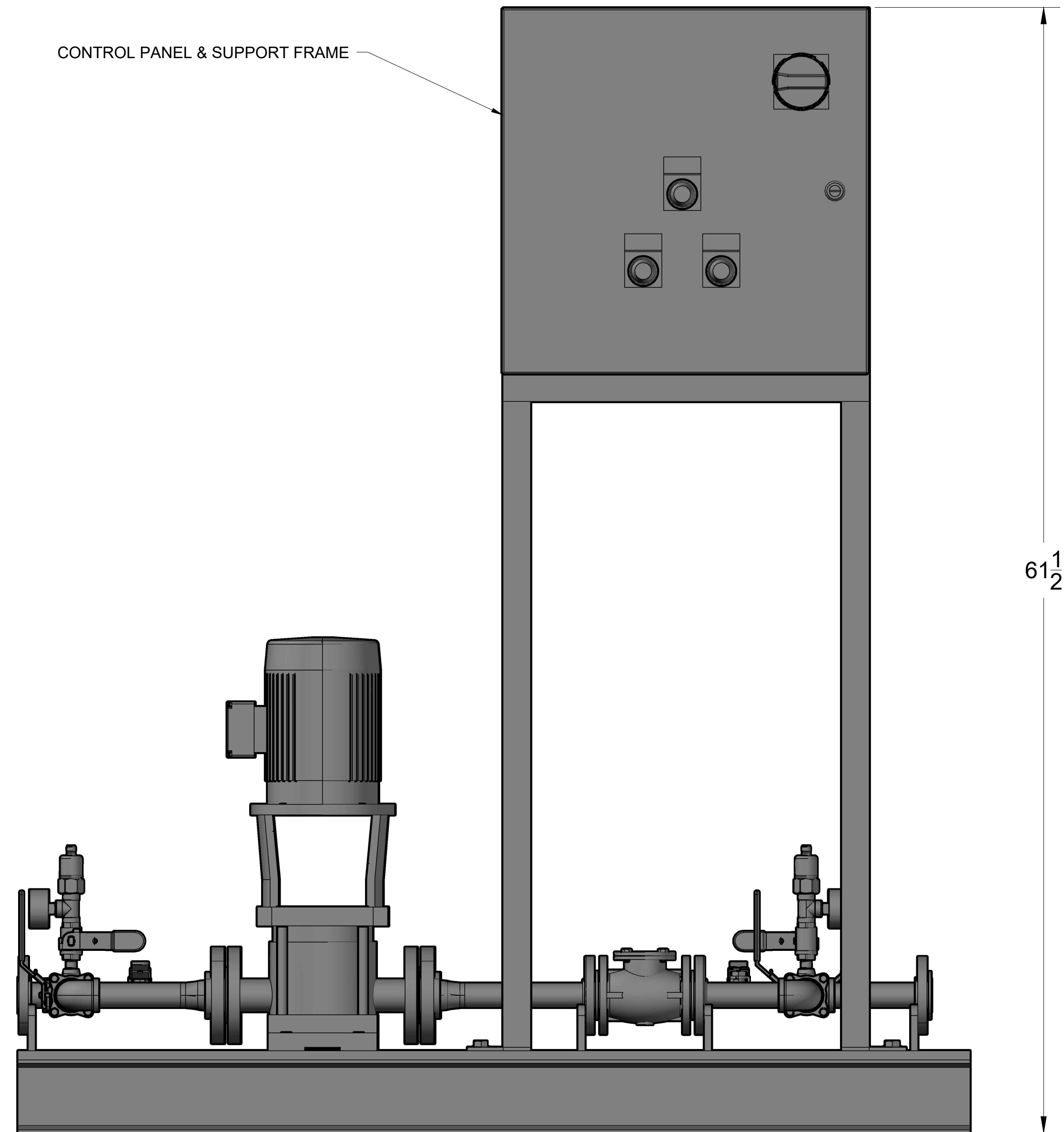
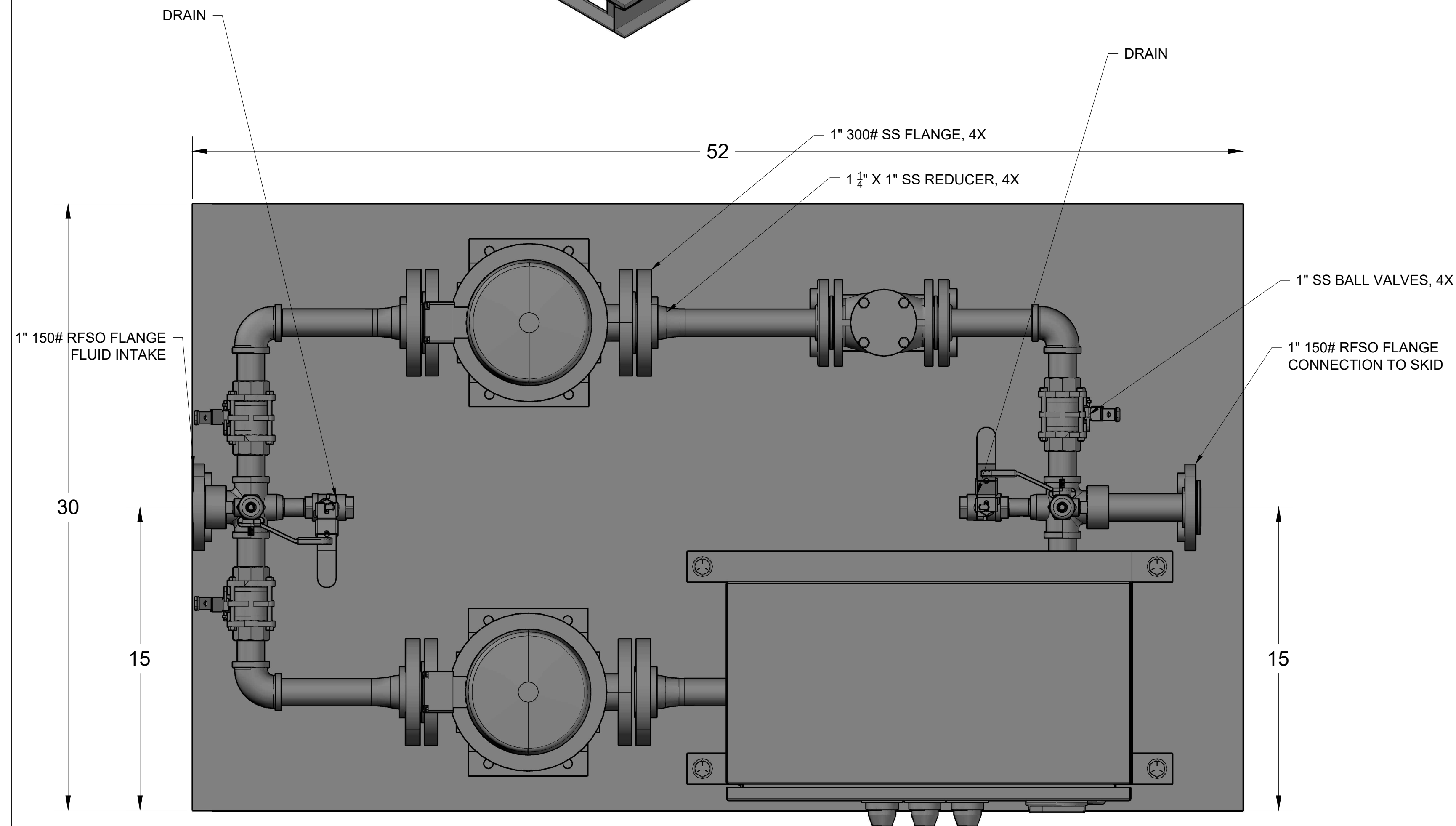
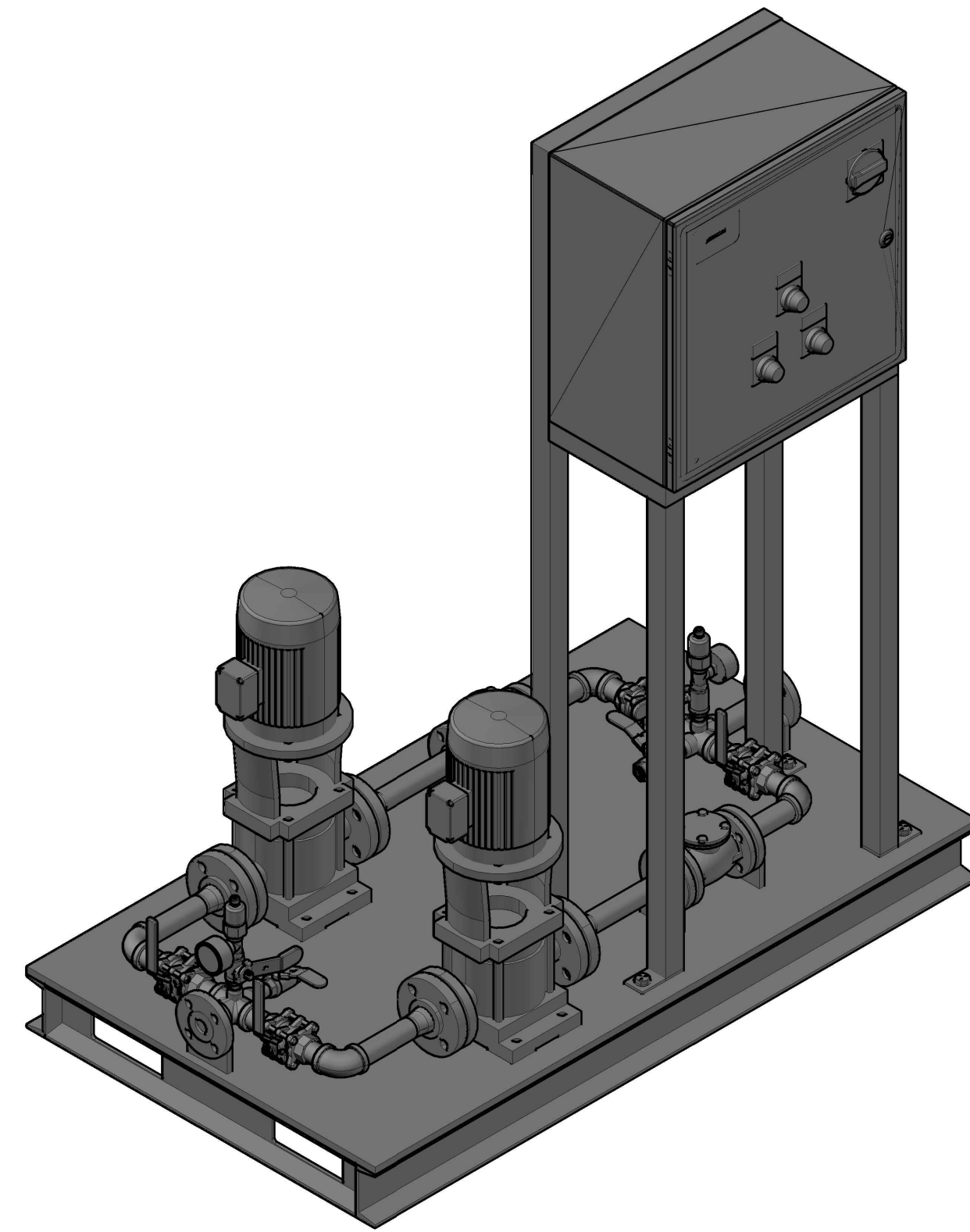
* HANDWAY CONFIGURATION TBD DURING MANUFACTURING PROCESS

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REVISION SUMMARY

DESIGN	
DRAWN	dmb
APRV	TBD
DATE	9/23/2021
JOB	
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STREAMLINE 100 DX
VESSEL DETAIL



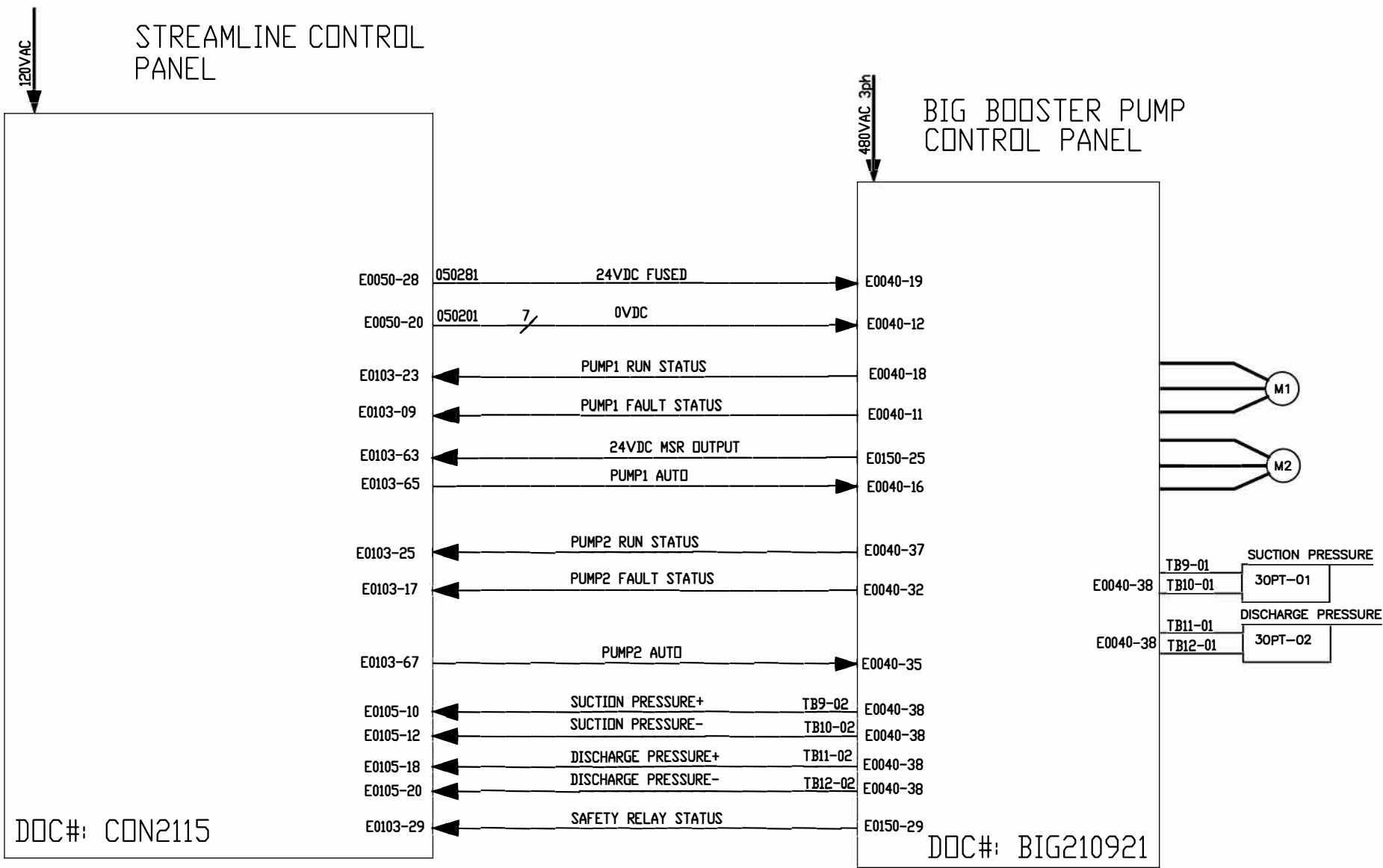
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REVISION SUMMARY

STREAMLINE 100 DX

PUMP SKID LAYOUT

LOOP DIAGRAM



REVISION SUMMARY					

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	CON2115
DWG	D0001
SHEET	1 OF 1

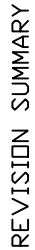
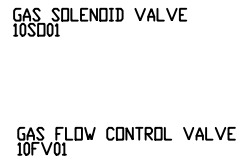
STREAMLINE ELECTRICAL SCHEMATIC

INDEX

SHEET	DWG	TITLE
1	G0001	Title Page & Index
2	E0050	120VAC / 24VDC Distribution
3	E0100	HMI, Ethernet, Current Output
4	E0103	PLC Digital I/O
5	E0105	Analog Current Input
6	L0001	Panel Enclosure
7	L0003	Panel Layout
8	N0001	Bill of Materials
9	N0002	Power Budget, Thermal Calculations

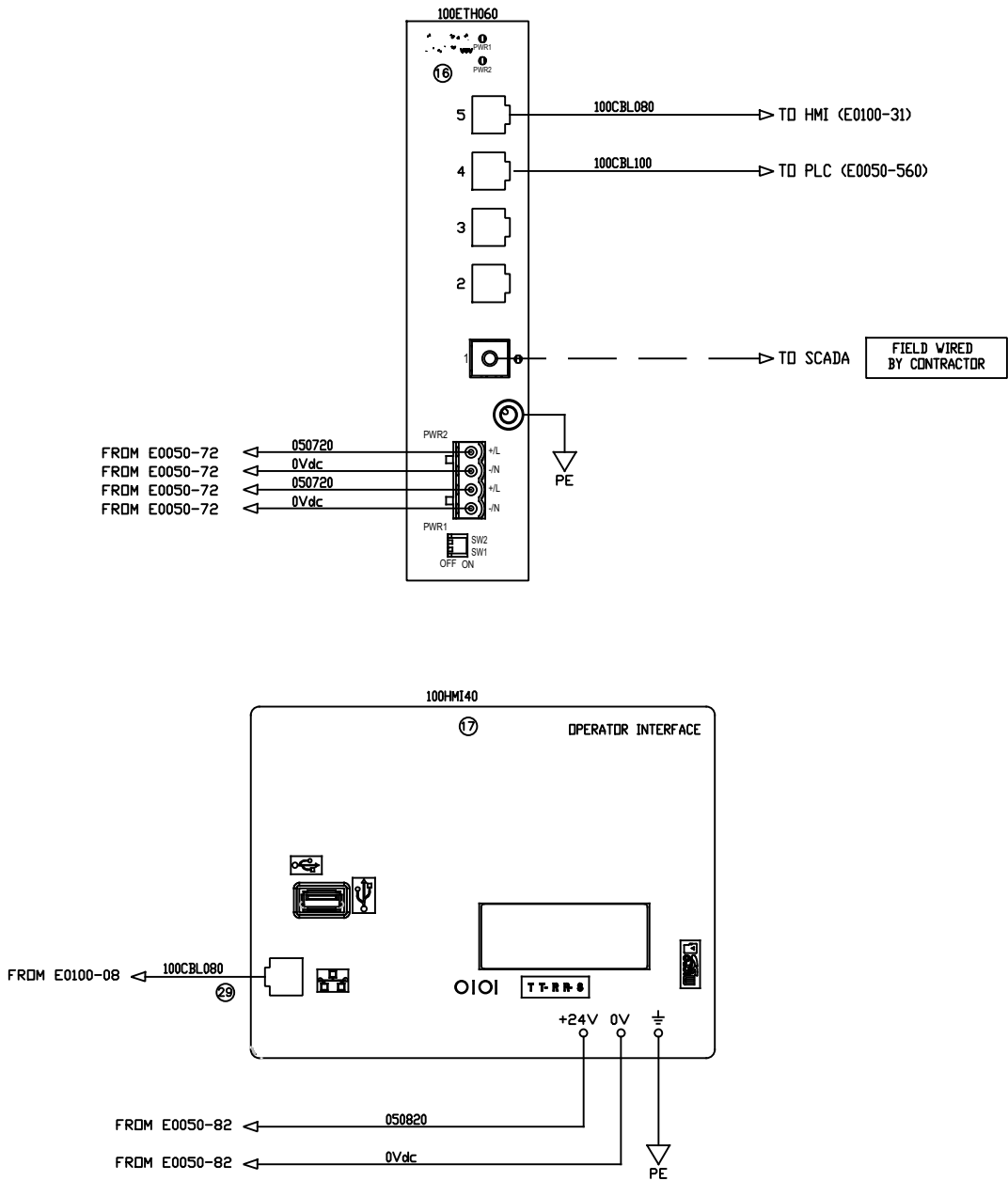
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DATE	9-23-21
JOB	CON2115
DWG	G0001
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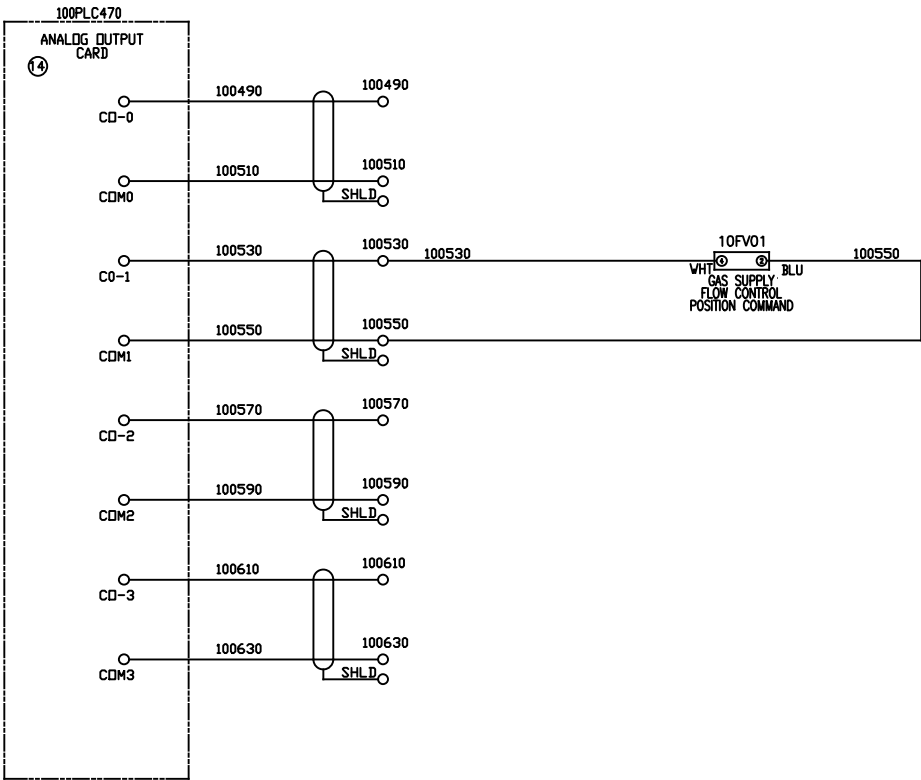
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DWG	E0050
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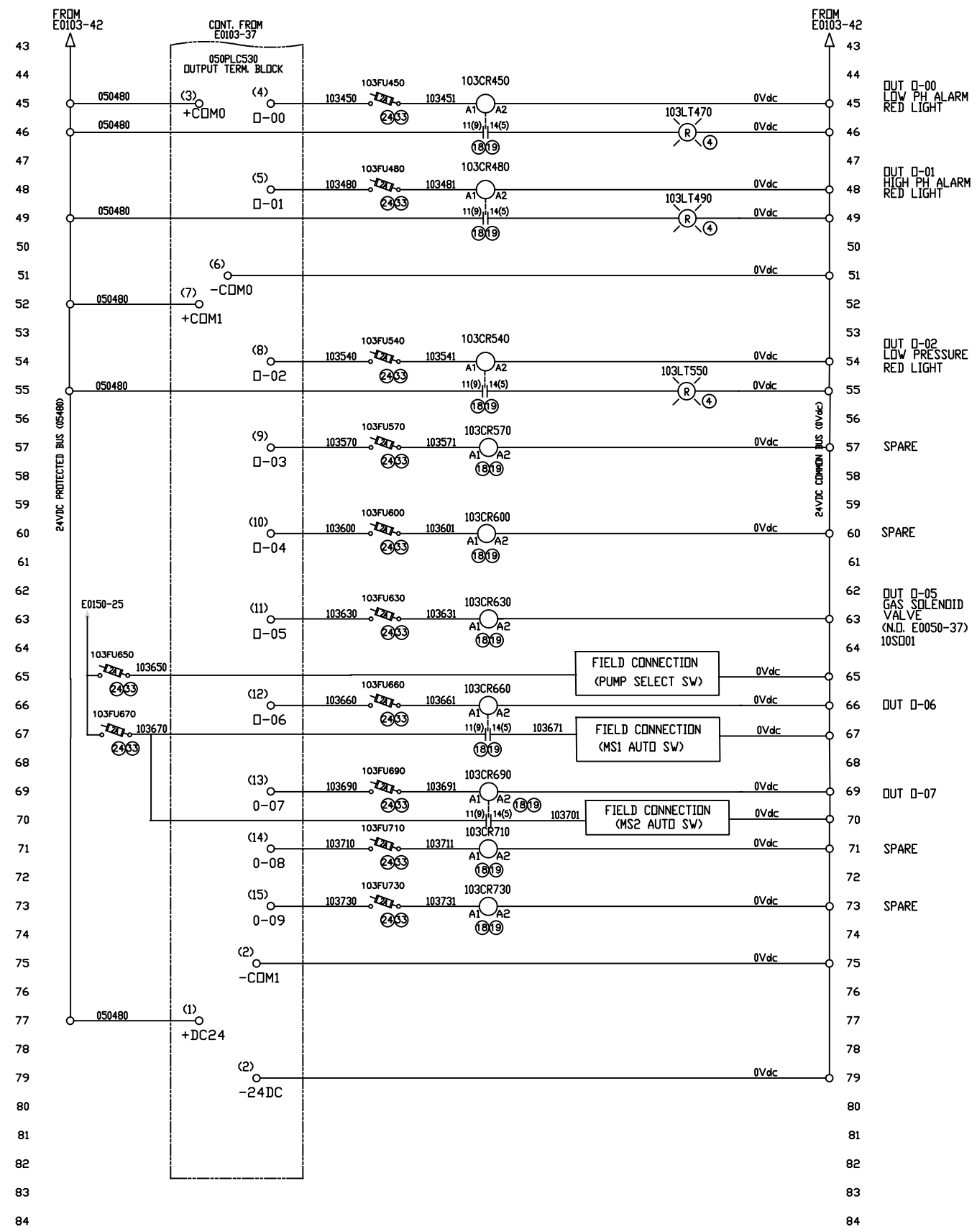
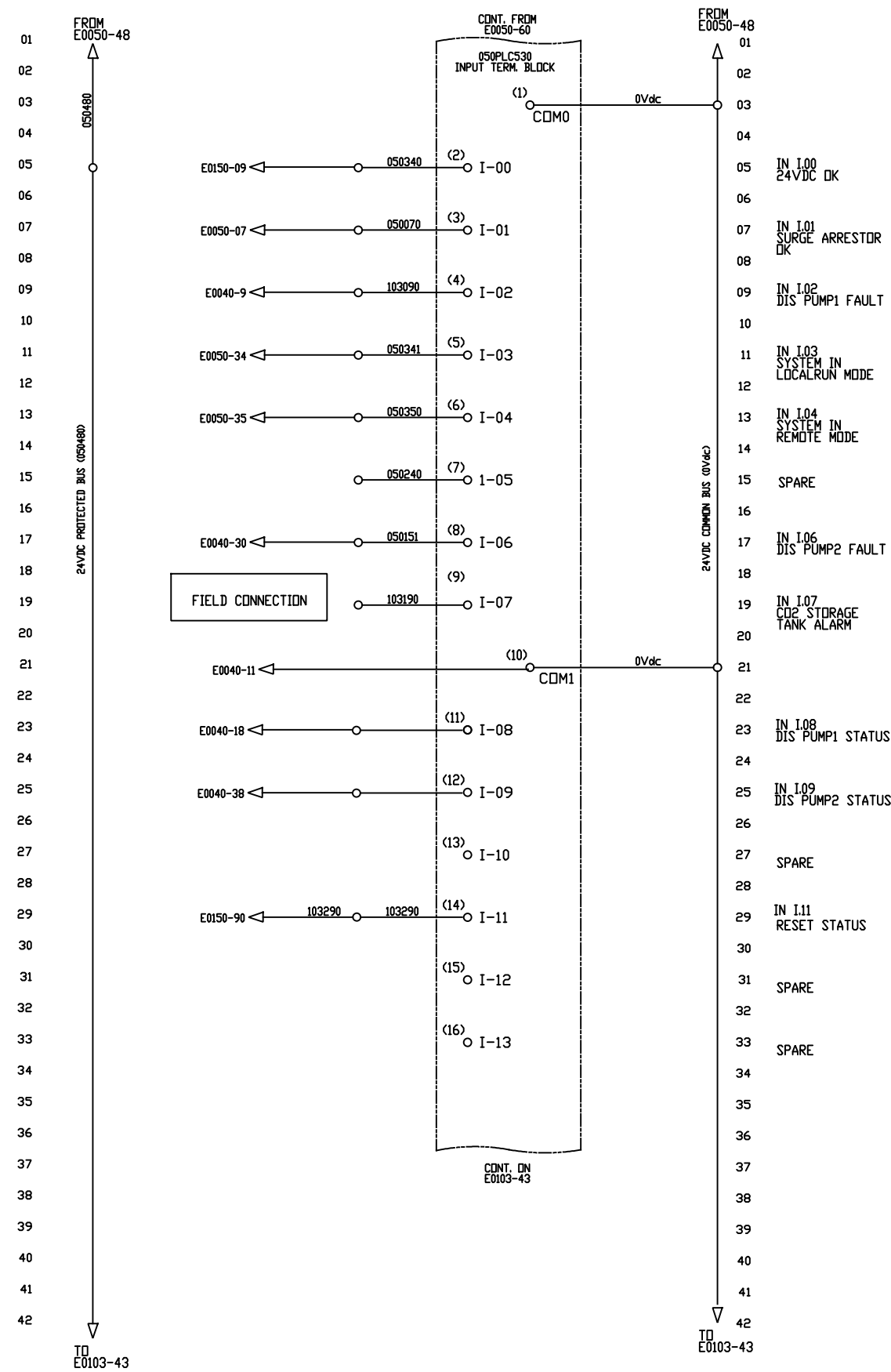


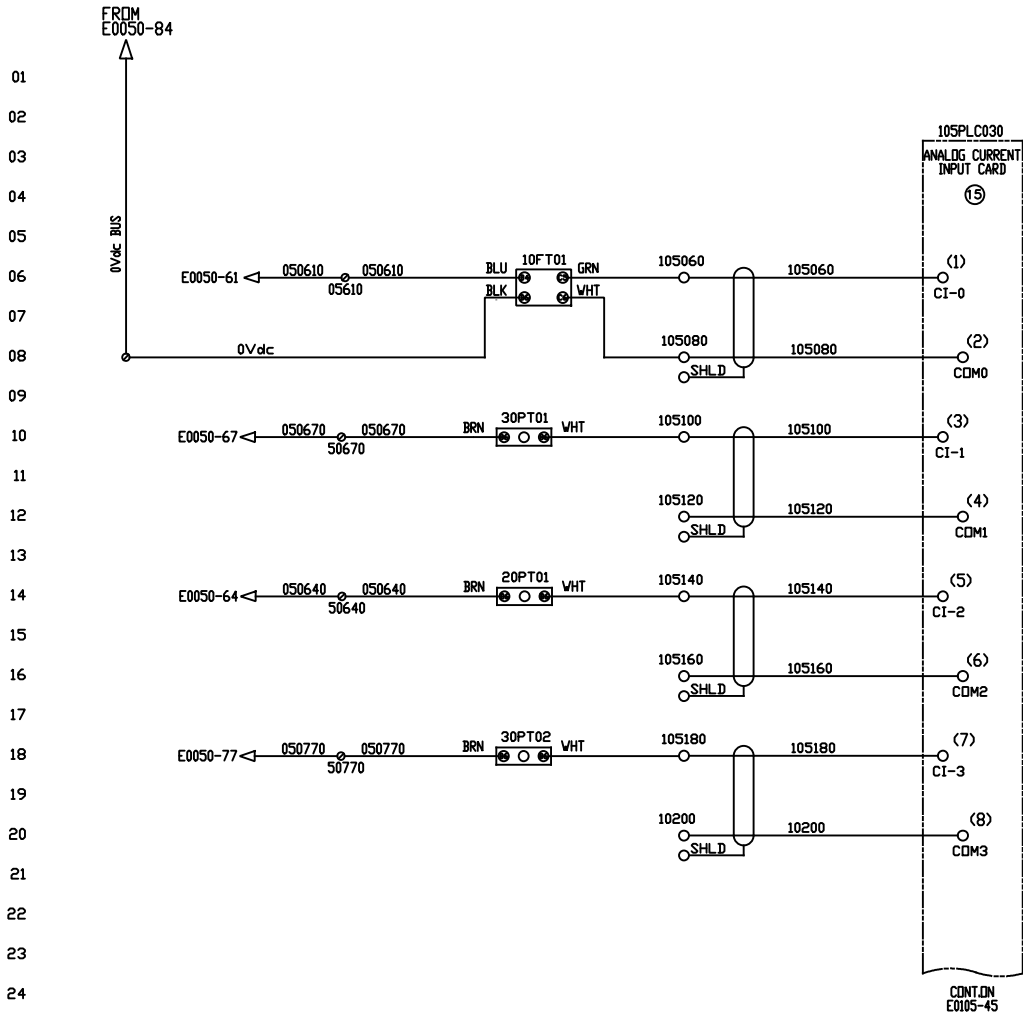
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GAS FLOW CONTROL VALVE

REVISION SUMMARY

PANEL VIEW, ETHERNET
CURRENT OUTPUT





IN I-0
GAS SUPPLY
FLOW RATE
10FT01

IN I-1
TANK
PRESSURE
20PT01

IN I-2
PUMP SUCTION
PRESSURE
30PT01

IN I-3
PUMP DISCHARGE
PRESSURE
30PT02

FIELD CONNECTIONS

FIELD CONNECTIONS

PLANT FLOW SIGNAL

PROCESS PH SIGNAL

CONT. FROM E0105-24

WATER FLOW METER
40FT01

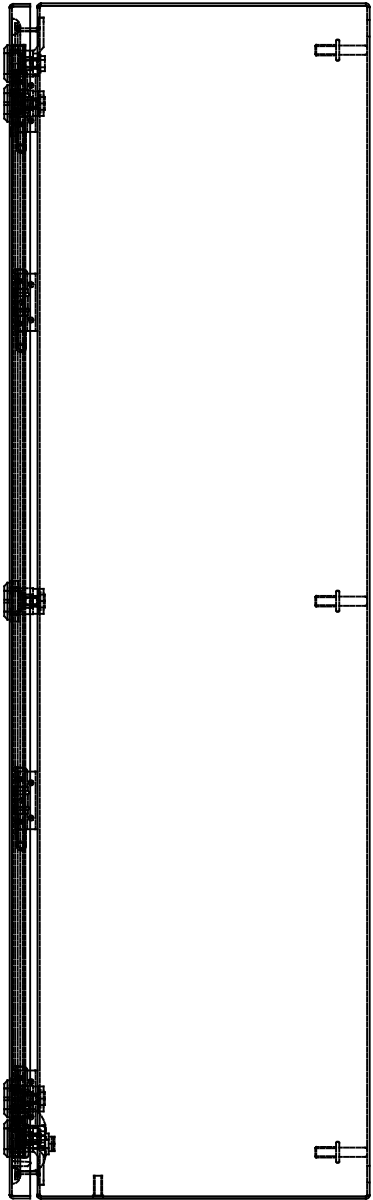
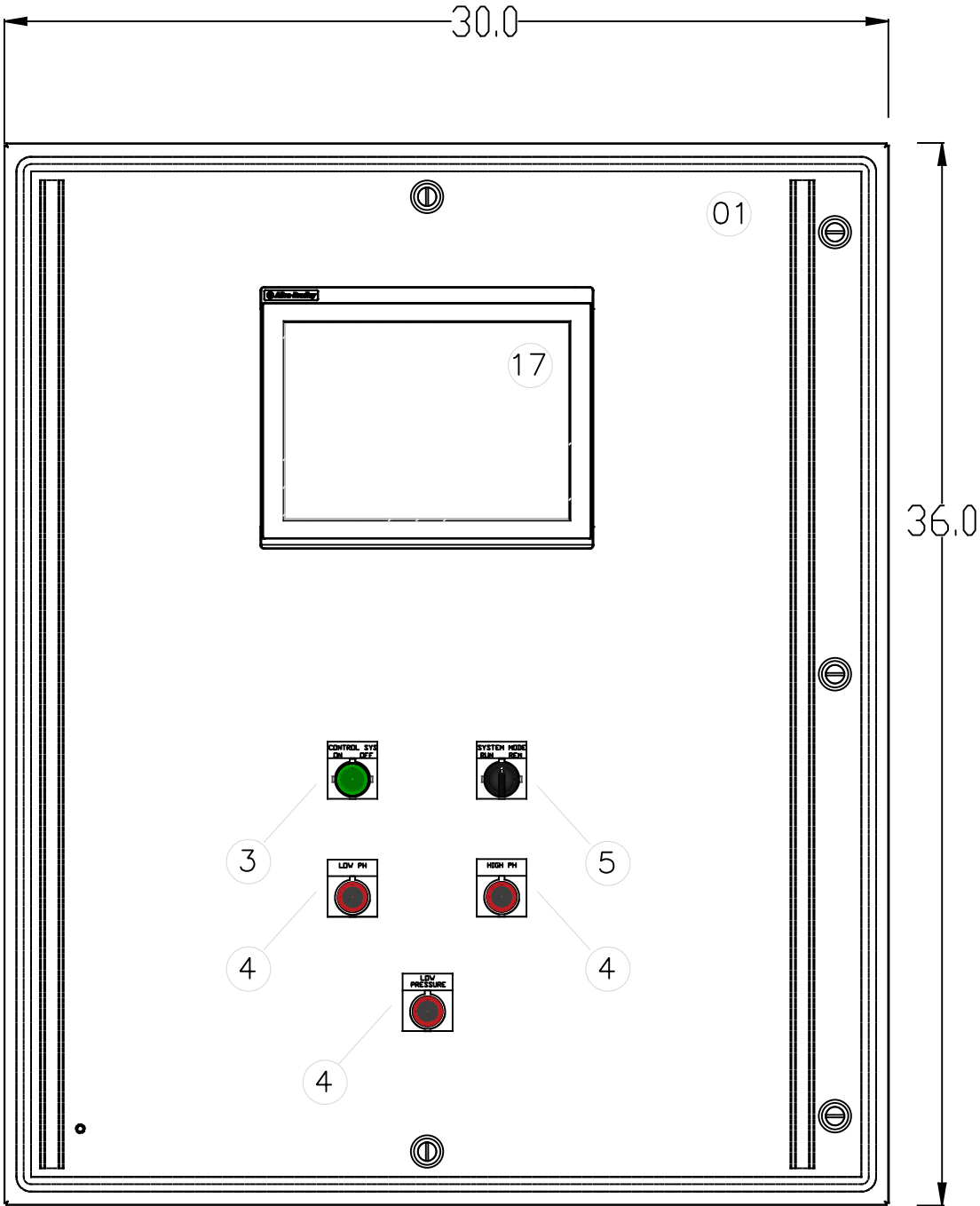
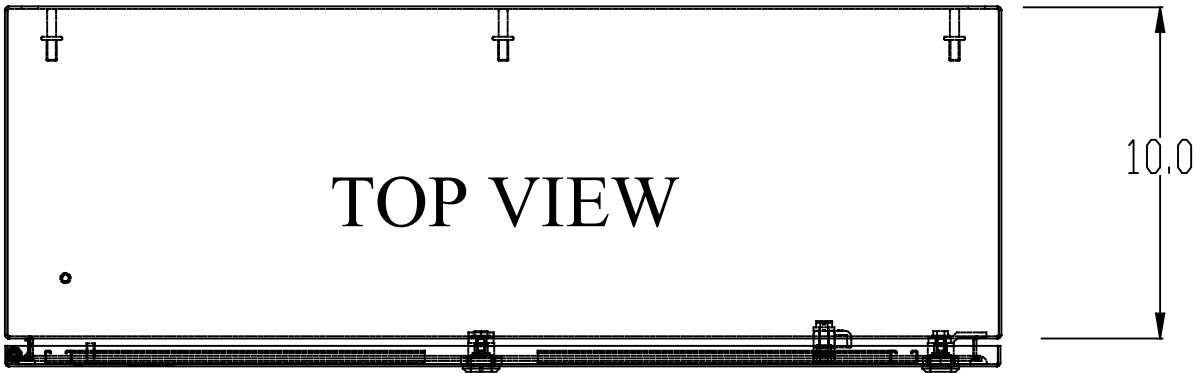
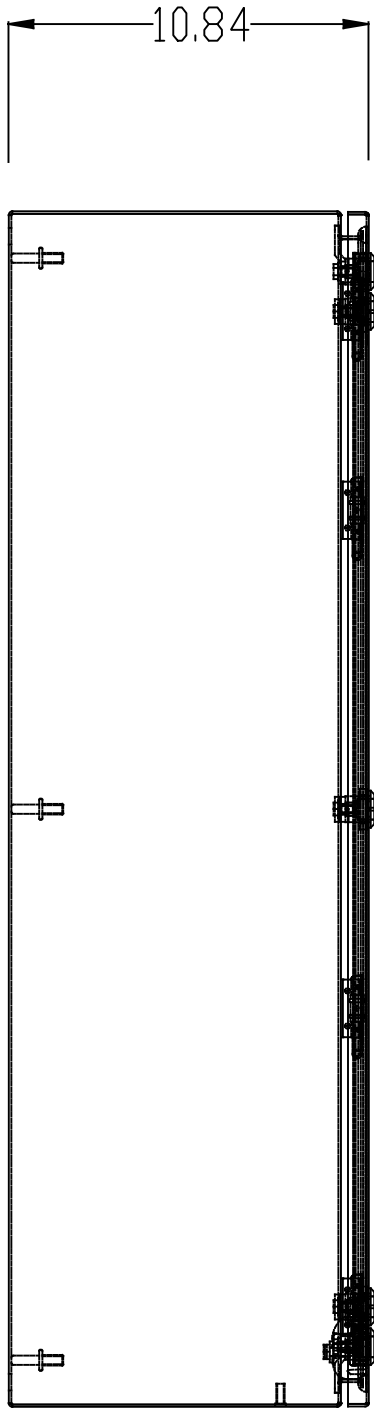
IN I-5
SPARE

IN I-6
PLANT FLOW SIGNAL

IN I-7
PROCESS PH SIGNAL

REVISION SUMMARY

ANALOG CURRENT INPUT



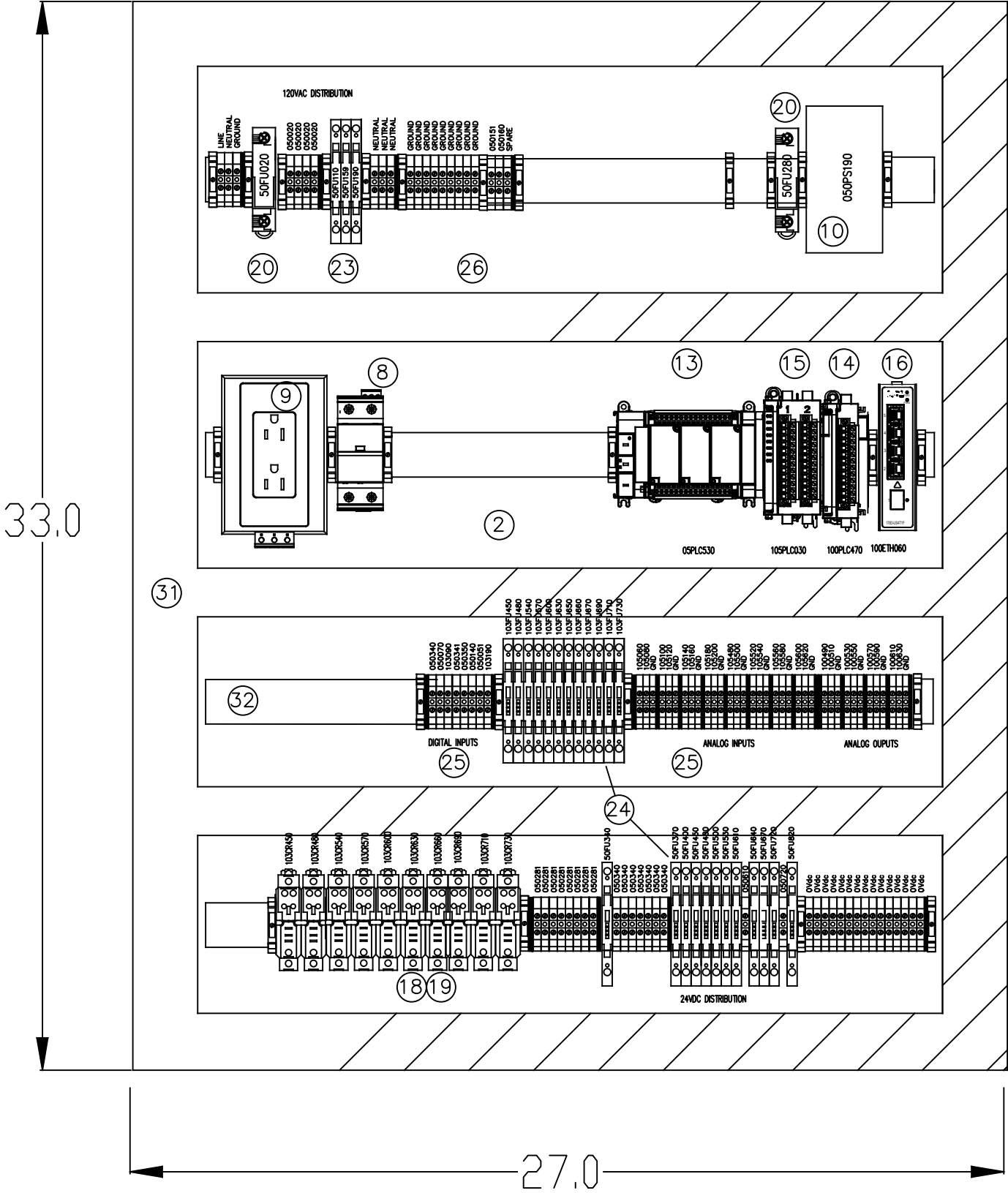
* Units are in Inches

REVISION SUMMARY

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	CON2115
DWG	L0001
SHEET	6 OF 9

PANEL ENCLOSURE

* Units are in Inches



/// ** DENOTES DC WIRE DUCT **

REVISION SUMMARY

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	CON2115
DWG	L0003
SHEET	7 OF 9

PANEL LAYOUT

BILL OF MATERIALS				
ITEM NO.	DESCRIPTION	MANUFACTURER	PART NO.	QTY
1	36 x 30 x 10 ENCLOSURE	HAMMOND	EN4SD363010S16	1
2	33 X 27 BACK PANEL	HAMMOND	EP3630	1
3	2 POSITION ILL. MAINTAINED SELECTOR SWITCH	SCHNEIDER ELECTRIC	9001SKS11B	1
4	PILOT Light 120VAC 30mm	SCHNEIDER ELECTRIC	9001SKP1R9	3
5	3 POSITION MAINTAINED SELECTOR SWITCH	SCHNEIDER ELECTRIC	9001SKS11B-H2	1
6	ENCLOSURE LIGHT	HAMMOND	FLK7LED	1
7	ENCLOSURE POCKET	HAMMOND	EPP1212	1
8	SURGE ARRESTOR	SCHNEIDER ELECTRIC	M9L11120	1
9	RECEPTACLE	PHOENIX CONTACT	5600452	1
10	24VDC / 3.8A POWER SUPPLY	PHOENIX CONTACT	2904599	1
11				
12				
13	PLC ETHERNET CPU	ALLEN BRADLEY	2080-LC50-24QBB	1
14	PLC 4 CHANNEL ANALOG OUTPUT CARD	ALLEN BRADLEY	2085-OF4	1
15	PLC 8 CHANNEL ANALOG INPUT CARD	ALLEN BRADLEY	2085-IF8	1
16	4 PORT UNMANAGED ETHERNET SWITCH W/FIBER	ALLEN BRADLEY	1783-US4T1F	1
17	10" OPERATOR INTERFACE	ALLEN BRADLEY	2711R-T10T	1
18	SPDT RELAY	SCHNEIDER ELECTRIC	RPM11BD	10
19	SPDT RELAY BASE	SCHNEIDER ELECTRIC	RPZF1	10
20	CLASS CC SINGLE POLE FUSEHOLDER	SQUARE D	DF101V	2
21	10A CLASS CC FUSE	BUSSMAN	LP-CC-10	1
22	5A CLASS CC FUSE	BUSSMAN	LP-CC-5	1
23	5mm 120VAC FUSEHOLDER, INDICATING	SCHNEIDER ELECTRIC	NSYTRV42SF5LA	3
24	5mm 24VDC FUSEHOLDER, INDICATING	SCHNEIDER ELECTRIC	NSYTRV42SF5LD	24
25	4MM TERMINAL BLOCKS	SCHNEIDER ELECTRIC	NSYTRV22	60
26	4MM GROUND TERMINAL BLOCKS	SCHNEIDER ELECTRIC	NSYTRV42PE	22
27				
28	1M ETHERNET PATCH CABLE, SHIELDED	ALLEN BRADLEY	1585J-M8CBJM-1	1
29	2M ETHERNET PATCH CABLE, SHIELDED	ALLEN BRADLEY	1585J-M8CBJM-2	1
30				1
31	2 X 3 WIRE DUCT	PANDUIT	F2X3WH6	8M
32	DIN RAIL	PHOENIX	0814681	4M
33	2A 5mm FUSE	BUSSMAN	GDC-2A	25
34	5A 5mm FUSE	BUSSMAN	GDC-5A	2
35				

DESIGN SERVICE CONDITIONS

Ambient Temperature Range	32	-	110F
Ambient Relative Humidity	5	-	95% condensing
Altitude	8000'		AMSL
Installation	Indoor		

24VDC POWER BUDGET

PLC with I/O Modules	1	34W
10" Allen Bradley HMI	1	14W
Network Switch	1	3.4W
Gas Solenoid Valve	1	1.5W
RCV Gas Flow Control Valve	1	24W
Gas Flow Meter	1	2.5W
TOTAL		79.4W (3.31A)

120VAC (DIRTY) POWER BUDGET

Cabinet Luminaire	1	7.2W
Relay	1	1.6W
Water Valve	1	30W
Convenience Outlet	1	300W
TOTAL		339W (2.8A)

120VAC (CLEAN) POWER BUDGET

24V Power Supply (active)	1	90W
24V Power Supply (standby)	1	1.0W
TOTAL		91W (0.76A)

EQUIPMENT ENVIRONMENTAL LIMITATIONS

Allen Bradley PLC & I/O Cards		
Operational Temperature	32	- 149F
Relative Humidity	5	- 95% non-condensing
Allen Bradley HMI		
Operational Temperature	32	- 122F
Relative Humidity	5	- 95% non-condensing
Allen Bradley Ethernet Switch		
Operational Temperature	-40	- 158F
Relative Humidity	5	- 95% non-condensing
Phoenix Contact Power Supply		
Operational Temperature	-13	- 140F
Relative Humidity	5	- 95% non-condensing

HEAT LOADS - DISSIPATED WITHIN CONTROLLER CABINET (OPERATING)

PLC with I/O Modules	1	34W	34W	116 BTU/hr
HMI	1	14W	14W	48 BTU/hr
Ethernet Switch	1	3.4W	3.4W	12 BTU/hr
Power Supply 24VDC	1	7W	7W	24 BTU/hr
TOTAL		58.4W		199 BTU/hr

HEAT LOADS - DISSIPATED WITHIN CONTROLLER CABINET (NON-OPERATING)

PLC with I/O Modules	1	34W	34W	116 BTU/hr
HMI	1	14W	14W	48 BTU/hr
Ethernet Switch	1	3.4W	3.4W	12 BTU/hr
Power Supply 24VDC	1	3.7W	3.7W	13BTU/hr
TOTAL		55.1W		188 BTU/hr

PANEL THERMAL CALCULATIONS (No Solar Exposure)

Operating Heat Load	= 199 BTU/hr
Panel Material	= 14 Gauge 316SS
Panel Surface Area	= 24.2 ft2
Exterior Convective co	= 1.42 BTU/(hr*ft2*F)
Interior Convective co	= 1.42 BTU/(hr*ft2*F)
Surface Emmissivity	= 0.2 (worst case)
Effective Sureface Area	= 12.1 ft2 (worst case)
Radiation	= 30.81 BTU/hr
Thermal Resistance Heat Xfer	= 168.1 BTU/hr
Surrounding Tempurature	= 111F max
Enclosure Temperature	= 121F max

REVISION SUMMARY

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	CON2115
DWG	N0002
SHEET	9 OF 9

STREAMLINE BOOSTER PUMP
BLUE IN GREEN

INDEX

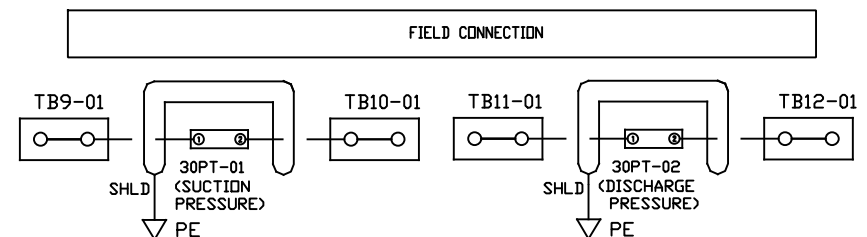
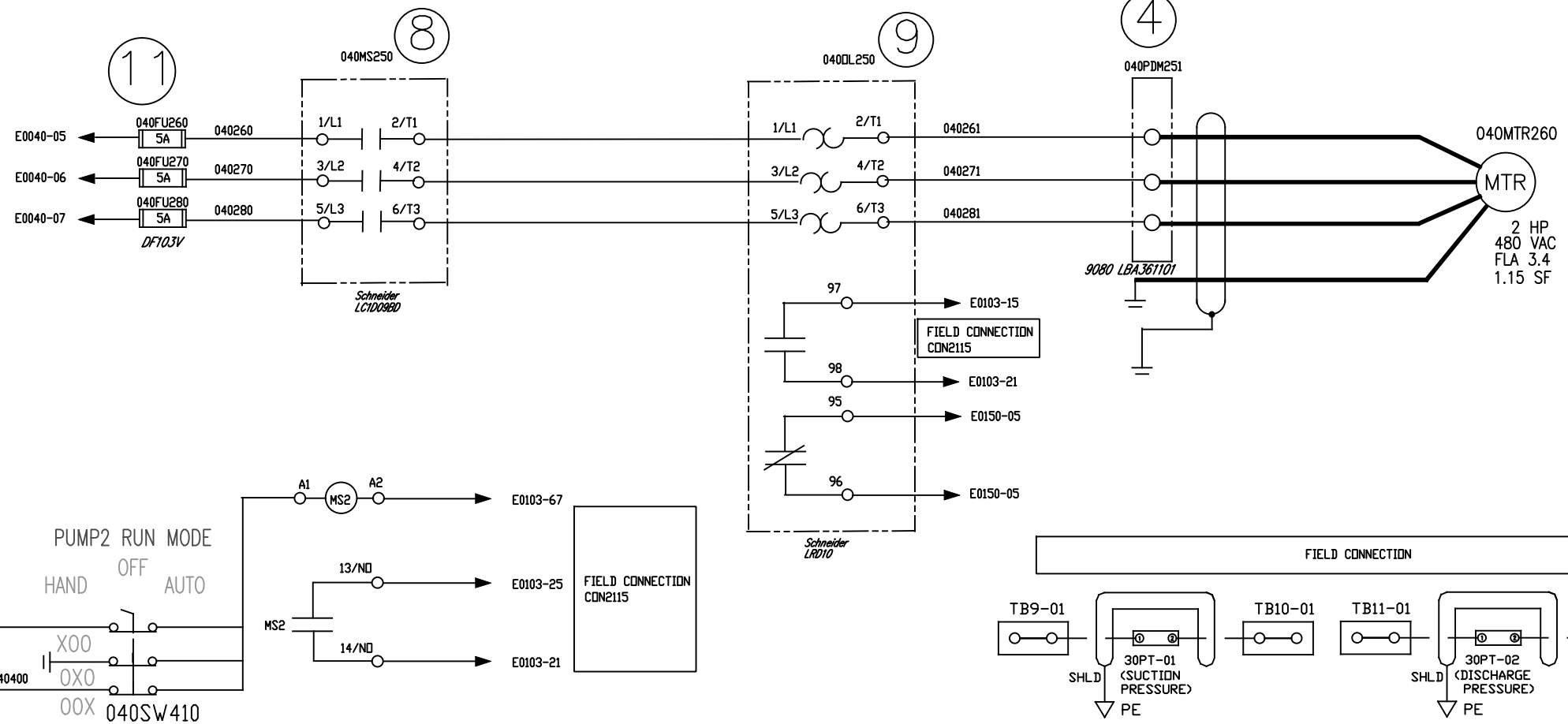
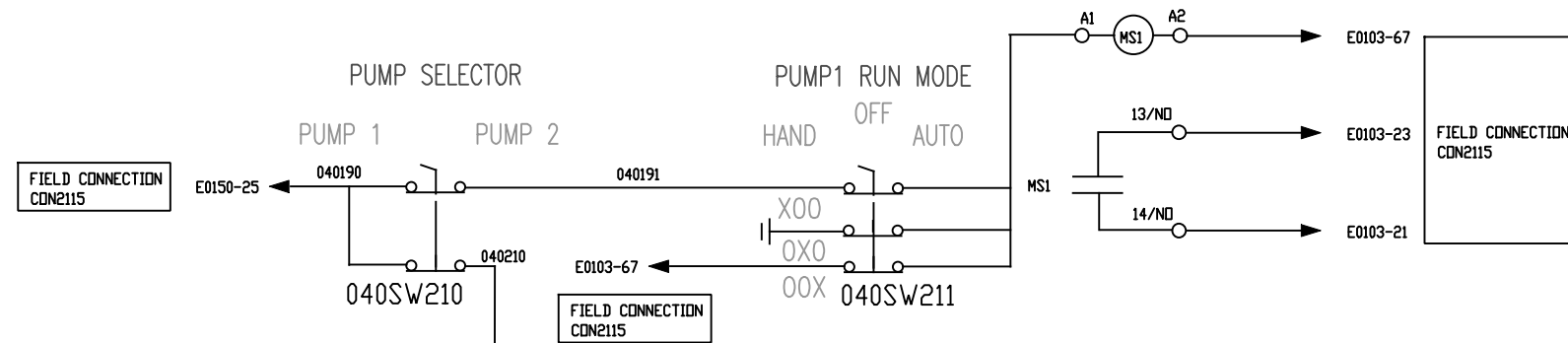
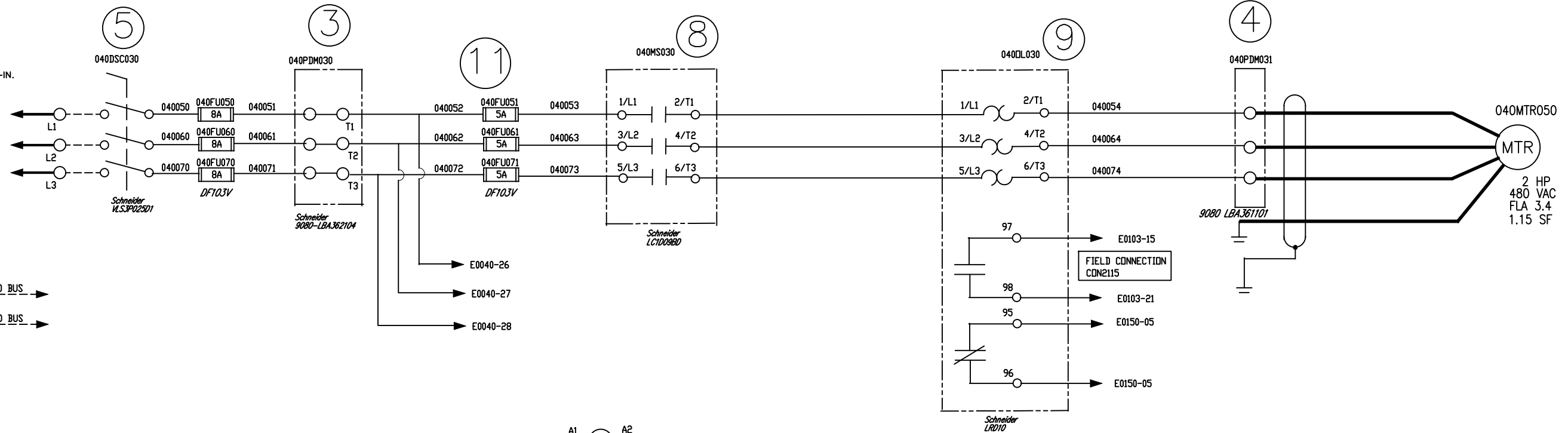
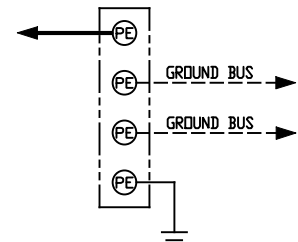
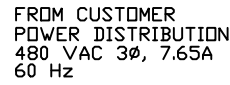
SHEET	DWG	TITLE
1	G0002	Title Page & Index
2	E0040	480VAC Distribution
3	E0150	Safety Relay Circuit
4	L0005	Pump Panel Enclosure
5	L0006	Pump Panel Layout
6	N0003	Bill of Materials 480VAC

REVISION SUMMARY

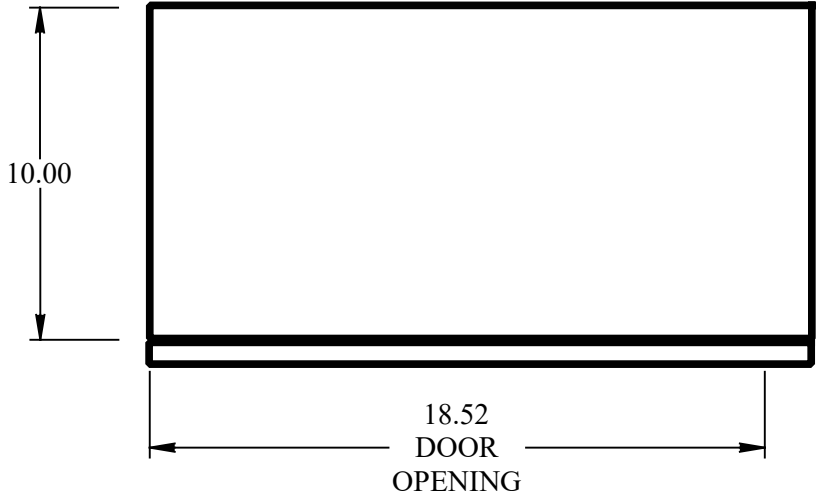
BLUE IN GREEN
STREAMLINE BOOSTER PUMP
INDEX



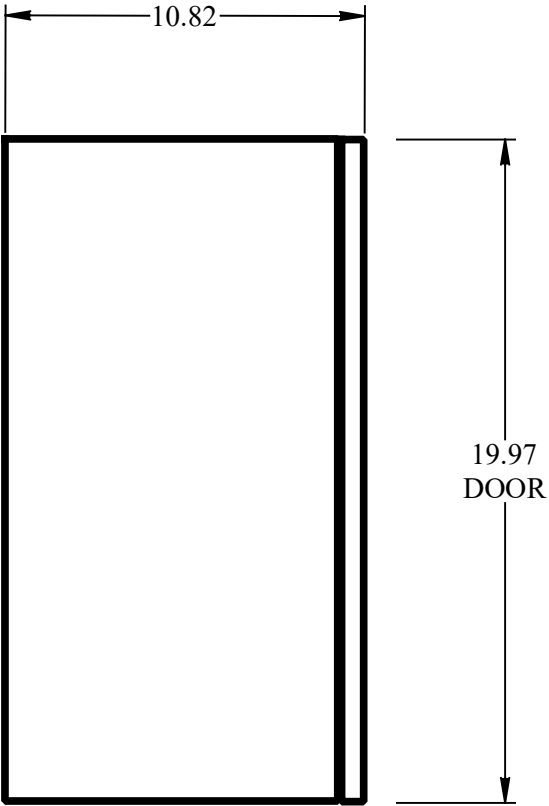
DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	BIG210921
DWG	G0002
SHEET	1 OF 6



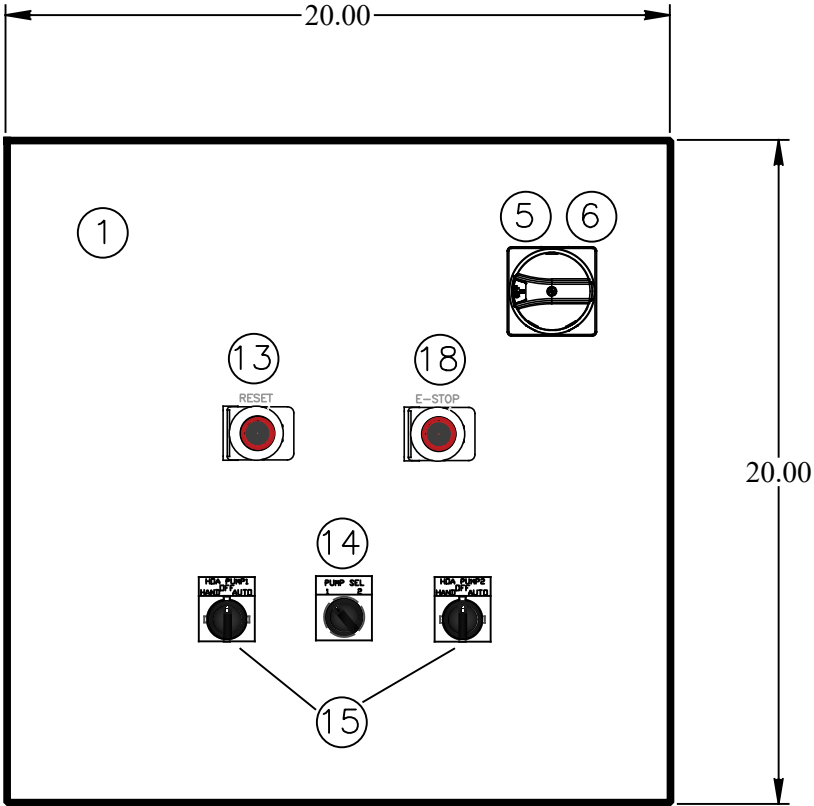
* Units are in Inches



TOP VIEW



SIDE VIEW



FRONT VIEW

REVISION SUMMARY							

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	BIG210921
DWG	L0005
SHEET	4 OF 6

* Units are in Inches

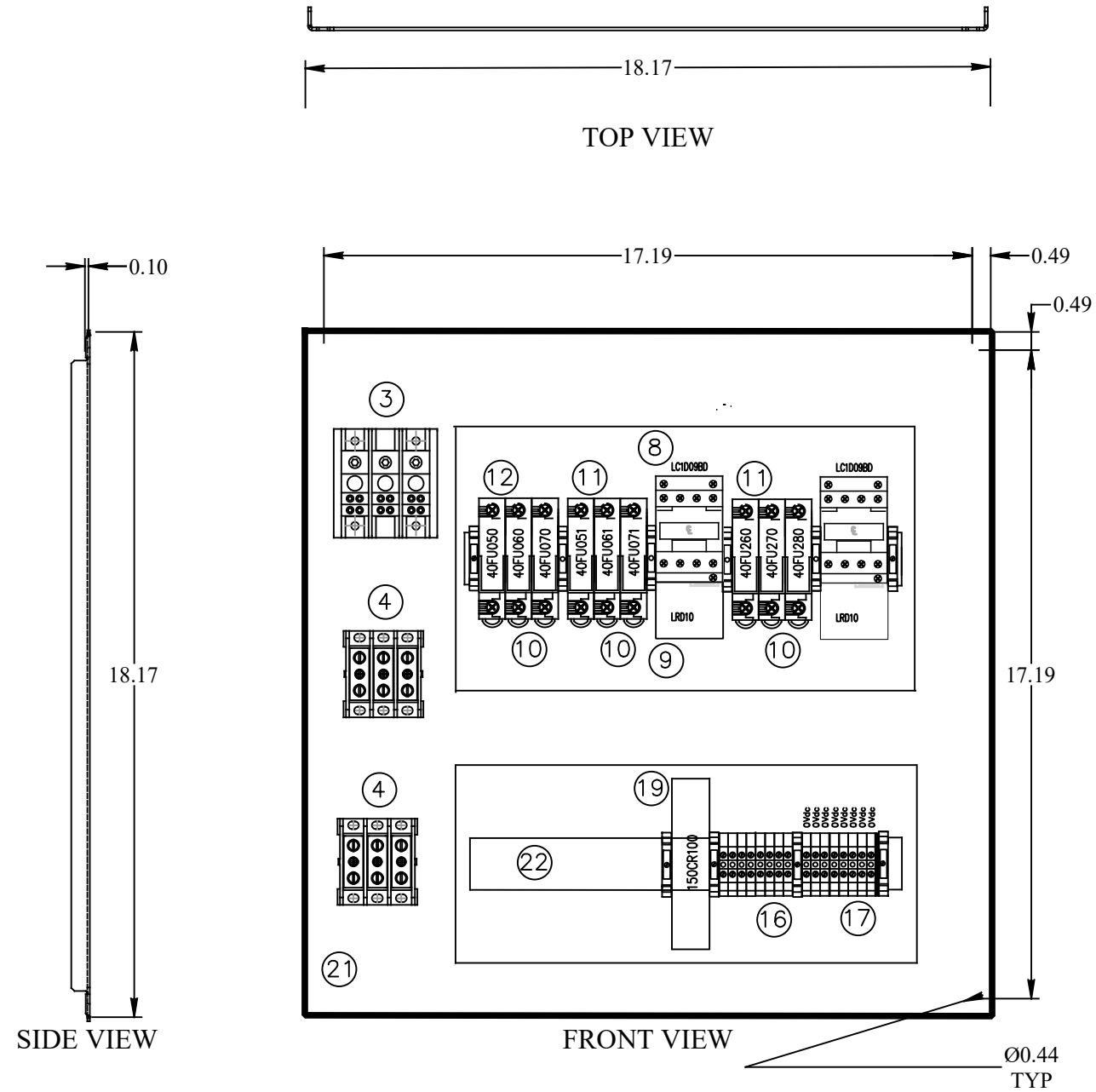
BLUE IN GREEN

STREAMLINE BOOSTER PUMP

PANEL LAYOUT

REVISION SUMMARY

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	BIG210921
DWG	L0006
SHEET	5 OF 6



BILL OF MATERIALS				
ITEM NO.	DESCRIPTION	MANUFACTURER	PART NO.	QTY
1	20 x 20 x 10 ENCLOSURE	HAMMOND	EN4SD202010S16	1
2	20 X 20 BACK PANEL	HAMMOND	EP2020	1
3	POWER DISTRIBUTION BLOCK	SCHNEIDER ELECTRIC	9080-LBA362104	1
4	POWER DISTRIBUTION BLOCK	SCHNEIDER ELECTRIC	9080-LBA361101	2
5	3 POLE 25A DOOR MOUNT DISCONNECT SWITCH	SQUARE D	VLS3P025D1	1
6	RED RECESSED ROTARY HANDLE	SQUARE D	VLSH1S5R	1
7	ENCLOSURE POCKET	HAMMOND	EPP1212	1
8	IEC CONTACTORS, 9A	SCHNEIDER ELECTRIC	LC1D09BD	2
9	OVERLOAD RELAYS, 4A TO 6A	SCHNEIDER ELECTRIC	LRD10	2
10	CLASS CC THREE POLE FUSEHOLDER	SQUARE D	DF103V	3
11	5A CLASS CC FUSE	BUSSMAN	LP-CC-5	6
12	8A CLASS CC FUSE	BUSSMAN	LP-CC-8	3
13	MOMENTARY PUSH BUTTON RESET	SCHNEIDER ELECTRIC	9001 SKR1LH13	1
14	2 POSITION SELECTOR SWITCH	SCHNEIDER ELECTRIC	9001SKS11B	1
15	3 POSITION MAINTAINED SELECTOR SWITCH	SCHNEIDER ELECTRIC	9001SKS43B	2
16	4MM TERMINAL BLOCKS	SCHNEIDER ELECTRIC	NSYTRV22	4
17	4MM GROUND TERMINAL BLOCKS	SCHNEIDER ELECTRIC	NSYTRV42PE	8
18	E-STOP PUSHBUTTON	SCHNEIDER ELECTRIC	9001 SKR9P35 LRRH13	1
19	CAT 4 SAFETY MODULE	SCHNEIDER ELECTRIC	XPSUAF13AP	1
20				
21	2 X 3 WIRE DUCT	PANDUIT	F2X3WH6	8M
22	DIN RAIL	PHOENIX	0814681	4M
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				

[illegible]

DESIGN	JDM
DRAWN	DJA
APRV	ACB
DATE	9-23-21
JOB	BIG210921
DWG	N0003
SHEET	6 OF 6

FL SERIES FL-200-1-200-S-S-10-DH-06



RETRACTABLE, HEAVY SERVICE, FLANGED INJECTION QUILL

The FL series injection quill is similar to the HS and HC series retractable quills with the obvious difference being the FL series use of a flanged ball valve instead of a threaded valve. Not only does this allow it to mount directly to a flanged outlet on a process main, tank, or other vessel but it also has advantages in applications with relatively long (> 24") insertion lengths with larger diameter solution tubes ($\geq 1"$). The weight and length of the quills is well supported in these applications with the FL series guide pipe assembly and use of the Dual-Bolt restraint.

SPECIFICATIONS	FL-075	FL-100	FL-125	FL-150	FL-200	FL-250	FL-300
SAFETY RATING (PSI)	250	250	250	250	250	250	250
CHECK VALVE	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
SAF-T-SEAL TIP	OPTIONAL	OPTIONAL	N/A	N/A	N/A	N/A	N/A
MINIMUM VALVE SIZE	3/4"	1"	1-1/2"	1-1/2"	2"	2-1/2"	3"
INLET CONNECTION*	3/8"	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"
SOLUTION TUBE SIZE	3/8"	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"
SOLUTION TUBE ID (W/SAF-T-SEAL)	.423"	.546"	.742"	.957"	1.500"	1.939"	2.323"
SOLUTION TUBE ID (W/O SAF-T-SEAL)	.493"	.622"	.824"	1.049"	1.610"	2.067"	2.469"
SOLUTION TUBE OD	.675"	.840"	1.050"	1.315"	1.900"	2.375"	2.875"
(A) OPERATING LENGTH	11.25"	11.75"	12.25"	13.25"	14"	13.75"	15.5"
(B) GUIDE PIPE LENGTH	8.5"	8.75"	8.75"	9.25"	9.5"	9.25"	10"
(C) VALVE LENGTH (SEE TABLE)	-	-	-	-	-	-	-
EXTRACTED LENGTH = (A) + (B) + (C) + INSERTION LENGTH							

* Selection of the optional check valve for the FL-075 series results in a 1/2" inlet connection.

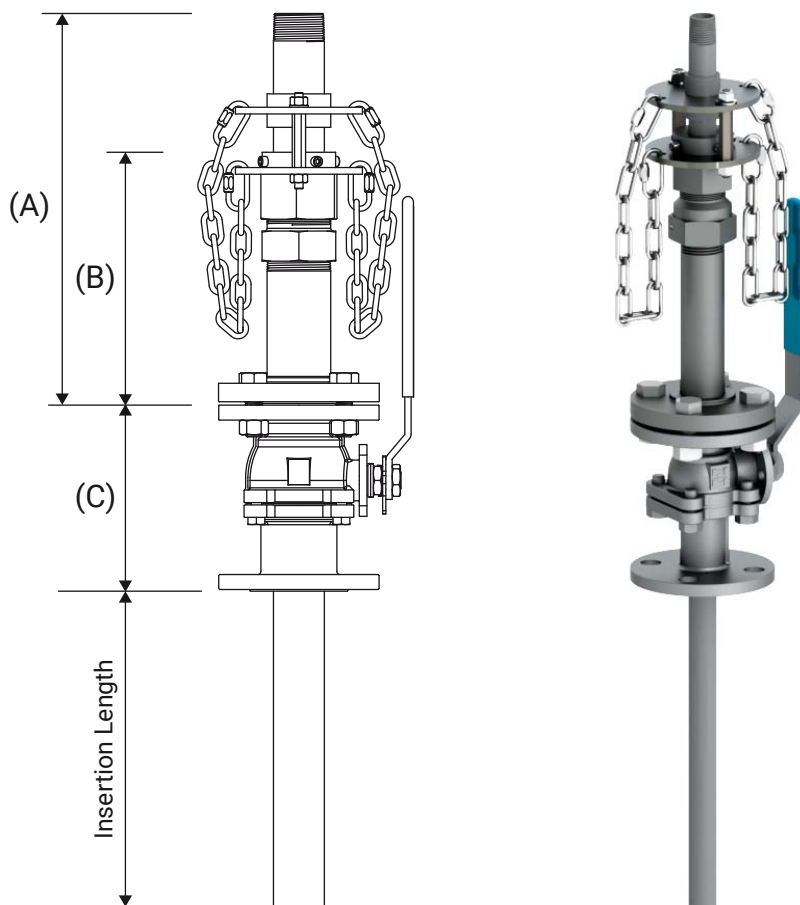
(C) VALVE LENGTH

Per ANSI B16.10

Size	150 Class	300 Class
3/4"	4.61	5.98
1"	5.00	6.50
1-1/2"	6.50	7.48
2"	7.01	8.50
2-1/2"	7.48	9.49
3"	7.99	11.14
4"	9.02	12.00
6"	15.51	16.00

A QUICK NOTE ON INSERTION LENGTHS

When selecting the insertion length for a flanged retractable quill it is important to keep in mind that not only will you need to have the quill protrude to the center, middle 3rd of the main but you will also need to account for the stand-off distance from the sidewall of the main/vessel to the face of the mounting flange.



FL SERIES

KEY FEATURES



1 INLET CONNECTION

Default connection type is male NPT with the size being the same as the solution tube.

2 DUAL-BOLT RESTRAINT

The 250 psi rated Dual-Bolt Restraint provides a positive locking mechanism, securing the solution tube to the main connection assembly.

3 PACKING NUT

The packing nut is the top half of the compression gland. When tightened, the nut compresses the o-ring, sealing off against the process pressure.

4 SOLUTION TUBE ADAPTER

The bottom half of the compression gland.

5 LIMIT CHAINS

The limit chains preventing the solution tube from fully retracting out of the compression gland when removing the tube for service. They also serve as a backup restraint to the dual-bolt system.

6 GUIDE PIPE

The guide pipe ties in the compression gland to the ball valve. On the interior, the port through which the solution tube passes is machined to a tight tolerance to the O.D. of the tube in order to provide additional support to the solution tube.

7 FLANGED BALL VALVE

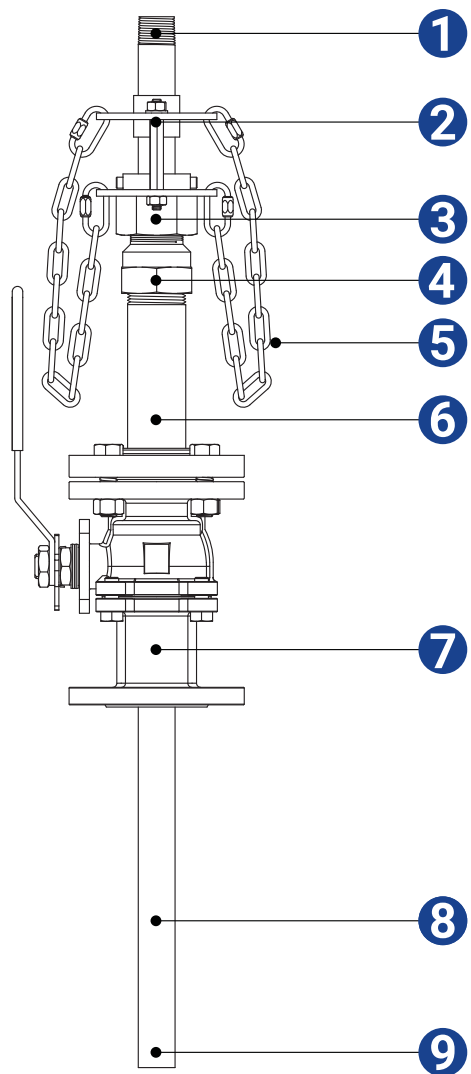
Available in 150 class or 300 class. Each FL series size has a corresponding minimum flange size. However, flanges larger than the minimum can be selected.

8 SOLUTION TUBE

The solution tube is the chemically wetted portion of the quill. It conveys the chemical on its interior from the inlet connection to the tip.

9 TIP

The tip is the point of discharge. There are various tip options depending on the exact model, including the SAF-T-Seal elastomeric tip, used to combat scaling.



FL SERIES

ORDERING INFORMATION



SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-075	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	1 = 150 CLASS 3 = 300 CLASS	075 = 3/4" 100 = 1" 150 = 1-1/2" 200 = 2" 250 = 2-1/2" 300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel CV = SAF-T-Seal, FKM CE = SAF-T-Seal, EPDM	X = None V = FKM E = EPDM K = KALREZ 6375

SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-100	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	1 = 150 CLASS 3 = 300 CLASS	100 = 1" 150 = 1-1/2" 200 = 2" 250 = 2-1/2" 300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel CV = SAF-T-Seal, FKM CE = SAF-T-Seal, EPDM	X = None V = FKM E = EPDM K = KALREZ 6375

SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-125	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	1 = 150 CLASS 3 = 300 CLASS	150 = 1-1/2" 200 = 2" 250 = 2-1/2" 300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel DH = Diffuser Holes	00 = None 05 = Alloy, FKM 06 = Alloy, EPDM

SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-150	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	1 = 150 CLASS 3 = 300 CLASS	150 = 1-1/2" 200 = 2" 250 = 2-1/2" 300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel DH = Diffuser Holes	00 = None 05 = Alloy, FKM 06 = Alloy, EPDM

FL SERIES

ORDERING INFORMATION



SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-200					10		
	1 = 150 CLASS 3 = 300 CLASS	200 = 2" 250 = 2-1/2" 300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel DH = Diffuser Holes	00 = None 05 = Alloy, FKM 06 = Alloy, EPDM

SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-250							
	1 = 150 CLASS 3 = 300 CLASS	250 = 2-1/2" 300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel DH = Diffuser Holes	00 = None 05 = Alloy, FKM 06 = Alloy, EPDM

SERIES	VALVE CLASS	VALVE SIZE	VALVE MATERIAL	SOLUTION TUBE MATERIAL	INSERTION LENGTH	TIP CONFIGURATION	CHECK VALVE
FL-300							
	1 = 150 CLASS 3 = 300 CLASS	300 = 3" 400 = 4" 600 = 6"	S = Stainless Steel H = Alloy C A = Alloy 20	H = Alloy C276 S = 316SS A = Alloy 20 T = Titanium Gr.2	Specify Length In Inches	0 = Standard B = 45° Bevel DH = Diffuser Holes	00 = None 05 = Alloy, FKM 06 = Alloy, EPDM

TECH NOTES

1. The check valve for the FL-075 and FL-100 is integrated into the solution tube of the quill and is a spring loaded ball check valve. The cracking pressure of the spring is 10 psi (FL-075) 5 psi (FL-100). For FL-125 through FL-300: Alloy check valves are threaded spring loaded check valves with a cracking pressure of .500 psi. When selecting alloy material the body material of the check valve will be the same as the solution tube material.
2. FL series quills have a minimum valve size needed to accommodate a given solution tube size. Valves can be larger than the minimum size (up to 6"). See individual FL model ordering information blocks for details specific to a given size.
3. Inlet connection is threaded (NPT) by default. Flanged inlet options may also be available. Consult factory for details.
4. For the FL-075, the SAF-T-Seal tip is not available when selecting Titanium solution tube material. For the FL-100, availability of the SAF-T-Seal tip when selecting Titanium solution tube material is subject to change with out notice. Please consult factory prior to selecting this configuration.
5. Diffuser Hole configurations to be provided by customer. SAF-T-FLO does not provide recommendations regarding diffuser holes.

Style SSB-7

Y-Strainer

Stainless Steel (ASTM A 351, Grade CF8M)

600 lb. Threaded

600 lb. Socket Weld



Cast 316 Stainless Steel Y-Strainer

APPLICATIONS

Steam, water, oil or gas where protection from foreign matter in a pipeline is required.

CONSTRUCTION

The Keckley Style SSB-7 strainers are constructed from rugged 316 stainless steel castings that are machined to exacting specifications.

Socket Weld bore is in compliance with ASME B16.11 unless otherwise specified.

FEATURES

The Keckley Style SSB-7 strainer features a machined groove in the body and cap for proper alignment and to ensure accurate reseating when servicing is required. This strainer has a straight threaded cap and is furnished standard with a NPT blow-off connection. The gasket is 304 stainless steel spiral wound and is compressed between the body and cap (for maximum strength and durability) and designed for both high pressure and high temperature service. Keckley Style SSB-7 strainers can be supplied with a stainless steel blow-off plug upon request.

SCREENS

Standard perforated 304 stainless steel screens are spot welded along the seam for maximum strength. Different size perforations and meshes are available in stainless steel, monel, and brass to meet specific media requirements. If media is not indicated, screens for *steam* will be supplied.

SELF CLEANING

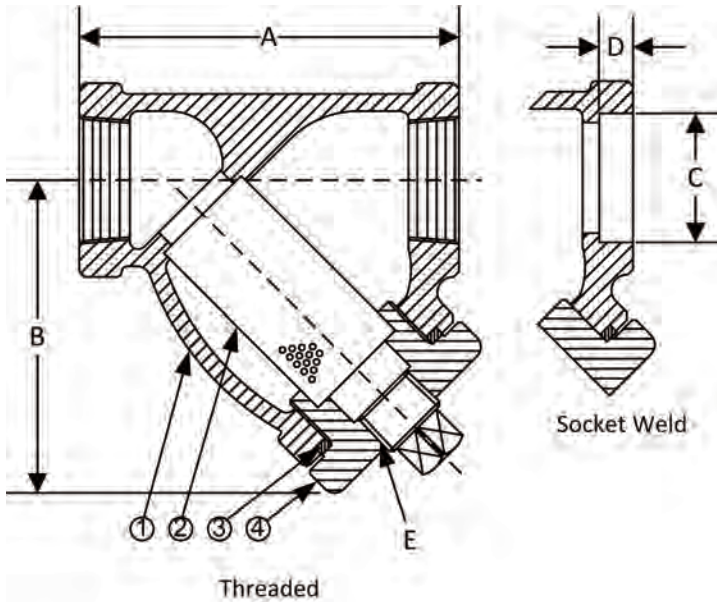
Self cleaning is accomplished by opening the valve or drain plug connected to the blow-off port. **Warning:** See Maintenance Instructions on page S6 of the Strainer Information Section for additional precautions and detailed information on servicing the strainer.

WORKING PRESSURES - NON SHOCK

NOM. RATING	MEDIA	1/4" to 3"	8 mm to 80 mm
600# (THREADED & SOCKET WELD)	STEAM	600 PSI @ 1125°F	4138 KPa @ 607°C
	W.O.G.	1440 PSI @ 100°F	9932 KPa @ 38°C

Style SSB-7

**Y-Strainer, 600 lb. Threaded & Socket Weld
Stainless Steel (ASTM A 351, Grade CF8M)**



PARTS LIST

ITEM	DESCRIPTION	MATERIAL
1	Body	Stainless Steel (ASTM A 351, Grade CF8M)
2	Screen	Stainless Steel (304)
3	Gasket	Spiral Wound Stainless Steel (304)
4	Cap	Stainless Steel (ASTM A 351, Grade CF8M)

Optional: Blow-off Plug, Carbon Steel (ASTM A 105).

*Optional Body Materials Available in 304 and 400 Series SS, Alloy 20, Hastelloy, Inconel, Monel and Stellite..

STANDARD SCREENS SUPPLIED

SIZE		SCREEN GAGE	SCREEN PERFORATION					
			FOR STEAM		OPEN AREA	FOR LIQUID		OPEN AREA
in	mm		in	mm		in	mm	
1/4 to 3	8 to 80	22	3/64	1.2	33%	1/16	1.6	30%

Standard screens supplied are for **steam service**, unless otherwise specified.
Options: Other perforations, meshes, and screen materials are available.

SIZE		DIMENSIONS										WEIGHTS	
		A		B		C		D		E			
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kgs
1/4	8	2-15/16	75	2-7/16	62	0.555	14	3/8	10	1/4	8	3	1
3/8	10	2-15/16	75	2-7/16	62	0.690	18	3/8	10	1/4	8	3	1
1/2	15	2-15/16	75	2-7/16	62	0.855	22	3/8	10	1/4	8	3	1
3/4	20	3-11/16	94	3	76	1.065	27	1/2	13	3/8	10	5	2
1	22	4-9/16	116	4-5/16	110	1.330	34	1/2	13	3/8	10	6	3
1-1/4	32	4-15/16	125	4-3/16	106	1.675	43	1/2	13	3/4	20	8	4
1-1/2	40	5-9/16	141	4-11/16	119	1.915	49	1/2	13	3/4	20	10	5
2	50	6-15/16	176	6-1/4	159	2.406	61	5/8	16	1	25	16	7
2-1/2	65	12	305	9-3/8	238	2.906	74	5/8	16	1-1/4	32	43	20
3	80	12	305	9-3/8	238	3.535	90	5/8	16	1-1/4	32	43	20

Certified dimensional drawings are available upon request.

†This table reflects only the nearest metric equivalents.

FLOW COEFFICIENTS

Size	C _v	Size	C _v	Size	C _v
1/4"	9.5	1"	30	2-1/2"	129.7
3/8"	9.5	1-1/4"	44.9	3"	161.3
1/2"	9.5	1-1/2"	61		
3/4"	18.7	2"	98		

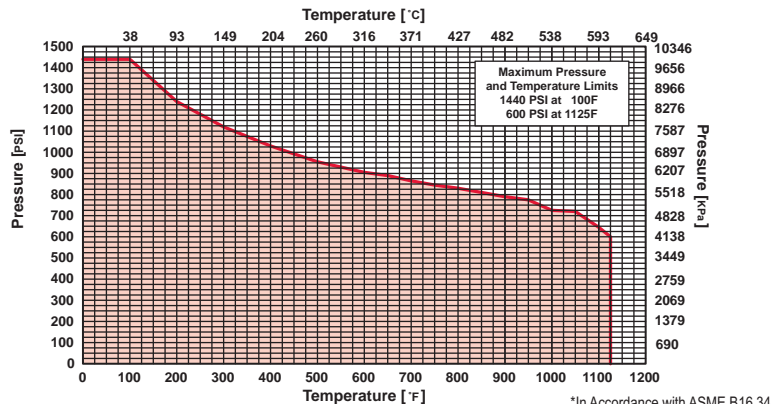
TOTAL SCREEN AREA

Size	(in ²)	Size	(in ²)	Size	(in ²)
1/4"	2.75	1"	10.08	2-1/2"	78.14
3/8"	2.75	1-1/4"	12.79	3"	78.14
1/2"	2.75	1-1/2"	16.33		
3/4"	4.71	2"	27.04		

*See DETERMINING RATIOS on page S5 of the Strainer Information Section for calculating NET FREE AREA of the screen to inside pipe area.

PRESSURE vs. TEMPERATURE CHART

600# Threaded & Socket Weld Stainless Steel (ASTM A 351, Grade CF8M)



PRESSURE DROP CHART

Threaded “Y” Pattern Strainers (Styles B, BDI, E-150, F-150, F-300, SB, SB-7, SSB and SSB-7)

This pressure drop chart is based on the flow of clean water through the Keckley “Y” strainers listed above with screen perforations ranging from 3/64” through 1/8” and is additionally for use with those units equipped with a 20 mesh screen as standard.

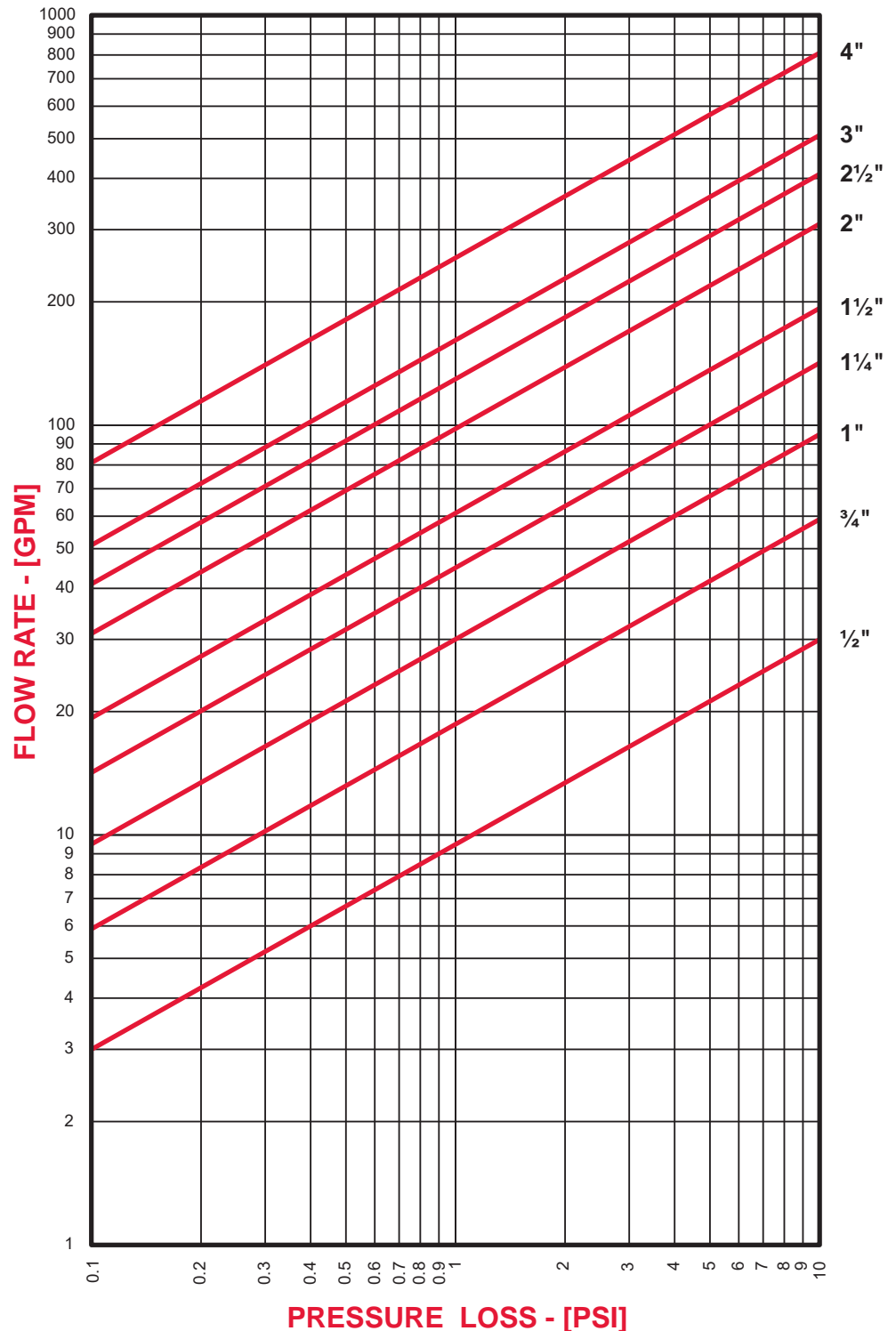
TO USE CHARTS:

Find your desired rate of flow (GPM) on the left hand side of the chart. Follow its corresponding horizontal line to the point where it intersects the diagonal line indicating the strainer pipe size. From this point of intersection, follow the vertical line down to the bottom of the chart to determine the approximate pressure drop.

CORRECTION FACTORS:

For finer mesh screens that are backed with a perforated sheet, multiply the pressure drops shown at right by the following:

40 mesh	x 1.2
60 mesh	x 1.4
80 mesh	x 1.6
100 mesh	x 1.7



STRAINER PRODUCT NUMBERS

Below Is An Example Of Building A Part Number For Ordering A Strainer

Size	Pressure Class	End Conn.	Strainer Type		Body Material	Perf Or Mesh	Screen Type	Screen Material		Gasket Type	Cover Conn.	Origin		Style
6	2	RF	Y	-	CS	M40	L	34	-	G	B	B	-	SA7

Description: 6" 150 lb. Raised Face Flange Y-strainer, Carbon Steel Body, 40 Mesh reinforced w/ perforated 304ss, spiral wound 304ss gasket with graphite filler, bolted cover, domestic (Buy American Act), Style SA-7.

Pressure Class

Ordering Number	ASME Pressure Class	Ordering Number	ASME Pressure Class
1	125 Lb.	5	600 Lb.
2	150 Lb.	6	900 Lb.
3	250 Lb.	7	1,500 Lb.
4	300 Lb.	8	2,500 Lb.
		X	Special

End Connection

Ordering Number	End Connection	Ordering Number	End Connection	Ordering Number	End Connection
TH	Threaded FNPT	RJ	Ring Joint Flange	B2	Butt Weld, Sch 120
SW	Socket Weld	B1	Butt Weld, Sch 10/10S	B9	Butt Weld, Sch 160
SJ	Solder Joint	B3	Butt Weld, Sch 30	BS	Butt Weld, Sch STD
SB	Silbraz	B4	Butt Weld, Sch 40/40S	BX	Butt Weld, Sch XS
FF	Flat Faced Flange	B6	Butt Weld, Sch 60	BZ	Butt Weld, Sch XXS
RF	Raised Face Flange	B8	Butt Weld, Sch 80/80S		

Strainer Type

Ordering Number	Strainer Type	Ordering Number	Strainer Type	Ordering Number	Strainer Type
Y	Y - Pattern Strainer	FB	Fabricated Simplex Basket Strainer	TB	Fabricated Temporary Basket Strainer
S	Simplex Basket Strainer	FD	Fabricated Duplex Basket Strainer	TP	Fabricated Temporary Plate Strainer
D	Duplex Basket Strainer	FT	Fabricated Tee Strainer	X	Special
FY	Fabricated Y- Pattern Strainer	TC	Fabricated Temporary Cone Strainer		

Body Material

Ordering Number	Body Material	Ordering Number	Body Material	Ordering Number	Body Material
CI	Iron (ASTM A 126, Class B)	NA	Nickel Aluminum Bronze (ASTM B 148, C95800)	HC	Hastelloy C276 (ASTM A 494, Grade CW12MW)
DI	Ductile Iron (ASTM A 536, Grade 65-45-12)	34	304 Stainless Steel (ASTM A 351, Grade CF8)	ML	Monel (ASTM A 494, Grade M35-2)
BC	Bronze (ASTM B 584, C84400)	36	316 Stainless Steel (ASTM A 351, Grade CF8M)	FCS	Fabricated Carbon Steel (ASTM A 53)
B1	Bronze (ASTM B 61, C92200)	A2	Alloy 20 (ASTM A 351, Grade CN7M)	F34	Fabricated 304 SS (ASTM A 312, Grade TP-304)
B2	Bronze (ASTM B 62, C83600)	DP	Duplex (ASTM A 351, CD4MCu)	F36	Fabricated 316 SS (ASTM A 312, Grade TP-316)
CS	Carbon Steel (ASTM A 216, Grade WCB)	TI	Titanium (ASTM B 37, Grade PD7B)	X	Special

Perf or Mesh

Ordering Number	Perf. or Mesh	Ordering Number	Perf. or Mesh	Ordering Number	Perf. or Mesh
033	1/32"	250	1/4"	M50	50 Mesh
045	3/64"	375	3/8"	M60	60 Mesh
062	1/16"	500	1/2"	M80	80 Mesh
094	3/32"	750	3/4"	M100	100 Mesh
125	1/8"	M20	20 Mesh	M150	150 Mesh
156	5/32"	M30	30 Mesh	M200	200 Mesh
188	3/16"	M40	40 Mesh	M300	300 Mesh
				X	Special

Screen Type

Ordering Number	Screen Type
P	Perforated
M	Mesh
L*	Perforated with Mesh Lining
S	Perforated with Mesh Lined Start Up
X	Special

*20 mesh and finer screens must be reinforced with perforated screen.

Screen Material

Ordering Number	Screen Material
34	Type 304 Stainless Steel
36	Type 316 Stainless Steel
BR	Brass
ML	Monel
TI	Titanium
HC	Hastelloy C276
DS	Duplex Stainless Steel
X	Special

Gasket Type

Ordering Number	Gasket Type	Ordering Number	Gasket Type
G	Spiral Wound SS (304) - Graphite Filler	VO	Viton "O-Ring"
T	Spiral Wound SS (304) - Teflon Filler	N	No Gasket
S	Spiral Wound SS (316) - Graphite Filler	R	Ring Joint
M	Spiral Wound Monel - Graphite Filler	C	Copper
B	Buna	F	Fiber
BO	Buna-n "O-Ring"	P	PTFE
V	Viton	X	Special

Cover Connection

Ordering Number	Cover Connection	Ordering Number	Cover Connection
T	Threaded	H	Hinged
B	Bolted	C	Clamped
K	Knob	D	Lifting Davit
Q	Quick Open	X	Special

Origin

Country Code	Origin	Country Code	Origin	Country Code	Origin
D	Domestic	B	Domestic (Buy American)	I	Import



8210P004 24-120V/50-60 Hz/DC (with manual operator)

- Higher DC pressure rating
- 80% reduction in power consumption
- Built-in surge suppression
- 3-year coil warranty
- Class I, Division 2 coils available

ELECTRONICALLY ENHANCED SOLENOID VALVES



RedHat Next Generation | Electronically Enhanced Solenoid Valve Technology

RedHat Next Generation is the future of solenoid valve technology, designed and manufactured to provide new capabilities. The Next Generation of solenoid valves provides lower operating cost, and represents an advancement in the performance, reliability, and ruggedness that you have come to expect from ASCO.

Electronics technology to manage power

RedHat Next Generation valves use electronics technology to manage power, providing a new standard of operation. The solenoid incorporates a power management circuit providing lower power consumption, enhanced pressure and flow ratings, and electrical surge suppression to both the solenoid and electronic controls.

Low power

The new solenoid draws only 1.0 watt of power for 12-24V DC and 1.5 watts for 24-120V AC/DC, 100-240V AC/DC. A conventional solenoid with the same performance can draw as high as 17 watts of power. The savings in power usage over the installed life of the valve will lower the total cost of ownership up to 14%.

Increased DC performance

The new technology accepts both AC and DC voltages without sacrificing flow or pressure specifications. DC performance has been increased by 150% to 500% from today's industry standards, making the valves' DC characteristics equivalent to AC pressure and flow values. This simplifies your control by eliminating the need for AC output cards, reduces wiring costs, and provides safer working environments for users operating on DC.

RedHat Next Generation coils are offered in three voltage ranges covering most electrical requirements – 100-240/AC or DC, 24-120/AC or DC, or 12-24/DC. Each coil has built-in electrical surge suppression that protects the coil from external voltage spikes and eliminates inductive voltage spikes associated with conventional solenoids. An optional solenoid is available for use in Class I, Division 2 hazardous locations.

Rugged Design

ASCO RedHat Next Generation addresses many other operating characteristics that will further improve the life of your solenoid valves. These include a much lower temperature rise, and an increase in valve ambient temperature rating to 140°F/60°C. Because of our confidence in the rugged design of the RedHat Next Generation solenoids, ASCO is pleased to extend a 3-year warranty on the coils.



Visit us online at www.ascovalve.com to see our comprehensive product portfolio.

ELECTRONICALLY ENHANCED SOLENOID VALVES

- 1/2 inch female conduit
- Polyester coated aluminum conduit hub
- Enclosure Types 1 through 4X
- Now standard with 24 inch leads
- Stainless steel nameplate
- Steel clip with epoxy powder coated paint
- LCP overmolded coil
- Optional Class I, Division 2 coil available for hazardous locations



VALVE SELECTION & ORDERING

As you use this catalog to select RedHat Next Generation products, note these key operating features:

- Increase in DC pressure ratings to AC levels on all products (up to a 500% improvement)
- Lower power operation
- Voltage ranging
- Built in surge suppression
- Elimination of AC hum
- Increase in AC and DC operating temperatures
- Low solenoid temperature rise
- Longer coil life due to lower operating temperatures and electrical surge suppression
- Solenoid approvals to UL, CSA, and CE standards
- RoHS 2 Compliant

How to order

Find the valve that you are looking for in the provided specifications tables. The tables contain the following information designed to help you in making your selection:

Pipe Size (in)	Orifice Dia. (in)	Cv Flow	Operating Pressure Differential (psi)				Max Fluid Temp. °F	Brass ①	Const. Ref.	Agency	Stainless Steel	Const. Ref.	Agency	Wattage		Approx. Shipping Weight (lbs.)
			Min.	Max.										DC	AC/DC	
				Air-Inert Gas	Water	Light Oil @ 300 SSU										
1/2	5/8	4	0	150	150	-	180	8210P094	4	○	-	-	-	1.0	1.5	3.2

① When ordering a valve product, specify the ASCO base catalog number (Ex. **8210P094**). This number will always be 8 digits long.

Choose one of the three operating voltage ranges (100-240V/50-60Hz/DC, 24-120V/50-60Hz/DC or 12-24/DC) and add it to the base catalog number (Ex. 8210P094 **24-120V/50-60Hz/DC**).

If you want to enhance the product with one or more of the options allowed in the Optional Features Chart for that catalog number, please add the appropriate prefix or suffix (as shown):

Pipe Size (in)	Orifice Dia. (in)	Solenoid Options ②	Base Catalog Number		Resilient Materials ③								Other ③		Standard Rebuild Kit ④	
		Class I, Division 2 Coil	Brass	Stainless Steel	NBR	FKM	EPDM	CR	Oxygen Service	PTFE	Urethane	Vacuum	Manual Operator	Mounting Bracket	Brass	Stainless Steel
1/2	5/8	EE	8210P094	-	●	V	E	J	N	-	-	VH	MO	MB	322670	-

② Optional Class I, Division 2 solenoid (Ex. **EE**8210P094 24-120V/50-60Hz/DC)

③ If an FKM elastomer and manual operator are required, add VMO to the back of the base catalog number. (Ex. 8210P094**VMO** 24-120V/50-60Hz/DC)

④ When ordering a rebuild kit for a valve, supply the rebuild kit number as shown in the table. (Ex. 322670) When ordering a rebuild kit for a valve with a suffix, add the suffix to the appropriate standard rebuild kit. (Ex. The rebuild kit for the above valve with FKM is 322670-V)

All constructions are available with prefix EE for Class I, Division 2 requirements.

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X.

Optional: Class I, Division 2 for Hazardous Locations and Watertight, Types 3, 3S, 4, 4X. (To order, add prefix "EE" to catalog number.)

When ordering a replacement coil, select from the following:

Voltage Range	Valve Prefix	Replacement Coil Part Number
100-240V/50-60Hz/DC	-	250404-605-*
24-120V/50-60Hz/DC	-	250404-606-*
12-24/DC	-	250404-607-*
100-240V/50-60Hz/DC	EE	250504-605-*
24-120V/50-60Hz/DC	EE	250504-606-*
12-24/DC	EE	250504-607-*

⚠ **Warning:** Improper selection or use of products and related items in this catalog can cause death, serious injury or property damage. If you need any assistance in selecting, specifying, or ordering a valve, please contact ASCO at (800) 972-2726.

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- Two-way (2/2) Next Generation solenoid valves have one inlet port and one outlet port.
- Control of air, water, light oil, and non-corrosive media.
- Normally closed (opens when energized) and normally open (closed when energized) operation.
- Pipe sizes – 1/8 to 2 inch.



Specifications

Pipe Size (in)	Orifice Dia. (in)	Cv Flow	Operating Pressure Differential (psi)				Max Fluid Temp. °F	Brass	Const. Ref.	Agency		Stainless Steel	Const. Ref.	Agency		Wattage					
			Min.	Max.						UL	UL			DC	AC/DC						
				Air-Inert Gas	Water	Light Oil @ 300 SSU															
General Service - Normally Closed																					
1/8	3/64	0.06	0	2200	2200	1700	140	-	-	-	8262R175 ⑤	1	●	1.0 ⑧	1.5 ⑨						
1/8	3/64	0.06	0	1500	1500	1500	140	8262R099 ⑤	1	●	-	-	-								
1/8	3/32	0.21	0	720	410	410	180	8262R277	1	○	8262R178	1	○								
1/8	1/8	0.35	0	540	395	360	180	8262R105	1	○	8262R174	1	○								
1/8	1/8	0.35	0	200	-	-	167	8262R077 ⑥	1	○	-	-	-								
1/4	3/64	0.06	0	1500	1500	1500	140	8262R107 ⑤	2	●	-	-	-								
1/4	3/64	0.06	0	2200	2200	1700	140	-	-	-	8262R181 ⑤	2	●								
1/4	3/32	0.21	0	720	410	410	180	8262R109	2	○	8262R183	2	○								
1/4	1/8	0.35	0	540	395	360	180	8262R232	2	○	8262R185	2	○								
1/4	5/32	0.52	0	300	225	225	180	8262R202	2	○	8262R220	2	○								
1/4	7/32	0.73	0	125	125	125	180	8262R208	2	○	8262R226	2	○								
1/4	9/32	0.88	0	105	105	105	180	8262R212	2	○	8262R230	2	○								
1/4	9/32	1.0	0	50	-	-	167	8262R078 ⑥	2	○	-	-	-								
1/4	5/16	1.5	10	1500	1500	1500	180	8223P025	18	-	-	-	-								
3/8	1/8	0.35	0	540	395	360	180	8263R115	3	○	8263R191	3	○								
3/8	5/32	0.52	0	300	225	225	180	8263R200	3	○	8263R193	3	○								
3/8	7/32	0.73	0	125	125	125	180	8263R124	3	○	8263R332	3	○								
3/8	9/32	0.88	0	105	85	85	180	8263R210	3	○	8263R333	3	○								
3/8	5/16	1.5	10	1500	1500	1500	180	8223P027	18	-	-	-	-								
3/8	5/8	3	0	150	150	-	180	8210P093	4	○	-	-	-								
3/8	5/8	3	5	300	300	300	180	8210P006	4	●	-	-	-								
1/2	3/8	3.2	25	1500	1500	1500	180	8223P003	5	-	8223P010	6	-								
1/2	5/8	4	0	150	150	-	180	8210P094	4	○	-	-	-								
1/2	5/8	4	0	150	150	125	180	-	-	-	8210P087	7	●								
1/2	5/8	4	5	300	300	300	180	8210P007	4	○	-	-	-								
3/4	5/8	4.5	0	150	150	125	180	-	-	-	8210P088	7	●								
3/4	3/4	5	0	150	150	-	180	8210P095	7	○	-	-	-								
3/4	3/4	5	0	3	3	-	180	8030P003	8	○	-	-	-								
3/4	3/4	7.8	25	750	750	750	180	8223P005	9	-	-	-	-								
1	1	13	5	150	150	100	180	8210P004	10	○	-	-	-								
1 1/4	1 1/8	15	5	150	150	100	180	8210P008	10	○	-	-	-								
1 1/2	1 1/4	22.5	5	150	150	100	180	8210P022	11	○	-	-	-								
2	1 3/4	43	5	150	125	90	180	8210P100	12	●	-	-	-								
General Service - Normally Open																					
1/8	3/64	0.06	0	1150	900	800	140	8262R155 ⑤	1	●	8262R168 ⑤	1	●	1.0 ⑧	1.5 ⑨						
1/8	3/64	0.06	0	750	750	750	180	8262R156	1	●	8262R169	1	●								
1/8	3/32	0.21	0	275	230	180	180	8262R128	1	●	8262R236	1	●								
1/8	1/8	0.35	0	160	145	125	180	8262R129	1	●	8262R237	1	●								
1/4	3/64	0.06	0	1150	900	800	140	8262R161 ⑤	2	●	8262R199 ⑤	2	●								
1/4	3/64	0.06	0	750	750	750	180	8262R260	2	●	8262R130	2	●								
1/4	3/32	0.21	0	275	230	180	180	8262R261	2	●	8262R134	2	●								
1/4	1/8	0.35	0	160	145	125	180	8262R262	2	●	8262R138	2	●								
1/4	5/32	0.54	0	90	90	70	180	8262R263	2	●	8262R142	2	●								
1/4	7/32	0.83	0	45	45	40	180	8262R264	2	●	8262R148	2	●								
1/4	9/32	0.96	0	30	30	30	180	8262R265	2	●	8262R152	2	●								
3/8	1/8	0.35	0	160	145	125	180	8263R070	3	●	8263R080	3	●								
3/8	5/32	0.54	0	90	90	70	180	8263R071	3	●	8263R081	3	●								
3/8	7/32	0.83	0	45	45	40	180	8263R072	3	●	8263R082	3	●								
3/8	9/32	0.96	0	30	30	30	180	8263R073	3	●	8263R083	3	●								
3/8	5/8	3	0	150	150	125	180	8210P033	15	●	-	-	-								
1/2	5/8	4	0	150	150	125	180	8210P034	15	●	-	-	-								
3/4	3/4	5.5	0	150	150	125	180	8210P035	16	●	-	-	-								
3/4	3/4	5.5	0	2	2	-	180	8030P083	17	●	-	-	-								
○ = Safety Shut-off Valve. ● = General Purpose Valve.																					

○ = Safety Shut-off Valve. ● = General Purpose Valve.



Pipe Size (in)	Orifice Dia. (in)	Base Catalog Number		Resilient Materials and Suffix Options														Other		Standard Rebuild Kit	
		Brass	Stainless Steel	Ammonia ⑦	Silicone Free	Dry Air	NBR	LT NBR	FKM	EPDM	CR	Oxygen Service	PTFE ②	Urethane	Vacuum	Manual Operator	Mounting Bracket	Brass	Stainless Steel		
1/8	3/64	8262R099 ⑤	8262R175 ⑤	-	SF	-	-	-	-	-	-	-	-	●	-	-	MB	323593-W	323595-W		
1/8	3/64	8262R155 ⑤	8262R168 ⑤	-	SF	-	-	-	-	-	-	-	-	●	-	-	MB	323986-W	323988-W		
1/8	3/64	8262R156	8262R169	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323986	323988		
1/8	3/32	8262R277	8262R178	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
1/8	3/32	8262R128	8262R236	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
1/8	1/8	8262R105	8262R174	NH	SF	-	●	A	V	E	J	N	T	-	VH	MS	MB	323593	323595		
1/8	1/8	8262R077 ⑥	-	-	SF	-	-	●	-	-	-	-	-	-	-	MB	325039	-			
1/8	1/8	8262R129	8262R237	NH	SF	-	●	A	V	E	J	N	T	-	VH	MS	MB	323987	323989		
1/4	3/64	8262R107 ⑤	8262R181 ⑤	-	-	-	-	-	-	-	-	-	-	●	-	-	MB	323593-W	323595-W		
1/4	3/64	8262R161 ⑤	8262R199 ⑤	-	SF	-	-	-	-	-	-	-	-	●	-	-	MB	323986-W	323988-W		
1/4	3/64	8262R260	8262R130	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323986	323988		
1/4	3/32	8262R109	8262R183	NH	SF	P	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
1/4	3/32	8262R261	8262R134	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
1/4	1/8	8262R232	8262R184	NH	SF	P	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
1/4	1/8	8262R262	8262R138	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
1/4	5/32	8262R202	8262R220	NH	SF	P	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
1/4	5/32	8262R263	8262R142	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
1/4	7/32	8262R208	8262R226	NH	SF	P	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
1/4	7/32	8262R264	8262R148	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
1/4	9/32	8262R212	8262R230	NH	SF	P	●	A	V	E	J	N	T	-	VH	MS	MB	323593	323595		
1/4	9/32	8262R265	8262R152	NH	SF	-	●	A	V	E	J	N	T	-	VH	MS	MB	323987	323989		
1/4	9/32	8262R078 ⑥	-	-	SF	-	-	●	-	-	-	-	-	-	-	MB	325039	-			
1/4	5/16	8223P025 ④	-	-	-	-	●	A	-	-	-	-	-	-	-	-	-	322815	-		
3/8	1/8	8263R115	8263R191	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
3/8	1/8	8263R070	8263R080	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
3/8	5/32	8263R200	8263R193	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
3/8	5/32	8263R071	8263R081	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
3/8	7/32	8263R124	8263R332	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
3/8	7/32	8263R072	8263R082	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
3/8	9/32	8263R210	8263R333	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323593	323595		
3/8	9/32	8263R073	8263R083	NH	SF	-	●	A	V	E	J	N	T	-	-	MS	MB	323987	323989		
3/8	5/16	8223P027 ④	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-	322815	-		
3/8	5/8	8210P093	-	-	-	-	●	-	V	E	J	N	-	-	VH	MO	MB	322670	-		
3/8	5/8	8210P033	-	-	-	-	●	-	V	E	J	N	-	-	VH	-	MB	322770	-		
3/8	5/8	8210P006	-	-	-	-	●	-	V	E	J	N	-	-	-	MO	MB	322654	-		
1/2	3/8	8223P003 ④	8223P010 ①	-	-	-	●	-	-	-	-	-	-	-	-	-	-	322816	322817		
1/2	5/8	8210P094	-	-	-	-	●	-	V	E	J	N	-	-	VH	MO	MB	322670	-		
1/2	5/8	8210P034	-	-	-	-	●	-	V	E	J	N	-	-	VH	-	MB	322770	-		
1/2	5/8	-	8210P087	-	-	-	●	-	V	E	J	N	-	-	-	MO	MB	-	322676		
1/2	5/8	8210P007	-	-	-	-	●	-	V	E	J	N	-	-	-	MO ③	MB	322654	-		
3/4	5/8	-	8210P088	-	-	-	●	-	V	E	J	N	-	-	-	MO	MB	-	322676		
3/4	3/4	8210P095	-	-	-	-	●	-	V	E	J	N	-	-	VH	MO	MB	322673	-		
3/4	3/4	8030P003	-	-	-	-	●	-	V	E	J	N	-	-	-	MO	MB	322758	-		
3/4	3/4	8210P035	-	-	-	-	●	-	V	E	J	N	-	-	VH	-	MB	322771	-		
3/4	3/4	8030P083	-	-	-	-	●	-	V	E	J	N	-	-	-	-	MB	322763	-		
3/4	3/4	8223P005 ④	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-	322818	-		
1	1	8210P004	-	-	-	-	●	-	V	E	J	N	-	-	-	MO	-	322677	-		
1 1/4	1 1/8	8210P008	-	-	-	-	●	-	V	E	J	N	-	-	-	MO	-	322680	-		
1 1/2	1 1/4	8210P022	-	-	-	-	●	-	V	E	J	N	-	-	-	MO	-	322680	-		
2	1 3/4	8210P100	-	-	-	-	●	-	V	E	J	N	-	-	-	MO	-	322682	-		

● = Standard. Other options may be available. All option combinations may not be available. Please consult your local ASCO contact.

① Valve contains PTFE main disc; ② Pressure rating reduced by 25%; ③ Pressure rating limited to 250 psi; ④ Valve contains Nylon 11 piston.

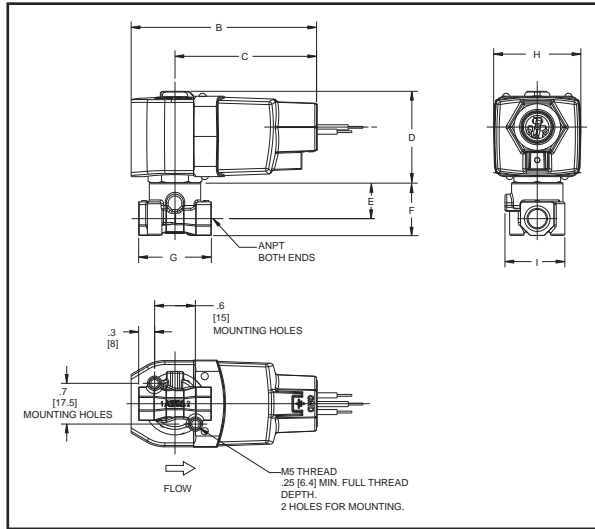
⑤ Cast UR disc supplied as standard, limits min. ambient temp. to 32°F (0°C). ⑥ Fuel gas service only; Ambient Temp. -40°F to 140°F; Fluid Temp. -40°F to 167°F; Gas capacity for 8262R077 is 18,700 Btu/hr, for 8262R078 53,500 Btu/hr based on 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.

⑦ NH suffix only available for Stainless Steel constructions. ⑧ 12-24V DC. ⑨ 24-120V AC/DC, 100-240V AC/DC.

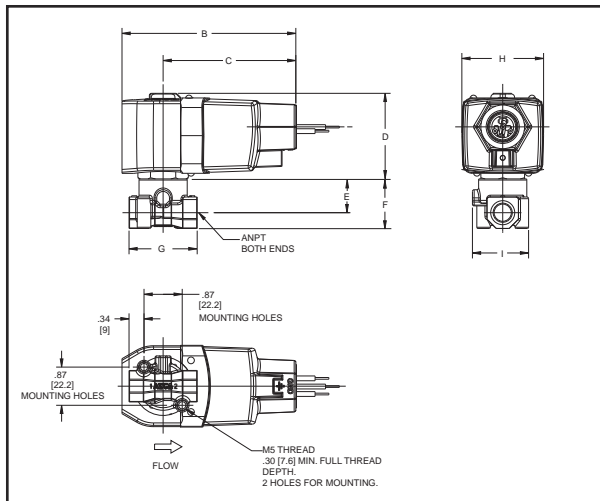
Dimensions: inches

Const. Ref.	B	C	D	E	F	G	H	I
1	3.98	3.04	2.00	0.69	1.00	1.19	1.87	1.24
2	3.98	3.04	2.00	0.78	1.11	1.56	1.87	1.29
3	3.98	3.04	2.00	0.77	1.20	1.88	1.87	1.25
4	3.98	3.04	2.00	1.28	1.84	2.75	1.87	2.28
5	3.98	3.04	2.00	1.05	2.31	-	1.87	3.03
6	3.98	3.04	2.00	1.13	2.31	-	1.87	3.13
7	3.98	3.04	2.00	1.46	2.19	2.81	1.87	2.28
8	3.98	3.04	2.00	1.44	2.13	2.81	1.87	2.28
9	3.98	3.04	2.00	1.61	3.03	-	1.87	3.6
10	3.98	3.04	2.00	2.21	3.67	3.75	1.87	-
11	3.98	3.04	2.00	2.36	4.14	4.38	1.87	3.92
12	3.98	3.04	2.00	2.75	5.52	5.06	1.87	4.72
15	3.98	3.04	2.00	1.72	2.18	2.75	1.87	2.28
16	3.98	3.04	2.00	1.88	2.57	2.81	1.87	2.28
17	3.98	3.04	2.00	0.85	1.81	2.81	1.87	2.28
18	3.98	3.04	2.00	0.77	1.20	1.88	1.87	1.25

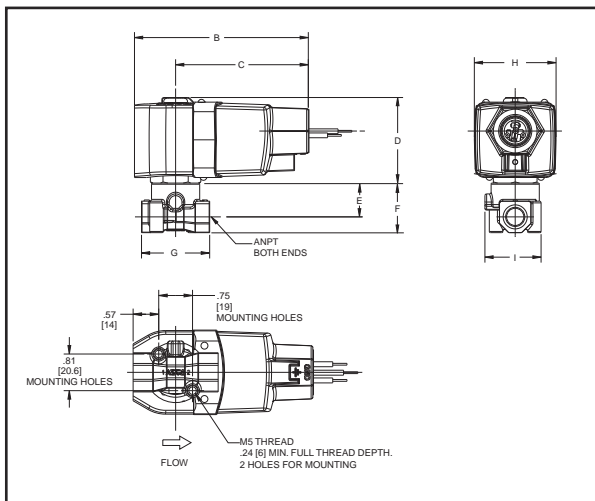
Const. Ref. 1



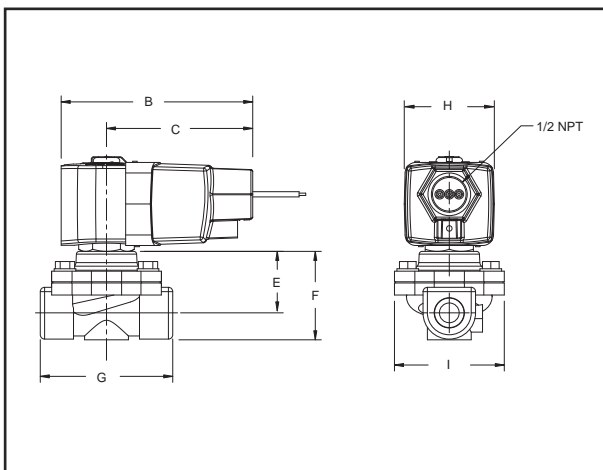
Const. Ref. 2



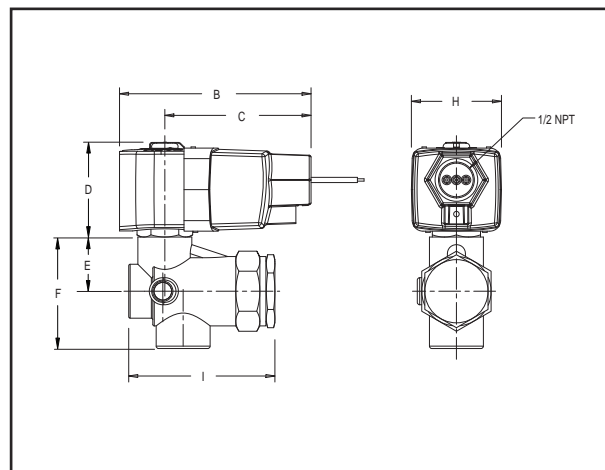
Const. Ref. 3



Const. Ref. 4, 7, 15, 16, 17

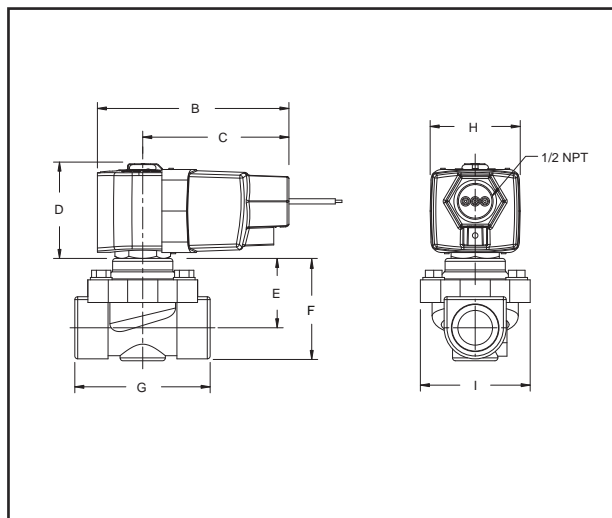


Const. Ref. 5, 6, 9

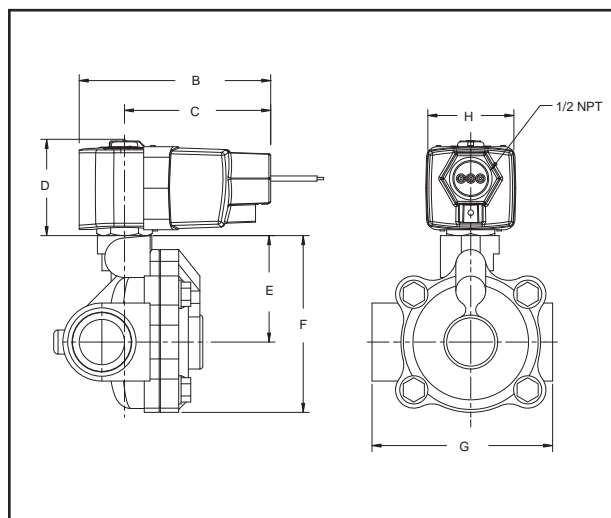


Dimensions: inches

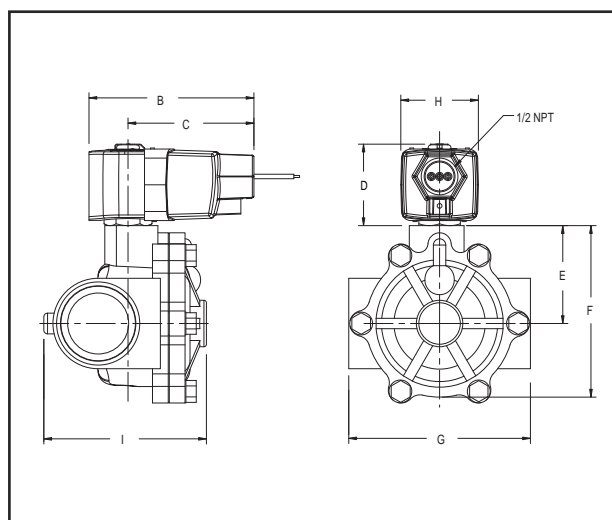
Const. Ref. 8



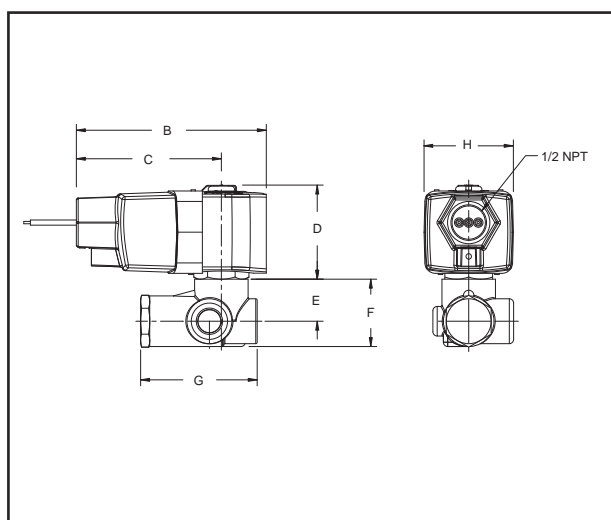
Const. Ref. 10



Const. Ref. 11, 12



Const. Ref. 18



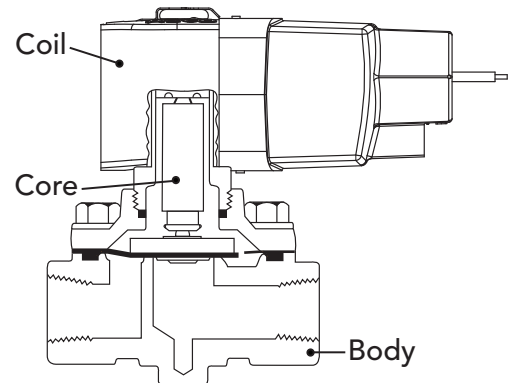
Engineering Section

Principles of Operation

A solenoid valve is a combination of two basic functional units:

- A solenoid (electromagnet) with its core.
- A valve body containing one or more orifices.

Flow through an orifice is controlled by the movement of the core when the solenoid is energized or de-energized. The core is enclosed in a sealed tube, providing a compact, leaktight assembly. For additional information on different types and functions of solenoid valves including direct acting, internally pilot operated valves, two-way, three-way, and four-way valves please visit our website at www.ascovalue.com.



Solenoids

All RedHat Next Generation solenoid valves are rated for continuous duty under the operating conditions outlined within this section.

Coil Operating Voltage Ranges

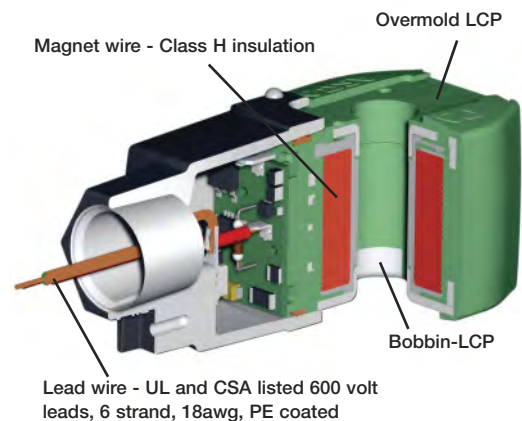
All coils are designed for industrial operating voltages and can be used on the following voltage ranges:

Voltage Range	Minimum Voltage	Maximum Voltage
100-240V/50 or 60Hz/DC	85	264
24-120V/50 or 60Hz/DC	20.4	132
12-24/DC only	10.4	26.4

The coils with voltage ranges of 100-240 and 24-120 have three lead wires, 24 inches long (2 red for power input, and one green lead for grounding where necessary). These two versions are not polarity sensitive.

The coil with a voltage range of 12-24/DC has 3 lead wires, one red, one black, and one green. This coil is polarity sensitive. The red lead is the positive, black is the negative, and green is the ground wire. This solenoid is also polarity protected. Reversing the polarity will not damage the coil, but the coil will not function until the correct polarity is applied.

Note: The 100-240 and 24-120 voltage range is also suitable for battery charging circuits designed around a 125/DC nominal voltage range.



Electrical Specifications

2 Watt Electronic Coils	Type
Maximum Ambient Temperature	140°F
Maximum Cycle Rate	1 Operation/ Second
Standard Coil Class of Insulation	H

Power Consumption

The Next Generation solenoid nominal power rating is 1.0 watt of power for 12-24V DC and 1.5 watts for 24-120V AC/DC, and 100-240V AC/DC.

The advanced technology used in the Next Generation coil includes electronic circuitry which may limit the compatibility with certain control system components. The following issues need to be considered when specifying an output card or device to operate the Next Generation coil. An initial inrush current spike is drawn by the Next Generation coil. This inrush spike is 72 msec in duration, which is sufficient time for the core to reach the plunger. The electrical requirement then drops to the holding value.

Inrush Current: The power source, wiring, and output device used need to have surge ratings equal to or greater than the inrush current value (appropriate to the voltage range) specified in the table below.

Inrush Current Rating	
Coil Version	Peak Inrush Current (Amps)
12-24/DC	3.2
24-120/50-60Hz/DC	1.4
100-240/50-60Hz/DC	0.32
Maximum Duration = 72 ms	

Holding Current: The power source, wiring, and output device used need to have continuous current ratings equal to or greater than the holding current value (appropriate to the voltage range) specified in the table below.

Holding Current Rating			
Coil Version	Input Voltage	Average Holding Current (Amps)	Average Holding Volt-Amps (VA)
12-24/DC	12	0.230	2.8
	24	0.190	4.5
24-120/50-60Hz/DC	24	0.140	3.4
	120	0.070	8.8
100-240/50-60Hz/DC	100	0.044	4.4
	240	0.032	7.8

Supervisory/Leakage Currents:

The leakage current is defined as a current that is supplied from an output device when the device is in its off or de-activated state. The Next Generation coil is suitable for systems using supervisory currents that do not exceed the drop-out currents noted in the table below.

Supervisory/Leakage Current Rating	
Coil Version	Drop-out Current (mA)
12-24/DC	20
24-120/50-60Hz/DC	15
100-240/50-60Hz/DC	7
Important: Supervisory and leakage currents above the drop-out current listed with cause improper operation. Consult your local ASCO Sales office for additional assistance.	

Solenoid Enclosures

The Next Generation solenoid coil is fully encapsulated using Dupont™ Zenite® Liquid Crystal Polymer resin (LCP). Zenite (LCP) is a thermoplastic polyester resin which exhibits several advantages over other thermoplastics. The advantages include excellent resistance to a wide range of organic solvents and automotive fluids*, resistance to impact, and long term retention of properties at continuous-use temperatures.

*Chemical resistance of Zenite LCP may not be suitable for all applications. Zenite LCP is not suitable for caustic solution. Please consult ASCO for appropriate product solutions.

Zenite is a registered Trademarks of E. I. du Pont de Nemours and Company.



General Purpose/Watertight – Intended for indoor and outdoor use and provides protection classifications from NEMA types 1 through 4X.

Type 1 General Purpose – Intended for indoor use, primarily to provide protection for enclosed parts in locations without unusual service conditions. DIN-type terminals meeting ISO 4400 and DIN Standard 43650.

Type 2 Dripproof – Intended for indoor use, primarily to provide protection against limited amounts of falling water or dirt.

Type 3 Raintight, Dusttight, and Sleet (Ice) Resistant – Intended for outdoor use, primarily to provide protection against wind-blown dust, rain, and sleet; undamaged by the formation of ice on the enclosure.

Type 3S Raintight, Dusttight, and Sleet (Ice) Resistant – Intended for outdoor use, primarily to provide protection against wind-blown dust, rain, and sleet; external mechanism remains operable when ice laden.

Type 3R Rainproof, Sleet (Ice) Resistant – Intended for outdoor use, primarily to provide protection against falling rain and sleet; undamaged by the formation of ice on the enclosure.

Type 4 Watertight and Dusttight – Intended for indoor or outdoor use to provide protection against splashing water, water seepage, falling or hose-directed water, and severe external condensation; undamaged by the formation of ice on the enclosure.

Type 4X Watertight, Dusttight, and Corrosion Resistant – Same as Type 4 but provides additional protection to resist corrosion.

Class I, Division 2 for Hazardous Locations/Watertight – Meets Types 1 through 4X and is UL listed and CSA certified for Class I, Division 2, Groups A, B, C, and D and Class II, Division 2, Groups F and G. Operating temperature code T4A (120°C).

Valve Specifications

Minimum Operating Pressure Differential

The minimum operating pressure differential is required to fully open the valve and keep it open. For 2-way valves with a floating diaphragm, the valve may start to close below the minimum pressure differential. For 3 and 4-way valves, the minimum operating pressure differential is measured between the pressure and exhaust ports and must be maintained through the operating cycle to ensure complete transfer from one position to the other.

Note: Hung diaphragm constructions do not require a minimum pressure differential, however, may not yield maximum flow rates at low-pressure differentials.

Maximum Operating Pressure Differential (MOPD)

The maximum operating pressure differential refers to the maximum difference in pressure between the inlet and outlet ports, against which the solenoid can safely operate the valve. If the pressure at the outlet is not known, it is safest to regard the supply pressure as the MOPD.

Minimum Ambient Temperature

The nominal limitation of 32°F (0°C) is advisable for any valve that might contain moisture (water vapor). Where freezing water is not a factor, the minimum ambient temperature of the products listed in this catalog is 14°F (-10°C). For 8262/8263/8314 Series, the minimum ambient temperature is -13°F (-25°C). Special constructions are available with low temperature elastomers to provide service at -40°F (-40°C) ambient temperatures. Consult ASCO for more information.

Maximum Ambient Temperature

The maximum ambient temperature is 140°F (60°C). This limit is based on continuous energization with the maximum fluid temperatures as shown on each catalog page.

Response Time

Response time from fully closed to fully open or vice versa depends on valve size, operating mode, fluids, temperature, inlet pressure, and pressure drop. The response times for Next Generation are defined as:

- Small direct acting valves – 10 to 60 msec
- Large direct acting valves – 25 to 90 msec

Internally pilot operated valves:

- Small diaphragm types – 20 to 100 msec
- Large diaphragm types – 80 to 150 msec
- Small piston types – 80 to 150 msec
- Large piston types – 105 to 200 msec

Operation on liquids has relatively little effect on small direct acting valves, however, response times of large direct acting and internally piloted valves may be lengthened by 50% to 100%.

Viscosity

All valves with a pressure rating for light oil are designed for use with oils rated for a maximum of 300 SSU's with the following exceptions:

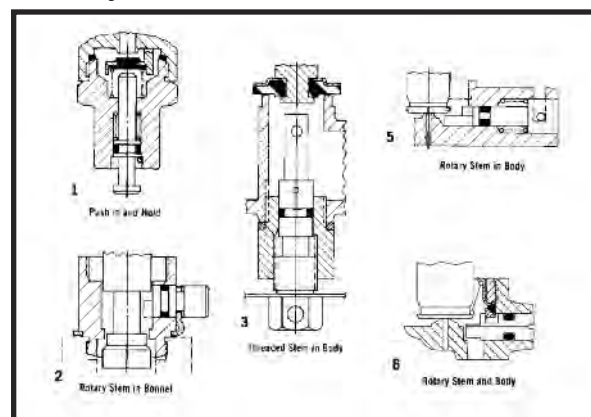
- Series 8314, 8317, 8321 – 45 SSU
- Series 8345 – 50 SSU

Manual Operators

Manual operators are provided to operate the valves manually when electric actuation is not provided. There are two basic types of manual operators, momentary and maintained. To determine which type of manual operator is available for your valves, please see the Optional Features Chart on the relevant valve catalog page. Once it is determined that the subject valve can accommodate a manual operator, the chart below will tell you the type of manual operator. The chart also references the relevant cutaway illustration.

Series Number	Const. Ref.	Manual Operator Suffix	Manual Operator Type	Illustration Number
8030	8	MO	Maintained	3
8210	4, 7, 10, 11, 12	MO	Maintained	2
8262	1	MS	Maintained	6
8263	1	MS	Maintained	6
8314	1	MS	Maintained	6
8316	5, 6	MO	Maintained	2
8320	2	MO	Momentary	1
8320	2	MS	Maintained	6
8321	4	MO	Momentary	1
8321	4	MS	Maintained	3
8344	1, 3, 4	MO	Maintained	2
8345	2	MO	Maintained	5

Cutaway Illustrations



Resilient Material Selection

Acetal (POM) – A high performance engineered plastic with good fatigue life, low moisture sensitivity, and high resistance to solvents and chemicals.

EPDM (Ethylene Propylene) – EPDM is selected for applications above the NBR temperature range, such as handling hot water and steam. Ethylene propylene has an extremely wide range of fluid compatibility, but has the distinct disadvantage that it cannot be used with petroleum-based fluids or contaminated fluids (such as lubricated air). It has a useful temperature range of -10°F to 300°F (-23°C to 149°C).

FKM – FKM is a fluorocarbon elastomer primarily developed for handling such hydrocarbons as jet fuels, gasolines, solvents, etc., which normally cause detrimental swelling to NBR. FKM has a high temperature range similar to EPDM, but more resistant to “dry heat.” FKM has a wide range of chemical compatibility. It has a useful temperature range of 0°F to 350°F (-18°C to 177°C).

CR (Chloroprene, Neoprene) – CR is principally used as an external seal in refrigeration applications. It is also utilized for oxygen service. It has a useful temperature range of 0°F to 180°F (-18°C to 82°C).

NBR (Buna "N", Nitrile) – NBR is commonly referred to as a nitrile rubber and is the standard synthetic elastomer for accomplishing resilient-type seating or sealing in ASCO valves. It has excellent compatibility for most air, water, and light oil applications. It has a useful temperature range of 0°F to 180°F (-18°C to 82°C).

Oxygen Service – All valve parts are degreased and blacklight inspected for cleanliness. They are assembled and tested in a clean area using oil-free air or nitrogen; helium mass spectrometer tested for external leakage. The pipe connections are sealed with plugs, and each valve is tagged certifying testing. All valves are shipped in sealed bags.

PTFE – PTFE and PTFE with fillers are considered more a plastic than a resilient-type material. They are virtually unattacked by any fluid. Their temperature usage has ranges from discs for cryogenic valves to discs for steam valves. They are not easily fabricated and are known to have “cold flow” characteristics which may contribute to objectionable leakage, particularly on gases.

Urethane – Urethane is primarily used on high pressure valves, and/or for long life applications, because of its high strength and abrasion resistance. The physical and chemical properties of urethane vary depending on whether the compound is polyester or polyether based. Urethane has a wide range of chemical resistance including alcohols, non-aromatic compounds, ethers, edible fats and oils, hydraulic fluid, and water. It has a useful temperature range of -90°F to 200°F for ethers, and -30°F to 200°F for esters. Polyester based Urethanes in contact with moisture should be limited to a maximum temperature of 140°F.

Valve Parts in Contact with Fluids						
Series	Body	Seals and Discs	Disc Holder	Core Guide	Springs	Shading Coil
8030	Brass	NBR	-	-	302 Stainless Steel	Copper
8210	304 Stainless Steel	NBR	-	-	302 Stainless Steel	Silver
	Brass	NBR	①	-	302 Stainless Steel	Copper
8223	304 Stainless Steel	PTFE, NBR	-	-	302 Stainless Steel	Silver
	Brass	NBR, PA, PTFE	-	-	302 Stainless Steel	Copper
8262 (≤ 750 psi)	304 Stainless Steel	NBR	-	-	302 Stainless Steel	Silver
8262 (> 750 psi)	304 Stainless Steel	UR	-	-	302 Stainless Steel	Silver
8262 (≤ 750 psi)	Brass	NBR	-	-	302 Stainless Steel	Copper
8262 (> 750 psi)	Brass	UR	-	-	302 Stainless Steel	Copper
8262R077	Brass	LT NBR	-	POM	Inconel	Copper
8262R078	Brass	LT NBR	-	POM	Inconel	Copper
8263	304 Stainless Steel	NBR	-	-	302 Stainless Steel	Silver
8263	Brass	NBR	-	-	302 Stainless Steel	Copper
8314	304 Stainless Steel	NBR, FKM	-	POM	302 Stainless Steel	Silver
8314	Brass	NBR, FKM	-	POM	302 Stainless Steel	Copper
8316	Brass	NBR	POM	POM	302, 17-7PH Stainless Steels	Copper
8317	Brass	NBR, FKM, CR	-	POM	302, 17-7PH Stainless Steels	Copper
8320	303 Stainless Steel	NBR	POM	POM	302 Stainless Steel	Silver
8320	Brass	NBR	POM	POM	302 Stainless Steel	Copper
8321	Brass	NBR	POM	POM	302 Stainless Steel	Copper
8344	Brass	NBR	POM	POM	302, 17-7PH Stainless Steels	Copper
8345	Brass	NBR, PA	-	POM	302 Stainless Steel	Copper
8551	316 Stainless Steel	NBR, PA	-	POM	302 Stainless Steel	Copper
8551	Anodized Aluminum	NBR, PA	-	POM	302 Stainless Steel	Copper

Note: All core tubes are 305 stainless steel and all cores and plugnuts are 430F stainless steel. ① 8210P033, 8210P034, and 8210P035 with PA Disc Holder

Approvals

Approval Listing Code and Information

UL, CSA, and CE listings are indicated on each series of valves in this catalog. Listing codes and other information follow in this section.

Agency Valve Classifications and Code Reference

Solenoid Recognized Components – Solenoids in this category are intended for use as factory-installed components of equipment where final acceptability must be determined by UL or CSA. ASCO RedHat Next Generation solenoids are listed in the UL recognized component index under Guide No. YSY12 for ordinary locations and VAPT for hazardous locations.

General Purpose Valves – Normally open or normally closed valves intended to control the fluid flow, but not to be depended upon to act as safety valves. This is a UL and CSA classification and is not intended to indicate valve service or application. General purpose valves are listed in UL index under Guide No YIOZ or YIOZ2 for ordinary locations and YTSX or YTSX2 for hazardous locations.

Safety Shutoff Valves – Normally closed valves of the “on” and “off” type, intended to be actuated by a safety control or emergency device, to prevent unsafe fluid delivery. They may also be used as General Purpose valves. Multiple port valves may be designated as safety shutoff valves only with respect to the normally closed port. This is a UL and CSA classification. Safety shutoff valves are listed in UL index under Guide YIOZ or YIOZ2 for ordinary locations and YTSX or YTSX2 for hazardous locations.

Underwriters Laboratories (UL)

UL429, “Electrically Operated Valves.”

UL1604, “Electrical Equipment for use in Class I and II, Division 2 and Class III hazardous classified locations.”

Canadian Standards Association (CSA)

Standard C22.2 No. 139, “Electrically Operated Valves.”

Standard C22.2 No. 213, “Electrical equipment for use in Class I, Division 2 hazardous locations.”

European Directive (CE)

The council of the European Communities under the treaty establishing the European Economic Community (EEC) adopted into law a series of directives to harmonize technical standards. Solenoid valves may be controlled by:

Council	Directive #
EMC(Electromagnetic Capability)	2004/108/7EC
Low Voltage	206/95/EC
PED(Pressure Equipment Directive)	97/23/EC

ASCO RedHat Next Generation valves comply with these directives as applicable, through third party or self-certification. The General Purpose/Watertight coils each bear the CE approval mark on the coil.



Quality Assurance

ASCO's Quality Assurance Program meets all the requirements of ISO9001-2008. ASCO can provide product from 17 ISO-certified facilities around the world.



Valves, Automation & Controls

Series 50M76

2-PIECE BALL VALVE

Design Features

- Full port
- 1000 CWP
- 316 Stainless Steel ASTM A351 CF8M
- Threaded Ends Connections
- Blow-out proof stem
- Lockable Lever Handle

1/4" - 50M76

1" - 50M76

Applicable Standards

- Threaded Ends ASME B16.11
- Shell and Seat Pressure Test ASME B16.34

Options

- Lockable Oval Handle
- Stem Extension, 2-1/2", Non-Locking



USA 800-766-0076

Fax 323-890-4456

www.smithcooper.com

www.sharpevalves.com

Los Angeles, CA

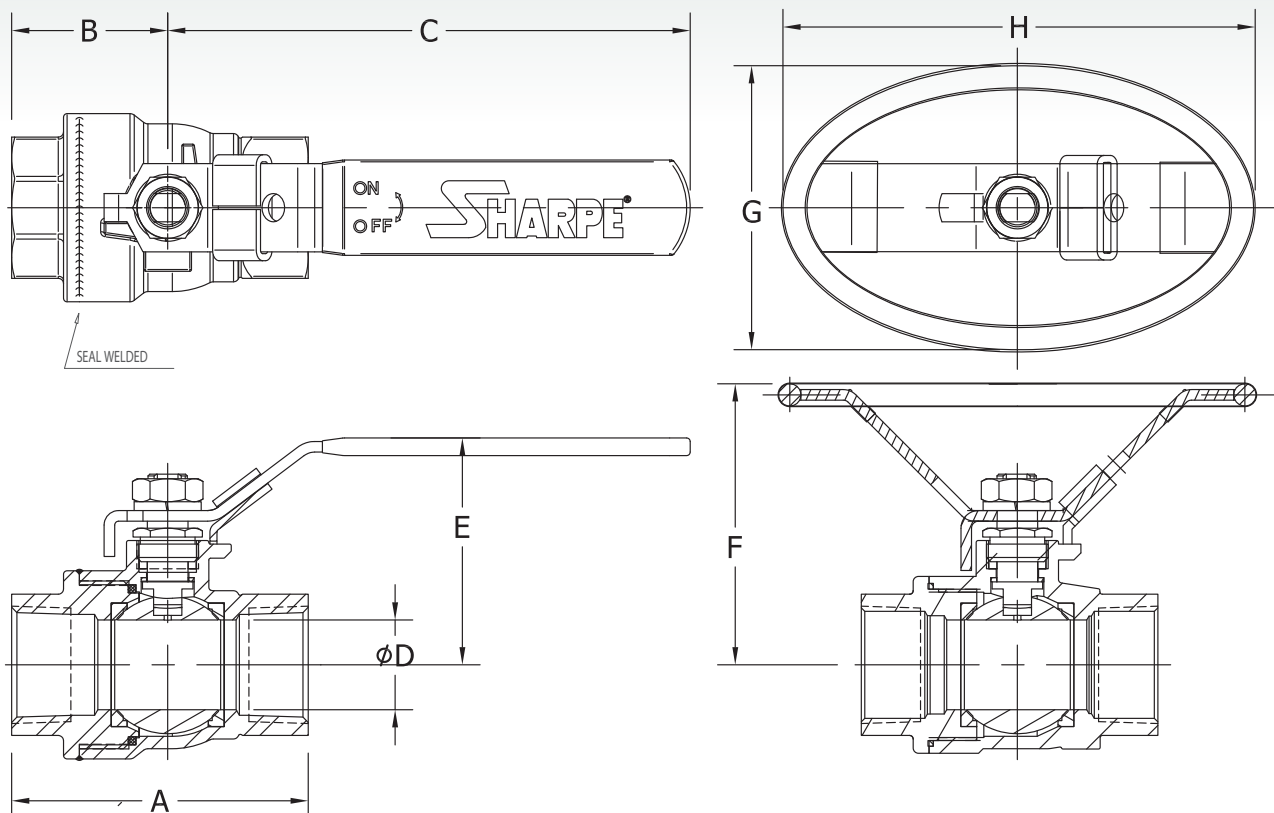
Chicago, IL

Atlanta, GA

Vancouver, WA

Houston, TX

Dimensions



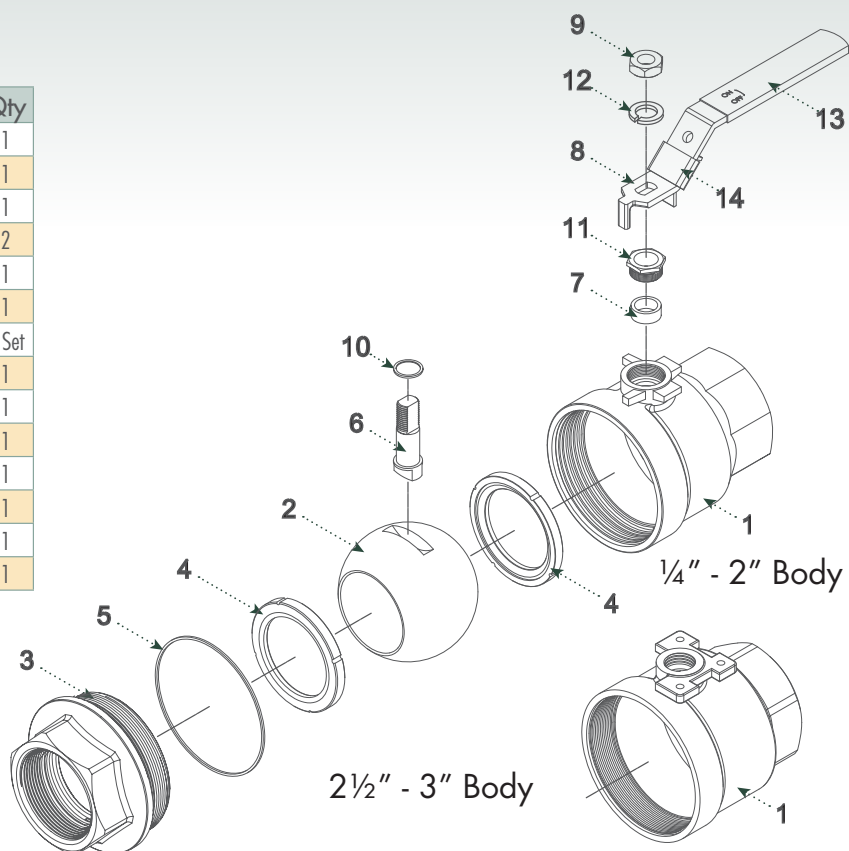
Dimensions (Inches)

Size	A	B	C	D	E	F	G	H
1/4	2.00	1.02	4.00	0.50	1.81	2.24	2.16	3.39
3/8	2.00	1.02	4.00	0.50	1.81	2.24	2.16	3.39
1/2	2.36	1.17	4.00	0.59	1.89	2.26	2.16	3.39
3/4	2.75	1.48	5.00	0.80	2.04	2.90	2.76	4.33
1	3.25	1.74	5.75	1.00	2.44	3.20	3.18	5.26
1-1/4	3.80	1.91	5.75	1.25	2.56	3.40	3.18	5.26
1-1/2	4.33	2.17	7.50	1.50	2.96	4.20	4.13	6.47
2	5.27	2.64	7.50	2.00	3.25	4.51	4.13	6.47
2-1/2	6.58	3.28	9.73	2.56	5.00	-	-	-
3	7.55	3.78	9.73	3.00	5.40	-	-	-

Series 50M76 2-PIECE BALL VALVE

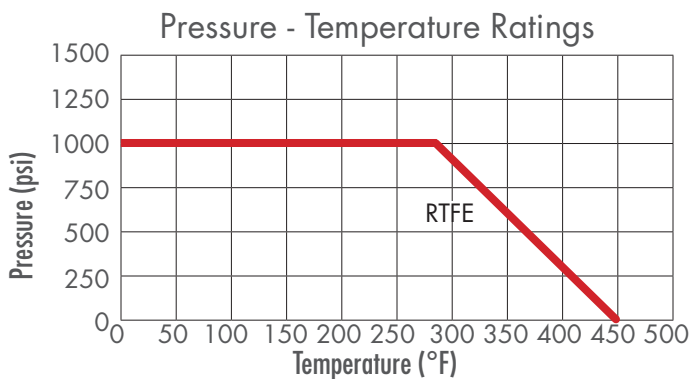
Parts & Materials

No.	Part Name	Material	Qty
1	Body	316 Stainless Steel ASTM A351 CF8M	1
2	Ball	316 Stainless Steel	1
3	End Piece	316 Stainless Steel ASTM A351 CF8M	1
4	Seat	RTFE	2
5	Body Seal	PTFE	1
6	Stem	316 Stainless Steel	1
7	Stem Packing	RTFE	1 Set
8	Handle	300 Series Stainless Steel	1
9	Handle Nut	300 Series Stainless Steel	1
10	Thrust Bearing	RTFE	1
11	Packing Nut	300 Series Stainless Steel	1
12	Lock Washer	300 Series Stainless Steel	1
13	Handle Sleeve	PVC	1
14	Locking Device	300 Series Stainless Steel	1



Technical Information

Size	C _v	Weight (lbs.)
1/4	6	0.6
3/8	6	0.6
1/2	24	0.6
3/4	35	1.1
1	47	1.8
1-1/4	81	3.0
1-1/2	105	4.2
2	241	8.0
2-1/2	319	14.0
3	580	22.8



How To Order

Size	Series	Options
1/4	50M76	OH Oval Handle NLS Non-Locking Stem Extension, 2-1/2"
3/8		
1/2		
3/4		
1		
1-1/4		
1-1/2		
2		
2-1/2		
3		

Example: 1/4 + 50M76 = 1/4"-50M76

D80 Series

Dry or Liquid Filled • Stainless Steel Case

UTILITY GAUGES



D82LFB shown



1 1/2", 2", 2 1/2", 4" Dial Sizes

±1.6% Accuracy

Stainless Steel Case

Glycerine Fill Standard

The Trerice **D80 Series** Utility Gauge is designed for rugged performance requirements at an economical cost. This liquid filled gauge is furnished with a stainless steel case and crimped ring. Wetted parts are either bronze tube with brass socket or stainless steel.

- Optional features and case style variations available: Please consult the Options & Accessories Section for details.
- For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.

Specifications

Models	Wetted Parts	
D82B	(dry)	Bronze tube, brass socket
D82LFB	(liquid filled)	
D83SS	(dry)	316 Stainless steel
D83LFSS	(liquid filled)	tube & socket
Dial Sizes	1 1/2", 2", 2 1/2", 4"	
Fill	Glycerine, other fills available See Optional Features Section	
Movement	D82: Brass D83: 316 Stainless steel	
Connection	Lower male or center back male, Lower back male on 4" D83	
Case	304 stainless steel, stem-mounted flangeless	
Ring	Crimped 304 stainless steel	
Window	Acrylic	
Pointer	Plain, black finished	
Dial Face	Aluminum, white background with black graduations and markings	
Additional Features	Restrictor screw standard on D83LFSS and D83SS	
Accuracy	±1.6% Full Scale	
Maximum Temperature	150°F (65°C)	
Approximate Shipping Weight	1 1/2" Dial Size: 0.4 lbs [0.18 kg] 2" Dial Size: 0.4 lbs [0.18 kg] 2 1/2" Dial Size: 0.5 lbs [0.23 kg] 4" Dial Size: 1.0 lbs [0.45 kg]	

HOW TO ORDER

Sample Order Number: **D82LFB 25 02 L A 110**

Model	Dial Size	Connection Size	Connection Location	Units of Measure	Range Code
D82LFB	15 1 1/2"	01 1/8 NPT*	L Lower	A psi	See Standard Ranges
D83LFSS	20 2"	02 1/4 NPT**	B Back	D psi/kPa	
D82B	25 2 1/2"				
D83SS	40 4"				

* 1/8 NPT connection size not available with 4" dial size.

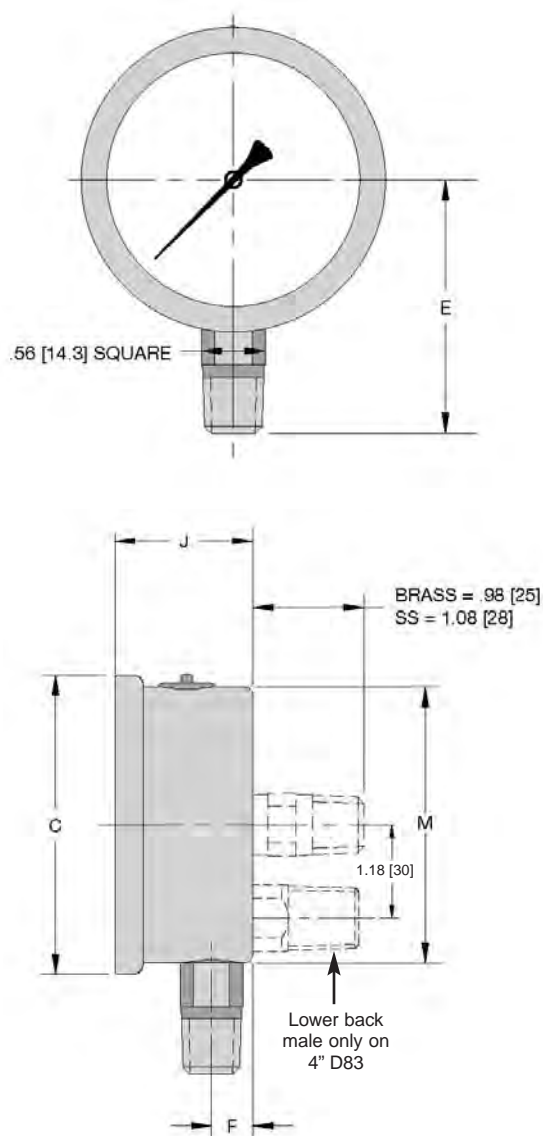
** 1/4 NPT connection size not available with 1 1/2" dial size.

D80 Series

All dimensions are nominal. Dimensions in [] are in millimeters.

Dry or Liquid Filled • Stainless Steel Case

UTILITY GAUGES



Standard Ranges

psi Ranges (A)		D82		D83	
Range Code	Specific Range (psi)	Figure Intervals	Minor Divisions	Figure Intervals	Minor Divisions
010	30" Hg to 0	5	0.5	5	0.5
020	30" Hg to 15 psi	10/5	1/0.5	10/5	1/0.5
030	30" Hg to 30 psi	10/10	2/1	10/5	2/1
040	30" Hg to 60 psi	10/10	2/2	10/10	2/1
050	30" Hg to 100 psi	30/20	2/2	30/20	5/2
060	30" Hg to 150 psi	30/30	10/5	30/30	10/5
070	30" Hg to 300 psi	30/50	10/5	30/50	10/5
080	0 to 15 psi	3	0.2	3	0.2
090	0 to 30 psi	5	0.5	5	0.5
100	0 to 60 psi	10	1	10	1
110	0 to 100 psi	20	2	10	2
120	0 to 160 psi	20	2	20	2
130	0 to 200 psi	20	2	20	2
140	0 to 300 psi	50	5	50	5
150	0 to 400 psi	50	5	50	5
160	0 to 600 psi	100	10	100	10
180	0 to 1000 psi	100	25	100	20
190	0 to 1500 psi	300	20	300	25
200	0 to 2000 psi	200	20	200	25
210	0 to 3000 psi	500	50	500	50
220	0 to 5000 psi	1000	100	1000	100

230	0 to 10000 psi	N/A	N/A	N/A	N/A
240	0 to 15000 psi	N/A	N/A	N/A	N/A

For dual scale ranges specify the appropriate **Units of Measure: D (psi/kPa)** followed by the corresponding **A (psi) Range Code**

Dial Size	C	E	F	J	M
1 1/2" D82	1.85 [47]	1.50 [38]	0.32 [8]	1.06 [27]	1.61 [41]
1 1/2" D83	1.85 [47]	1.50 [38]	0.32 [8]	1.06 [27]	1.61 [41]
2" D82	2.28 [58]	1.89 [48]	0.39 [10]	1.14 [29]	2.05 [52]
2" D83	2.28 [58]	2.05 [52]	0.35 [9]	1.18 [30]	2.05 [52]
2 1/2" D82	2.68 [68]	2.24 [57]	0.39 [10]	1.18 [30]	2.44 [62]
2 1/2" D83	2.68 [68]	2.32 [59]	0.51 [13]	1.38 [35]	2.44 [62]
4" D82	4.29 [109]	3.07 [78]	0.47 [12]	1.42 [36]	3.90 [99]
4" D83	4.29 [109]	3.94 [100]	0.75 [19]	1.93 [49]	3.94 [100]

Small Control Valve

Type 807

DESCRIPTION

For more than 60 years, the Type 807 valve has performed in some of the world's most demanding applications. If your application requires critical control of liquid, gas or steam, your choice of control valves is one of the most important decisions you will make.

When it comes to specifying a control valve, the variables are complicated and exacting. That is why Research Control® Valves are available in a broad range of options—so we can design a truly engineered solution that matches your requirements.

APPLICATION

Processing plants, research facilities and government agencies worldwide rely on Research Control Valves for repeatable performance and durability. Built for applications 1 in. (25.4 mm) and under, our 807 control valve is an integral component in systems ranging from petrochemical to pharmaceutical manufacturing. It is an ideal choice for additive injection or flow and pressure control.

CONSTRUCTION

Body – Bonnet	
Standard	316/316L stainless steel, carbon steel (WCB)
Optional	Monel®, alloy 20, Hastelloy® C or ASTM equivalent, DIN 1.4581/1.4571. Other materials available upon request.
Innervalue	
Standard	316 stainless steel
Optional	Stellite®, Monel, alloy 20, Hastelloy C or B or ASTM equivalent
Packing	
Standard	TFE chevron rings
Optional	Graphite, Reduced Emissions Kalrez® (REK)
Actuator	
Standard	Die cast aluminum
Optional	316L stainless steel on 1/2", 3/4" and 1" models

ACTUATOR CHOICES

Standard	Air to open, fail close Air to close, fail open
Optional	With integral top-mounted positioner
Standard Signals	3-15#, 3-27#, 6-30#
Optional Signals	3-9#, 9-15#, with positioner
Accessories	Filter regulator, gauges, I/P converter, limit switches, handwheel, solenoids



Shown with Type 754 Actuator

STANDARD FEATURES

- 1/4 in. (6.4 mm), 1/2 in. (12.7 mm), 3/4 (19.1 mm) and 1 in. (25.4 mm) models
- Interchangeable trim sets
- Threaded bonnet for quick disassembly
- Trim characteristics: Linear, equal percent, quick open or double taper
- TFE chevron packing
- ANSI Class IV shutoff (size O and larger)

OPTIONAL FEATURES FOR 1/2 IN. (12.7 MM), 3/4 IN. (19.1 MM) AND 1 IN. (25.4 MM) MODELS

- Butt and socket weld ends, BSPP, tube connection and others
- Bonnet extensions for temperature extremes
- Bellows packing solutions
- Angle pattern bodies
- Reduced Emissions Kalrez® (REK), graphite, spring loaded chevron and others
- Exotic alloys for complete valves or trims
- Stellite trims & soft seats (PTFE & Kel-F)
- TiN coating of innervalue stem and seat
- Purge or leak ports

PRESSURE VS TEMPERATURE RATINGS FOR VALVE SUPERSTRUCTURE

The pressure/temperature ratings listed here are based on material cross sections at the joint between the body and bonnet where a gasketed screw type bonnet is used. When the proper torque levels are used, the valve should not experience rupture of the joint or the material. The listed torque levels were used in hydrostatic tests at the factory at 70° F (21.1° C) at maximum body rating and were found to provide acceptable seating. Other factors, such as high or cyclic temperatures, light process gases, or poor gasket surfaces can dictate the ability of a seal to be made. Under such conditions, the only way to be sure of tight sealing is to perform a test under the actual process conditions.

These charts are not intended as an indication of functionality or suitability for control service. Other charts are available to assist in the choosing of valve type, bonnet type, trim type and actuator.

When flanges, fittings or other pressure containing elements are added to the valve, the pressure rating of the total valve assumes the rating of the weakest component.

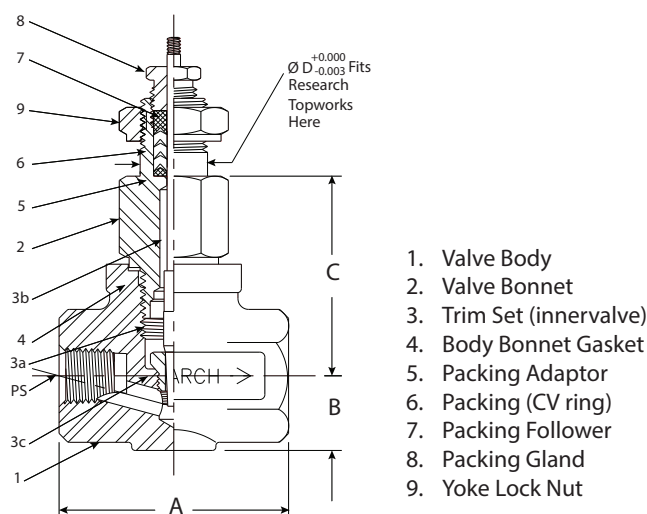
The following charts exclude packing or end fittings:

1/4 in. Research Control Valve						
Temp	316 S/S	Carbon Steel	Hastelloy B or =	Hastelloy C or =	Monel	Alloy 20
100° F (37.8° C)	5000	4000	5000	5000	4000	5000
200° F (93.3° C)	5000	3700	5000	5000	4000	5000
300° F (148.9° C)	4750	3500	5000	5000	3880	4850
400° F (204.4° C)	4190	3200	5000	5000	3770	4700
500° F (260.0° C)	4000	2900	4900	4900	3740	4500
600° F (315.6° C)	3820	2600	4850	4850	3740	4200
700° F (371.1° C)	3640	2300	4800	4800	3640	3900
800° F (426.7° C)	3580	—	4750	4750	3580	3700
900° F (482.2° C)	2840	—	—	4500	2280	3000
1000° F (537.8° C)	1160	—	—	4000	940	1500
1100° F (593.3° C)	Consult factory for higher temperatures.			3500	—	—
1200° F (648.9° C)				3000	—	—
Rec. Torque ft lb (+/- 2 ft-lb)	37	37	39	37	31	35

1/2 in. Research Control Valve						
Temp	316 S/S	Carbon Steel	Hastelloy B or =	Hastelloy C or =	Monel	Alloy 20
100° F (37.8° C)	5000	4000	5000	5000	4000	5000
200° F (93.3° C)	4750	3800	5000	5000	3780	5000
300° F (148.9° C)	4310	3600	5000	5000	3520	4950
400° F (204.4° C)	3860	3300	5000	5000	3420	4850
500° F (260.0° C)	3640	3100	4900	4900	3390	4600
600° F (315.6° C)	3470	2900	4850	4870	3390	4300
700° F (371.1° C)	3310	2700	4800	4610	3310	4200
800° F (426.7° C)	3255	—	4750	4430	2090	4000
900° F (482.2° C)	3190	—	—	4200	2070	3000
1000° F (537.8° C)	1860	—	—	4000	850	1500
1100° F (593.3° C)	Consult factory for higher temperatures.			3400	—	—
1200° F (648.9° C)				3000	—	—
Rec. Torque ft lb (+/- 2 ft lb)	122	122	131	124	102	117

3/4 in. and 1 in. Research Control Valve				
Temp	316 S/S		Carbon Steel	
	3/4 in. (19.1 mm)	1 in. (25.4 mm)	3/4 in. (19.1 mm)	1 in. (25.4 mm)
100° F (37.8° C)	1500	1500	1500	1500
200° F (93.3° C)	1450	1450	1350	1350
300° F (148.9° C)	1325	1325	1325	1325
400° F (204.4° C)	1175	1175	1275	1275
500° F (260.0° C)	1100	1100	1200	1200
600° F (315.6° C)	1050	675	1100	1100
700° F (371.1° C)	840	250	1075	1075
800° F (426.7° C)	575	—	—	—
3/4 in. and 1 in. Torque = 290 ft-lb				

DIMENSIONS



PS	A	B	C	D	Stroke
0.25 in. (6.4 mm)	2.12 in. (53.8 mm)	0.68 in. (17.3 mm)	1.87 in. (47.5 mm)	0.625 in. (115.9 mm)	0.437 in. (11.1 mm)
0.50 in. (12.7 mm)	2.75 in. (69.9 mm)	1.00 in. (25.4 mm)	2.85 in. (72.4 mm)	0.875 in. (22.2 mm)	0.562 in. (14.3 mm)
0.75 in. (19.1 mm)	3.37 in. (85.6 mm)	1.18 in. (30.0 mm)	3.84 in. (97.5 mm)		
1 in. (25.4 mm)	4.00 in. (101.6 mm)	1.50 in. (38.1 mm)	3.95 in. (100.3 mm)		

INNERVALVE CHART

Valve Size	Trim Designation	Max Cv	Orifice Dia.	Orifice Area	Nominal Rangeability Linear	Equal %
1 in. (25.4 mm)	6.0	6.0	0.6250 (15.9 mm)	0.3068 in. ² (197.9 mm ²)	50:1	60:1
	5.0	5.0	0.6250 (15.9 mm)	0.3068 in. ² (197.9 mm ²)	50:1	60:1
	4.5	4.5	0.5000 (12.7 mm)	0.1963 in. ² (126.6 mm ²)	50:1	60:1
3/4 in. (19.1 mm) and 1 in. (25.4 mm)	4.0	4.0	0.5000 (12.7 mm)	0.1963 in. ² (126.6 mm ²)	50:1	60:1
	3.5	3.5	0.5000 (12.7 mm)	0.1963 in. ² (126.6 mm ²)	50:1	60:1
	A	2.5	0.3750 (9.5 mm)	0.1104 in. ² (71.2 mm ²)	40:1	50:1
1/2 in. (12.7 mm), 3/4 in. (19.1 mm) and 1 in. (25.4 mm)	B	2.0	0.3750 (9.5 mm)	0.1104 in. ² (71.2 mm ²)	40:1	50:1
	C	1.25	0.2810 (7.1 mm)	0.0620 in. ² (40.0 mm ²)	40:1	50:1
	D	0.8	0.2500 (6.4 mm)	0.0491 in. ² (31.7 mm ²)	40:1	50:1
	E	0.5	0.2500 (6.4 mm)	0.0491 in. ² (31.7 mm ²)	40:1	50:1
	F	0.32	0.1560 (3.9 mm)	0.0191 in. ² (12.3 mm ²)	30:1	40:1
1/4 in. (6.4 mm), 1/2 in. (12.7 mm), 3/4 in. (19.1 mm) and 1 in. (25.4 mm)	G	0.2	0.1560 (3.9 mm)	0.0191 in. ² (12.3 mm ²)	30:1	40:1
	H	0.13	0.1560 (3.9 mm)	0.0191 in. ² (12.3 mm ²)	30:1	40:1
	I	0.08	0.1560 (3.9 mm)	0.0191 in. ² (12.3 mm ²)	30:1	40:1
	J	0.05	0.1560 (3.9 mm)	0.0191 in. ² (12.3 mm ²)	30:1	40:1
	K	0.03	0.0860 (2.2 mm)	0.0058 in. ² (3.7 mm ²)	25:1	—
	L	0.02	0.0860 (2.2 mm)	0.0058 in. ² (3.7 mm ²)	25:1	—
	M	0.01	0.0860 (2.2 mm)	0.0058 in. ² (3.7 mm ²)	25:1	—
	N	0.006	0.0860 (2.2 mm)	0.0058 in. ² (3.7 mm ²)	25:1	—
	O	0.003	0.0860 (2.2 mm)	0.0058 in. ² (3.7 mm ²)	25:1	—
1/4 in. (6.4 mm) and 1/2 in. (12.7 mm)	P1	0.002	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P2	0.0013	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P3	0.001	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P4	0.0006	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P5	0.0004	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P6	0.00027	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P7	0.00018	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P8	0.00012	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
	P9	0.00008	0.0625 (1.6 mm)	0.0031 in. ² (2.0 mm ²)	15:1	—
1/4 in. (6.4 mm)	P10	0.00005	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P11	0.000036	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P12	0.000024	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P13	0.000016	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P14	0.00001	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P15	0.000006	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P16	0.000004	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P17	0.0000027	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—
	P18	0.0000018	0.0420 (1.1 mm)	0.0014 in. ² (0.9 mm ²)	15:1	—

Research Control Valves

Model Numbers

1. The first 4 digits are base model number and designate valve size

Digits	Valve Size
1001	1/4 in.
1002	1/2 in.
1003	3/4 in.
1004	1 in.
1005	1-1/2 in.
1007	2 in.
1000	Parts
1006	Repairs
1011	1/4 in. Trim
1012	1/2 in. Trim
1013	3/4 in. Trim
1014	1 in. Trim
1015	1-1/2 in. Trim
1016	"P" Trim
1017	Topworks

2. The next 2 digits designate body type

Digits	Body Type
GC	Globe Cast
GB	Globe Barstock
AB	Angle Barstock
AH	Angle High Pressure Union
GH	Globe High Pressure Union
TC	Three-Way Cast
TB	Three-Way Barstock
GS	Globe Sanitary
AS	Angle Sanitary
GE	Globe, Extended (CBX, Hastelloy C bellow)
GU	Globe Cast High Pressure Union

3. The next digit designates body end fitting

Digit	Body End Fitting
N	NPT
F	Flanged (size, rating or face finish not specified)
S	Socket Weld (size not specified)
B	Butt Weld (extension nipples) (size not specified)
T	Tube Fittings (for example, Swagelok, AE)
W	Wafer (clamp between flanges)
Y	Clamp Type (sanitary)
U	Union Type (sanitary)

4. The next 2 digits designate the body-bonnet material

Digits	Body-Bonnet Material
16	DIN 1.4462/Duplex 2205
17	DIN 1.4571/1.4581
36	316 S/S
3L	316L S/S
34	304 S/S
37	347 S/S
BR	Brass or Bronze
CS	Carbon Steel
MN	Monel
C2	Carpenter 20 (Alloy 20)
HB	Hastelloy B (Alloy B)
HC	Hastelloy C (Alloy C)
H2	Hastelloy C-22
HG	Hastelloy G
IN	Inconel
TI	Titanium
TA	Tantalum
NI	Nickel
KY	Kynar
PC	PVC
ZR	Zirconium

5. The next 2 digits designate bonnet style and packing

Digits	Bonnet Style	Packing
SV	Standard	Cv Ring
SK	Standard	Kalrez Cv Rings
SG	Standard	Grafoil
SR	Standard	Reversed Cv Ring
CV	Cooling Fin	Cv Ring
CG	Cooling Fin	Grafoil
CK	Cooling Fin	Kalrez Cv Rings
CM	Cooling Fin, Medium Guided (Packing not specified, assumes PTFE)	
BV	Bellows	Cv Ring
BG	Bellows	Grafoil
EG	Extension Neck	Grafoil
EV	Extension Neck	Cv Ring
HV	Heavy Duty Guide	Cv Ring
HG	Heavy Duty Guide	Grafoil
KV	H.D. Guided Cooling Fin	Cv Ring
KG	H.D. Guided Cooling Fin	Grafoil
MV	Medium Guided Trim w/	Cv Ring
DV	Double Cv Rings (PTFE)	Cv Ring
DK	Double Cv Rings (Kalrez)	Cv Ring
MU	Manual, Union	Disk

Sanitary Bonnets

YO	Clamp Type with O-Ring
UO	Union Type with O-Ring
YD	Clamp Type with Double O-Rings
UD	Union Type with Double O-Rings
YP	Clamp Type with Purge Port and Double O-Rings
UP	Union Type with Purge Port and Double O-Rings
YR	Sanitary Clamp Type with Rolling Diaphragm
UR	Sanitary Clamp Type with Rolling Diaphragm

6. The next 2 digits designate actuator type

Digits	Actuator Type
OS	ATO Standard
CS	ATC Standard
OP	ATO-P with Positioner
CP	ATC-P with Positioner
OB	ATO with Buyout Positioner
CB	ATC with Buyout Positioner
OR	ATO Reversible
CR	ATC Reversible
O3	ATO S/S Topworks
C3	ATC S/S Topworks
OO	Less Topworks
MN	Manual
OE	EVA-1 Signal-to-Open
CE	EVA-1 Signal-to-Close
O9	EVA-100/200 Signal-to-Open
C9	EVA-100/200 Signal-to-Close
OH	ATO With Handwheel
CH	ATC With Handwheel
OT	ATO Size 35 (1.125 in. mounting) w/o positioner
CT	ATC Size 35 (1.125 in. mounting) w/o positioner
OW	ATO Size 35 (1.125 in. mounting) with positioner
CW	ATC Size 35 (1.125 in. mounting) with positioner
Oz	ATO Size 35 (1.0 in. mounting) with positioner [For BA-2500, BA-2030, etc.]
CZ	ATC Size 35 (1.0 in. mounting) with positioner [For BA-2500, BA-2030, etc.]

7. Next 3 digits designate trim size & characteristic—
examples only

NOTE: The following are just examples of how the innervalue model number is constructed. A complete list of all the innervalue would be too large to list.

Digits	Trim Size and Characteristics
ALN	"A" Linear
BEP	"B" =%
CLN	"C" Linear
DEP	"D" =%
60L	6.0 Linear
50P	5.0 =%
P01	"P-1"
ELN	"E" Linear
FFP	"F" =%
GLN	"G" Linear
HEO	"H" =%
45L	4.5 Linear
35P	3.5 =%
P15	"P-15"
AQO	"A" Quick Open, metal-to metal
AQS	"A" Quick Open, soft seat
ALS	"A" Linear, soft seat
000	Less Trim
APS	"A" =%, soft seat

8. The next 2 digits designate trim material (normally same as body material)

NOTE: "X" in any space denotes "Special"

Digits	Trim Material
16	DIN 1.4462/Duplex 2205
17	DIN 1.4571
36	316 S/S
3L	316L S/S
ST	Stellite (with 316 base material)
S6	Stellite, 416 S/S
HB	Hastelloy B (Alloy B)
HC	Hastelloy C (Alloy C)
H2	Hastelloy C-22
HG	Hastelloy G
3T	316 S/S, Teflon
3K	316 S/S, Kel-F
TC	Tungsten Carbide
S3	Stellite, 316 S/S
S2	Stellite, Carp. 20
SB	Stellite, Hastelloy B (Alloy B)
SC	Stellite, Hastelloy C (Alloy C)
TA	Tantalum
TI	Titanium
KY	Kynar
PC	PVC
NI	Nickel
MN	Monel
37	347 S/S
S4	Stellite & 304
C2	Carpenter 20 (Alloy 20)
TS	Titanium Nitride-Coated Stellite
SP	Stellite & Phosphor Bronze (P Trim)
ZR	Zirconium

Example: 1002-GC-N-36-SV-OS-ALN-36

1002	1/2 in. Valve
GC	Globe Cast
N	NPT
36	316 S/S
SV	Standard Bonnet, Cv Ring Packing
OS	ATO Standard
ALN	"A" Linear
36	316 S/S

Electronic Valve Actuator

Model EVA-1

DESCRIPTION

The Model EVA-1 is a small, electronically controlled valve actuator developed specifically to fit 1/4...1 in. (6...25 mm) Research Control Valves. Its accurate positioning and compact size make it especially suited to flow control in research and small process applications. The unit features:

- Microprocessor-controlled, linear stepper motor
- 4...20 mA analog input
- Position 4...20 mA analog output (optional)
- Choice of 12 speeds
- Up to 40 pounds of stem thrust
- Accurate and repeatable positioning
- Adjustable split range
- Quick and simple zero and span input and output adjustments
- Adjustable stroke range 0.1875...0.5625 in. (4...14 mm)
- User adjustable direct or reverse action
- RS-232 Serial Port for all adjustments without removing the cover*
- Controlled seating force to prevent innervalue damage
- Built-in temperature compensation
- Stainless steel yoke and rugged epoxy coated aluminum housing
- 115V AC/12V DC, 230V AC/12V DC, and 24V DC models available

* Not Explosion Proof when RS-232 port is uncovered or when cover is removed.

OPERATION

The Model EVA-1 consists of a microprocessor-controlled, linear stepper motor that responds to an input signal of 4...20 mA DC. It also has an optional isolated loop powered 4...20 mA position output for signaling back to an indicator or control panel. The standard Model EVA-1 requires a 115V AC power supply with 230V AC and 24V DC models available. A stroke of 0.437 in. (11 mm) for the 1/4 in. (6 mm) unit or a stroke of 0.562 in. (14 mm) for the 1/2...1 in. (12...25 mm) units is standard and can be adjusted quickly and easily with two switches under the actuator cover or via the communication port. This ease of calibration can be used to split range the input or limit the up or down travel of the valve. The unit uses a dual speed operating mode. The low speed mode generates high thrust for seating the valve and overcoming packing friction while the high speed mode allows the valve to respond quickly to large input signal changes.



RATINGS

- NEMA 4, Watertight
- Explosion Proof * Class 1, Division 1, Group C & D
- Standard models approved by FM and CSA

* Not Explosion Proof when RS-232 port is uncovered or when cover is removed.

SPECIFICATIONS

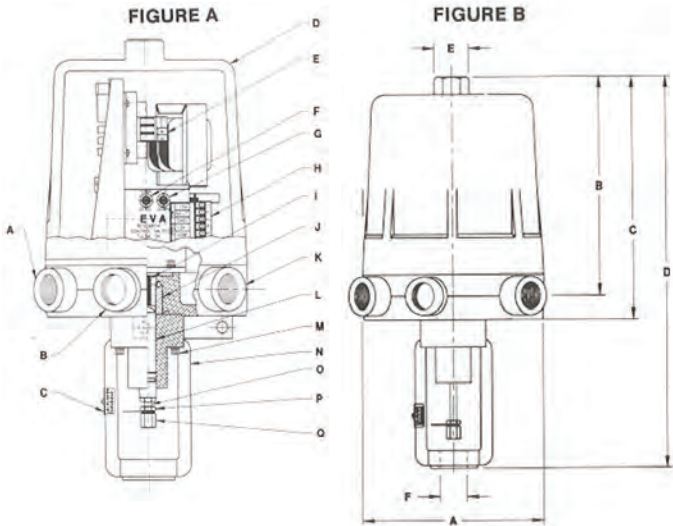
Electrical

Supply Power/Standard	115V AC +/- 10% @ 50...60 Hz and/or 12V DC
Supply Power/Optional	230V AC +/- 10% @ 50...60 Hz and/or 12V DC 24V DC +/- 3%
Control input	4...20 mA DC @ 125 ohms
Position Output	4...20 mA DC isolated, 0...800 ohm loop impedance

Mechanical

Stroke Length	Up to 0.562 in. (143 mm) (adjustable)
Thrust	40 lb (18.1 kg) at minimum step rate; 10 lb (4.5 kg) at maximum step rate See "Specifications" on page 2
Height	13 in. (330.2 mm) (actuator with yoke only)
Weight	12 lb (5.4 kg) (actuator with yoke only)
Operating Temperature Range	14...140° F (-10...60° C)

DIMENSIONS



Description of Items

- A: Setup/service port (1/2 in. NPT)

B: Signal port (1/2 in. NPT)

C: Travel scale

D: Cover

E: Input terminal block (4...20 mA)

F: Span/zero switch

G: Travel switch

H: Power supply board
- I: Motor shaft

J: Anti-rotation sleeve

K: Supply power port (1/2 in. NPT)

L: Spring loaded stem assembly

M: Cap screw

N: Yoke

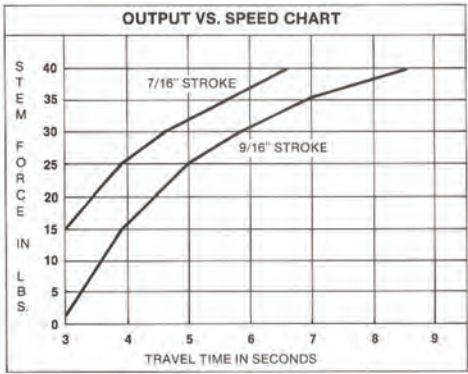
O: Actuator stem connector

P: Travel pointer locknut

Q: Trim stem connector

Valve Size in. (mm)	Dimensions in. (mm)						
	A	B	C	D	E	F	Stroke
1/4 (6.4)	6.18 (157.0)	6.93 (176.0)	7.0 (177.8)	12.19 (309.6)	1.13 (28.7) HEX	0.625 (15.9)	0.437 (11.1)
1/2 (12.7), 3/4 (19.1), 1 (25.4)	6.18 (157.0)	6.93 (176.0)	7.0 (177.8)	12.31 (312.7)	1.13 (28.7) HEX	0.875 (22.2)	0.562 (14.3)

SPECIFICATIONS



CALIBRATION PROCEDURE

1. Input Zero: With P1 jumper set to the *Normal* position, apply input signal for the *Closed* valve position. Use the **Up/Down** switch to close the valve. Push the **Span/Zero** switch to *Zero*.

2. Input Span: Apply input signal for the *Open* valve position. Use the **up/down** switch to open the valve. Push the **Span/Zero** switch to *Span*.

3. Output Zero*: Apply input signal for the *Closed* valve position. Move P1 jumper to the *Zero* position. Adjust the output to read 4 mA with the **Up/Down** switch. Push the **Span/Zero** switch to *Zero*.

4. Output Span*: Apply input signal for the *Open* valve position. Move **P1 jumper** to the *Span* position. Adjust the output to read 20 mA with the **Up/Down** switch. Push the **Span/Zero** switch to *Span*.

5. Return **P1 Jumper** to the *Normal* position.
- Normal

Zero

Span

P1

NOTE: P1 is located on the electronic logic card.
*Optional feature.

WIRING CONNECTIONS

1

2

3

4

5

115V AC

230V AC (Opt.)

Neutral AC Voltage

Ground

AC

12V DC*

24V DC (Opt.)

DC Common

DC

*12V DC Std. on AC Units, NA on 24V DC.

Input Terminal Block
See item E of of Dimensions figure.

+

-

+

-

+

-

+

-

Position Output

(Optional feature)

4...20 mA DC isolated

Signal Input

4...20 mA DC

OUT

IN

Control. Manage. Optimize.



Sage Integral Prime In-Line Style With Flanged End Connections 24 VDC Power

)5-0::6 h

Specifications

Wetted Parts: 7:WL SS Wetted Parts, 6w" Hastelloy Options havailable
Process Temperature: Standard -f0 to 600°FsOptional to 700° F and f50 ° F
Pressure Rating: 500psigs:00 0 sig Optional
Accuracy: 83-½ a of Full Scale 83- a of Reading
Repeatability: 096a
Enclosure: Nema fs Powder Coated Aluminum
Electronics Temp Rating: -f0 to :50 ° F c-f0 to ww .
Flanged Ends: :50 Class, hs, Raised Faced ch TM h:(6 and h3/ ASME :w 95.

Outputs: f-60h (Flo.s 6f DC Pulse c ot.)
Digital Communication: Modbus Rf(53 RTU
User Supplied Power: 6f DC c:(-6(.)
Power Consumption: 69f Watts Maximum
Approvals: CSh 6696s :w 0fs Class I Div 6 Groups Bs s

SIP - 100 - S150FLG100 - DC24 - CO2

Model Number

(Example: SIP-050-S150FLG050-DC24-CO2)

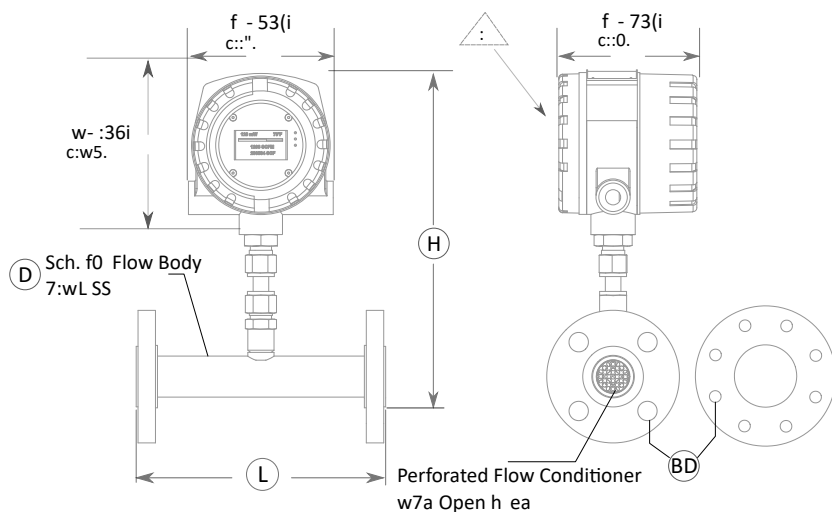
SIP- -6f -

Flow Bodies

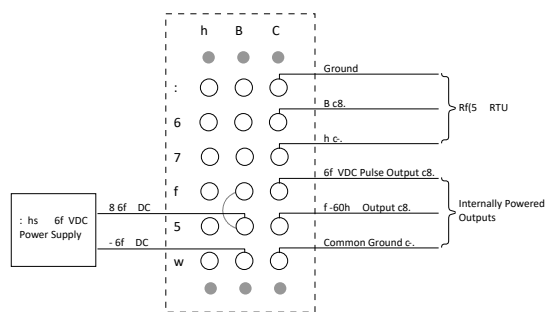
Code	(D)	(L)	(H)	(BD) Number and Diameter of Holes
050-S150FLG050	:36i c:5.	"i c:"9(.)	:096fi c6w0)	f - 09w6ic:w.
075-S150FLG075	73fi c60.	"i c:"9(.)	:0975i c6w7)	f - 09w6ic:w.
100-S150FLG100	:i c65.	(i c60796.	:09f" i c6ww)	f - 09w6ic:w.
125-S150FLG125	: -3fi c76.	:0i c65f.)	:09w5 c6":.)	f - 09w6ic:w.
150-S150FLG150	: -36i cf0.	:6i c70f9(.)	:09"" i c6"f.)	f - 09w6ic:.)
200-S150FLG200	6i c50.	:6i c70f9(.)	::900 i c6")	f - 0"5i c:.)
250-S150FLG250	6:-36i cw5.	:6i c70f9(.)	::965 i c6(w.)	f - 0"5i c:.)
300-S150FLG300	7i c(0.	:6i c70f9(.)	::95" i c6)f .)	f - 0"5i c:.)
400-S150FLG400	fi c:00.	:6i c70f9(.)	:690"i c70".)	(- 09"5i c:.)


Gas

Code		Code	
AIR	hR	CL2	CHLORINE
N2	NITROGEN	CO	CARBON MONOXIDE
NG	h TURAL hS	HE	HELIUM
CH4	METHANE	H2	HYDROGEN
PROPANE	PROPhE	DIG GAS	DIGESTER hS
BUTANE	BUTHe	BIOGAS	BIOGAS
NH3	AMMONIA	LFG	LANDFILL hS
CO2	CARBON DIOXIDE	FLARE GAS	FLARE hS
AR	h GON	FLUEGAS	FLUEhS
O2	OXYGEN	MIX	MIXTURE
O3	OZONE		



Wiring Diagram

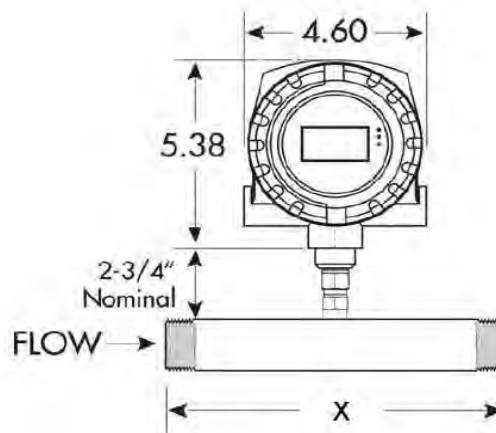


	INSTRUMENT DATA SHEET	DOCUMENT NO. 100-0108 Rev. 11
SAGE PRIME THERMAL MASS FLOW METER	GAS MASS FLOW	SAGE SIP SPECIFICATIONS INTEGRAL STYLE PRIME IN-LINE MASS FLOW METER

GENERAL INFORMATION

STYLE:	Integral In-Line Mass Flow Meter
SENSOR:	Two reference grade Platinum RTD clad in 316SS sheath
MATERIAL:	Wetted metal components: 316SS
POWER:	24VDC Standard (12VDC or 115/230VAC optional)
POWER DISSIPATION:	<2.5 W
ELECTRONICS:	Microprocessor based (Hybrid-Digital)
ELECTRONICS ENCLOSURE:	Integral mount, NEMA 4 enclosure
DISPLAY:	High contrast photo-emissive OLED graphical display (Flow Rate, Totalizer, Temperature)
TURNDOWN:	100 to 1
RESOLUTION:	1000 to 1
LOW END SENSITIVITY:	5 SFPM
FIELD CALIBRATION CHECK:	Yes - Digital system allows raw signal validation (milli-watts)
COMMUNICATIONS:	Modbus® compliant RS485 RTU or optional HART® communications
APPROVALS:	CSA C22.2 (24 VDC); UL1604, Class I, Div 2, Groups B, C, D T4 (24VDC); CE (AC Power or 24VDC)
FIELD RECONFIGURABLE:	Sage ADDRESSER required
FLOW ACCURACY:	+/- 0.5% of Full Scale +/- 1% of reading (Enhanced accuracy optionally available with limited turn-down)
FLOW REPEATABILITY:	0.2%
RESPONSE TIME:	1 second time constant
GAS TEMPERATURE RANGE:	Standard -40° to 200°F (93°C), Optional to 300°F (149°C) and 450°F (232°C)
GAS PRESSURE:	500 PSIG (If higher pressure needed, contact Sage)
FLOW OUTPUT:	4 to 20 mA for Rate
TOTALIZER:	24VDC pulse for Totalized value
TEMPERATURE OUTPUT:	Through Modbus® only
AMBIENT TEMPERATURE:	-40° to 150°F (66°C)
FLOW BODY:	316SS Schedule 40 Flow Bodies sized from 1/4" x 6" long to 4" x 12" long. Male NPT ends standard (Flanges and other options available)
RELAYS:	N/A
FLOW CONDITIONING:	Flow Conditioners are built in to In-Line Style Flow Bodies from 1/2" to 4"
ENCLOSURE DEPTH:	DC: 4.35" ; AC: 5.35"

Make the Wise Choice. Choose Sage Flow Meters.



USA 800-766-0076

Fax 323-890-4456

www.smithcooper.com

www.sharpevalves.com

Los Angeles, CA

Chicago, IL

Atlanta, GA

Vancouver, WA

Houston, TX



Valves, Automation & Controls

1" - 3903 - 6 - SW

Series 3903

3-PIECE BALL VALVE

Design Features

- Full Port
- 1000 CWP
- Carbon Steel ASTM A216 WCB or 316 Stainless Steel ASTM A351 CF8M
- Threaded or Socket Weld* Ends
- Blow-Out Proof Stem
- Lockable Lever

Applicable Standards

- Socket Weld and Threaded Ends ASME B16.11
- Shell and Seat Tests ASME B16.34

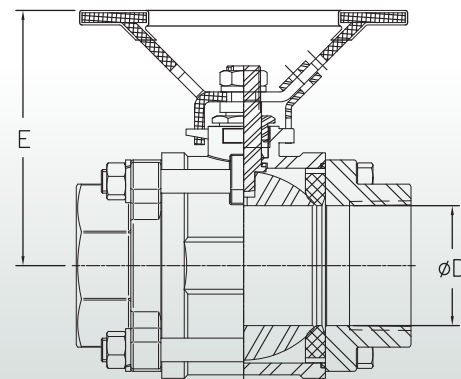
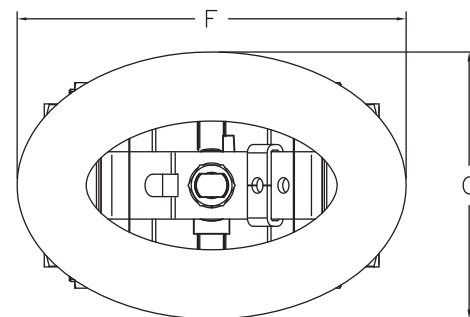
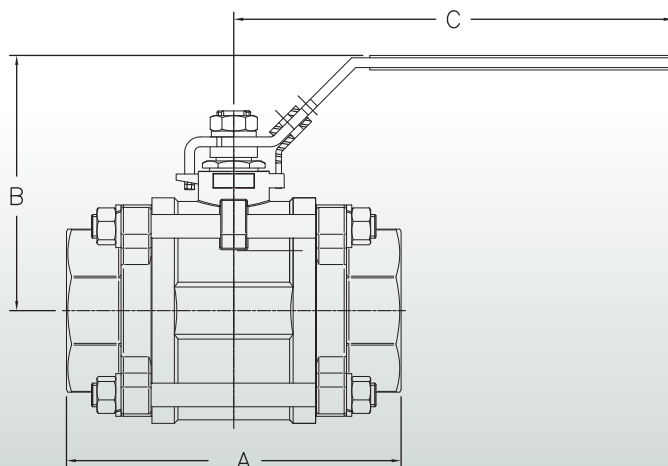
Options

- Lockable Oval Handle
- Stem Extensions, Non-Locking

Dimensions

Size	A	B	C	øD	E	F	G
1/4	2.22	1.85	4.02	0.41	2.68	4.02	2.48
3/8	2.30	1.85	4.02	0.50	2.68	4.02	2.48
1/2	2.46	2.38	5.07	0.59	2.68	4.02	2.48
3/4	2.87	2.50	5.07	0.79	3.01	4.02	2.48
1	3.32	2.94	6.03	0.98	3.62	5.20	3.19
1-1/4	3.76	3.30	6.03	1.26	3.84	5.20	3.19
1-1/2	4.47	3.63	7.33	1.50	4.09	5.20	3.19
2	5.23	3.86	7.33	1.97	4.31	5.20	3.19

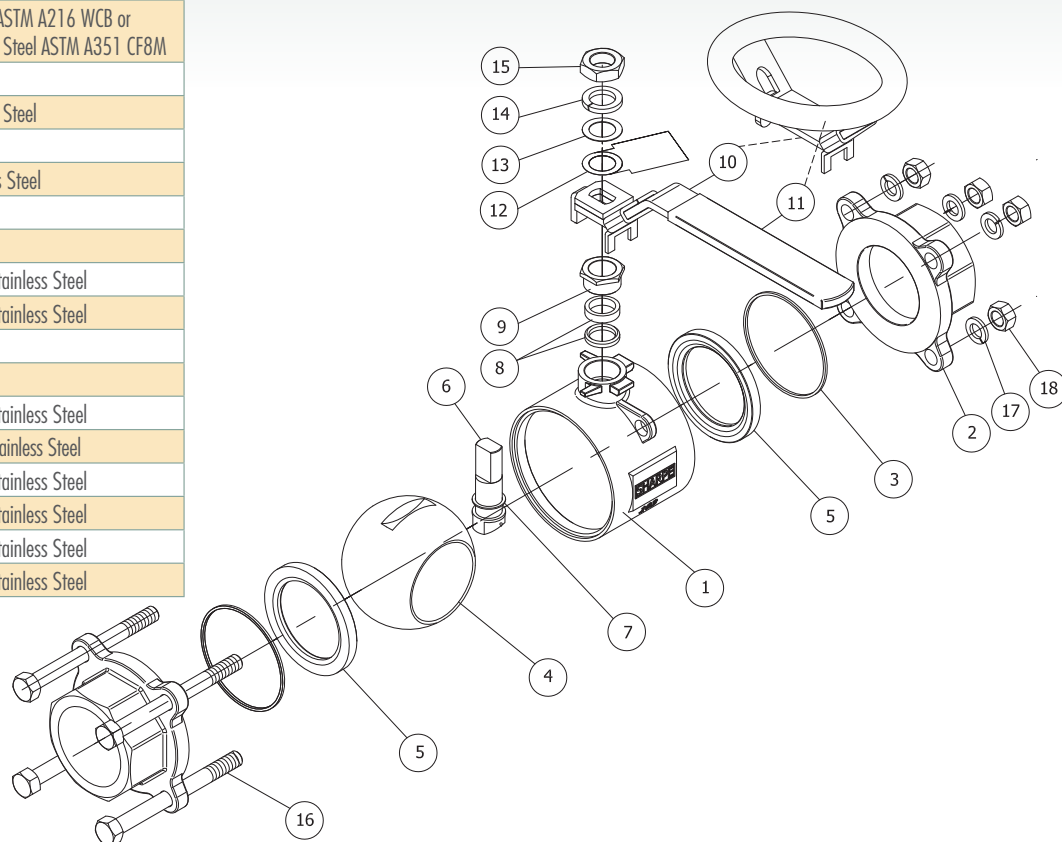
Dimensions (Inches)



* Valves with Welded Ends supplied with extra set of PTFE Body Seals

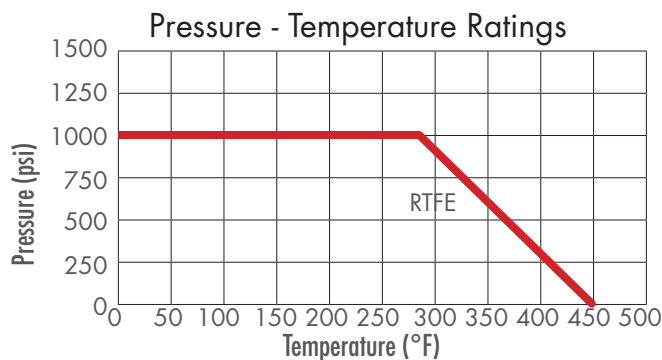
Parts & Materials

No.	Part Name	Qty	Material
1	Body	1	Carbon Steel ASTM A216 WCB or 316 Stainless Steel ASTM A351 CF8M
2	End Piece	2	Carbon Steel ASTM A216 WCB or 316 Stainless Steel ASTM A351 CF8M
3	Body Seal	2	PTFE
4	Ball	1	316 Stainless Steel
5	Seat	2	RTFE
6	Stem	1	316 Stainless Steel
7	Thrust Bearing	1	PTFE
8	Stem Packing	2	PTFE
9	Gland Packing	1	300 Series Stainless Steel
10	Handle	1	300 Series Stainless Steel
11	Handle Sleeve	1	PVC
12	Name Tag	1	Coated Paper
13	Flat Washer		300 Series Stainless Steel
14	Lock Washer	1	300 Series Stainless Steel
15	Handle Nut	1	300 Series Stainless Steel
16	Bolt	4	300 Series Stainless Steel
17	Lock Washer	4	300 Series Stainless Steel
18	Nut	4	300 Series Stainless Steel



Technical Information

Size	Cv	Weight (lbs)
1/4	20	0.6
3/8	25	0.6
1/2	28	1.0
3/4	50	1.4
1	70	1.8
1-1/4	112	2.8
1-1/2	170	4.2
2	395	7.3



How to Order

Size	Series	Body & Ends	Ends	Options
1/4	3903	4 Carbon Steel	TE Threaded	OH Oval Handle
3/8		6 316 Stainless Steel	SW Socket Weld	NLS Stem Extension, 2-1/2", Non-Locking
1/2				
3/4				
1				
1-1/4				
1-1/2				
2				

Example: 1/4 + 3903 + 6 + TE + = 1/4"-3903-6-TE



Job Name:	
Job Location:	
Engineer:	
Contractor:	
Tag:	
PO#:	
Rep:	
Wholesale Dist.:	

DESCRIPTION

ASME Section VIII capacity certified safety relief valve for overpressure protection of steam, air/gas and liquid systems, pressure vessels, piping and similar equipment.

FEATURES

- ASME Section VIII Certified Capacities
- 5 - 1200 psig Set Pressures @ 800° F max*
- 1/2" - 2" Inlet Connections
- Bronze, Carbon or Stainless Steel Construction
- Lapped Metal Seats; O-ring and PCTFE Seats Optional
- Screwed Cap or Packed Lift Lever Configuration
- **Made in the USA**

APPROVALS

- ASME Section VIII Div 1 Pressure Vessels for Steam, Air/Gas and Liquids
- CRN 0G8547.5C
- Directive 2011/65/CE (RoHS) Compliant (530-540)
- Pressure Equipment Directive 2014/68/EU (PED)
- Oxygen Cleaning to CGA 4.1 (Optional)

**Set pressures and temperatures vary by model.
Refer to catalog for sizing and selection information*

STANDARD MATERIALS LIST

BODY	ASTM B584 Bronze ASTM A216 Carbon Steel ASTM A351 Stainless Steel
NOZZLE	ASTM B16 Brass ASTM A479 Stainless Steel
SPRING	Stainless Steel
SEAT	Stainless Steel

CAPACITY, SCFM (NM3/HR)

NATIONAL BOARD CAPACITY CERTIFIED, SECTION VIII AIR

SET PRESSURE PSIG (BAR)	D ORIFICE	E ORIFICE	F ORIFICE
15 (1.03)	67 (107)	118 (189)	185 (298)
100 (6.90)	255 (409)	449 (721)	706 (1135)
500 (34.48)	1153 (1853)	2032 (3267)	3197 (5138)
SET PRESSURE PSIG (BAR)	G ORIFICE	H ORIFICE	J ORIFICE
15 (1.03)	304 (488)	474 (762)	776 (1247)
100 (6.90)	1158 (1862)	1808 (2907)	2959 (4756)
500 (34.48)	5246 (8433)	8189 (13164)	13399 (21538)

AVAILABLE CONFIGURATIONS

MODEL NUMBER	ORIFICE	SIZE	INSTALLED HEIGHT IN. (MM)
5xxDCB	D	1/2M x 1F	6.97 (177)
5xxDCD*		1/2M x 3/4F	6.97 (177)
5xxddb		3/4M x 1F	6.97 (177)
5xxDDD*		3/4M x 3/4F	6.97 (177)
5xxED	E	3/4M x 1-1/4F	8.45 (215)
5xxEE		1M x 1-1/4F	8.45 (215)
5xxFE	F	1M x 1-1/2F	9.64 (245)
5xxFF		1-1/4M x 1-1/2F	9.64 (245)
5xxGF	G	1-1/4M x 2F	12.62 (321)
5xxGG		1-1/2M x 2F	12.62 (321)
5xxHG	H	1-1/2M x 2-1/2F	14.42 (367)
5xxHH		2M x 2-1/2F	14.42 (367)
5xxJH	J	2M x 3F	16.50 (419)

*Bronze Body Only

PART NUMBER MATRIX

52	3	J	H	B	K	M	AA	0425	Q
SERIES BODY/ TRIM MATERIAL	CAP	ORIFICE LETTER	INLET SIZE	CONNECTION	SERVICE	SEAT	SPECIAL OPTIONS	SET PRESSURE	SUFFIX
51 - BRONZE/BRASS	1 - SCREWED CAP	D	C - 1/2"	B - MNPT X NPT	J - SEC VIII LIQUID	M - METAL	FACTORY ISSUED LETTERS/NUMBERS FOR SPECIAL OPTIONS OR FEATURES	SET PRESSURE, PSIG (4 DIGITS)	Q - PERFORMANCE (CALIBRATION) TEST REPORTS
52 - BRONZE/STAINLESS	2 - SCREWED + GAG	E	D - 3/4"	D - 3/4 OUTLET (MODEL 510 & 520 D ORIFICE ONLY)	K - SEC VIII AIR/GAS	B - BUNA-N		VACUUM "HG" PREFIX + 2 DIGITS	
53 - CARBON/STAINLESS	3 - PACKED LEVER	F	E - 1"		L - SEC VIII STEAM	E - EPR			
54 - ALL STAINLESS	4 - PACKED + GAG	G	F - 1-1/4"		M - NON CODE LIQUID	K - PCTFE			
		H	G - 1-1/2"		N - NON CODE AIR	N - NEOPRENE	"AA" - DEFAULT SETTING	145	
		J	H - 2"		P - NON CODE STEAM	Z - KALREZ*	"CE" - CE/PED		
					Q - VACUUM	S - SILICONE	"HT" - HIGH TEMP SPRING		
						V - VITON	"OX" - CLEANED FOR OXYGEN		

*Not all configurations available together

500 SERIES

MULTI-PURPOSE SAFETY RELIEF

ASME SECTION VIII - AIR

Standard cubic feet per minute (normalized cubic meters per hour) of air at 10% overpressure. National Board Certified. Ratings are 90% of actual.

US CUSTOMARY UNITS SCFM

ORIFICE LETTER AREA (IN. ²)	D 0.1295	E 0.2282	F 0.3589	G 0.5890	H 0.9195	J 1.5044
SET PRESSURE PSIG						
5*	39	69	108	178	277	454
10*	54	96	151	248	387	633
15	67	118	185	304	474	776
20	77	136	213	350	547	895
25	87	154	242	397	619	1,013
30	97	172	270	443	692	1,132
35	109	191	301	494	772	1,262
40	120	211	332	545	851	1,393
45	131	231	363	596	931	1,523
50	142	251	395	648	1,011	1,654
55	154	271	426	699	1,091	1,784
60	165	290	457	750	1,170	1,915
65	176	310	488	801	1,250	2,045
70	187	330	519	852	1,330	2,176
75	198	350	550	903	1,410	2,306
80	210	370	581	954	1,489	2,437
85	221	389	612	1,005	1,569	2,567
90	232	409	644	1,056	1,649	2,698
95	243	429	675	1,107	1,729	2,828
100	255	449	706	1,158	1,808	2,959
125	311	548	862	1,414	2,207	3,611
150	367	647	1,017	1,669	2,606	4,264
175	423	746	1,173	1,925	3,005	4,916
200	479	845	1,329	2,180	3,404	5,569
225	535	944	1,484	2,436	3,802	6,221
250	592	1,043	1,640	2,691	4,201	6,874
275	648	1,142	1,796	2,947	4,600	7,526
300	704	1,240	1,951	3,202	4,999	8,179
325	760	1,339	2,107	3,458	5,398	8,831
350	816	1,438	2,263	3,713	5,796	9,484
375	872	1,537	2,418	3,969	6,195	10,136
400	928	1,636	2,574	4,224	6,594	10,789
425	985	1,735	2,730	4,480	6,993	11,441
450	1,041	1,834	2,885	4,735	7,392	12,094
475	1,097	1,933	3,041	4,991	7,791	12,746
500	1,153	2,032	3,197	5,246	8,189	13,399
525	1,209	2,131	3,352	5,501	-	-
550	1,265	2,230	3,508	5,757	-	-
575	1,321	2,329	3,664	6,012	-	-
600	1,378	2,428	3,819	6,268	-	-
625	1,434	2,527	-	-	-	-
650	1,490	2,626	-	-	-	-
675	1,546	2,725	-	-	-	-
700	1,602	2,824	-	-	-	-
725	1,658	2,923	-	-	-	-
750	1,715	3,022	-	-	-	-
775	1,771	3,121	-	-	-	-
800	1,827	3,220	-	-	-	-
825	1,883	3,319	-	-	-	-
850	1,939	3,418	-	-	-	-
875	1,995	3,517	-	-	-	-
900	2,051	3,616	-	-	-	-
950	2,163	-	-	-	-	-
1000	2,276	-	-	-	-	-
1050	2,388	-	-	-	-	-
1100	2,501	-	-	-	-	-
1150	2,613	-	-	-	-	-
1200	2,725	-	-	-	-	-
Approx.1 psi Increment	2.2	4.0	6.2	10.2	16.0	26.1

METRIC UNITS KG/HR.

ORIFICE LETTER AREA (CM ²)	D 0.8352	E 1.4721	F 2.3155	G 3.8001	H 5.9321	J 9.7058
SET PRESSURE BARG						
0.4*	67	119	187	307	479	784
0.8*	94	165	260	427	667	1,091
1.1	110	195	306	503	784	1,283
2	153	270	425	697	1,089	1,781
3	205	362	569	934	1,458	2,386
4	258	454	714	1,172	1,830	2,994
5	310	546	859	1,411	2,202	3,603
6	362	639	1,005	1,649	2,574	4,211
7	415	731	1,150	1,887	2,946	4,819
8	467	823	1,295	2,125	3,317	5,428
9	519	916	1,440	2,363	3,689	6,036
10	572	1,008	1,585	2,601	4,061	6,644
12	676	1,192	1,875	3,078	4,805	7,861
14	781	1,377	2,166	3,554	5,548	9,078
16	886	1,561	2,456	4,031	6,292	10,295
18	991	1,746	2,746	4,507	7,036	11,511
20	1,095	1,931	3,037	4,983	7,779	12,728
22	1,200	2,115	3,327	5,460	8,523	13,945
24	1,305	2,300	3,617	5,936	9,267	15,162
26	1,409	2,484	3,907	6,413	10,010	16,378
28	1,514	2,669	4,198	6,889	10,754	17,595
30	1,619	2,853	4,488	7,365	11,498	18,812
32	1,724	3,038	4,778	7,842	12,241	20,029
34	1,828	3,222	5,069	8,318	12,985	21,245
36	1,933	3,407	5,359	8,795	-	-
38	2,038	3,591	5,649	9,271	-	-
40	2,142	3,776	5,939	9,747	-	-
42	2,247	3,961	-	-	-	-
44	2,352	4,145	-	-	-	-
46	2,457	4,330	-	-	-	-
48	2,561	4,514	-	-	-	-
50	2,666	4,699	-	-	-	-
52	2,771	4,883	-	-	-	-
54	2,875	5,068	-	-	-	-
58	3,085	5,437	-	-	-	-
62	3,294	5,806	-	-	-	-
65	3,450	-	-	-	-	-
69	3,659	-	-	-	-	-
72	3,815	-	-	-	-	-
76	4,020	-	-	-	-	-
79	4,177	-	-	-	-	-
82	4,381	-	-	-	-	-
Approx. 0.1 bar Increment	5.24	9.23	14.51	23.82	37.18	60.84

Maximum Set Pressure Limits for Air/Gas Service

510 Series - 300 psig/20.7 barg

520 Series - 1200 psig/82.7 barg

530 Series - 1200 psig/82.7 barg

540 Series - 1200 psig/82.7 barg



500 SERIES

MULTI-PURPOSE SAFETY RELIEF

ASME SECTION VIII - WATER

- U.S. gallons per minute (cubic meters per hour) of water at 10% over pressure. National Board Certified. Ratings are 90% of actual.

US CUSTOMARY UNITS GPM

ORIFICE LETTER AREA (IN. ²)	D 0.1295	E 0.2282	F 0.3589	G 0.5890	H 0.9195	J 1.5044
SET PRESSURE PSIG						
5*	13	24	37	61	95	156
10*	14	24	38	63	98	161
15	14	25	40	65	102	167
20	16	29	45	74	115	189
25	18	32	50	82	127	208
30	19	34	54	89	138	226
35	21	37	58	96	149	244
40	22	40	62	102	160	261
45	24	42	66	108	169	277
50	25	44	70	114	178	292
55	26	46	73	120	187	306
60	28	48	76	125	195	320
65	29	50	79	130	203	333
70	30	52	82	135	211	345
75	31	54	85	140	218	357
80	32	56	88	145	226	369
85	33	58	91	149	233	381
90	34	59	93	153	239	392
95	35	61	96	158	246	402
100	36	63	98	162	252	413
125	40	70	110	181	282	462
150	44	77	121	198	309	506
175	47	83	130	214	334	546
200	50	89	139	229	357	584
225	53	94	148	242	378	619
250	56	99	156	256	399	653
275	59	104	163	268	418	685
300	62	108	171	280	437	715
325	64	113	178	291	455	744
350	66	117	184	302	472	772
375	69	121	191	313	489	799
400	71	125	197	323	505	826
425	73	129	203	333	520	851
450	75	133	209	343	535	876
475	77	136	215	352	550	900
500	79	140	220	361	564	923
525	81	143	226	370	-	-
550	83	147	231	379	-	-
575	85	150	236	388	-	-
600	87	153	241	396	-	-
625	89	157	-	-	-	-
650	91	160	-	-	-	-
675	92	163	-	-	-	-
700	94	166	-	-	-	-
725	96	169	-	-	-	-
750	97	171	-	-	-	-
775	99	174	-	-	-	-
800	100	177	-	-	-	-
825	102	180	-	-	-	-
850	104	183	-	-	-	-
875	105	185	-	-	-	-
900	107	188	-	-	-	-
950	109	-	-	-	-	-
1000	112	-	-	-	-	-

METRIC UNITS M3/HR.

ORIFICE LETTER AREA (CM ²)	D 0.8352	E 1.4721	F 2.3155	G 3.8001	H 5.9321	J 9.7058
SET PRESSURE BARG						
0.4*	2.0	3.6	5.6	9.2	14.4	23.6
0.8*	2.9	5.1	8.0	13.1	20.4	33.3
1.1	3.3	5.9	9.3	15.2	23.8	38.9
2	4.4	7.7	12.1	19.8	30.9	50.6
3	5.3	9.4	14.8	24.2	37.8	61.8
4	6.1	10.8	17.0	28.0	43.6	71.4
5	6.9	12.1	19.0	31.3	48.8	79.8
6	7.5	13.3	20.9	34.2	53.4	87.4
7	8.1	14.3	22.5	37.0	57.7	94.5
8	8.7	15.3	24.1	39.5	61.7	101.0
9	9.2	16.2	25.6	41.9	65.5	107.1
10	9.7	17.1	26.9	44.2	69.0	112.9
12	10.6	18.8	29.5	48.4	75.6	123.7
14	11.5	20.3	31.9	52.3	81.6	133.6
16	12.3	21.7	34.1	55.9	87.3	142.8
18	13.0	23.0	36.1	59.3	92.6	151.5
20	13.7	24.2	38.1	62.5	97.6	159.7
22	14.4	25.4	39.9	65.6	102.3	167.5
24	15.1	26.5	41.7	68.5	106.9	174.9
26	15.7	27.6	43.4	71.3	111.3	182.0
28	16.3	28.7	45.1	74.0	115.5	188.9
30	16.8	29.7	46.7	76.6	119.5	195.5
32	17.4	30.6	48.2	79.1	123.4	202.0
34	17.9	31.6	49.7	81.5	127.2	208.2
36	18.4	32.5	51.1	83.9	-	-
38	18.9	33.4	52.5	86.2	-	-
40	19.4	34.2	53.9	88.4	-	-
42	19.9	35.1	-	-	-	-
44	20.4	35.9	-	-	-	-
46	20.8	36.7	-	-	-	-
48	21.3	37.5	-	-	-	-
50	21.7	38.3	-	-	-	-
52	22.2	39.0	-	-	-	-
54	22.6	39.8	-	-	-	-
58	23.4	41.2	-	-	-	-
62	24.2	42.6	-	-	-	-
65	24.8	-	-	-	-	-
69	25.6	-	-	-	-	-

Maximum Set Pressure Limits for Liquid Service

510 Series - 300 psig/20.7 barg

520 Series - 1000 psig/68.9 barg

530 Series - 1000 psig/68.9 barg

540 Series - 1000 psig/68.9 barg

Note:

To determine water capacity at 25% overpressure, multiply the capacity at 10% by 1.066.

*Pressure settings below 15 psig/1.03 barg are non-ASME code.

SS - 4GUF8

General Utility Service Needle Valves



GU SERIES
NEEDLE

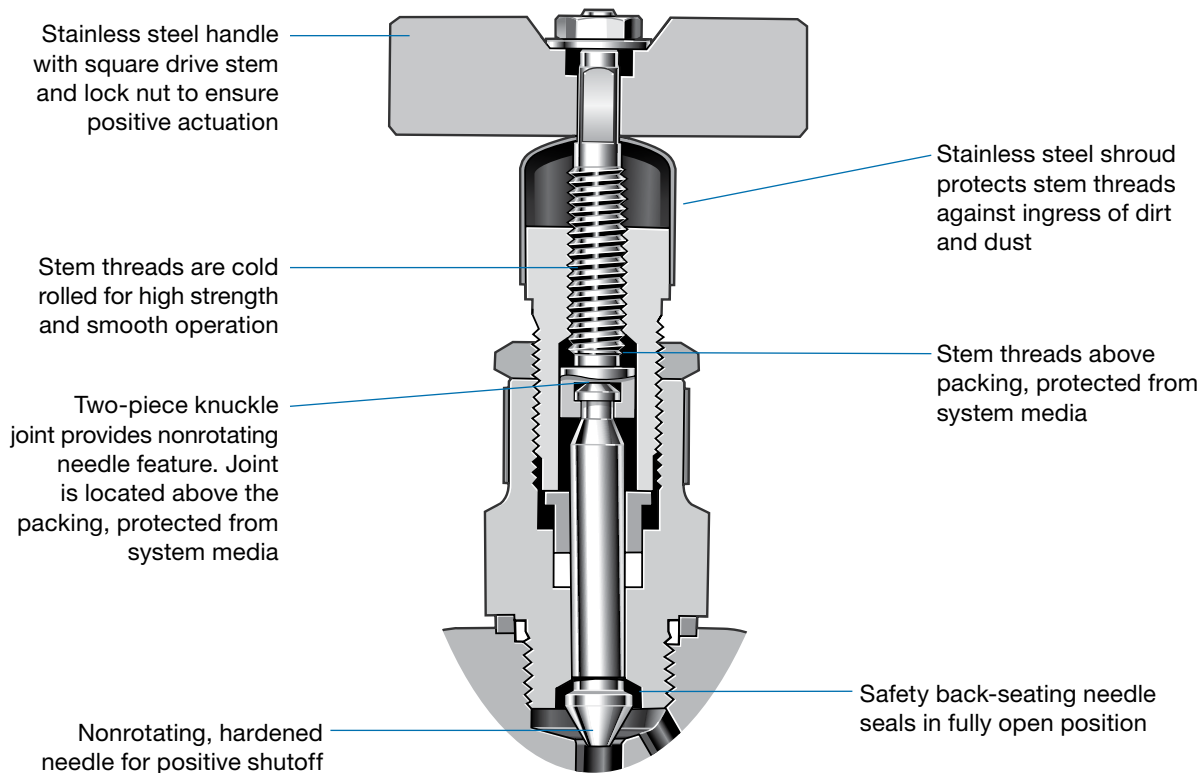
GU Series

- Straight and angle patterns
- Stainless steel and carbon steel body material
- Pressures up to 6000 psig (413 bar)
- Temperatures up to 450°F (232°C) with PTFE packing; up to 650°F (343°C) with optional graphite packing

Features

GU series needle valves are for use in general-purpose applications to isolate or vent system media. The hardened stainless steel, nonrotating needle promotes leak-tight shutoff and long service life. The valve stem threads are isolated from the media.

- Compact design
- Stainless steel stop pin
- High-temperature packing and bonnet seal option available
- Antitamper and lockable handle features available
- Suitable for sour gas service; materials are selected in accordance with NACE MR0175/ISO 15156.



Materials of Construction

Component	Valve Body Material	
	Stainless Steel	Carbon Steel
	Material Grade/ASTM Specification	
Body	316 SS/ A479	Zinc plated ^① carbon steel/ AISI 1018
Bonnet		316 SS/A479
Needle	S17400 SS/A564 Condition H1150D	
Packing, bonnet seals	Carbon/glass-filled PTFE or graphite	
Lubricant	Fluorinated base with PTFE and tungsten disulfide	
Bonnet seal ring, gland nut, shroud, stem, gland, handle, handle lock nut, handle washer, locking pin	316 SS	
Gland lock nut	Powdered metal 300 series SS	

Wetted components listed in *italics*.

① Bodies with weld end connections receive a rust-preventive coating instead of zinc plating.

Pressure-Temperature Ratings

Temperature, °F (°C)	Packing Material	
	PTFE	Graphite
	Working Pressure, psig (bar)	
-20 (-28) to 0 (-17)	—	6000 (413)
0 (-17) to 100 (37)	6000 (413)	6000 (413)
200 (93)	5160 (355)	5160 (355)
300 (148)	4680 (322)	4680 (322)
400 (204)	4260 (293)	4260 (293)
450 (232)	4110 (283)	4110 (283)
500 (260)	—	3960 (272)
600 (315)	—	3780 (260)
650 (343)	—	3660 (252)

Testing

Every Swagelok GU series needle valve is factory tested with nitrogen at 1000 psig (69 bar). Seats have a maximum allowable leak rate of 0.1 std cm³/min. Shell testing is performed to a requirement of no detectable leakage with a liquid leak detector.

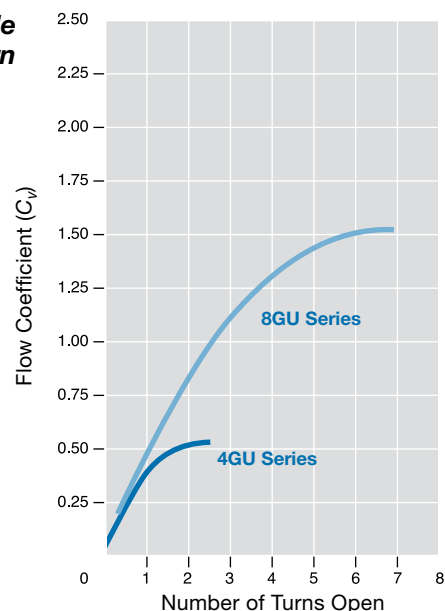
Cleaning and Packaging

Every Swagelok GU series needle valve is cleaned and packaged in accordance with Swagelok *Standard Cleaning and Packaging* (SC-10) (MS-06-62), page 1174.

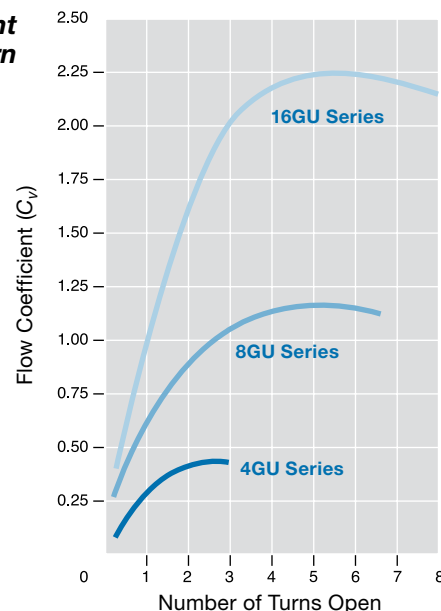
Flow Data

Flow Coefficient at Turns Open

Angle Pattern

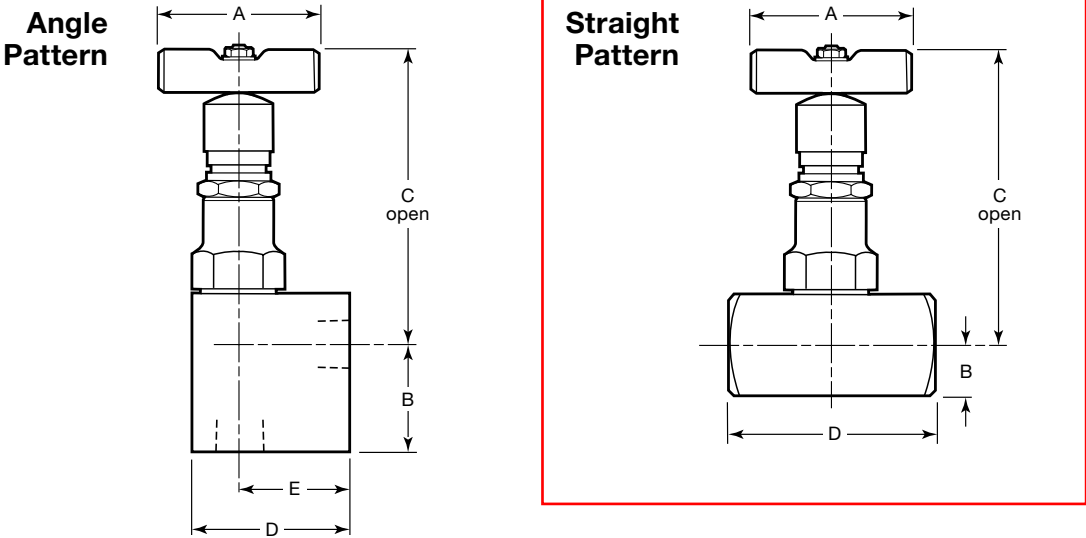


Straight Pattern



Ordering Information and Dimensions

Dimensions are for reference only and are subject to change.



Angle Pattern

End Connections		C _v	Orifice in. (mm)	Ordering Number		Dimensions, in. (mm)						
Type	Size			Stainless Steel	Carbon Steel	A	B	C	D	E		
Female NPT	1/4 in.	0.55	0.20 (5.0)	SS-4GUF4-A	S-4GUF4-A	1.75 (44.5)	0.85 (21.6)	3.20 (81.2)	1.50 (38.1)	1.00 (25.4)		
	3/8 in.			SS-4GUF6-A	S-4GUF6-A		1.10 (27.9)		1.75 (44.5)	1.25 (31.8)		
	1/2 in.			SS-4GUF8-A	S-4GUF8-A		1.23 (31.2)		3.33 (84.6)	2.00 (51.0)	1.31 (33.3)	
	1/2 in.	1.60	0.31 (8.0)	SS-8GUF8-A	S-8GUF8-A	2.00 (51.0)	1.23 (31.2)	3.87 (98.3)	2.00 (51.0)	1.38 (35.1)		
	3/4 in.			SS-8GUF12-A	S-8GUF12-A		1.60 (40.6)		3.98 (101)	2.50 (63.5)	1.50 (38.1)	
	1 in.			SS-8GUF16-A	S-8GUF16-A				4.25 (108)	2.76 (70.0)	1.75 (44.5)	

GU SERIES
NEEDLE

Ordering Information and Dimensions

Dimensions are for reference only and are subject to change.

Straight Pattern

End Connections		C _v	Orifice in. (mm)	Ordering Number		Dimensions, in. (mm)			
Type	Size			Stainless Steel	Carbon Steel	A	B	C	D
Female NPT	1/4 in.	0.45	0.20 (5.0)	SS-4GUF4	S-4GUF4	1.75 (44.5)	0.50 (12.7)	3.20 (81.2)	2.13 (54.1)
	3/8 in.			SS-4GUF6	S-4GUF6				2.25 (57.2)
	1/2 in.	0.45	0.20 (5.0)	SS-4GUF8	S-4GUF8	1.75 (44.5)	0.63 (16.0)	3.33 (84.6)	2.63 (66.8)
		1.20	0.31 (8.0)	SS-8GUF8	S-8GUF8	2.00 (51.0)		3.87 (98.3)	2.76 (70.0)
	3/4 in.	1.20	0.31 (8.0)	SS-8GUF12	S-8GUF12	2.00 (51.0)	0.75 (19.1)	3.98 (101)	3.00 (76.2)
		2.25	0.43 (11.0)	SS-16GUF12	S-16GUF12	3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.25 (82.6)
	1 in.	1.20	0.31 (8.0)	SS-8GUF16	S-8GUF16	2.00 (51.0)	1.00 (25.4)	4.25 (108)	3.50 (88.9)
		2.25	0.43 (11.0)	SS-16GUF16	S-16GUF16	3.00 (76.2)		5.35 (136)	4.02 (102)
Male NPT/ female NPT	1/4 in.	0.45	0.20 (5.0)	SS-4GUM4-F4	S-4GUM4-F4	1.75 (44.5)	0.50 (12.7)	3.20 (81.2)	2.38 (60.5)
	3/8 in.			SS-4GUM6-F6	S-4GUM6-F6				
	1/2 in.	0.45	0.20 (5.0)	SS-4GUM8-F8	S-4GUM8-F8	1.75 (44.5)	0.63 (16.0)	3.33 (84.6)	2.76 (70.0)
		1.20	0.31 (8.0)	SS-8GUM8-F8	S-8GUM8-F8	2.00 (51.0)		3.87 (98.3)	3.00 (76.2)
	3/4 in.	1.20	0.31 (8.0)	SS-8GUM12-F12	S-8GUM12-F12	2.00 (51.0)	0.75 (19.1)	3.98 (101)	3.13 (79.6)
		2.25	0.43 (11.0)	SS-16GUM12-F12	S-16GUM12-F12	3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.50 (88.9)
	1 in.	1.20	0.31 (8.0)	SS-8GUM16-F16	S-8GUM16-F16	2.00 (51.0)	1.00 (25.4)	4.25 (108)	3.50 (88.9)
		2.25	0.43 (11.0)	SS-16GUM16-F16	S-16GUM16-F16	3.00 (76.2)		5.35 (136)	4.02 (102)
Fractional tube socket weld	1/4 in.	0.45	0.20 (5.0)	SS-4GUSW4T	S-4GUSW4T	1.75 (44.5)	0.50 (12.7)	3.20 (81.3)	2.00 (50.8)
	3/8 in.			SS-4GUSW6T	S-4GUSW6T				
	1/2 in.	0.45	0.20 (5.0)	SS-4GUSW8T	S-4GUSW8T	1.75 (44.5)	0.50 (12.7)	3.20 (81.3)	2.25 (57.2)
		1.20	0.31 (8.0)	SS-8GUSW8T	S-8GUSW8T	2.00 (51.0)	0.63 (16.0)	3.87 (98.3)	2.63 (66.8)
	3/4 in.	1.20	0.31 (8.0)	SS-8GUSW12T	S-8GUSW12T	2.00 (51.0)	0.63 (16.0)	3.87 (98.3)	2.63 (66.8)
		2.25	0.43 (11.0)	SS-16GUSW12T	S-16GUSW12T	3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.25 (82.6)
	1 in.	1.20	0.31 (8.0)	SS-8GUSW16T	S-8GUSW16T	2.00 (51.0)	0.75 (19.1)	3.98 (101)	2.63 (66.8)
		2.25	0.43 (11.0)	SS-16GUSW16T	S-16GUSW16T	3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.25 (82.6)
Fractional pipe socket weld	1/4 in.	0.45	0.20 (5.0)	—	S-4GUSW4P	1.75 (44.5)	0.50 (12.7)	3.20 (81.2)	2.25 (57.2)
	3/8 in.				S-4GUSW6P		0.63 (16.0)	3.33 (84.6)	
	1/2 in.	0.45	0.20 (5.0)		S-4GUSW8P	1.75 (44.5)	0.75 (19.1)	3.45 (87.6)	2.50 (63.5)
		1.20	0.31 (8.0)		S-8GUSW8P	2.00 (51.0)		3.98 (101)	
	3/4 in.	1.20	0.31 (8.0)		S-8GUSW12P	2.00 (51.0)	0.88 (22.4)	4.13 (105)	3.25 (82.6)
		2.25	0.43 (11.0)		S-16GUSW12P	3.00 (76.2)		5.24 (133)	
	1 in.	1.20	0.31 (8.0)		S-8GUSW16P	2.00 (51.0)	1.00 (25.4)	4.25 (108)	3.50 (88.9)
		2.25	0.43 (11.0)		S-16GUSW16P	3.00 (76.2)		5.35 (136)	
Metric tube socket weld	6 mm	0.45	0.20 (5.0)	SS-4GUSW6MMT	—	1.75 (44.5)	0.50 (12.7)	3.20 (81.2)	2.38 (60.5)
	8 mm			SS-4GUSW8MMT					2.00 (51.0)
	10 mm			SS-4GUSW10MMT					
	12 mm	0.45	0.20 (5.0)	SS-4GUSW12MMT		1.75 (44.5)	0.50 (12.7)	3.20 (81.2)	2.25 (57.2)
		1.20	0.31 (8.0)	SS-8GUSW12MMT		2.00 (51.0)	0.63 (16.0)	3.87 (98.2)	2.63 (66.8)
	14 mm	1.20	0.31 (8.0)	SS-8GUSW14MMT		2.00 (51.0)	0.63 (16.0)	3.87 (98.2)	2.63 (66.8)
		2.25	0.43 (11.0)	SS-16GUSW14MMT		3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.75 (95.3)
	16 mm	1.20	0.31 (8.0)	SS-8GUSW16MMT		2.00 (51.0)	0.63 (16.0)	3.87 (98.2)	2.63 (66.8)
		2.25	0.43 (11.0)	SS-16GUSW16MMT		3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.50 (88.9)
	18 mm	2.25	0.43 (11.0)	SS-16GUSW18MMT		3.00 (76.2)	0.88 (22.4)	5.24 (133)	3.25 (82.6)
	25 mm			SS-16GUSW25MMT					

 GU SERIES
NEEDLE

Options

To order valves with multiple options, add the appropriate designator in *alphabetical order*.

High-Temperature Stem Packing, Bonnet Seal

Graphite stem packing and bonnet seal material is available for temperatures up to 650°F (343°C).

To order valves with graphite material, add **-G** to the valve ordering number:

Example: SS-4GUF4-G

Antitamper Handle

The antitamper handle reduces the risk of human error and deliberate tampering. The valve can be operated with the antitamper key, sold separately.

To order valves with antitamper handles, add **-AT** to the valve ordering number.

Example: SS-4GUF4-AT



Round Lockable Handles

The lockable handles can lock the valve in any position. These round handles accommodate shackle diameters smaller than 0.22 in. (5.7 mm) for 4GU and 8GU series valves and 0.28 in. (7.0 mm) for 16GU series valves.



Nylon

A nylon lockable handle is available for ambient temperatures up to 250°F (121°C) and process temperatures up to 450°F (232°C).

To order, add **-NLH** to the valve ordering number.

Example: SS-4GUF8-NLH

Stainless Steel

A stainless steel lockable handle is available for marine service.

To order, add **-SLH** to the valve ordering number.

Example: SS-4GUF8-SLH

- ⚠ **A packing adjustment may be required periodically to increase service life and to prevent leakage.**
- ⚠ **Valves that have not been cycled for a period of time may have a higher initial actuation torque.**
- ⚠ **To increase service life, ensure proper valve performance, and prevent leakage, apply only as much torque as is required to achieve positive shutoff.**

Caution: Do not mix or interchange parts with those of other manufacturers.

Accessories

Antitamper Key

- Fits all vent valves within the system
- Order separately



Valve Series	Ordering Number
4GU	S004468
8GU	
16GU	S007240

Handle Kits

Standard stainless steel bar handle kits contain a handle, washer, lock nut, and instructions.

Optional round lockable nylon or stainless steel handle kits contains a handle, lock shield, retaining ring, label, washer, lock nut, and instructions.

Handle Style	Valve Series	Kit Ordering Number
Stainless steel bar	4GU	SS-5K-4GU
	8GU	SS-5K-8GU
	16GU	SS-5K-16GU
Round lockable nylon	4GU	SS-5K-4GU-NLH
	8GU	SS-5K-8GU-NLH
	16GU	SS-5K-16GU-NLH
Round lockable stainless steel	4GU	SS-5K-4GU-SLH
	8GU	SS-5K-8GU-SLH
	16GU	SS-5K-16GU-SLH

About this document

Thank you for downloading this electronic catalog, which is part of General Product catalog Swagelok published in print. This type of electronic catalog is updated as new information arises or revisions, which may be more current than the printed version.

Swagelok Company is a major developer and provider of fluid system solutions, including products, integration solutions and services for industry research, instrumentation, pharmaceutical, oil and gas, power, petrochemical, alternative fuels, and semiconductor. Our manufacturing facilities, research, service and distribution facilities support a global network of more than 200 authorized sales and service centers in 57 countries.

Visit www.swagelok.com to locate your Swagelok representative and obtain any information on features, technical information and product references, or to learn about the variety of services available only through authorized sales centers and service Swagelok.

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

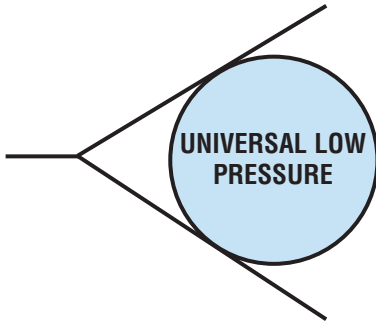
Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit your Swagelok Web site or contact your authorized Swagelok representative.

Swagelok, Ferrule-Pak, Goop, Hinging-Colleting, IGC, Kenmac, Micro-Fit, Nupro, Snoop, Sno-Trik, SWAK, VCO, VCR, Ultra-Torr, Whitey—TM Swagelok Company
Aflas—TM Asahi Glass Co. Ltd.
AL-6XN—TM Allegheny Ludlum Corporation
AutoCAD—TM Autodesk, Inc.
CSA—TM Canadian Standards Association
DeviceNet—TM ODVA
Kalrez, Krytox—TM DuPont
Elgiloy—TM Elgiloy Specialty Metals
FM—TM FM Global
Grafoil—TM GrafTech International Holdings, Inc.
MAC—TM MAC Valves Inc.
Microsoft, Windows—TM Microsoft Corp.
NACE—TM NACE International
picofast—TM HansTurck KG
Pillar—TM Nippon Pillar Packing Company, Ltd.
15-7 PH, 17-7 PH—TM AK Steel Corp.
Sandvik—TM SandvikAB
Silconert—TM Silcotek Corporation
Simriz—TM Freudenberg-NOK
SolidWorks—TM SolidWorks Corporation

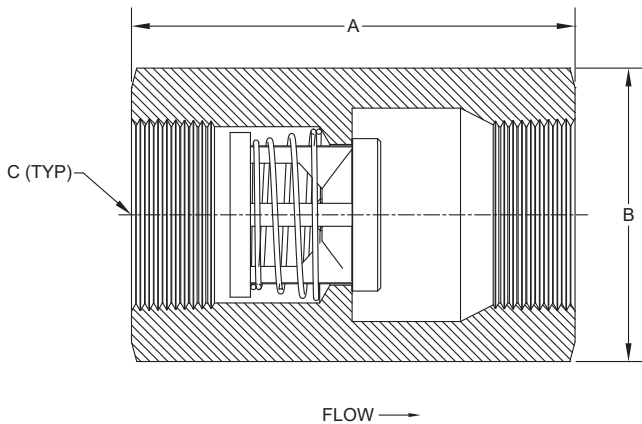


U3HSSKZ.500SS



The **Universal Low Pressure (U3, UR)** check valve is a one piece body machined from bar stock and is designed for minimum pressure drop. The valve has a light-weight, compact design that provides maintenance-free, dependable service. NPT threads are per ASME B1.20.1. Also available with ISO 7 "Rp" threads. (UR). These valves can also be used as a low pressure relief valve or vacuum breaker by using the desired spring settings.

NOTE: Many valves in this series can be supplied with B16.34 certification. Consult the factory for more information.



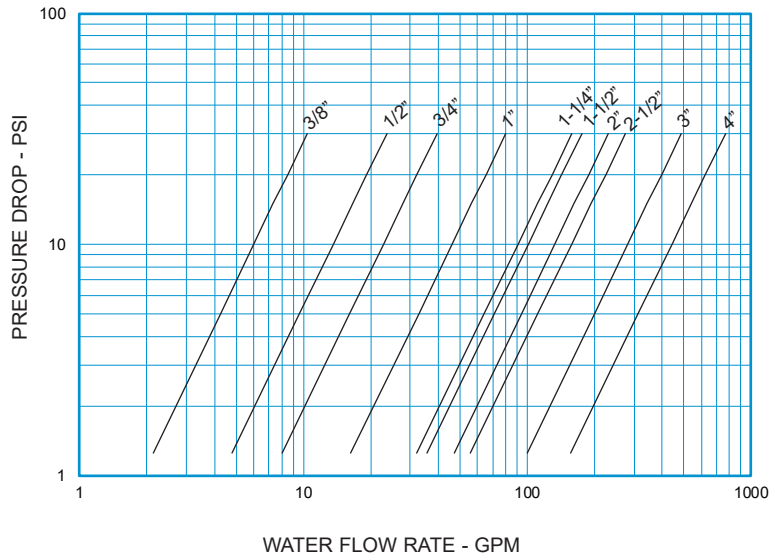
Nom. Pipe Size	Size Code	A	Hex ^① Size B	C	Orifice Diameter
3/8	C	2.16	13/16	3/8 NPT	0.348
1/2	D	2.71	1-1/8	1/2 NPT	0.464
3/4	F	2.95	1-1/4	3/4 NPT	0.593
1	H	3.64	1-5/8	1 NPT	0.890
1-1/4	I	3.91	2-1/4	1-1/4 NPT	1.135
1-1/2	J	4.36	2-1/2	1-1/2 NPT	1.385
2	K	5.85	3	2 NPT	1.555
2-1/2	L	5.50	3-3/4	2-1/2 NPT	1.555
3	M	6.25	4-1/2	3 NPT	2.025
4	N	7.13	5-1/2	4 NPT	2.560

^① May be larger and/or round.

Body Material ②	Availability	Non-Shock Pressure-Temperature Rating	
316 Stainless Steel (SS)	Standard	3/8" - 3" 3000 PSIG @ 100°F (1500 PSIG for o-ring seats)	4" 1500 PSIG @ 100°F
Carbon Steel (CS)			
Brass (BR)			
Alloy 20 (A2)	Semi-standard		
Alloy C-276 (HC)			
Alloy 400 or Monel ® (MO)			
Alloy B (HB)	Contact the factory for these or other materials		
Titanium (TI)			

^② See page 54 for material grade information.

Universal Low Pressure
For Water at 72°F



Note: All flow curves and Cv values presume the valves are fully open with 1/2 PSI cracking pressure springs. Consult the factory for more information.

STYLE U3 C _v VALUES & VALVE WEIGHTS			
C _v	SIZE	SS & CS ALLOYS	BRASS
1.9	3/8	3.0 oz.	3.3 oz.
4.3	1/2	8.5 oz.	9.1 oz.
7.2	3/4	9.6 oz.	10.1 oz.
14.6	1	1.2 lb.	1.3 lb.
28.8	1-1/4	2.9 lb.	3.2 lb.
31.9	1-1/2	3.6 lb.	3.9 lb.
42.0	2	6.5 lb.	7.2 lb.
50.0	2-1/2	9.2 lb.	10 lb.
89.0	3	14.3 lb.	15.5 lb.
140	4	21.7 lb.	23.9 lb.

See page 49 for Flow Formulae.
Valve weights are approximate.

HOW TO ORDER CHECK-ALL STYLE U3

BODY MATERIAL

ALLOY 20 = A2
BRASS = BR
CARBON STEEL = CS
ALLOY B = HB
ALLOY C-276 = HC
ALLOY 400 OR MONEL® = MO
316 SS = SS
TITANIUM = TI

See p. 3 for temperature rating

SPRING CRACKING PRESSURES (PSI)
Must use decimal as a character unless selecting NO SPRING. *Specify Exact Setting*

SPRING RANGES	EXAMPLE
.000 TO .999	= .500
1.00 TO 9.99	= 1.50
10.0 TO 85.0	= 15.0
NO SPRING	= NOSPRG

STANDARD CRACKING PRESSURES ①

.125 **.500** 1.50 3.50
(Sizes C-I Only)

Note: Many other cracking pressures are available. All spring tolerances +/- 15%.

U

VALVE STYLE

NPT Threads = U3
ISO 7 Rp Threads = UR

SIZE

3/8 = C
1/2 = D
3/4 = F
1 = H
1-1/4 = I
1-1/2 = J
2 = K
2-1/2 = L
3 = M
4 = N

SEAT MATERIAL ②

AFLAS® = AS
BUNA-N = BN
EPDM ③ = EP
KALREZ® = KZ
“METAL-TO-METAL” = MT
NEOPRENE = NE
PTFE = TF
VITON® = VT

See p. 3 for temperature ratings

SPECIAL OPTIONS

T = FEP ENCAPSULATED SPRING
See p. 4 for temperature rating
Contact the factory for more options

SPRING MATERIAL

316 SS = SS
ALLOY C-276 = HC
ALLOY B = HB
ALLOY X750 OR INCONEL® X750 = IX
ALLOY 400 OR MONEL® = MO
17-7PH SS = PH
TITANIUM = TI

See p. 4 for temperature ratings

Listed above are the most common material selections. Please contact the factory for additional options.

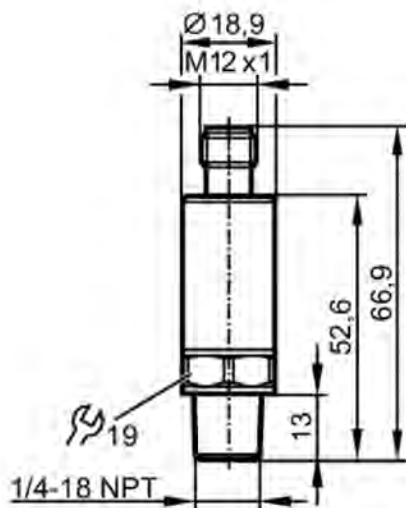
- ① .500 PSI is the only standard cracking pressure for spring materials other than Stainless Steel. .125 PSI springs are not recommended for installations with flow vertical down.
- ② Seat materials other than “metal-to-metal” have a maximum pressure rating of 1500 PSI. “Metal-to-Metal” and PTFE seats are not resilient. See page 50 for allowable leakage rates.
- ③ EP seats not recommended for use with Carbon Steel valves.

PT2494



Pressure transmitter

PT-020PSEN14-A-ZVG/US/ IW



Product characteristics

Output signal	analog signal
Measuring range [psi]	-14.5...200
Process connection	threaded connection 1/4" NPT external thread

Application

Application	for industrial applications
Media	liquids and gases
Medium temperature [°C]	-40...90
Min. bursting pressure [psi]	6525
Pressure rating [psi]	580
Note on pressure rating	static
Vacuum resistance [psi]	-14.5
Type of pressure	relative pressure
MAWP (for applications according to CRN) [psi]	580

Electrical data

Operating voltage [V]	8.5...36 DC
Min. insulation resistance [MΩ]	100; (500 V DC)
Protection class	III
Reverse polarity protection	yes
Power-on delay time [s]	0.1

Inputs / outputs

Number of inputs and outputs	Number of analog outputs: 1
------------------------------	-----------------------------



Pressure transmitter

PT-020PSEN14-A-ZVG/US/ IW

Outputs		
Total number of outputs		1
Output signal		analog signal
Number of analog outputs		1
Analog current output [mA]		4...20
Max. load [Ω]		($U_b - 8,5 \text{ V}$) / 21,5 mA; @8,5V= 0 Ω; @12V max. 160 Ω; @24V max. 720 Ω
Short-circuit proof		yes
Overload protection		yes
Measuring/setting range		
Measuring range [psi]		-14.5...200
Accuracy / deviations		
Repeatability [% of the span]		< ± 0,05; (with temperature fluctuations < 10 K)
Characteristics deviation [% of the span]		< ± 0,5; (incl. drift when overtightened, zero point and span error, non-linearity, hysteresis)
Linearity deviation [% of the span]		< ± 0,1 (BFSL) / < ± 0,2 (LS)
Hysteresis deviation [% of the span]		< ± 0,2
Long-term stability [% of the span]		< ± 0,1; (per 6 months)
Temperature coefficient zero point and span [% of the span / 10 K]		< 0,1 (-25...90 °C) / < 0,2 (-40...-25 °C)
Reaction times		
Step response time analogue output [ms]		1
Operating conditions		
Ambient temperature [°C]		-40...90
Storage temperature [°C]		-40...100
Protection		IP 67; IP 69K
Tests / approvals		
EMC	DIN EN 61000-6-2	
	DIN EN 61000-6-3	
Shock resistance	DIN EN 60068-2-27	50 g (11 ms)
Vibration resistance	DIN EN 60068-2-6	20 g (10...2000 Hz)
MTTF [years]		787
UL approval	UL approval number	J027
Pressure equipment directive	sound engineering practice; can be used for group 2 fluids; group 1 fluids on request	

PT2494



Pressure transmitter

PT-020PSEN14-A-ZVG/US/ IW

Mechanical data		
Weight	[g]	58
Material		1.4542 (17-4 PH / 630); stainless steel (1.4404 / 316L); PEI
Materials (wetted parts)		1.4542 (17-4 PH / 630)
Min. pressure cycles		60 million; (at 1.2 times nominal pressure)
Tightening torque	[Nm]	< 50; (recommended tightening torque; Depends on lubrication, seal and pressure rating)
Process connection		threaded connection 1/4" NPT external thread
Restrictor element integrated		no (can be retrofitted)

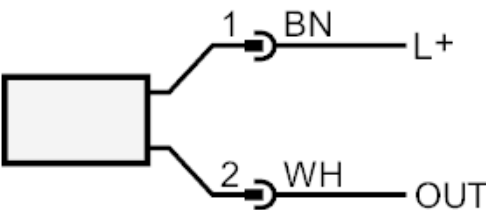
Remarks	
Remarks	BFSL = Best Fit Straight Line LS = limit value setting
Pack quantity	1 pcs.

Electrical connection

Connector: 1 x M12



Connection



OUT analog output
 Colours to DIN EN 60947-5-2
 Core colors :
BN = brown
WH = white

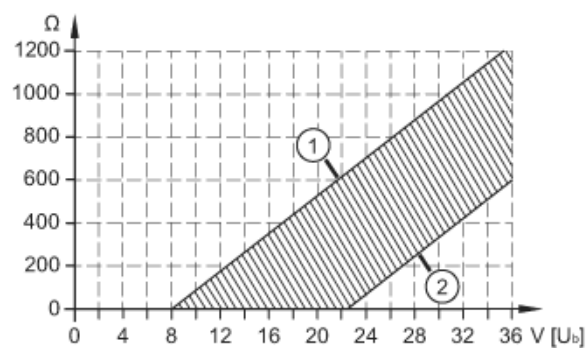
PT2494

Pressure transmitter

PT-020PSEN14-A-ZVG/US/ IW



Diagrams and graphs



1: Max. load

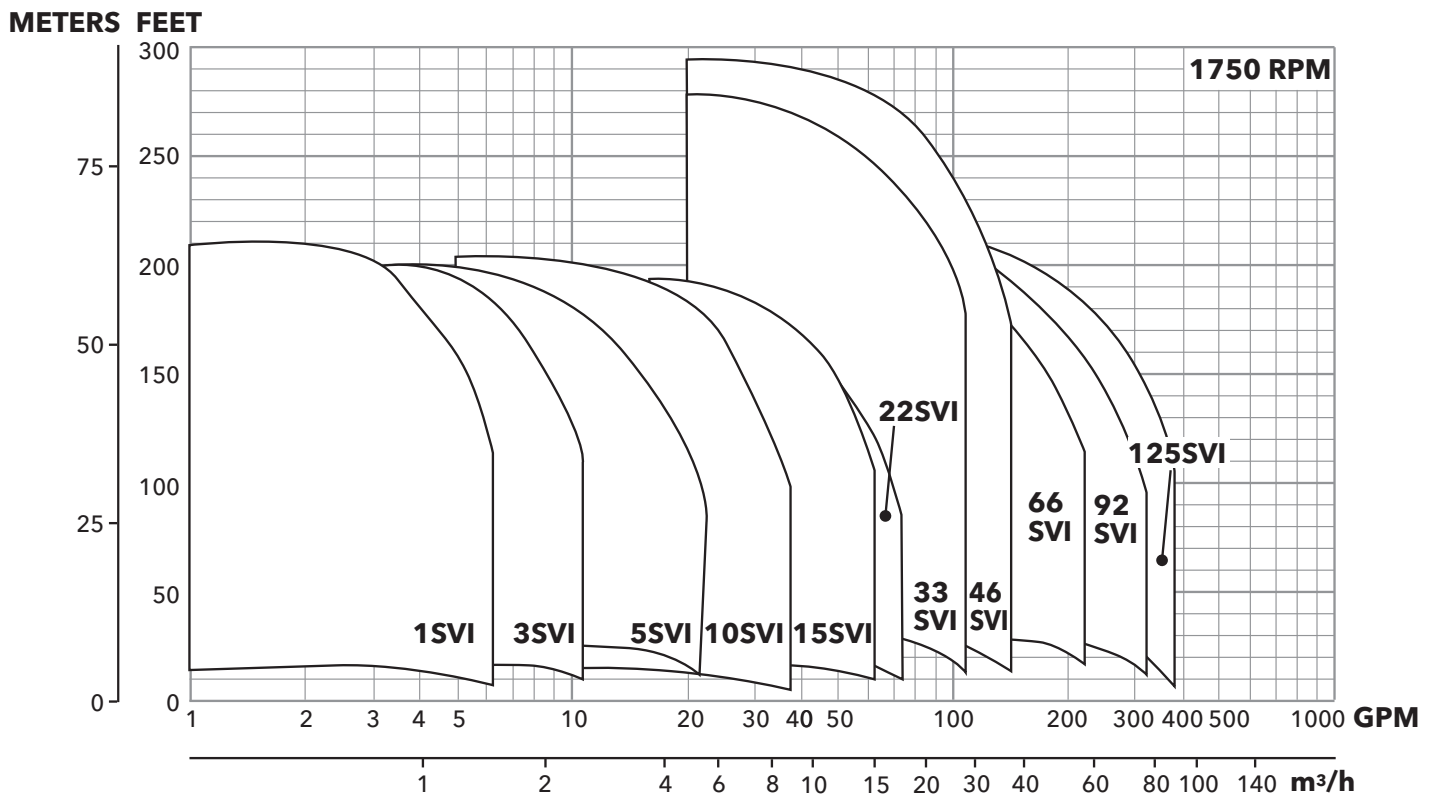
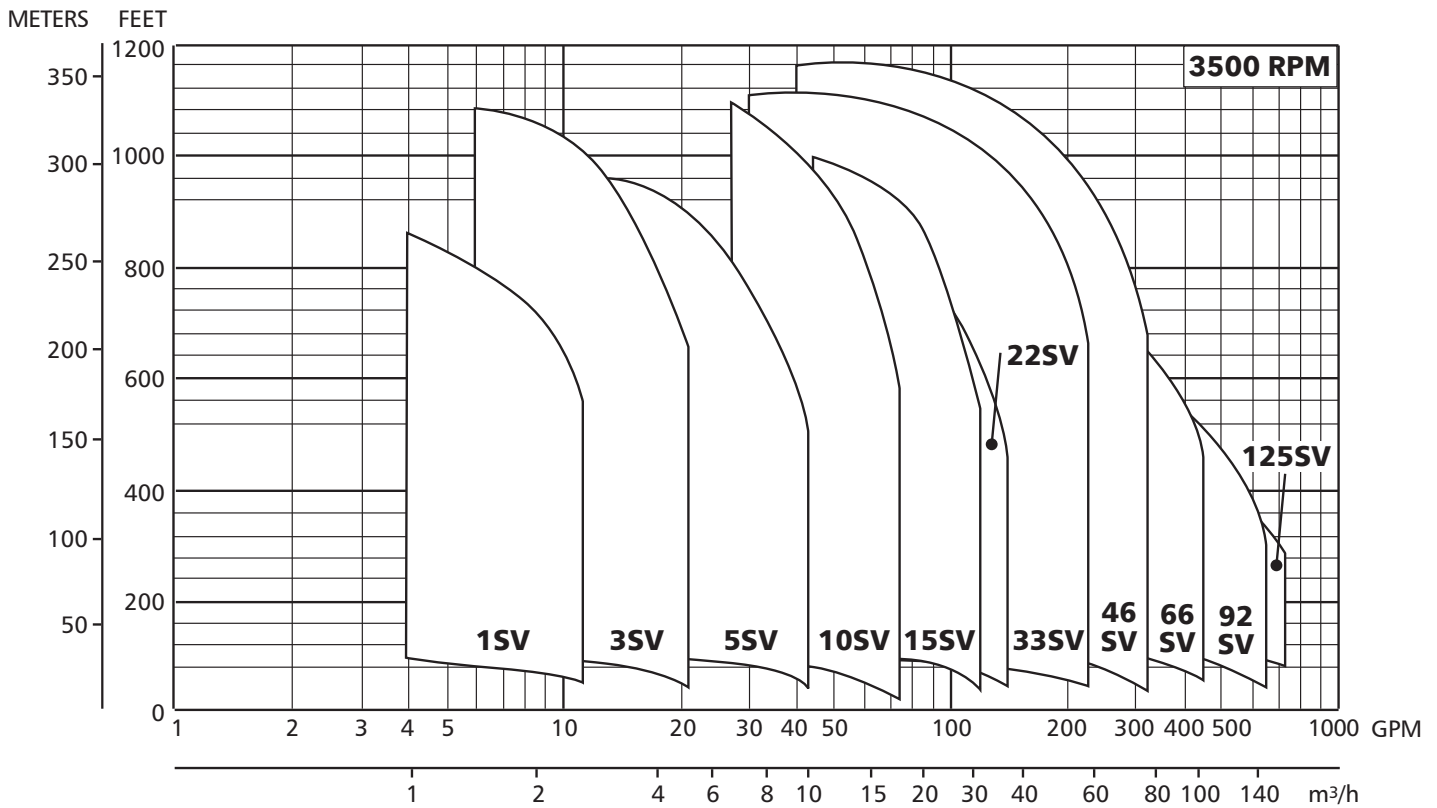
2: Min. load



e-SV Series Vertical Multistage Pumps

60 HZ TECHNICAL MANUAL

e-SV Pump Coverage Curve



e-SV Multistage Pump General Market Specifications

INDUSTRIAL, COMMERCIAL BUILDING SERVICES, GENERAL MANUFACTURING, AGRICULTURE AND WATER UTILITIES

Applications

- Handling of water, free of suspended solids, in the municipal, industrial and agricultural markets
- Pressure boosting and water supply systems
- Boiler feed
- Fire fighting jockey pumps
- Irrigation systems
- Wash systems
- Reverse osmosis
- Handling of moderately aggressive liquids, demineralized water, water and glycol, etc.
- Circulation of hot and cold water for heating, cooling and conditioning systems

Specifications

PUMP

The e-SV pump is a non-self priming vertical multistage pump coupled to a standard motor. The liquid end, located between the upper cover and the pump casing, is held in place by tie rods. The pump casing is available with different configurations and connection types.

- Delivery: up to 725 gpm
- Head: up to 1200 feet
- Temperature of pumped liquid:
-20°F to 250°F (-30°C to 120°C) standard version
- Optional temperature range up to 300°F (149°C) high temperature version
- Maximum operating pressure
 - SV1-22 with oval flanges: 230 psi (16 bar)
 - SV1-22 with round flanges or Victaulic: 362 or 575 psi (25 or 40 bar)
 - SV33, 46: 362 or 580 psi (25 or 40 bar)*
 - SV 66, 92: 362 or 580 psi (25 or 40 bar)*
 - SV 125: 362 or 580 psi (25 or 40 bar)
- Direction of rotation: clockwise looking at the pump from the top down (marked with an arrow on the adapter and on the coupling).

MOTOR

- Standard NEMA premium TC frame motors in open drip proof or totally enclosed fan cooled.
- 3500 rpm nominal
- Standard voltage:
 - Single-phase version: 115-208/230 V, 60 Hz up to 3 hp or 208-230 V for 5 hp
 - Three-phase version, 2 pole: 208-230/460 V, 60 Hz up to 75 hp

* Based on pump staging

e-SV Pump Characteristics

1SV, 3SV, 5SV, 10SV, 15SV, 22SV Series

- Vertical multistage centrifugal pump. All metal parts in contact with the pumped liquid are made of stainless steel.
- The following versions are available:
 - F – ANSI flanges, in-line delivery and suction ports, AISI 304
 - T – Oval flanges (NPT), in-line delivery and suction ports, AISI 304
 - R – ANSI flanges, delivery port above the suction port, with four adjustable positions, AISI 304
 - N – ANSI flanges, in-line delivery and suction ports, AISI 316
 - P – Victaulic couplings, in-line delivery and suction ports, AISI 316
 - G – ANSI flange, in-line delivery and suction ports, Class 35/40B cast iron.
 - C – ISO clamp, AISI 316
- Innovative axial load compensation system on pumps with higher head. This ensures reduced axial thrusts and enables the use of standard NEMA TC motors.
- Seal housing chamber designed to prevent the accumulation of air in the critical area next to the mechanical seal
- Mechanical seal according to EN 12756 (ex DIN 24960) and ISO 3069
- Versions with ANSI flanges that can be coupled to ANSI raised face counter-flanges
- Threaded oval counter-flanges made of stainless steel are standard supply for the T versions
- Easy maintenance. No special tools required for assembly or disassembly
- Standard version for temperatures ranging from: -20°F to 250°F (30°C to 120°C)

33SV, 46SV, 66SV, 92SV, 125SV Series

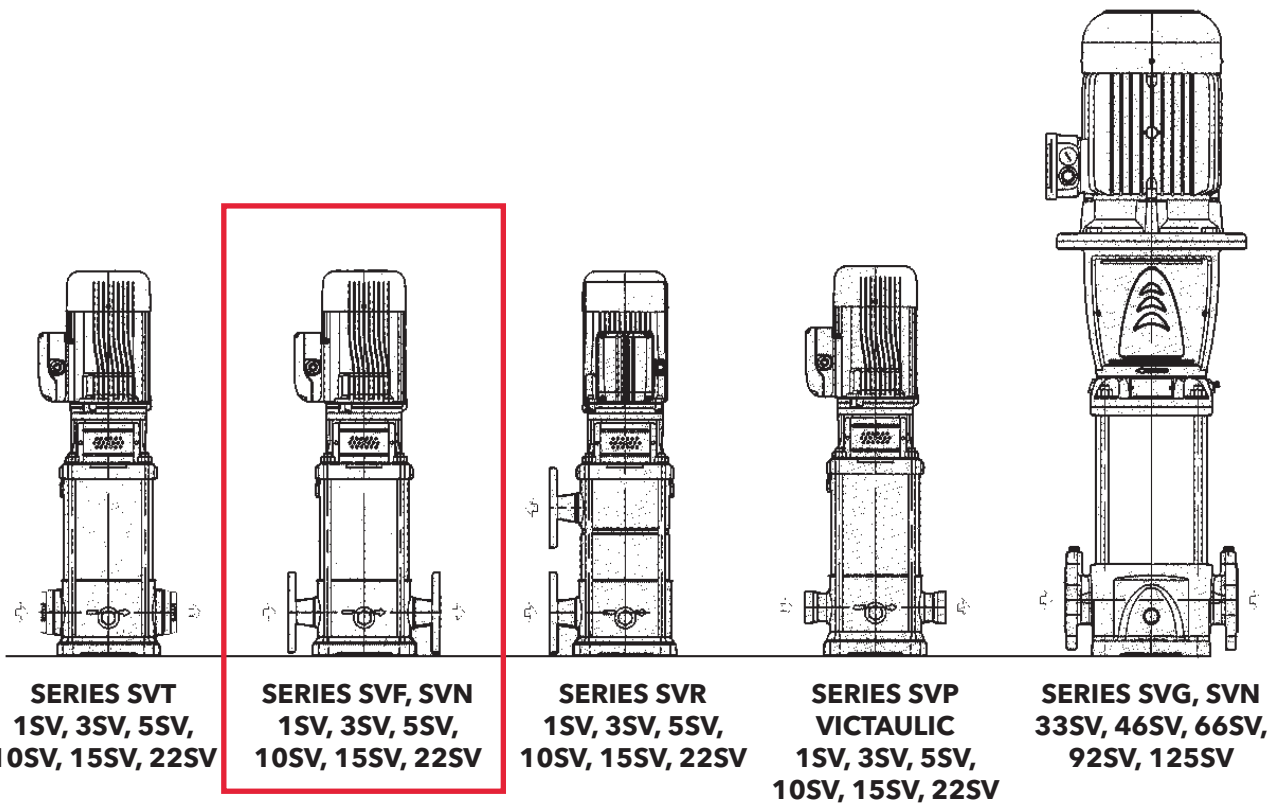
- Vertical multistage centrifugal pump with impellers, diffusers and outer sleeve made entirely of stainless steel, and with pump casing and motor adapter made of cast iron in the standard version
- Rotating components made entirely of AISI 316 stainless steel
- High heads and capacities five sizes: 33SV, 46SV, 66SV, 92SV, 125SV
- Redesigned liquid end provides improved efficiency and energy savings
- Innovative axial load compensation system on pumps with higher head. This ensures reduced axial thrusts and enables the use of standard NEMA TC motors.
- Balanced mechanical seal according to EN 12756 (ex DIN 24960) and ISO 3069, which can be replaced without removing the motor from the pump
- Seal housing chamber designed to prevent the accumulation of air in the critical area next to the mechanical seal
- Standard version for temperature ranging from: -20°F to 250°F (-30°C to 120°C)
- Pump body fitted with taps for installing pressure gauges on both suction and delivery flanges
- In-line ports with ANSI flanges that can be coupled to counter-flanges, in compliance with ANSI raised face.
- Mechanical sturdiness and easy maintenance. No special tools required for assembly or disassembly.

Optional Features

- Horizontal version
- Special voltages, 50 Hz frequency
- Special materials for the mechanical seal, gaskets and elastomers
- Tropicalized motors
- Explosion proof and wash down motors
- 1750 rpm, 4 pole motors
- Passivation

Commercial Water

General Characteristics - 2-pole



e-SV Product Range	1SV	3SV	5SV	10SV	15SV	22SV	33SV	46SV	66SV	92SV	125SV
Nominal Flow (GPM)	9	15	30	50	80	110	150	220	350	450	600
Flow Range(GPM)	2-12	3-22	7-45	9-75	18-125	21-150	30-195	45-285	70-420	90-580	120-700
Max. Head (Ft)	860	1085	975	1150	1060	880	1125	1210	850	715	570
Max. Working Pressure (PSIG)	362/580										
Temperature Range (°F)	Standard -20°F - 250°F (-30°C - 121°C)										
High Temp Option	up to 300°F (150°C)							-			
Motor Power [HP]	½ - 5 HP	½ - 7½	¾ - 10	¾ - 20	2 - 25	3 - 30	3 - 60	7½ - 75	10 - 75	15 - 75	20 - 75
Max Pump Efficiency	51%	60%	70%	70%	70%	71%	76%	78%	78%	80%	79%
Materials of Construction											
SVT	304 SS						-				
SVF	304 SS						-				
SVN	316L SS						Cast Stainless Steel / 316L SS				
SVR	304 SS						-				
SVP	316L SS						-				
SVC	316L SS						-				
SVG	ASTM Class 35/40B Cast Iron / 304 SS										
Connection Sizes											
SVT - Oval NPT	1¼"	1¼"	1¼"	2"	2"	2"	-				
SVF - Round ANSI Size/Class	1¼" 300#	1¼" 300#	1¼" 300#	2" 300#	2" 300#	2" 300#	-				
SVN - Round ANSI Size/Class	1¼" 300#	1¼" 300#	1¼" 300#	2" 300#	2" 300#	2" 300#	2½" 150/300#	3" 150/300#	4" 150/300#	4" 150/300#	5" 150/300#
SVR - Top/Bottom Round ANSI Size/Class	1¼" 300#	1¼" 300#	1¼" 300#	2" 300#	2" 300#	2" 300#	-				
SVP - Victaulic	1¼"	1¼"	1¼"	2"	2"	2"	-				
SVC - Clamp	1½"	1½"	1½"	2"	2"	2"	-				
SVG - Cast Iron Size/Class	1¼" 250#	1¼" 250#	1¼" 250#	2" 250#	2" 250#	2" 250#	2½" 125/250#	3" 125/250#	4" 125/250#	4" 125/250#	5" 125/250#

Commercial Water

e-SV Multistage Pumps

Product Code for 1 - 22SV Pump & Motor Combination

Each e-SV pump is identified by a product code on the pump label. Each digit in the code is described below. The product code is also the catalog number for the pump.

Note: Not all combinations are possible.

Example Product Code

2 SV 2 2 F A 2 F 5 1 A H

Special Configurations (1 or 2 Characters)

F = Destaged - 1 stage
G = Destaged - 2 stage
H = Horizontal mount only
J = Horizontal mount + Passivation
K = Horizontal mount + Low NPSH
L = Horizontal mount + High Pressure
N = Low NPSH only
P = Passivation only
S = Customized Configuration
Z = High Press (250/300# pump body)

Seal Material

0 = Carb-SilCar-Viton
1 = Carb-SilCar-AFLAS (HighTemp)
2 = SilCar-SilCar-Viton
4 = SilCar-SilCar-EPR
6 = Carb-SilCar-EPR

Motor Enclosure

1 = ODP
2 = TEFC
3 = X-Proof
4 = WD - Tropical
5 = Prem-ODP
6 = Prem-TEFC
7 = Prem-XP
8 = Prem-WD
9 = Marine
A = Chem
B = Prem-Chem
C = Class 1 Div 2

Voltage

A = 115/230
B = 230
C = 230/460
D = 460
E = 575
F = 208-230/460
G = 200
H = 190/380
J = 115/208-230
K = 208
L = 208-230
M = 190-380/415
N = 380
P = 110/220
R = 220
S = 415
T = 220/380 WYE
U = 380-660 WYE
V = 208-230/460 WYE
W = 220/380/440

Pole-Hz-Phase

1 = 2-50-1
2 = 2-50-3
3 = 2-60-1
4 = 2-60-3
5 = 4-50-1
6 = 4-50-3
7 = 4-60-1
8 = 4-60-3

HP Rating

A = 0.50
B = 0.75
C = 1.00
D = 1.50
E = 2
F = 3
G = 5
H = 7.5
J = 10
K = 15
L = 20
M = 25
N = 30
P = 40
R = 50
S = 60
T = 75
U = 100

Configuration OPTION

C = Clamp-316

F = Round-304 (SVB)

G = Cl-304

N = Round-316 (SVD)

P = Victaulic-316

T = Oval-304 (SVA)

Bottom / Top

R = (SVC) 12Suct-12Disch
W = (SVC) 12Suct-03Disch
X = (SVC) 12Suct-06Disch
Y = (SVC) 12Suct-09Disch

Suction
discharge
location

Total Number of Impeller Stages (may be 1 or 2 characters)

6

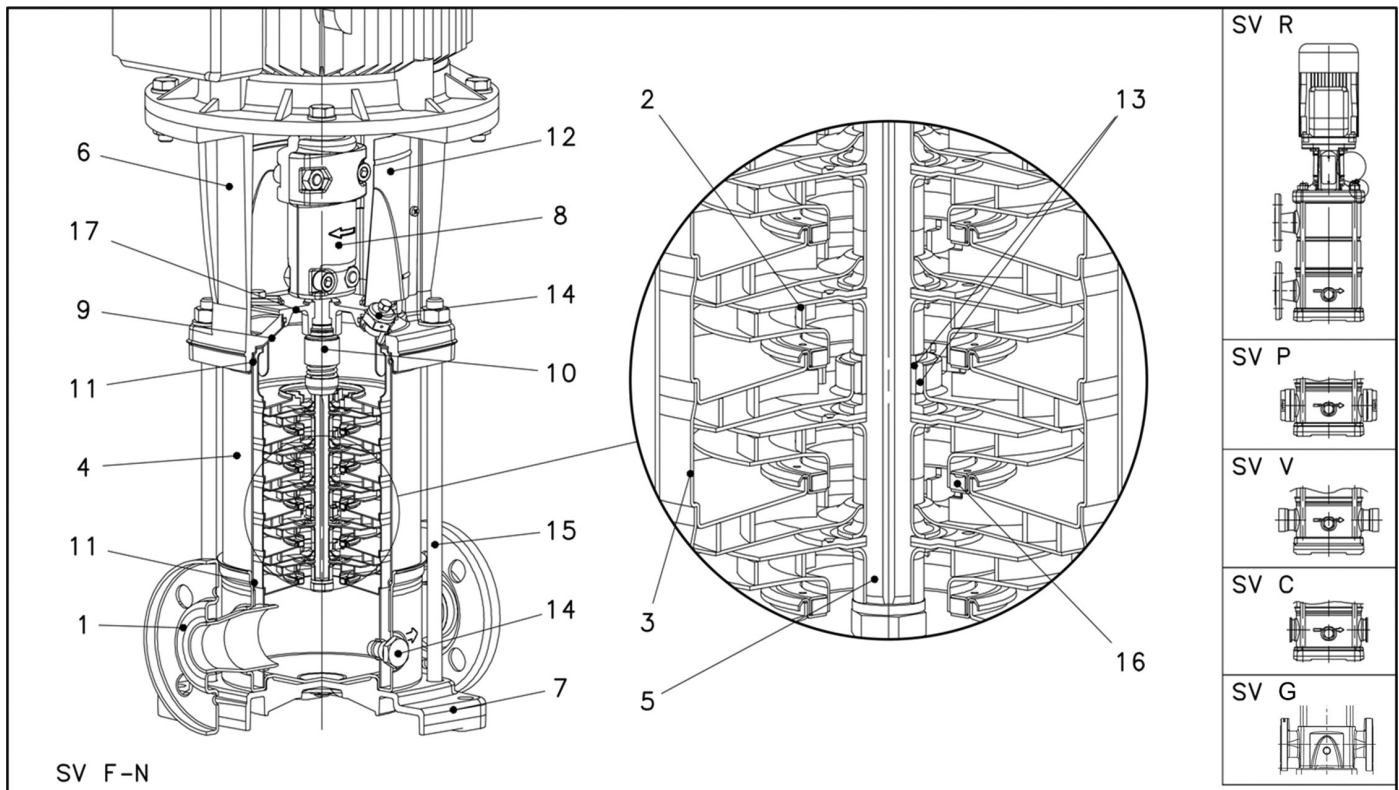
Product Line:

SV - Stainless Vertical

Nominal Flow:

1 = 5 GPM
3 = 16 GPM
5 = 26 GPM
10 = 53 GPM
15 = 80 GPM
22 = 116 GPM

Base Models: 1-22SV – Major Components



Base Models: 1-22SV – Major Components

F, G, P, R VERSIONS

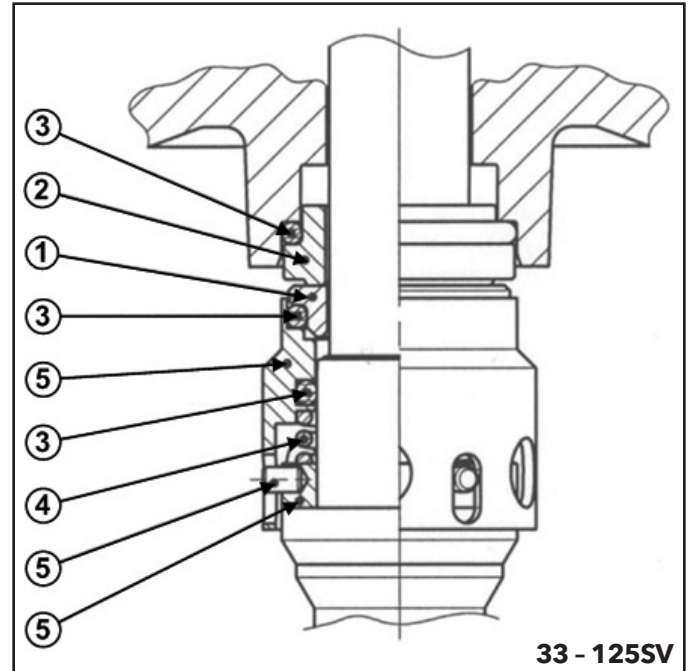
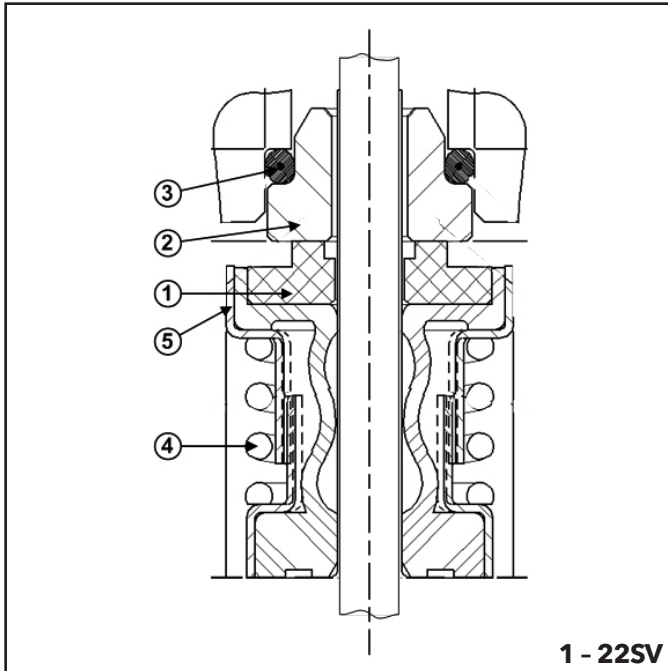
Ref. No.	Name	Material	Reference Standards	
			USA	Europe
1	Pump Body	Stainless Steel (F, P, R)	AISI 304	EN 10088-1-X5-CrNi18-10 (1.4301)
		Cast Iron (G)	ASTM Class 35/40B	EN 1561 GJL 250 (JL1040)
2	Impeller	Stainless Steel	AISI 304	EN 10088-1-X5-CrNi18-10 (1.4301)
3	Diffuser	Stainless Steel	AISI 304	EN 10088-1-X5-CrNi18-10 (1.4301)
4	Casing	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNiMo17-12-2 (1.4404)
5	Shaft	Stainless Steel	AISI 316	EN 10088-1-X2-CrNiMo17-12-2 (1.4401)
6	Adapter	Cast Iron	ASTM Class 35/40B	EN 1561-GJL-250 (JL1040)
7	Base	Aluminum (F, P, R)	A384.0-F	EN 1706-AC-AISI11Cu2(Fe) (AC46100)
		N/A (G)	N/A	N/A
8	Coupling	Aluminum	A384.0-F	EN 1706-AC-AISI11Cu2(Fe) (AC46100)
9	Seal Plate	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNi17-12-2 (1.4404)
10	Mechanical Seal	Silicon Carbide / Carbon / Viton (opt. EPDM)		
11	Elastomers	Viton (opt. EPDM)		
12	Coupling Guard	Stainless Steel	AISI 304	EN 10088-1-X5-CrNi18-10 (1.4301)
13	Shaft Sleeve and Bushing	Tungsten Carbide		
14	Fill/Drain Plugs	Stainless Steel	AISI 316	EN 10088-1-X2-CrNiMo17-12-2 (1.4401)
15	Tie Rods	Carbon Steel / Zinc Plated	A29 Gr. 1045	EN 10277
16	Wear Ring	PPS		
17	Seal Gland	Stainless Steel	AISI 316	EN 10088-1-X2-CrNiMo17-12-2 (1.4401)

N, P, C VERSIONS

Ref. No.	Name	Material	Reference Standards	
			USA	Europe
1	Pump Body	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNiMo17-12-2 (1.4404)
2	Impeller	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNiMo17-12-2 (1.4404)
3	Diffuser	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNiMo17-12-2 (1.4404)
4	Casing	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNiMo17-12-2 (1.4404)
5	Shaft	Stainless Steel	AISI 316	EN 10088-1-X2-CrNiMo17-12-2 (1.4401)
6	Adapter	Cast Iron	ASTM Class 35/40B	EN 1561-GJL-250 (JL1040)
7	Base	Aluminum	A384.0-F	EN 1706-AC-AISI11Cu2(Fe) (AC46100)
8	Coupling	Aluminum	A384.0-F	EN 1706-AC-AISI11Cu2(Fe) (AC46100)
9	Seal Plate	Stainless Steel	AISI 316L	EN 10088-1-X2-CrNi17-12-2 (1.4404)
10	Mechanical Seal	Silicon Carbide / Carbon / Viton (opt. EPDM)		
11	Elastomers	Viton (opt. EPDM)		
12	Coupling Guard	Stainless Steel	AISI 304	EN 10088-1-X5-CrNi18-10 (1.4301)
13	Shaft Sleeve and Bushing	Tungsten Carbide		
14	Fill/Drain Plugs	Stainless Steel	AISI 316	EN 10088-1-X2-CrNiMo17-12-2 (1.4401)
15	Tie Rods	Carbon Steel / Zinc Plated	A29 Gr. 1045	EN 10277
16	Wear Ring	PPS		
17	Seal Gland	Stainless Steel	AISI 316	EN 10088-1-X2-CrNiMo17-12-2 (1.4401)

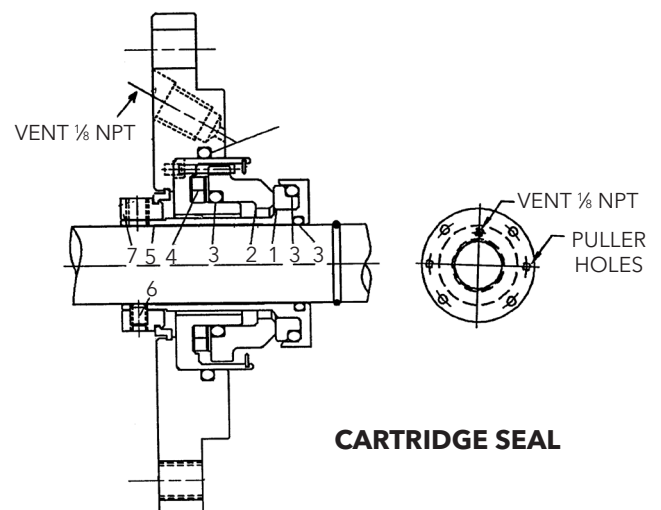
Commercial Water

e-SV Mechanical Seals



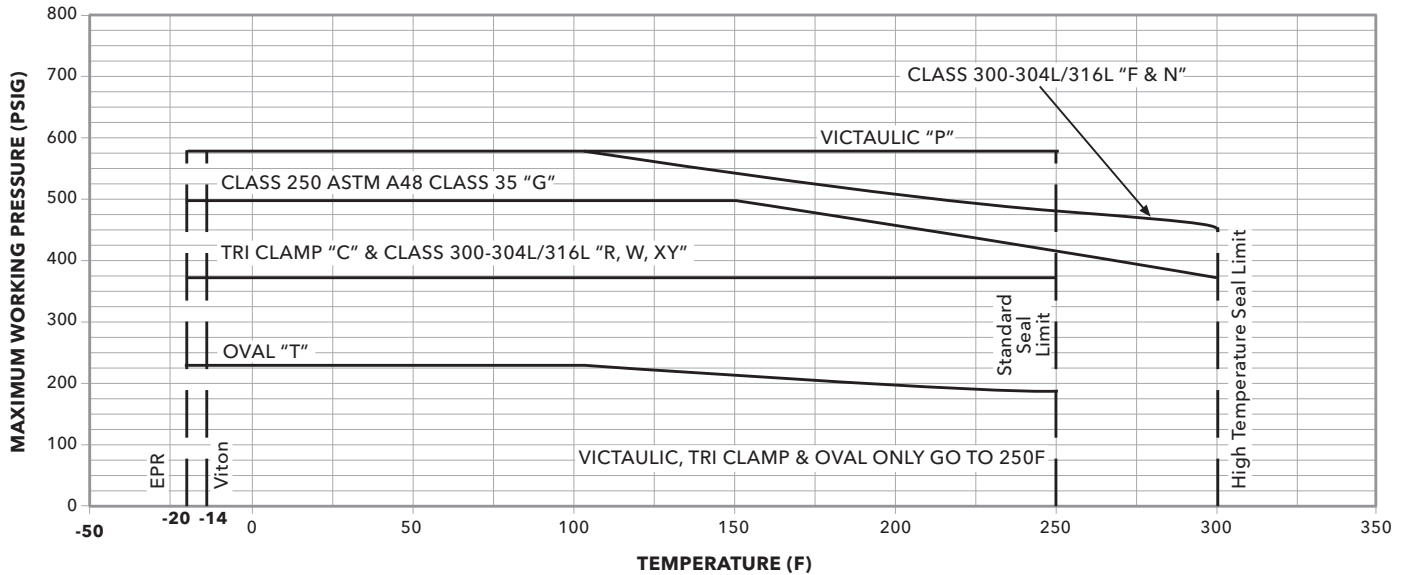
Pump	Code	Rotating Face 1	Stationary Face 2	Elastomers 3	Spring 4	Metal Components 5	Elastomer Temp Limits °F (°C)	Seal Temp Limits °F (°C)	Max. Working Pressure	Application
1SV thru 22SV	0	Carbon	Silicon Carbide Graphite Filled	Viton	316SS	316SS	-14 - 392°F (-10 - 200°C)	-22 - 250°F	580 psi (40 bar)	General Service
	2	Silicon Carbide Graphite Filled		EPR			-30 - 300°F (-34 - 150°C)			Severe Duty
	4									Severe Duty Boiler Feed
	6	Carbon		AFLAS			-14 - 392°F (-10 - 200°C)	up to 300°F (149°C)	255 psi (17.6 bar)	General Service Boiler Feed
	1	FDA Grade Carbon								Boiler Feed
33SV thru 125SV	0	Carbon	Silicon Carbide Graphite Filled	Viton	316SS	316SS	-14 - 392°F (-10 - 200°C)	-22 - 250°F (-30 - 120°C)	580 psi (40 bar)	General Service
	2	Silicon Carbide Graphite Filled		EPR			-22 - 250°F (-30 - 120°C)			Severe Duty
	4									Severe Duty Boiler Feed
	6	Carbon		General Service Boiler Feed						

Pump	Rotating Face 1	Stationary Face 2	Elastomers 3	Spring 4	Sleeve 5	Set Screw 6	Locking Collar
33SV	Silicon Carbide	Carbon	Viton	316SS	316SS	300SS	316SS
46SV		Carbon	Viton				
66SV		Silicon Carbide	EPR				
92SV		Silicon Carbide	EPR				

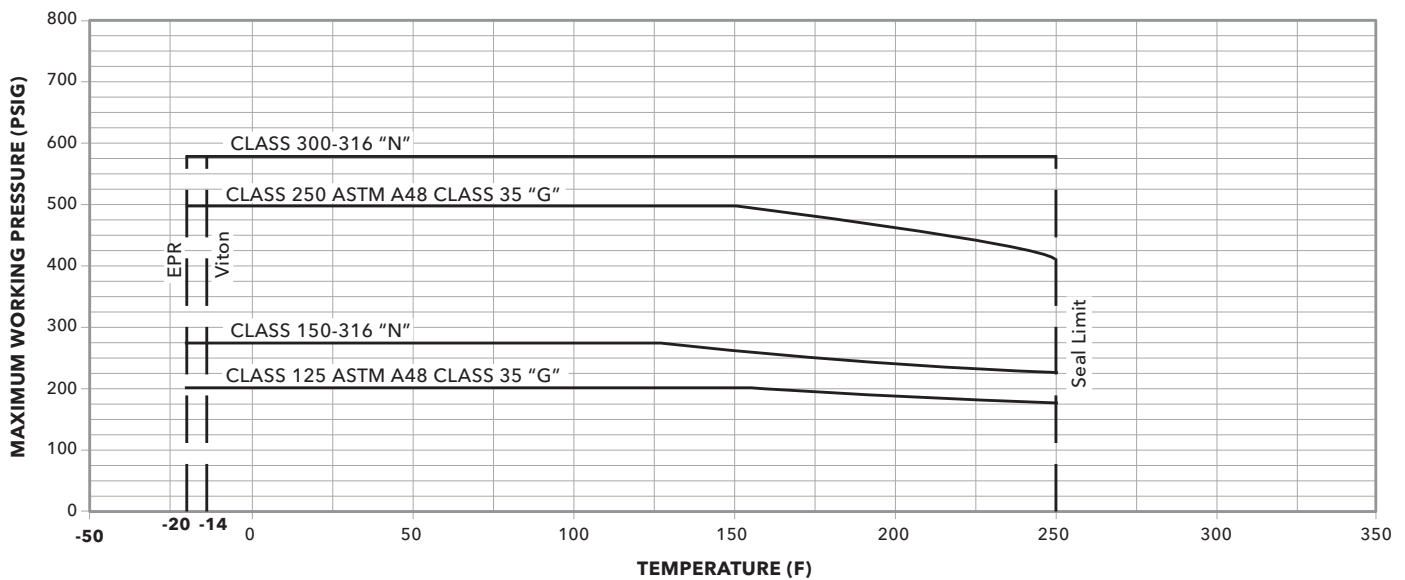


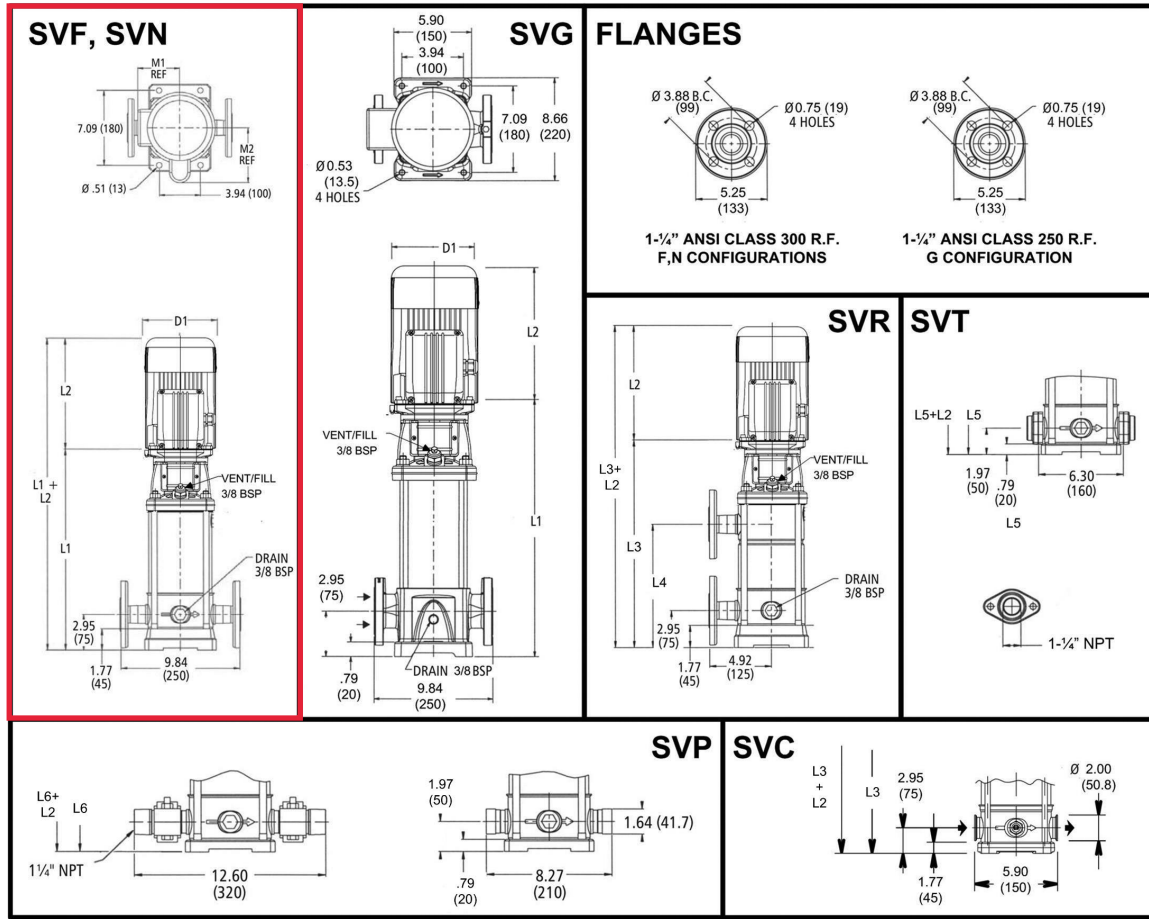
Maximum Allowable Working Pressure Charts

1SV-22SV



33SV-125SV





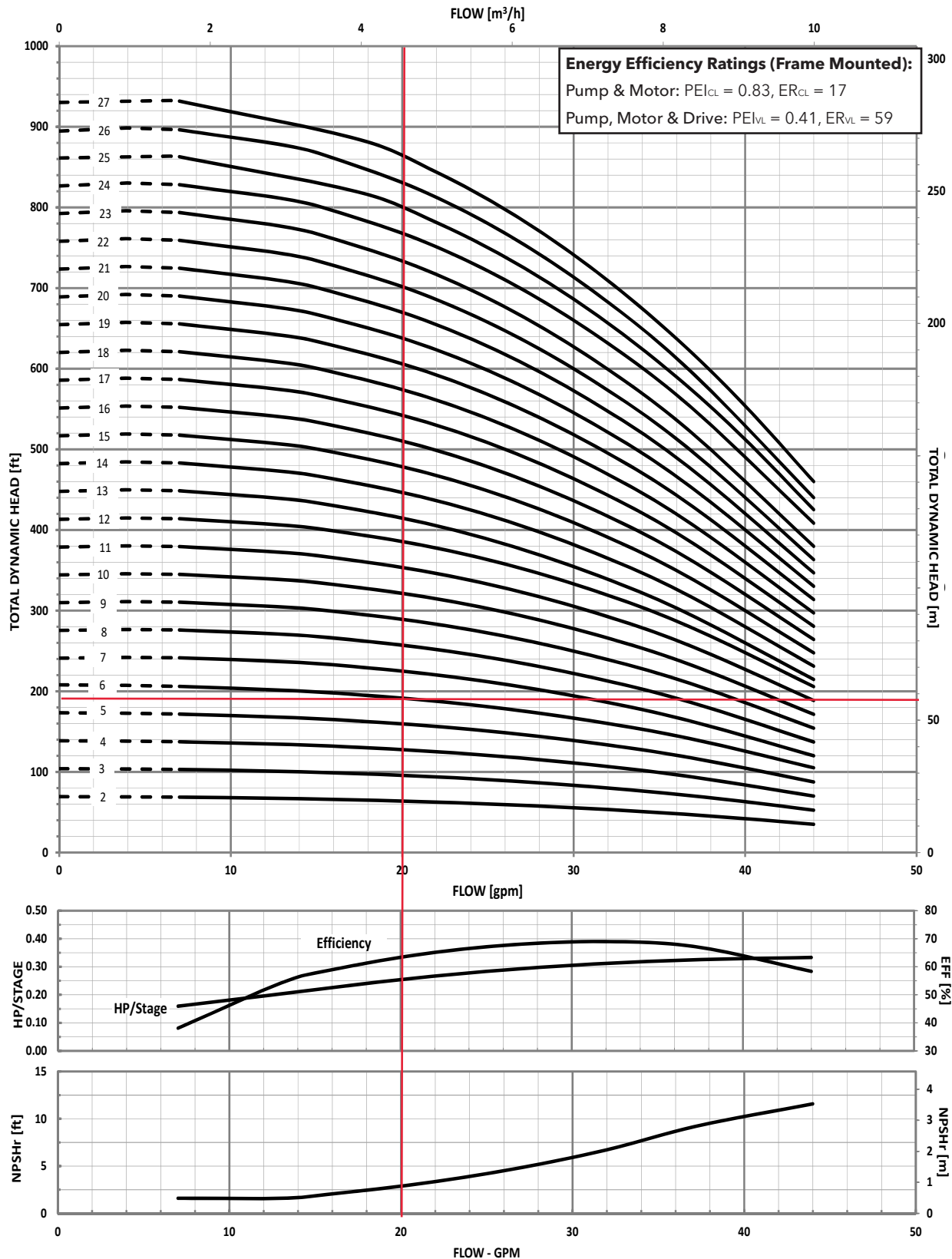
5SV SERIES – 60Hz, 3500 RPM ODP/TEFC Enclosures

Pump Type Stages	Motor				Dimensions (in)																Weight (lbs.)								
	HP	NEMA Frame				L1	L2				L3	L4	L5	L6	M (Ref.)	D1 (max.)				D2	Pump Only	Motor				Pump/Motor			
		ODP 10	TEFC 10	ODP 30	TEFC 30		ODP 10	TEFC 10	ODP 30	TEFC 30						ODP 10	TEFC 10	ODP 30	TEFC 30			ODP 10	TEFC 10	ODP 30	TEFC 30	ODP 10	TEFC 10	ODP 30	TEFC 30
5SV-02	0.75	56C	2		13.86	10.79	9.91	9.16	9.29	-	-	12.88	12.88	5.19	6.19	6.19	6.19	6.19	4.13	25	27	29	21	21	52	54	46	46	
5SV-03	1				13.86	10.66	11.19	9.16	9.29	-	-	12.88	12.88	5.74	6.19	7.19	6.19	6.19	4.13	26	32	40	23	23	58	66	49	49	
5SV-04	1.5				14.85	10.67	11.19	10.66	9.91	-	-	13.86	13.86	5.74	6.19	7.19	6.19	6.19	4.72	28	32	40	30	28	60	68	58	56	
5SV-05	2				15.83	10.67	11.19	10.66	9.91	-	-	14.85	14.85	5.74	6.19	7.19	6.19	6.19	4.72	29	32	40	30	28	61	69	59	57	
5SV-06					16.81	11.18	12.06	11.16	10.79	-	-	15.83	15.83	5.74	7.19	7.19	6.19	6.19	4.72	30	43	51	32	33	73	81	62	63	
5SV-07					17.80	11.18	12.06	11.16	10.79	17.80	9.53	16.81	16.81	5.74	7.19	7.19	6.19	6.19	4.72	31	43	51	32	33	74	82	63	64	
5SV-08	3				18.78	11.57	13.44	11.18	11.16	18.78	10.51	17.80	17.80	5.75	6.50	7.19	7.16	7.19	5.51	33	49	64	41	44	82	97	74	77	
5SV-09					19.77	11.57	13.44	11.18	11.16	19.77	11.50	18.78	18.78	5.75	6.50	7.19	7.16	7.19	5.51	33	49	64	41	44	82	97	74	77	
5SV-10					20.75	11.57	13.44	11.18	11.16	20.75	12.48	19.77	19.77	5.75	6.50	7.19	7.16	7.19	5.51	34	49	64	41	44	83	98	75	78	
5SV-11	5	184TC	182TC	184TC	22.44	13.93	15.43	12.55	13.93	22.44	13.46	21.45	21.45	6.87	8.88	8.86	9.02	8.86	5.51	37	81	92	62	69	118	129	99	106	
5SV-12					23.42	13.93	15.43	12.55	13.93	23.42	14.45	22.44	22.44	6.87	8.88	8.86	9.02	8.86	5.51	38	81	92	62	69	119	130	100	107	
5SV-13					24.40	13.93	15.43	12.55	13.93	24.40	15.43	23.42	23.42	6.87	8.88	8.86	9.02	8.86	5.51	40	81	92	62	69	121	132	102	109	
5SV-14					25.39	13.93	15.43	12.55	13.93	25.39	16.42	24.40	24.40	6.87	8.88	8.86	9.02	8.86	5.51	40	81	92	62	69	121	132	102	109	
5SV-15					26.37	13.93	15.43	12.55	13.93	26.37	17.40	-	25.39	6.87	8.88	8.86	9.02	8.86	5.51	41	81	92	62	69	122	133	103	110	
5SV-16					27.36	13.93	15.43	12.55	13.93	27.36	18.39	-	26.37	6.87	8.88	8.86	9.02	8.86	5.51	43	81	92	62	69	124	135	105	112	
5SV-17					28.54	13.93	15.43	12.55	13.93	28.54	19.37	-	27.55	6.87	8.88	8.86	9.02	8.86	5.51	45	81	92	62	69	126	137	107	114	
5SV-18	7.5	213TC	184TC	29.33	13.88	15.53	13.93	15.43	29.33	20.35	-	28.34	8.05	8.89	10.62	8.88	8.86	5.51	46	100	120	75	85	146	166	121	131		
5SV-19				30.51	13.88	15.53	13.93	15.43	30.51	21.34	-	29.52	8.05	8.89	10.62	8.88	8.86	5.51	47	100	120	75	85	147	167	122	132		
5SV-20				31.69	13.88	15.53	13.93	15.43	31.69	22.32	-	30.70	8.05	8.89	10.62	8.88	8.86	5.51	48	100	120	75	85	148	168	123	133		
5SV-21				32.28	13.88	15.53	13.93	15.43	32.28	23.31	-	31.29	8.05	8.89	10.62	8.88	8.86	5.51	49	100	120	75	85	149	169	124	134		
5SV-22				33.34	13.88	15.53	13.93	15.43	33.34	24.29	-	32.36	8.05	8.89	10.62	8.88	8.86	5.51	50	100	120	75	85	150	170	125	135		
5SV-23				34.25	13.88	15.53	13.93	15.43	34.25	25.28	-	33.26	8.05	8.89	10.62	8.88	8.86	5.51	51	100	120	75	85	151	171	126	136		
5SV-24				35.31	13.88	15.53	13.93	15.43	-	-	-	34.33	8.05	8.89	10.62	8.88	8.86	5.51	53	100	120	75	85	153	173	128	138		
5SV-25				36.21	13.88	15.53	13.93	15.43	-	-	-	35.23	8.05	8.89	10.62	8.88	8.86	5.51	53	100	120	75	85	153	173	128	138		
5SV-26				37.28	13.88	15.53	13.93	15.43	-	-	-	36.29	8.05	8.89	10.62	8.88	8.86	5.51	54	100	120	75	85	154	174	129	139		
5SV-27	10	215TC	213TC	215TC	38.84	16.63	16.68	15.55	15.51	-	-	-	37.86	8.77	10.62	10.18	10.18	10.28	5.51	62	132	145	107	122	194	207	169	184	

Performance Curve

5SV 3500 RPM

60 Hz



MINIMUM FLOW RATE: 7 GPM [1.6 m³/hr]

TECHNICAL DATA - PUMP HYDRAULICS / MOTOR SIZING

5SV 3500 RPM

No. of Impellers	Maximum HP draw	Motor Selection using SF			Motor Selection 1.0 SF			Shutoff TDH (Feet)	Shutoff TDH (psi)	Shutoff TDH (Bar)	Casing/Sleeve Pressure Rating (standard assy.)	Pump Flange Rating
		Rated HP	NEMA Motor Frame		Rated HP	NEMA Motor Frame						
			ODP	TEFC		ODP	TEFC					
27	8.80	10.00	215TC	215TC	10.00	215TC	215TC	975	422	29.1	40 Bar (580 psi)	Class 250 / 300
26	8.48	7.50	213TC	213TC		215TC	215TC	940	407	28.0		
25	8.15		213TC	213TC		215TC	215TC	900	390	26.9		
24	7.82		213TC	213TC		215TC	215TC	865	375	25.8		
23	7.50		213TC	213TC	7.50	213TC	213TC	825	357	24.6		
22	7.17		213TC	213TC		213TC	213TC	785	340	23.4		
21	6.85		213TC	213TC		213TC	213TC	745	323	22.2		
20	6.52		213TC	213TC		213TC	213TC	715	310	21.3		
19	6.19		213TC	213TC		213TC	213TC	685	297	20.4		
18	5.87		213TC	213TC		213TC	213TC	650	282	19.4		
17	5.54		184TC	184TC		213TC	213TC	615	266	18.4		
16	5.22	184TC	184TC	213TC	213TC	575	249	17.2				
15	4.89	184TC	184TC	5.00	184TC	184TC	540	234	16.1			
14	4.56	184TC	184TC		184TC	184TC	505	219	15.1			
13	4.24	184TC	184TC		184TC	184TC	470	204	14.0			
12	3.91	184TC	184TC		184TC	184TC	430	186	12.8			
11	3.59	184TC	184TC		184TC	184TC	395	171	11.8			
10	3.26	3.00	56C	56C	184TC	184TC	360	156	10.7			
9	2.93		56C	56C	56C	56C	320	139	9.5			
8	2.61		56C	56C	56C	56C	285	123	8.5			
7	2.28	2.00	56C	56C	2.00	56C	56C	250	108	7.5		
6	1.96		56C	56C		56C	56C	220	95	6.6		
5	1.63	1.50	56C	56C	56C	56C	180	78	5.4			
4	1.30		56C	56C	1.50	56C	56C	145	63	4.3		
3	0.98	1.00	56C	56C	1.00	56C	56C	110	48	3.3		
2	0.65	0.75	56C	56C	0.75	56C	56C	70	30	2.1		

10SV 3500 RPM

No. of Impellers	Maximum HP draw	Motor Selection using SF			Motor Selection 1.0 SF			Shutoff TDH (Feet)	Shutoff TDH (psi)	Shutoff TDH (Bar)	Casing/Sleeve Pressure Rating (standard assy.)	Pump Flange Rating
		Rated HP	NEMA Motor Frame		Rated HP	NEMA Motor Frame						
			ODP	TEFC		ODP	TEFC					
20	17.84	20.00	254TC	256TC	20.00	254TC	256TC	1150	498	34.3	40 Bar (580 psi)	Victaulic
19	16.95	15.00	215TC	254TC		254TC	256TC	1095	474	32.7		
18	16.06		215TC	254TC		254TC	256TC	1035	448	30.9		
17	15.16		215TC	254TC		254TC	256TC	975	422	29.1		
16	14.27		215TC	254TC		215TC	254TC	920	398	27.5		
15	13.38	10.00	215TC	254TC	15.00	215TC	254TC	860	372	25.7	25 Bar (362 psi)	Class 250 / 300
14	12.49		215TC	215TC		215TC	254TC	805	349	24.0		
13	11.60		215TC	215TC		215TC	254TC	745	323	22.2		
12	10.70		215TC	215TC		215TC	254TC	690	299	20.6		
11	9.81		215TC	215TC		215TC	215TC	630	273	18.8		
10	8.92	215TC	215TC	10.00	215TC	215TC	575	249	17.2			
9	8.03	213TC	213TC		215TC	215TC	520	225	15.5			
8	7.14	7.50	213TC	213TC	7.50	213TC	213TC	460	199	13.7		
7	6.24		213TC	213TC		213TC	213TC	400	173	11.9		
6	5.35	5.00	184TC	184TC	5.00	213TC	213TC	340	147	10.1		
5	4.46		184TC	184TC		184TC	184TC	285	123	8.5		
4	3.57		184TC	184TC		184TC	184TC	225	97	6.7		
3	2.68	3.00	56C	56C	3.00	56C	56C	170	74	5.1		
2	1.78	2.00	56C	56C	2.00	56C	56C	115	50	3.4		
1	0.89	0.75	56C	56C	1.00	56C	56C	60	26	1.8		

TECHNICAL DATA - COMPATABILITY CHART FOR MATERIALS IN CONTACT WITH MOST COMMONLY USED LIQUIDS

Liquid	Concentration (%)	Temperature Min/Max °F	Specific Weight (lb/in³)	SV 1, 3, 5, 10, 15, 22		SV 33, 46, 66, 92		Recommended Seal	Elastomers
				304	316	CI/316	316		
Water	100	23/248		•	•	•	•	Q;BEGG	E
Deionized, demineralized or distilled water	100	-13/230		•	•	•	•	Q;BEGG	E
Water and oil emulsion	any	23/194		•	•	•	•	Q;BVGG	V
Acetic acid (•)	80	14/158	.038	•	•	•	•	Q;BEGG	E
Citric acid	5	14/158	.056	•	•	•	•	Q;BEGG	E
Hydrochloric acid	2	23/77	.043		•		•	Q;Q;VGG	V
Phosphoric acid	10	23/86	.048		•		•	Q;BEGG	E
Nitric acid (•)	50	23/86	.053	•	•	•	•	Q;Q;VGG	V
Sulphuric acid (•)	2	14/77	.066		•		•	Q;BVGG	V
Tannic acid	20	32/122			•		•	Q;BEGG	E
Tartaric acid	50	14/77	.063	•	•	•	•	Q;Q;VGG	V
Uric acid	80	14/176	.068	•	•	•	•	Q;BEGG	E
Benzoic acid	70	32/158	.047	•	•	•	•	Q;BVGG	V
Boric acid	Saturated	14/194	.052	•	•	•	•	Q;Q;VGG	V
Formic acid (•)	5	5/77	.044	•	•	•	•	Q;BEGG	E
Ethyl alcohol (•)	100	23/104	.029	•	•	•	•	Q;BEGG	E
Methyl alcohol (•)	100	23/104	.029	•	•	•	•	Q;BEGG	E
Propyl alcohol (•)	100	23/176	.029	•	•	•	•	Q;BEGG	E
Butyl alcohol	100	23/176	.030	•	•	•	•	Q;BVGG	V
Denatured alcohol (•)	100	23/158	.030	•	•	•	•	Q;BEGG	E
Ammonia in water (•)	25	-4/122	.038	•	•	•	•	Q;BEGG	E
Chloroform		14/86	.053	•	•	•	•	Q;BVGG	V
Caustic soda	25	32/158	.077	•	•	•	•	Q;Q;EGG	E
Water, detergents, mineral oils mixture		23/176		•	•	•	•	Q;Q;VGG	V
Cleaning products		23/212		•	•	•	•	Q;Q;VGG	V
Glycerine	100	68/194	.046	•	•	•	•	Q;BEGG	E
Sodium Hypochlorite	1	14/77			•		•	Q;Q;VGG	V
Phosphates/polyphosphates		23/194			•		•	Q;Q;VGG	V
Sodium nitrate	Saturated	14/176	.081	•	•	•	•	Q;BEGG	E
Cutting fluid	100	23/230	.033	•	•	•	•	Q;BVGG	V
Peanut oil (•)	100	23/230	.034	•	•	•	•	Q;BEGG	E
Colza oil (•)	100	23/230	.034	•	•	•	•	Q;BEGG	E
Linseed oil (•)	100	23/230	.034	•	•	•	•	Q;BEGG	E
Coconut oil (•)	100	-4/194	.033	•	•	•	•	Q;BEGG	E
Soybean oil (•)	100	32/194		•	•	•	•	Q;BEGG	E
Diathermic oil	100	23/230	.033	•	•	•	•	Q;BVGG	V
Hydraulic oil	100	23/230		•	•	•	•	Q;BVGG	V
Mineral oil	100	23/230	.034	•	•	•	•	Q;BVGG	V
Sodium sulfate	15	14/104	.094	•	•	•	•	Q;Q;EGG	E
Aluminum sulfate	30	23/122	.097		•		•	Q;Q;EGG	E
Ammonium sulfate	10	14/140	.064		•		•	Q;Q;EGG	E
Iron sulfate	10	23/86	.076		•		•	Q;BEGG	E
Copper sulfate	20	32/86	.082		•		•	Q;Q;VGG	V
Trichloroethylene		14/104	.053	•	•	•	•	Q;BVGG	V
Perchloroethylene		14/86	.057	•	•	•	•	Q;BVGG	V

Legend

Q₁ = Silicon carbide B = Impregnated carbon E = EPDM V = Viton G = AISI 316 (spring, metal components)

(•) A special version may be necessary for this fluid. For additional information, please contact our sales network.

Series 25116

150# Flanged Stainless Steel Check Valve



Valves, Automation & Controls

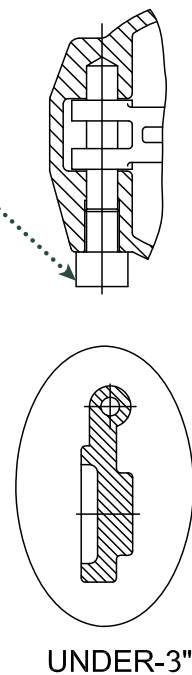
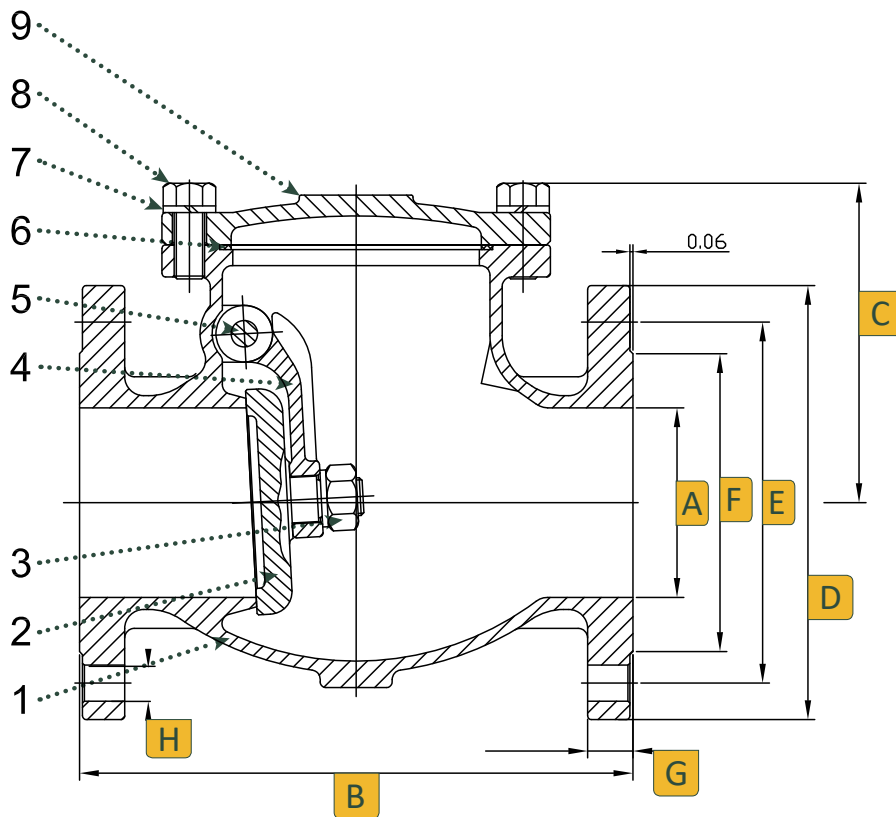
Features

- Bolted Cover
- Swing Type
- Horizontal or Vertical lines
- For Horizontal or Vertical lines
- Integral Seat
- Flanged Ends
- Butt-weld Ends
- Applicable Standards:
 - Steel valves ANSI B16.34
 - Face to face ANSI B16.10
 - End flanges ANSI B16.5
 - Butt-weld ends ANSI B16.25
 - Inspection and test API 598

1"-25116



1/2" - 14" Dimensions, Parts & Materials



Size	A	B	C	D	E	F	G	H	Num of Bolt Holes
1/2	0.59	4.25	2.00	3.50	2.38	1.38	0.43	0.625	4
3/4	0.79	4.62	2.13	3.88	2.75	1.69	0.43	0.625	4
1	0.98	5.00	2.52	4.25	3.12	2.00	0.43	0.625	4
1-1/2	1.57	6.50	2.95	5.00	3.88	2.88	0.56	0.625	4
2	1.97	7.99	3.86	6.00	4.75	3.62	0.62	0.75	4
2-1/2	2.56	8.50	4.41	7.00	5.50	4.12	0.69	0.75	4
3	3.15	9.49	4.88	7.50	6.00	5.00	0.75	0.75	4
4	3.94	11.50	6.34	9.00	7.50	6.19	0.94	0.75	8
5	4.92	13.00	7.09	7.09	8.50	7.31	0.94	0.88	8
6	5.90	14.02	8.07	8.07	9.50	8.50	1.00	0.88	8
8	7.87	19.49	9.29	9.29	11.75	10.62	1.12	0.88	8
10	9.84	24.49	11.90	11.90	14.25	12.75	1.19	1.00	12
12	11.81	27.48	13.40	13.40	17.00	15.00	1.25	1.00	12
14	13.27	30.98	15.16	15.16	18.75	16.26	1.38	1.125	12

No.	Part Name	Material
1	Body	316 Stainless Steel - CF8M
2	Disc	316 Stainless Steel - CF8M
3	Nut	304 Stainless Steel
4	Arm Hinge	316 Stainless Steel
5	Hinge Pin	316 Stainless Steel
6	Gasket	PTFE
7	Washer	304 Stainless Steel
8	Bolt	304 Stainless Steel
9	Cover	316 Stainless Steel - CF8M
10	Bolt	304 Stainless Steel

Temperature °F	Working Pressure psi
-20 to 100	275
200	235
300	215
400	195
500	170
600	140
650	125
700	110
750	95
800	80
850	65
900	50
950	35
1000	20

Ordering

Fig: 8 - 25 - 1 - 1 - 6

Description: 8" - Series 25 - 150# Flange Ends - Stainless Steel

Size	Series	Class	Ends	Body Material	Options
1/2	25	1 150	1 Flange	6 316 Stainless Steel	X Oxygen Service SF Silicon Free RTJ Ring Type Joint Flange
3/4			2 Butt-weld		
1					
1-1/2					
2					
2-1/2					
3					
4					
5					
6					
8					
10					
12					
14					
16					
18					
20					
24					

ABB MEASUREMENT & ANALYTICS | DATA SHEET | DS/WM-EN REV. AA

WaterMaster

Electromagnetic flowmeter



Measurement made easy

The perfect fit for all water and waste water applications

State-of-the-art technology

- revolutionary data storage enables transmitter interchange and commissioning without the need for re-configuration
- self-calibrating transmitter with ultra-low temperature coefficient for highest accuracy

Versatile and simple configuration

- 'Through-the-Glass' (TTG) configuration eliminating the need to remove the cover
- smart key based functionality
- 'Easy Setup' function

VeriMaster in situ verification software option

- enables the customer to perform in situ verification of the flowmeter system

Unparalleled service ability

- fault-finding Help texts on the display
- minimized downtime with replaceable electronics cartridges

MID and OIML R49 approved with R49 self-checking

- type-approved to accuracy Class 1 and Class 2 for any pipe orientation and bidirectional flows
- type P-approved continuous self-checking of the sensor and transmitter to ensure the highest accuracy and long-term performance

The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a world leader in process automation technology our worldwide presence, comprehensive service and application-oriented know-how make ABB a leading supplier of flow measurement products.

Introduction

Setting the standard for the Water Industry

The WaterMaster range, available in sizes 10 to 2400 mm (3/8 to 96 in.), is designed specifically for use on the many diverse applications encountered in the Water and Waste-water industry. The modular design concept offers flexibility, cost-saving operation and reliability while providing a long service life and exceptionally low maintenance.

Integration into ABB asset management systems and use of the self-monitoring and diagnostic functions increase the plant availability and reduce downtimes.

VeriMaster – the verification tool

An easy-to-use utility, available through the infra red service port. Uses the advanced self-calibration and diagnostic capability of WaterMaster, coupled with fingerprinting technology, to determine the accuracy status of the WaterMaster flowmeter to within $\pm 1\%$ of its original factory calibration. VeriMaster also supports printing of calibration verification records for regulatory compliance.



Diagnostic functions

Using its diagnostic functions, the flowmeter monitors both its own operability and the process. Limit values for the diagnostic parameters can be set locally. When these limits are exceeded, an alarm is tripped. In the event of an error, diagnostic-dependent help text appears on the display. This considerably simplifies and accelerates the troubleshooting procedure.

In accordance with NAMUR NE107, alarms and warnings are classified with the status of 'Maintenance Required', 'Check Function', 'Failure' and 'Out of Specification'.

Flow performance

Utilizing its advanced filtering methods, the WaterMaster improves accuracy even under difficult conditions.

WaterMaster has an operating flow range with $\pm 0.4\%$ accuracy as standard ($\pm 0.2\%$ optional) in both forward and reverse flow directions.

Easy and quick commissioning

'Fit-and-Flow' data storage inside WaterMaster eliminates the need to match sensor and transmitter in the field. On initial installation, the self-configuration sequence automatically replicates into the transmitter all calibration factors, meter size and serial numbers, as well as customer site-specific settings, eliminating the potential for error.

Intuitive, convenient navigation

The 'Easy Setup' function reliably guides unpracticed users through the menu step by step. The smart key based functionality makes handling a breeze – it's just like using a cell phone. During configuration, the permissible range of each parameter is indicated on the display and invalid entries are rejected.

Universal transmitter – powerful and flexible

The backlit display can be rotated easily without the need for tools. The contrast is adjustable and the display fully-configurable. The character size, number of lines and display resolution (number of decimal points) can be set as required. In multiplex mode, several different display options can be pre-configured and invoked one after the other. The smart modular design of the transmitter unit enables easy disassembly without the need to unscrew cables or unplug connectors. HART is used as the standard communications protocol. Optionally, the transmitter is available with PROFIBUS DP or MODBUS communication.

Assured quality

WaterMaster is designed and manufactured in accordance with international quality procedures (ISO 9001) and all flowmeters are calibrated on nationally-traceable calibration rigs to provide the end-user with complete assurance of both quality and performance of the flowmeter.



...Introduction

WaterMaster – always the first choice

WaterMaster sets the standard for the water industry. The specification, features and user benefits offered by this range are based on ABB's worldwide experience in this industry and they are all targeted specifically to the industry's requirements.

Submersible and buriable

WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the Water and Waste Industry. The sensors are, as standard, inherently submersible (IP68, NEMA 6P), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding.

A unique feature of the WaterMaster sensors is that sizes DN40 to DN2400 (1½ to 96 in. NB) are buriable; installation simply involves excavating to the underground pipe, fitting the sensor, cabling back to the transmitter and then backfilling the hole.



The WaterMaster family

Overview of the WaterMaster

A wide range of features and user benefits are built into WaterMaster as standard:

- bi-directional flow
- unique self-calibrating transmitter (patented) for the ultimate in stability and repeatability
- OIML-type continuous self-checking, with alarms, ensures both sensor and transmitter accuracy
- true electrode and coil impedance measurement
- comprehensive simulation mode
- universal switch-mode power supply (options are available for AC and DC supplies)
- comprehensive self-diagnostics compliant with NAMUR NE107
- programmable multiple-alarm capability
- bus options: HART (4 to 20 mA), PROFIBUS DP (RS485), MODBUS (RS485)
- 3 configurable pulse / frequency and alarm outputs
- advanced infrared service port supports remote HMI, HART, cyclic data out and parameter download
- VeriMaster in situ verification software available as option
- read-only switch and ultra-secure service password for total security

OIML / MID approved

WaterMaster has been type tested and Internationally approved to the highest accuracy class 1 and 2 for cold and hot potable water meters – OIML R49-1 (Organisation Internationale de Métrologie Légale). For full details, OIML R49 is available to download from www.oiml.org. Its requirements are very similar to other International standards, such as EN14154 and ISO4064.

WaterMaster has been assessed by type approval at the National Measurement Office (NMO) to OIML R49 and passed to the very highest accuracy designations for sizes DN40 to DN200 (1½ to 8 in. NB).

The approval is for:

- Class 1 and Class 2 accuracy (calibration option)
- Environmental class T50 for water temperatures of 0.1 to 50 °C (32.18 to 122 °F)
- Electromagnetic Environment E2 (10 V/m)
- Any pipe orientation
- 5 Diameters upstream pipe
- 0 Diameters downstream pipe
- Pressure Loss Class <0.25 bar (3.62 psi)
- Integral or remote transmitter (<200 m [<656 ft.] cable)
- DN40 to DN200 (1½ to 8 in. NB), bi-directional flow

A major advance in WaterMaster is the self-checking capabilities that meet and exceed the R49 requirements and is the first electromagnetic flowmeter to be approved to OIML Type P permanent self checking during normal operation (not just at startup) and alarm indication for:

- transmitter and sensor status, with an accuracy alarm
- program ROM and RAM status
- double, independent storage of totalizer values, in both the sensor and transmitter non-volatile memories
- display test

The OIML R49-1 certificate of conformity is available from:

<http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx>

WaterMaster is also approved under the EU Measuring Instruments Directive (MID) 2004/22/EC, that covers putting into use water flowmeters for certain applications. MID WaterMaster is secured against tampering and is available as an option, along with fingerprinting for ABB VeriMaster in situ verification product, with certificate printout to ±1 % accuracy.

WaterMaster certificates of EC type-examination of a measuring instrument are available from:

<http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx>

Superior control through advanced sensor design

The innovative, patented octagonal sensor design improves flow profile and reduces up- and down-stream piping requirements for the most commonly used sizes of 40 to 200 mm (1½ to 8 in.). This optimized full bore meter provides impressive results in the most difficult of installation requirements.

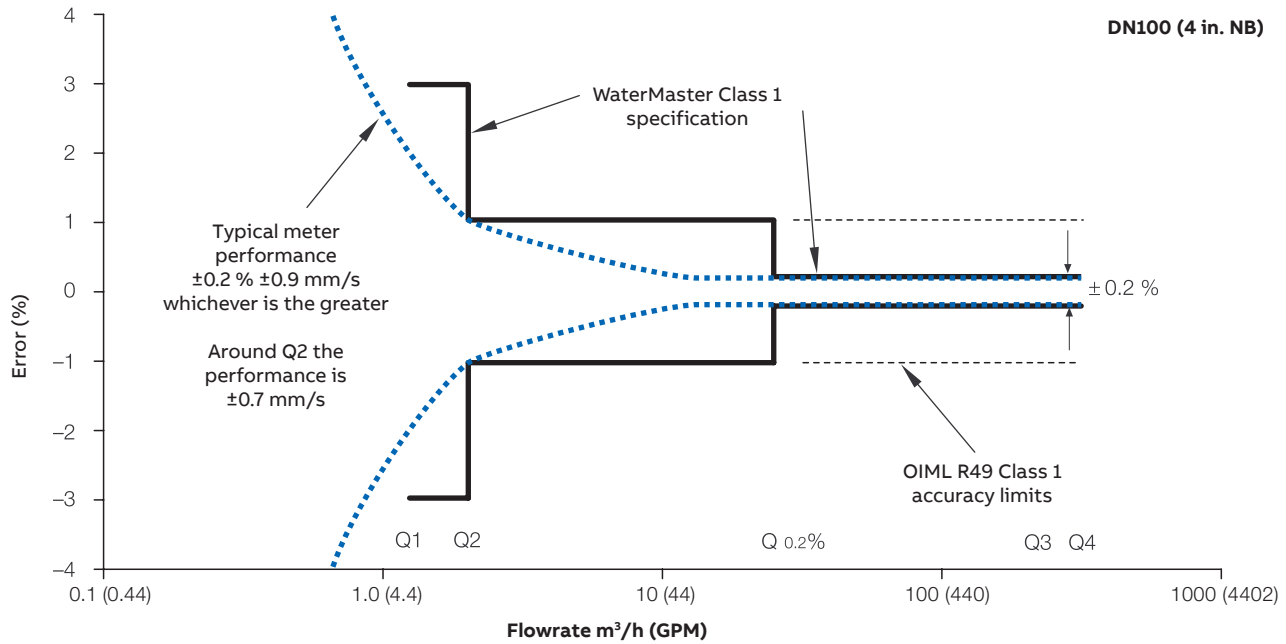


WaterMaster sensors are also available in reduced-bore geometries giving the ultimate in low-flow performance with a very high turn-down range.

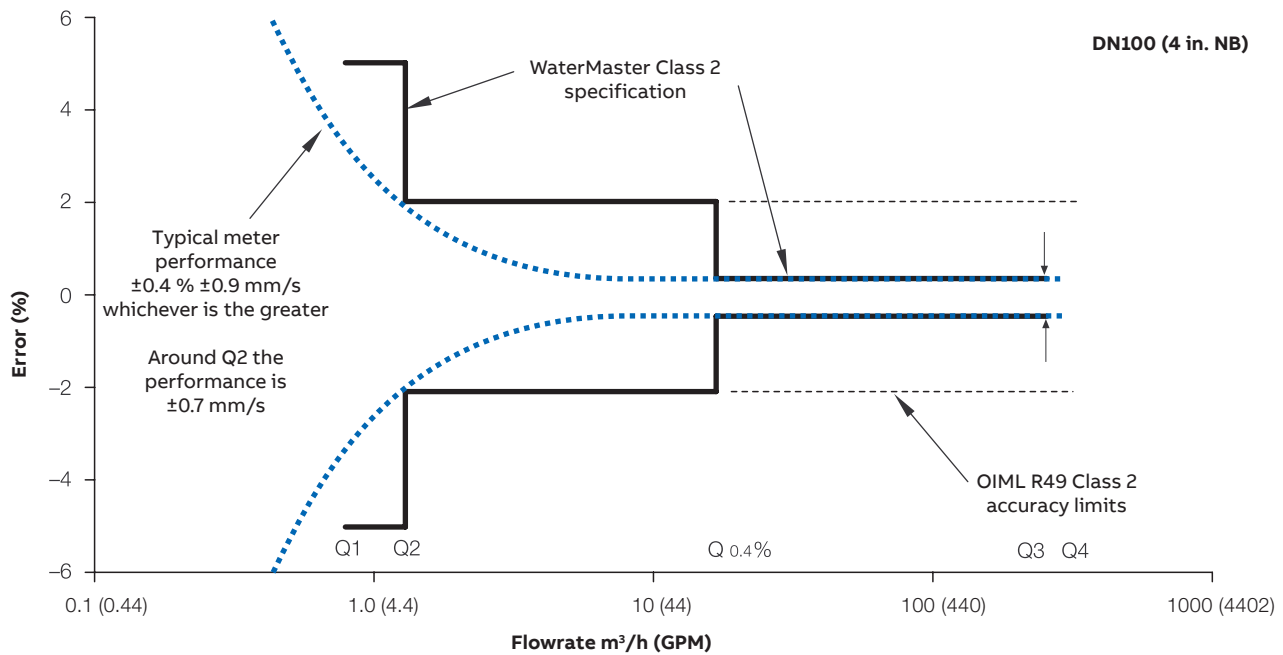
The unique design of the reduced-bore sensor conditions the flow profile in the measuring section so that distortions in the flow profile, either upstream or downstream, are flattened. The result is excellent in situ flowmeter performance, even with very bad hydraulic installation conditions.

Specification

WaterMaster specification to OIML R49 Class 1



WaterMaster specification to OIML R49 Class 2



Although OIML R49 does not define the flow accuracy below Q1, WaterMaster continues to measure flow at lower flow rates down to a cutoff velocity of $\pm 5 \text{ mm/s}$ ($\pm 0.2 \text{ in./s}$). The accuracy between cutoff and Q1 is typically $\pm 0.9 \text{ mm/s}$ ($\pm 0.04 \text{ in./s}$).

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – m³/h

DN	Q4	Q3	Standard Calibration – 0.4 % Class 2			High Accuracy Calibration – 0.2 % Class 1		
			Q _{0.4%}	Q2	Q1	Q _{0.2%}	Q2	Q1
10	3.1	2.5	0.167	0.013	0.008	0.31	0.02	0.012
15	7.88	6.3	0.42	0.032	0.02	0.79	0.05	0.03
20	12.5	10	0.67	0.05	0.032	1.25	0.08	0.05
25	20	16	1.1	0.08	0.05	2	0.13	0.08
32	31.25	25	1.67	0.13	0.08	3	0.20	0.13
40*	50	40	4.2	0.2	0.13	6	0.32	0.2
50*	79	63	4.2	0.32	0.20	7.9	0.5	0.32
65*	125	100	6.7	0.5	0.32	12.5	0.8	0.5
80*	200	160	10.7	0.81	0.51	16	1.3	0.8
100*	313	250	16.7	1.3	0.79	25	2	1.25
125*	313	250	16.7	1.3	0.79	25	2	1.25
150*	788	630	42	3.2	2.0	63	5	3.2
200*	1,250	1,000	67	5.1	3.2	100	8	5
250	2,000	1,600	107	8.1	5.1	160	13	8
300	3,125	2,500	167	12.7	7.9	250	20	12.5
350	5,000	4,000	267	20.3	12.7	400	32	20
400	5,000	4,000	267	20.3	12.7	400	32	20
450	7,875	6,300	420	32	20	630	50	32
500	7,875	6,300	420	32	20	630	50	32
600	12,500	10,000	667	51	32	1000	80	50
700	20,000	16,000	1600	102	64	1600	160	100
750	20,000	16,000	1600	102	64	1600	160	100
30 in. (750)	20,000	16,000	1600	102	64	1600	160	100
800	20,000	16,000	1600	102	64	1600	160	100
900	31,250	25,000	2500	160	100	2500	250	156
1000	31,250	25,000	2500	160	100	2500	250	156
42 in	31,250	25,000	2500	160	100	2500	250	156
1100	31,250	25,000	2500	160	100	2500	250	156
1200	50,000	40,000	4000	256	160	4000	400	250
1350	78,750	63,000	6300	403	252	6300	630	394
1400	78,750	63,000	6300	403	252	6300	630	394
1500	78,750	63,000	6300	403	252	6300	630	394
60 in. (1500)	78,750	63,000	6300	403	252	6300	630	394
1600	78,750	63,000	6300	403	252	6300	630	394
1650	78,750	63,000	6300	403	252	6300	630	394
1800	125,000	100,000	10000	640	400	10000	1000	625
1950	125,000	100,000	10000	640	400	10000	1000	625
2000	125,000	100,000	10000	640	400	10000	1000	625
2200	200,000	160,000	16000	1024	640	16000	1600	1000
2400	200,000	160,000	16000	1024	640	16000	1600	1000

* OIML R49 Certificate of Conformance to Class 1 and Class 2, with OIML R49 and MID versions available.

Q2 = 1.6 * Q1

Q4 = 1.25 * Q3

Note: OIML R49–1 allow Class 1 only for meters with Q3 ³ 100 m³/h. Meters outside this range have been tested and conform to Class 1.

...Specification

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – gal/min

NPS/NB (DN)	Q4	Q3	Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
			Q _{0.4%}	Q2	Q1	Q _{0.2%}	Q2	Q1
3/8 (10)	13.8	11	0.73	0.06	0.035	1.38	0.09	0.053
1/2 (15)	34.7	27.7	1.85	0.14	0.09	3.48	0.22	0.14
3/4 (20)	55	44	2.94	0.22	0.14	5.5	0.35	0.22
1 (25)	88	70.4	4.7	0.35	0.22	8.8	0.57	0.35
1 1/4 (32)	137.6	110	7.3	0.57	0.35	13.2	0.88	0.57
1 1/2 (40)	220	176	18.5	0.89	0.56	26.4	1.41	0.88
2 (50)	347	277	18.5	1.41	0.88	34.7	2.22	1.39
2 1/2 (65)	550	440	29.4	2.24	1.40	55.0	3.52	2.20
3 (80)	881	704	47.0	3.58	2.24	70.4	5.64	3.52
4 (100)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
5 (125)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
6 (150)	3,467	2,774	185	14.1	8.81	277	22.2	13.9
8 (200)	5,504	4,403	294	22.4	14.0	440	35.2	22.0
10 (250)	8,806	7,045	470	35.8	22.4	704	56.4	35.2
12 (300)	13,759	11,007	734	55.9	34.9	1,101	88.1	55.0
14 (350)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
16 (400)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
18 (450)	34,673	27,738	1,849	141	88.1	2,774	222	139
20 (500)	34,673	27,738	1,849	141	88.1	2,774	222	139
24 (600)	55,036	44,029	2,935	224	140	4,403	352	220
27/28* (700)	88,057	70,446	7,045	451	282	7,045	704	440
30 (750)	88,057	70,446	7,045	451	282	7,045	704	440
32 (800)	88,057	70,446	7,045	451	282	7,045	704	440
36 (900)	137,590	110,072	11,007	704	440	11,007	1,100	688
39/40* (1000)	137,590	110,072	11,007	704	440	11,007	1,100	688
42 (1050)	137,590	110,072	11,007	704	440	11,007	1,100	688
44 (1100)	137,590	110,072	11,007	704	440	11,007	1,100	688
48 (1200)	220,143	176,115	17,611	1,127	704	17,611	1,761	1,101
52 (1350)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
54 (1400)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
60 (1500)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
66 (1600)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
68 (1650)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
77 (1800)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
77 (1950)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
84 (2200)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403
96 (2400)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403

*Size is dependent on flange specification

Q2 = 1.6 * Q1

Q4 = 1.25 * Q3

Specification – Sensor

Functional specification

Temperature limitations

Ambient temperature	
Remote transmitter	–20 to 70 °C (–4 to 158 °F)
Integral transmitter	–20 to 60 °C (–4 to 140 °F)
Process temperature	See table below. 0.1 to 50 °C (32.2 to 122 °F) OIML R49 T50 Approved

Medium temperature °C (°F)				
Code	Lining	Flange material	Minimum	Maximum
FEF, FEW3	Hard rubber	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–10 (14)	80 (176)
FEW1	PTFE	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–25 (–13)	80 (176)
FEW3	PTFE	Carbon steel	–10 (14)	80 (176)
		Stainless steel	–10 (14)	80 (176)
FEW3	Elastomer	Carbon steel	–5 (23)	80 (176)
		Stainless steel	–5 (23)	80 (176)
FEF, FER	Elastomer	Carbon steel	–6 (21)	70 (158)
FEV	Polypropylene		–6 (21)	70 (158)

Pressure limitations

As flange rating
 PN25 Max Process Temp 50 °C (122 °F)
 PN40 Max Process Temp 40 °C (104 °F)
 OIML / MID Approved Meters 16 bar (232 psi)
 UL Fire Service approved meters 285 psi

Pressure equipment directive 97/23/EC

This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt.

IP rating

IP68 (NEMA 6) to 7 m (20 ft.) depth
Note. Not sizes DN10 to DN32 (3/8 – 1 ¼ in. NB)
 IP67 (NEMA 4X) – DN10 to DN32 (3/8 – 1 ¼ in. NB)

Buriable (sensor only)

FEV – DN40 to 200 (1 ½ to 8 in. NB)
 FER – DN40 to 600 (1 ½ to 24 in. NB)
 FEF – DN250 to 600 (10 to 24 in. NB)
 FEW – DN450 to 2400 (18 to 96 in. NB)
 to 5 m (16 ft.) depth

Conductivity

>20 µS cm^{–1}

Transmitter mounting

Integral (not FEF) or remote

Electrical connections

20 mm glands
 ½ in. NPT
 20 mm armored glands

Sensor cable

ABB WaterMaster cable available in two forms –
 standard and armored
 Maximum length 200 m (660 ft.)

Suspended solids

Suspended solids percentage of process medium should not exceed 6 % of total volume

Physical specification

Wetted parts

Electrode material

Stainless steel 316 L / 316 Ti
 Super-austenitic steel
 Hastelloy® C-22 and Hastelloy C4
 (other electrode materials available on request)

Potential equalizing rings

Minimum of 1 recommended

Lining material / potable water approvals

			Potable Water Approvals				
Code	Size Range	Liner	WRAS	WRAS 60°C	ACS DVGW	NSF-61	AZ/ NZS 4020
FEW1	DN10 to 32 (⅜ to 1¼ in. NB)	PTFE	✓				
FEW3	DN10 to 600 (⅜ to 24 in. NB)	PTFE					
FEW3	DN40 to 2400 (1½ to 96 in. NB)	Elastomer	✓				✓
FEW3	DN40 to 2400 (1½ to 96 in. NB)	Hard rubber	✓	✓	✓	✓	
FEV	DN40 to 200 (1½ to 8 in. NB)	Polypropylene	✓		✓	✓	✓
FEF	DN250 to 600 (10 to 24 in. NB)	Elastomer	✓		✓	✓	✓
FEF	DN250 to 600 (10 to 24 in. NB)	Hard rubber	✓	✓	✓	✓	
FER	DN40 to 600 (1½ to 24 in. NB)	Elastomer	✓		✓	✓	✓

*Size is dependent on flange specification

Lining protection plates

Not required

Installation conditions (recommended)

Straight pipe requirements		
	Upstream	Downstream
FEW / FEF	5 x DN	2 x DN
FEV	5 x DN	0 x DN
FER	0 x DN	0 x DN

Pressure loss

Negligible at Q3	All full bore meters
<0.25 bar (<3.62 psi) at Q3	FEV (DN40 to 200 [1½ to 8 in. NB])
<0.63 bar (<9.13 psi) at Q3	FER (DN40 to 600 [1½ to 24 in. NB])

Non-wetted parts**Flange material**

Carbon steel	DN20 to DN2400 ($\frac{3}{4}$ to 96 in. NB)
Stainless steel	DN10 to DN2400 ($\frac{3}{8}$ to 96 in. NB)
SG iron	FEV – DN40 to DN150 [1 $\frac{1}{2}$ to 6 in. NB)
	FER – DN40 to DN150 [1 $\frac{1}{2}$ to 6 in. NB)

Meter tube

Stainless steel	DN10 to DN2400 ($\frac{3}{8}$ to 96 in. NB)
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Housing material

Carbon steel	FEV – DN40 to 200 (1 $\frac{1}{2}$ to 8 in. NB)
	FEW – DN450 to 2400 (18 to 96 in. NB)
Plastic FEF –	DN250 to 600 (10 to 24 in. NB)
Aluminium	FEW – DN10 to 400 ($\frac{3}{8}$ to 16 in. NB)

Terminal box material

Polycarbonate

Cable gland material

Plastic, brass

Paint specification

Zinc-based primed (all sensors), paint coat $\geq 70 \mu\text{m}$ thick
RAL 9002 (light grey)

Specification – transmitter

Functional specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 % /-30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A
Supply voltage fluctuations within the specified range have no effect on accuracy	

Digital Outputs (3)

Rating	30 V @ 220 mA, open collector, galvanically isolated*
Maximum output frequency	5250 Hz
1 off dedicated to Alarm / Logic, programmable function	
2 off configurable to either Pulse / Frequency or Alarm / Logic function	

Current output – HART FEX100 variant

4 to 20 mA or 4 to 12/20 mA, galvanically isolated*	
Maximum loop resistance	750 W
HART protocol	Version 5.7 (HART registered)
Signal levels compliant with NAMUR NE 43	(3.8 to 20.5 mA)
Low alarm	3.6 mA, High alarm 21.8 mA

Additional accuracy

±0.1 % of reading	
Temperature coefficient:	typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP variant

Registered name:	FEX100-DP
RS485	(9.6kbps to 1.5Mbps), galvanically isolated
DPV0, DPV1	
PA Profile	3.01
Standard idents:	9700, 9740, 9741
FEX100-DP specific ident:	3431
3 Concurrent MS2 master connections	

RS485 Communications – MODBUS FEX100-MB variant

MODBUS RTU protocol	
RS485	(9.6kbps to 115.2kbps), galvanically isolated

Electrical connections

20 mm glands	½ in. NPT, 20 mm armored glands
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Temperature limitations

Ambient temperature	-20 to 60 °C (-4 to 140 °F)
Temperature coefficient	Typically <±10 ppm/°C @ Vel ³0.5 m/s

Environmental protection

Humidity:	0 to 100 %
Rating:	IP67 (NEMA 4X) to 1m (3.3 ft.) depth

Tamper-proof security

Write access prevented by internal switch combined with external security seals for MID applications

Languages

English, French, German, Italian, Spanish, Polish

Infrared service port

USB adapter (accessory), USB 1.1. and 2.0 compatible
Driver software for Windows 2000, XP, 7 (32-bit) and Vista

Housing material

Powder-coated aluminium with glass window

Paint specification

Paint coat ³70 µm thick RAL 9002 (light grey)

Transmitter vibration testing

Vibration level:	7 m/s²
Frequency range:	20 to 150 Hz
No. of sweeps in 3 orthogonal planes:	20
Undetectable shift in transmitter span or zero performance	

Hazardous approvals

FM & FMC Class 1 Div 2	
(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG / T4,	
Ta=60C; Type 4X, IP67 – for transmitter and integral	
mounting	
Ta=70C, Type 6P, IP68 – for remote sensor type,	
IP67 on DN10 to 32 [3/8 to 11/4 in.NB])	
(FMC listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG / T4,	
Ta=60C; Type 4X, IP67 – for transmitter and integral	
mounting	
Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on	
DN10 to 32 [3/8 to 11/4 in.NB])	
FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84 in. NB)	
only	

*Size is dependent on flange specification

ATEX/UKEX* Zone 2, 21 & 22

II 3 G Ex nA IIC T5 Gc	
II 2 D Ex tb IIIC T100°C Db	
TA = -20°C to +60°C (integral transmitter)	
TA = -20°C to +70°C (remote sensor)	

IECEx* Zone 2, 21 & 22

Ex tb IIIC T100°C Db	
Ex nA IIC T5 Gc	
TA = -20°C to +60°C (integral transmitter)	
TA = -20°C to +70°C (remote sensor)	

*FEW, FEV, FET and FEF ³700 (27/28 in. NB) only

Declaration of Conformance

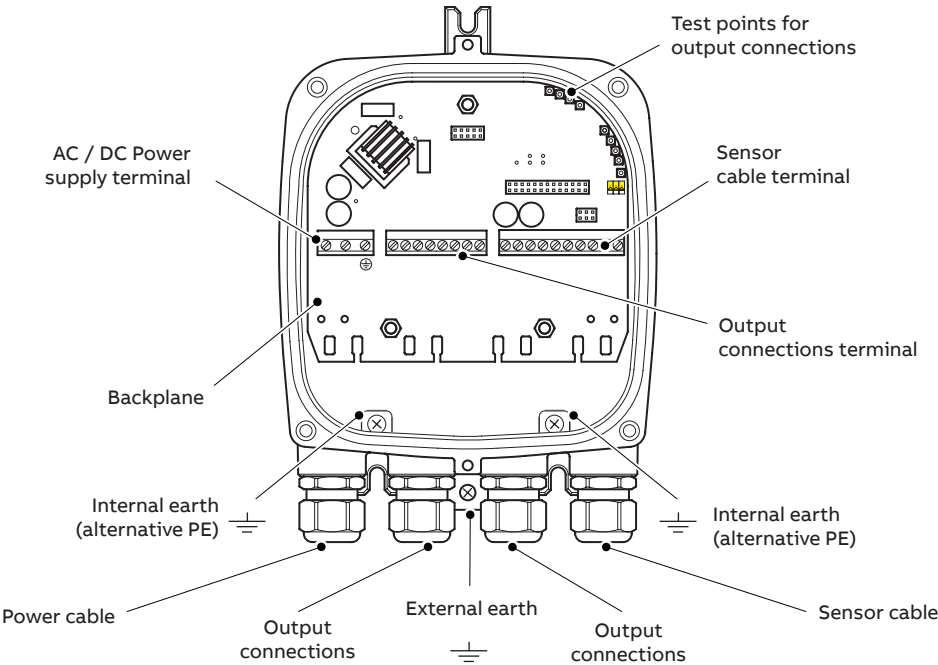
Copies of CE certification will be available on request.
WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200 [1½ to 8 in.NB]).
Copies of accuracy certification are available on request.
WaterMaster (FEV DN40 to 200 [1½ to 8 in.NB]) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

* When installed, do not leave galvanically isolated circuits (pulse and current) floating.

Transmitter connections

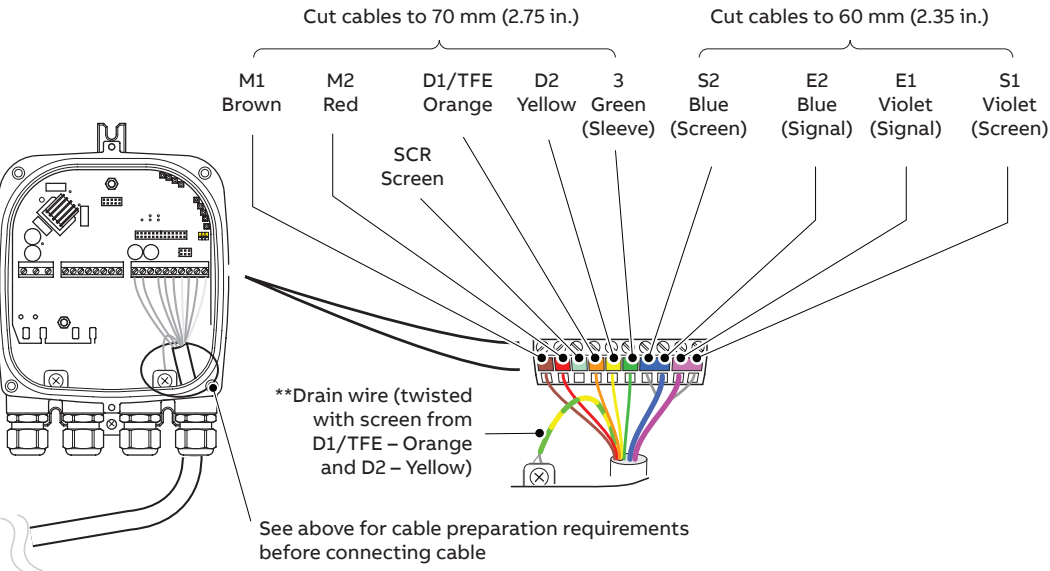
Transmitter terminal connections overview

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and safety precautions – refer to the User Guide OI/FET100–EN.



Cable gland / conduit entry (Remote transmitter shown)

Sensor cable terminal connections and recommended cable lengths



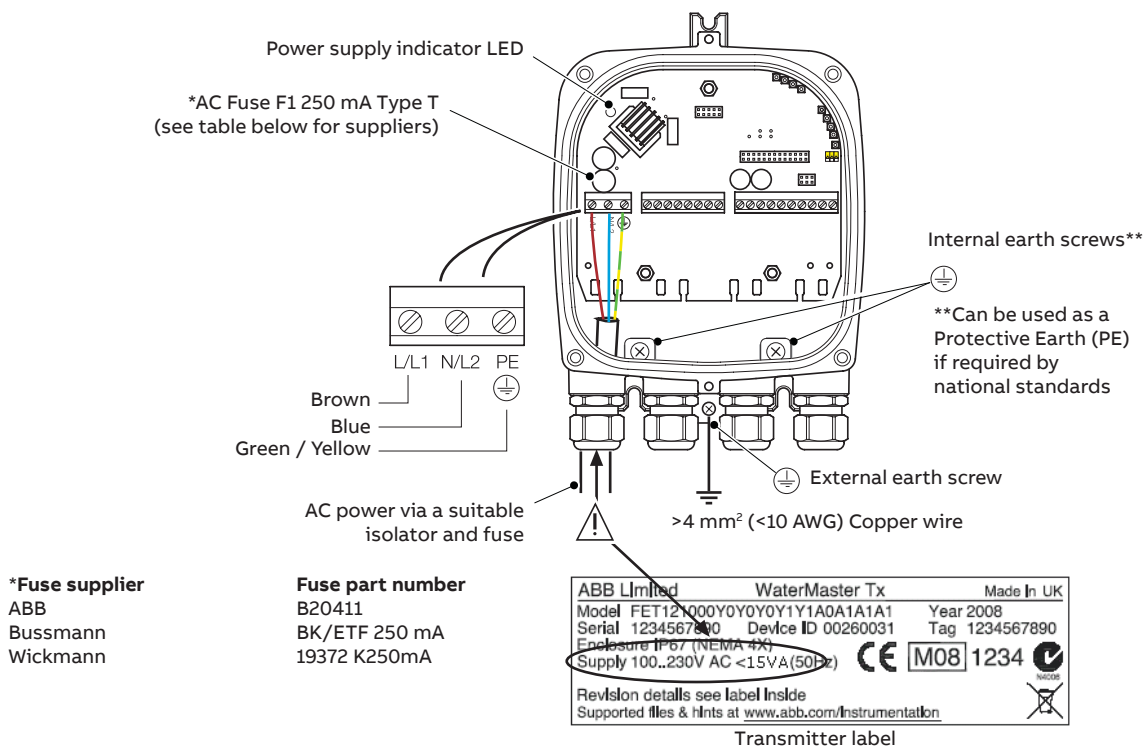
*Inner wire
**For cathodically-protected systems (or if the transmitter enclosure does not have an earth screw) connect the drain wire to terminal SCR.

Sensor cable connections at transmitter terminal block – remote transmitter

...Transmitter connections

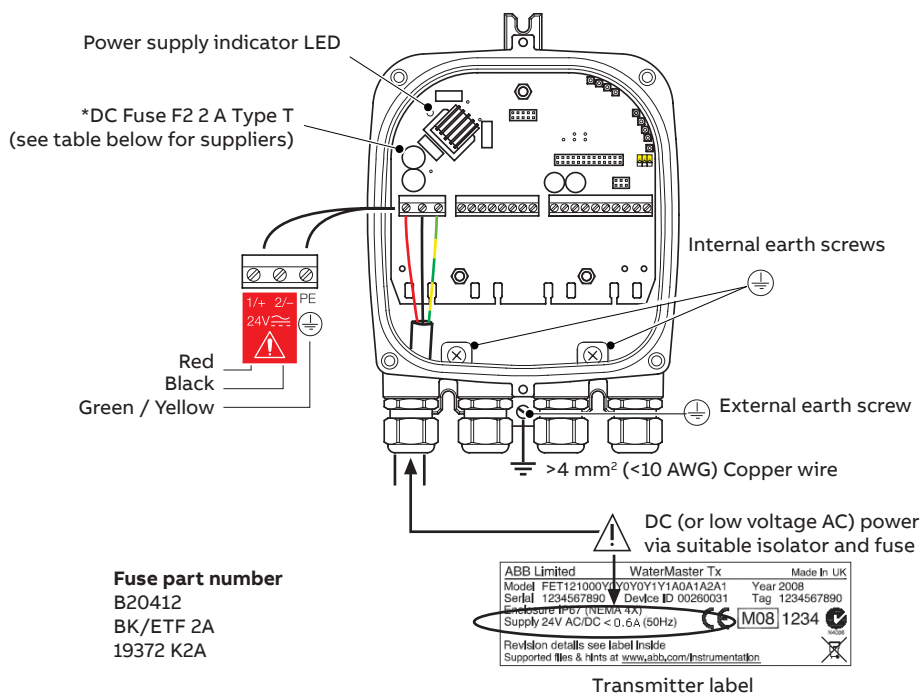
Power supply connections

AC power supply



AC power supply connections

DC (and low voltage AC) power supply



DC (and low voltage AC) power supply connections

Configuration DIP switches

Three configuration DIP switches are mounted on the transmitter backplane board.

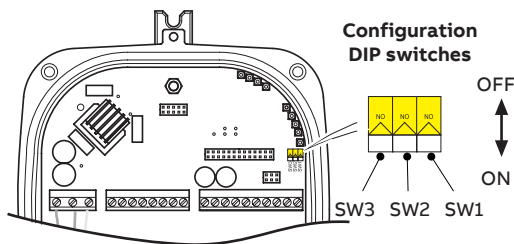
These are factory-set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters the read-only / MID protection switch is set to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.



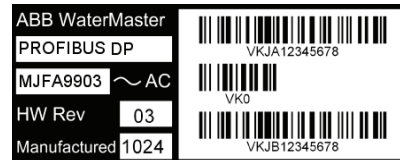
DIP Switch functions

SW1 – Read-only / MID Protection
SW2 – (future product)
SW3 – Internal sensor memory

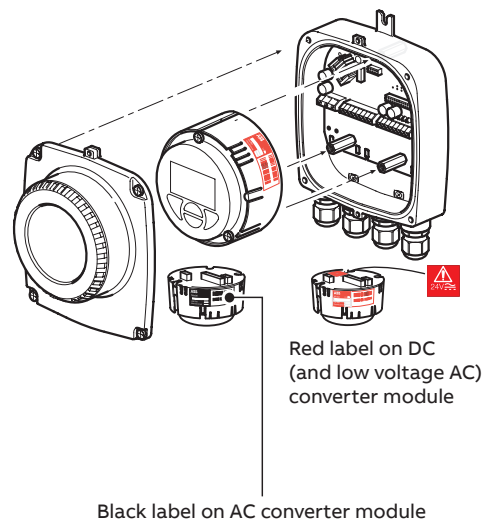
Configuration DIP switches

Transmitter module identification

Note. The communications bus type is HART FEX100 if not specified on the transmitter module label. An example of the PROFIBUS FEX100-DP variant transmitter module label is shown below.



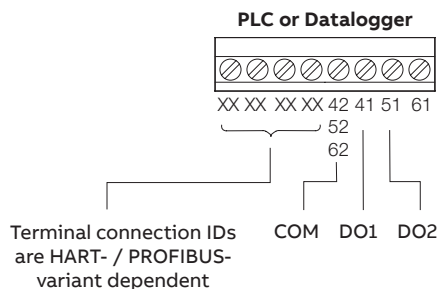
PROFIBUS FEX-100P label



Transmitter module identification

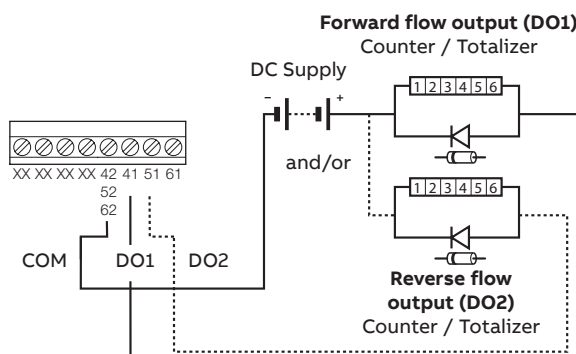
Output connections

Frequency outputs

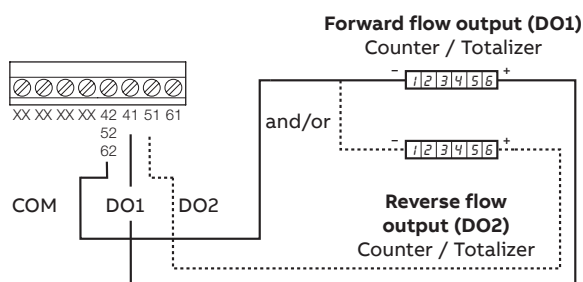


PLC / Datalogger connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

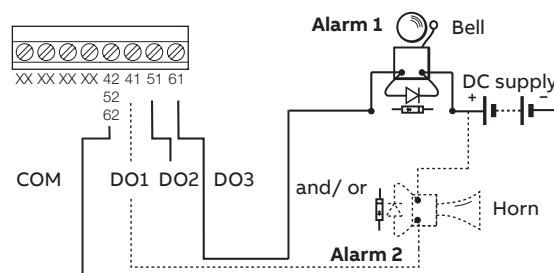
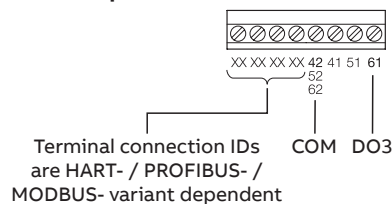


Electromechanical connections



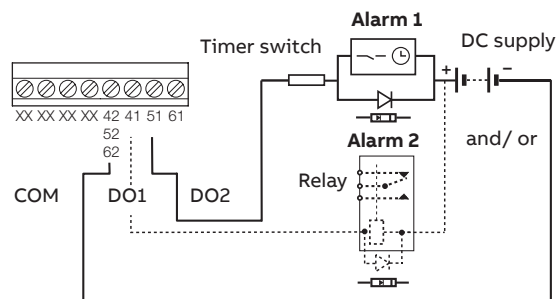
Telemetry / Electronic counters connections

Alarm outputs

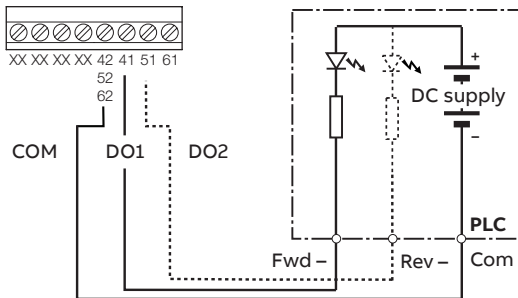
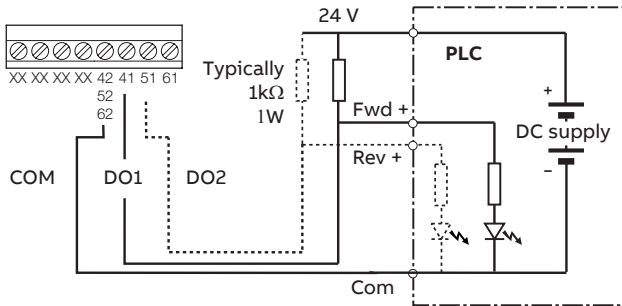


Note.

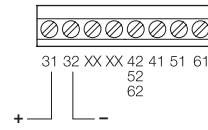
- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in **Electromechanical connections** and **Telemetry / Electronic counters connections**, opposite.
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).



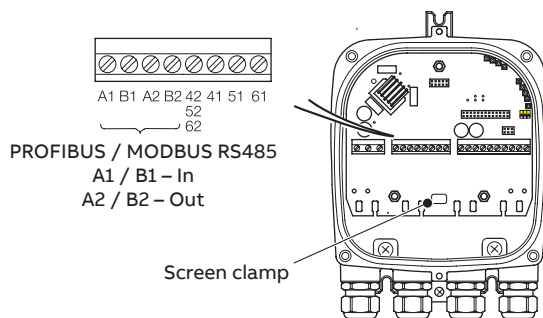
Note. Relay and timer switch shown for example only.

PLC interface**Note.**

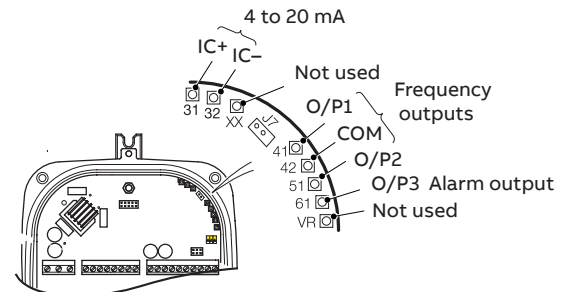
- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA.

Current output (4 to 20 mA) – HART (FEX100) variant

Refer to IM/WMP for HART-Protocol communication details

Current output (4 to 20 mA) – HART (FEX100) variant**RS485 communications – PROFIBUS (FEX100-DP) and MODBUS (FEX100-MB) variants****Test point access**

Note. A typical DVM probe can access (fit) the PCB's test holes.



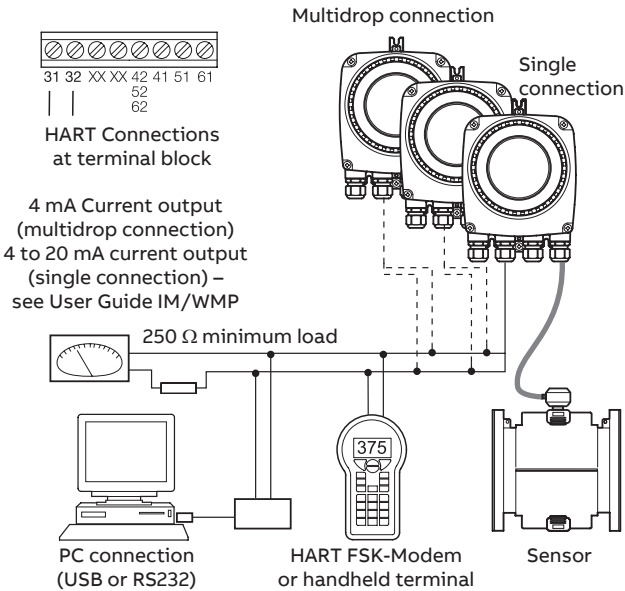
*These 2 test points are connected on the HART FEX100 backplane only (they are present on the PROFIBUS FEX100-DP / MODBUS FEX100-MB backplane but not connected)

Digital communication

The transmitter has the following options for digital communication.

HART protocol

The unit is registered with HART Communication Foundation.



HART protocol	
Configuration	Directly on the Device Software Asset Vision Basic (+ HART – DTM)
Transmission	Install a HART modem (FSK [Frequency Shift Keyed]-Modem) for HART-Communication when connecting to a PC. The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector
Max. signal amplitude	1.2 mA
Current output load	Min. 250W, max. = 560W
Cable	AWG 24 twisted
Max. cable length	1500 m (4921 ft.)
Baud rate	1.200 baud

System integration

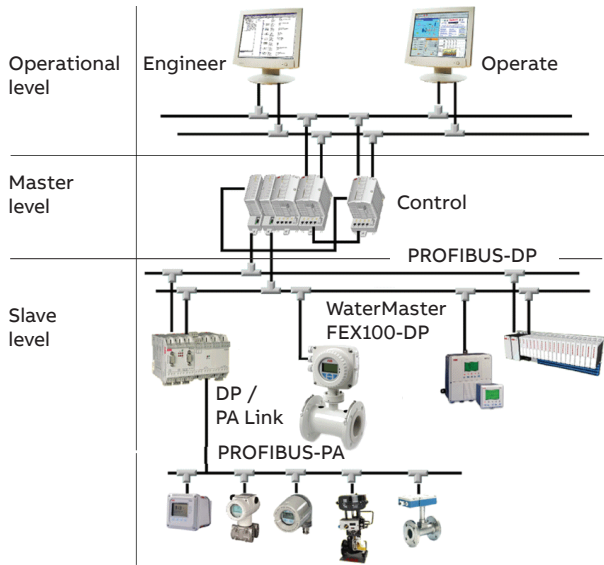
WaterMaster can be integrated into control systems and configuration devices using any Frame application, such as ABB AssetVision or similar third-party applications. ABB Device Type Managers (DTMs) for WaterMaster provide a unified structure for accessing device parameters, configuring and operating the devices and diagnosing problems. FDT (Field Device Tool) technology standardizes the communication and configuration interface between all field devices and host systems.

PROFIBUS DP protocol

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

PROFIBUS DP ID no.	0x3431
Alternative standard ID no.	0x9701 or 0x9741
Configuration	Directly on the device Software Asset Vision Basic (+PROFIBUS DP-DTM)
Transmission signal	Accuracy to IEC 61158-2
Cable	Shielded, twisted cable (accurate to IEC 61158-2, types A or B)

All devices are connected in a bus structure ('line') as shown in below. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment. Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.



System integration

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format.

This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

- General specifications
 - Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.
- DP slave-related specifications
 - Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

MODBUS protocol

MODBUS is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.modbus.org).

Using the MODBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment. WaterMaster FEX100-MB follows the specification for Modbus Over Serial Line V1.02, using 2-wire TIA/EIA-485 (RS485) physical layer.

Cable Properties

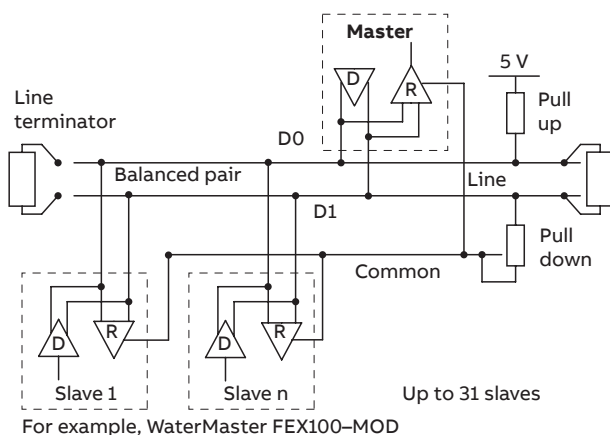
The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).

For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m (3280 ft.). Where 4-wire cabling is used as a 2-wire cabling system the maximum length must be divided by 2. The tap cables must be short, never more than 20 m (65.6 ft.). If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m (131 ft.) divided by n .

The maximum serial data transmission line length for RS485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) – standard screened or twisted pair cable.
- Up to 300 m (984 ft.) – twin twisted pair with overall foil screen and an integral drain wire – for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) – twin twisted pair with separate foil screens and integral drain wires – for example, Belden 9729 or equivalent.

Category 5 cables may be used for RS485-MODBUS to a maximum length of 600 m (1968 ft.). For the balanced pairs used in an RS485-system, a characteristic impedance with value higher than 100Ω is preferred especially for 19200 and higher Baud rates.

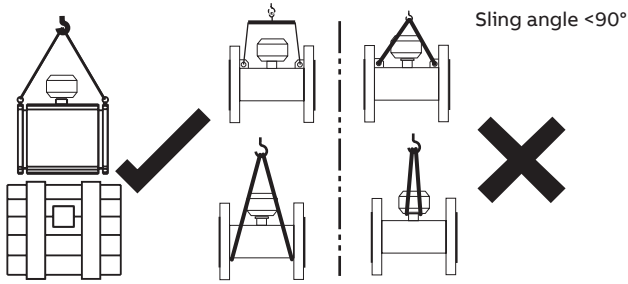


Installation requirements

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and Safety precautions refer to User Guide OI/FEF/FEV/FEW-EN.

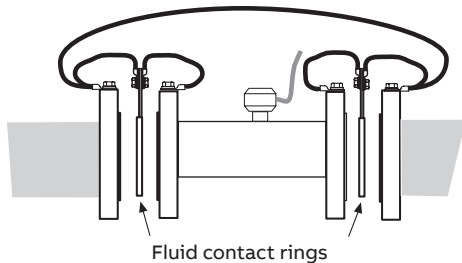
Unpacking the flowmeter

Care must be taken when lifting the flowmeter to use the lifting hooks provided or sling under the body of the meter. Never lift using the terminal connection box of the sensor cable as this will cause damage and invalidate warranty.



Grounding

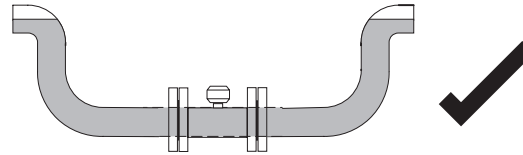
The flowmeter sensor must be cross-bonded to the upstream and downstream pipes. For technical reasons, this potential should be identical to the potential of the metering fluid. The fluid connection is made by installing 2 fluid contact rings (for grounding).



Mounting

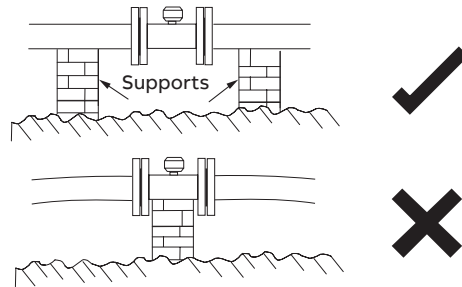
The installation conditions shown below must be observed to achieve the best operational results.

The sensor tube must always be completely full.

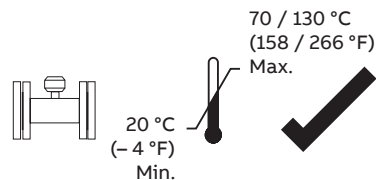


The flow direction must correspond to the identification plate. The device measures the flowrate in both directions. Forward flow is the factory setting.

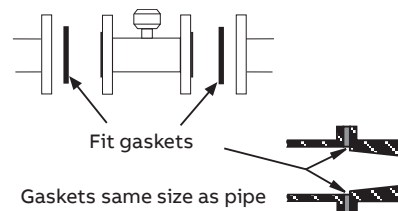
The devices must be installed without mechanical tension (torsion, bending). If required support the pipeline.



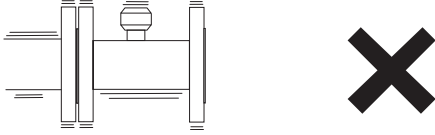
The flange seals must be made from a compatible material for the fluid and fluid temperatures if required.



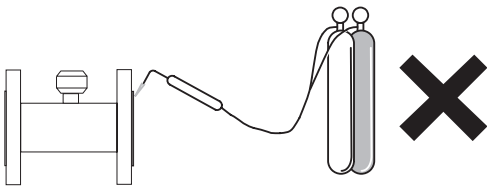
Seals must not extend into the flow area since possible turbulence could influence the device accuracy.



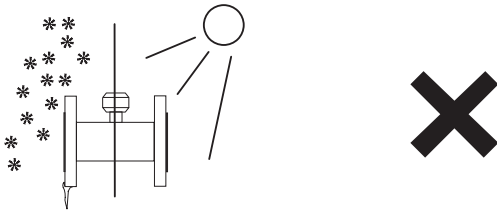
The pipeline may not exert any unallowable forces and torques on the device, such as vibration.



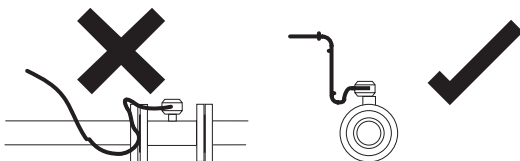
The flowmeter must not be submitted to any localized heat during installation; take care to remember this is a measuring instrument.



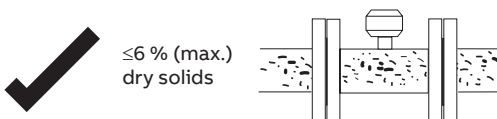
The flowmeter must not be exposed to direct sunlight or provide for appropriate sun protection where necessary.



The cable to the flowmeter should be installed neatly or within a conduit, both loose or conduit should have a u shape below the terminal connection box height to allow any water run off to avoid any capillary action into the flowmeter sensor.

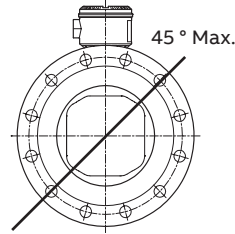


Ensure a maximum 6 % dry solids content flow through pipe – for higher dry solids content, refer to ABB's ProcessMaster range.



Electrode axis

Electrode axis should be horizontal if at all possible or no more than 45° from horizontal.



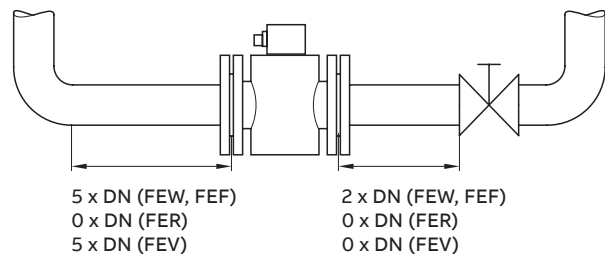
Upstream and Downstream pipe sections

The metering principle is tolerant of the flow profile.

- Wherever possible do not install fittings (for example, manifolds, valves) directly in front of the flowmeter sensor.
- Butterfly valves should be installed so that the valve plate does not extend into the flowmeter sensor.
- Valves or other turn-off components should be installed in the Downstream pipe section.

Experience has shown that, in most installations, straight upstream sections 3 x DN long and straight downstream sections 2 x DN long are normally sufficient. We would recommend conditions of 5 x DN straight upstream and 2 x DN straight downstream where possible.

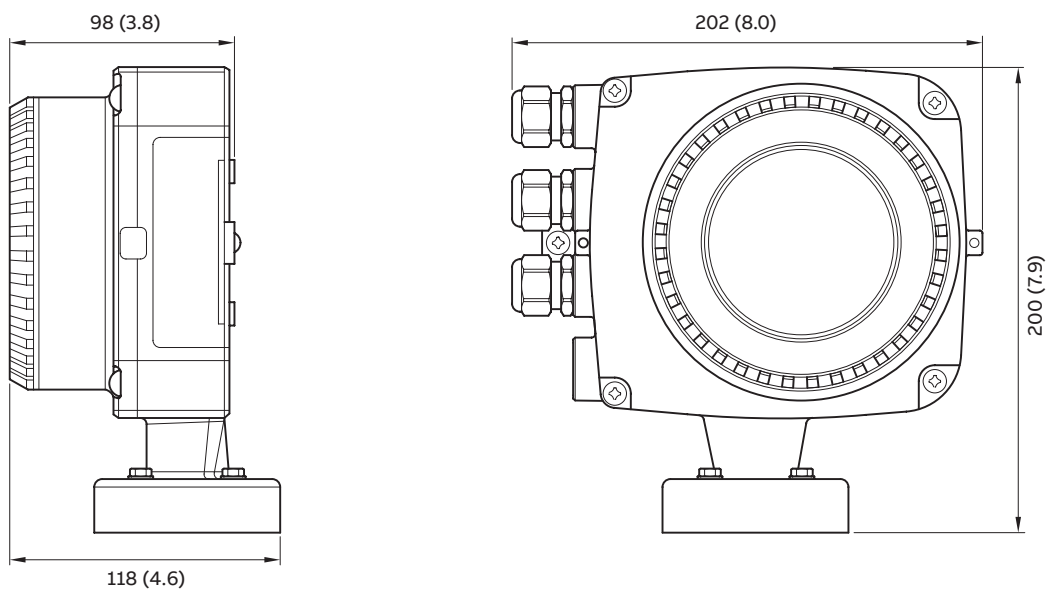
For reduced-bore meters (FER), these straight pipe sections are often not necessary.



Transmitter dimensions

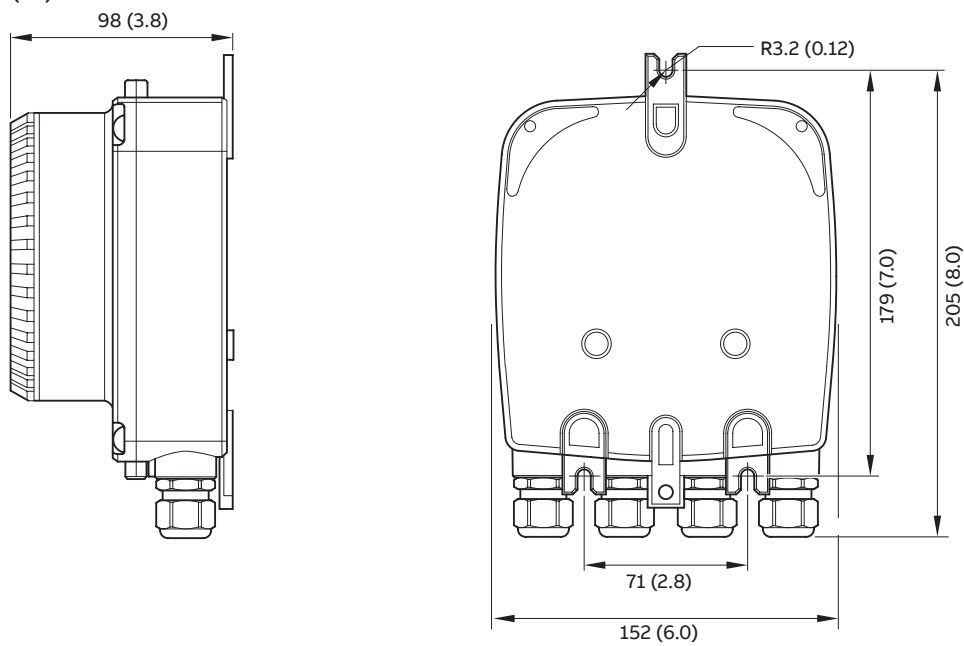
Integral transmitter

Dimensions in mm (in.)



Remote transmitter

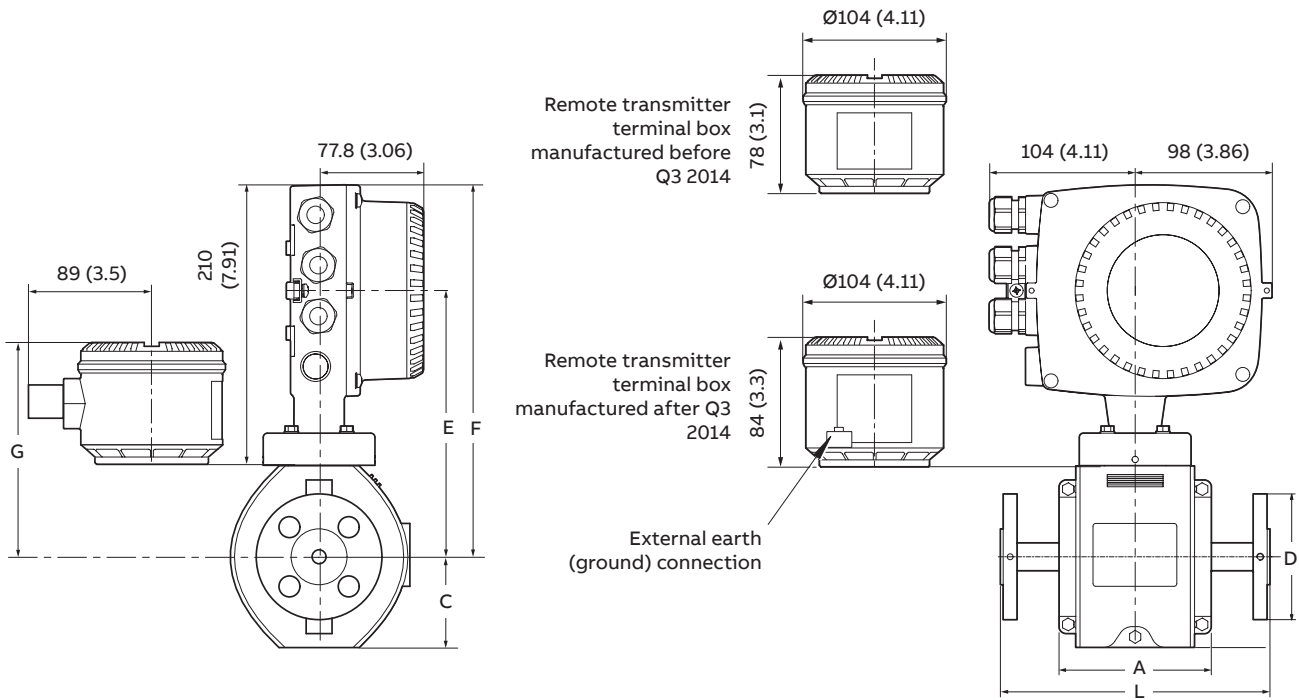
Dimensions in mm (in.)



Sensor dimensions

FEW – DN10 to 125 (3/8 to 5 in. NB)

Dimensions in mm (in.)



DN10 to 125 (3/8 to 5 in. NB) (FEW)

...Sensor dimensions

DN	Process connection type	Dimensions in mm (in.)							Approx. weight in kg (lb)						
		D	L	F	C	E	G	A	Integral	Remote					
DN10 (3/8 in.)	JIS10K	90 (3.54)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)							
	PN10 to 40	90 (3.54)													
	ASME B16.5 CL150	90 (3.54)													
	ASME B16.5 CL300	96 (3.78)													
DN15 (1/2 in.)	PN10 to 40	95 (3.74)									6 (13)	4 (9)			
	JIS5K	80 (3.15)													
	JIS10K	95 (3.74)													
	ASME B16.5 CL300	95 (3.74)													
DN20 (3/4 in.)	ASME B16.5 CL150	90 (3.54)													
	PN10 to 40	105 (4.13)													
	JIS5K	85 (3.35)													
	JIS10K	100 (3.94)													
DN25 (1 in.)	ASME B16.5 CL300	115 (4.53)									8 (18)	6 (13)			
	ASME B16.5 CL150	98 (3.86)													
	PN10 to 40	115 (4.53)													
	JIS5K	95 (3.74)									268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)
JIS10K	125 (4.88)														
ASME B16.5 CL300	125 (4.88)														
ASME B16.5 CL150	108 (4.25)														
DN32 (1 1/4 in.)	PN10 to 40	140 (5.51)							275 (10.83)	92 (3.62)	200 (7.87)	155 (6.10)	113 (4.45)	10 (22)	8 (18)
	JIS5K	115 (4.53)													
	JIS10K	135 (5.31)													
	ASME B16.5 CL300	135 (5.31)													
DN40 (1 1/2 in.)	ASME B16.5 CL150	117 (4.61)													
	PN10 to 40	150 (5.91)													
	JIS5K	120 (4.72)													
	JIS10K	140 (5.51)													
DN50 (2 in.)	ASME B16.5 CL300	155 (6.10)	200 (7.87)	281 (11.06)	97 (3.82)	206 (8.11)	161 (6.34)	115 (4.53)	12 (26)	10 (22)					
	ASME B16.5 CL150	127 (5.00)													
	PN10 to 40	165 (6.5)													
	JIS5K	130 (5.12)													
DN65 (2 1/2 in.)	JIS10K	155 (6.10)							292 (11.50)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	13 (29)	11 (24)
	AS4087 PN16	150 (5.91)													
	AS4087 PN35	165 (6.50)													
	ASME B16.5 CL150	152 (5.98)													
DN80 (3 in.)	ASME B16.5 CL300	165 (6.50)	292 (11.5)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	15 (33)						13 (29)	
	PN10 to 40	185 (7.28)													
	JIS5K	155 (6.10)													
	JIS10K	175 (6.89)													
DN100 (4 in.)	AS4087 PN16	165 (6.50)						314 (12.36)	122 (4.8)	239 (9.41)	194 (7.64)	125 (4.92)	19 (42)	17 (37)	
	AS4087 PN35	185 (7.28)													
	ASME B16.5 CL150	178 (7.01)													
	ASME B16.5 CL300	190 (7.48)													
DN125 (5 in.)	ASME B16.5 CL300	210 (8.28)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)						22 (48)	20 (44)	
	PN10 to 40	200 (7.87)													
	JIS5K	180 (7.09)													
	JIS10K	185 (7.28)													
DN150 (6 in.)	AS4087 PN16	185 (7.28)						250 (9.84)					19 (42)	17 (37)	
	AS4087 PN35	205 (8.07)													
	ASME B16.5 CL150	190 (7.48)													
	ASME B16.5 CL300	210 (8.28)													
DN200 (8 in.)	PN10 to 16	220 (8.66)	250 (9.84)										19 (42)	17 (37)	
	PN25 to 40	235 (9.25)													
	JIS5K	200 (7.87)													
	JIS10K	210 (8.27)													
DN250 (10 in.)	AS4087 PN16	215 (8.46)						250 (9.84)					23 (51)	21 (46)	
	AS4087 PN35	230 (9.06)													
	ASME B16.5 CL300	255 (1.04)													
	ASME B16.5 CL150	229 (9.00)													
DN300 (12 in.)	PN10 to 16	250 (9.84)	250 (9.84)										22 (48)	20 (44)	
	PN25 to 40	270 (10.63)													
	JIS5K	235 (9.25)													
	JIS10K	250 (9.84)													
DN350 (14 in.)	ASME B16.5 CL150	254 (10.00)						324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	22 (48)	20 (44)	
	ASME B16.5 CL300	280 (11.02)													
	PN10 to 16	250 (9.84)													
	PN25 to 40	270 (10.63)													
DN400 (16 in.)	JIS5K	235 (9.25)	324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)						22 (48)	20 (44)	
	JIS10K	250 (9.84)													
	ASME B16.5 CL150	254 (10.00)													
	ASME B16.5 CL300	280 (11.02)													

DN10 to 125 (3/8 to 5 in. NB) (FEW) dimensions / weights

Electromagnetic flowmeter WaterMaster – FEW31, FEW32 and FEW38

Product coding field number	1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	FEW31																				
Flowmeter system – full bore, remote mount	FEW32	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only – for use with WaterMaster transmitter / remote	FEW38																				
Design																					
Non-hazardous areas	1																				
Hazardous areas	5																				
Bore diameter																					
DN10 (3/8 in.)			010																		
DN15 (1/2 in.)			015																		
DN20 (3/4 in.)			020																		
DN25 (1 in.)			025																		
DN32 (1 1/4 in.)			032																		
DN40 (1 1/2 in.)			040																		
DN50 (2 in.)			050																		
DN65 (2 1/2 in.)			065																		
DN80 (3 in.)			080																		
DN100 (4 in.)			100																		
DN125 (5 in.)			125																		
DN150 (6 in.)			150																		
DN200 (8 in.)			200																		
DN250 (10 in.)			250																		
DN300 (12 in.)			300																		
DN350 (14 in.)			350																		
DN400 (16 in.)			400																		
DN450 (18 in.)			450																		
DN500 (20 in.)			500																		
DN600 (24 in.)			600																		
DN700 (28 in.)			700																		
DN750 (30 in.)			750																		
DN800 (32 in.)			800																		
DN900 (36 in.)			900																		
DN1000 (40 in.)			001																		
DN1050 (42 in.)			051																		
DN1100 (44 in.)			101																		
DN1200 (48 in.)			201																		
DN1350 (54 in.)			351																		
DN1400 (56 in.)			401																		
DN1500 (60 in.)			501																		
DN1600 (64 in.)			601																		
DN1650 (66 in.)			651																		
DN1800 (72 in.)			801																		
DN1950 (78 in.)			951																		
DN2000 (80 in.)			002																		
DN2100 (84 in.)			102																		
DN2200 (88 in.)			202																		
DN2400 (96 in.)			402																		
Others			999																		
Liner material																					
PTFE – DN10 to 600 (3/8 to 24 in. NB)				A																	
Hard rubber – DN40 to 2400 (1 1/2 to 96 in. NB)				H																	
Elastomer – DN40 to 2400 (1 1/2 to 96 in. NB)				K																	
Electrode design																					
Standard				1																	
Other				9																	
Measuring electrodes material																					
Hastelloy® C-4 (2.4610)*				D																	
Stainless steel 316Ti/316L				S																	
Hastelloy C-22				C																	
Grounding accessories																					
Not required				0																	
Standard				1																	
One potential equalizing ring (stainless steel)				3																	
Two potential equalizing rings (stainless steel)				4																	

Continued on next page...

* Standard option for sizes greater than DN600

...Ordering information

Electromagnetic flowmeter WaterMaster – FEW31, FEW32 and FEW38

Product coding field number	1	...	5	6	7	...	9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	FEW31																								
Flowmeter system – full bore, remote mount	FEW32																								
Full bore sensor only – for use with WaterMaster transmitter / remote	FEW38																								
Process connection type																									
Flanges ASME B16.47 series B / API 605 / B16.5 Class 150												A1													
Flanges ASME B16.47 series B / API 605 / B16.5 Class 300												A3													
Flanges ASME B16.47 series A / MSS SP-44 / B16.5 Class 150												B1													
Flanges ASME B16.47 series A / MSS SP-44 / B16.5 Class 300												B3													
Flanges AWWA C207 Class B												C1													
Flanges AWWA C207 Class D												C2													
Flanges AWWA C207 Class E												C3													
Flanges AWWA C207 Class F												C4													
Flanges JIS 10K												J1													
Flanges JIS 5K												J2													
Flanges AS 4087 PN 16												E1													
Flanges AS 2129 Table E												E4													
Flanges AS 2129 Table D												E5													
Flanges AS 4087 PN 35												E8													
ISO 7005, DIN, EN 1092-1 PN6												S0													
ISO 7005, DIN, EN 1092-1 PN10												S1													
ISO 7005, DIN, EN 1092-1 PN16												S2													
ISO 7005, DIN, EN 1092-1 PN25												S3													
ISO 7005, DIN, EN 1092-1 PN40												S4													
Process connection material																									
Carbon steel flanges													B												
Stainless steel flange												D													
Usage certifications																									
Standard (without PED)																1									
Calibration type																									
Class 2 calibration – standard accuracy 0.4 %																A									
Class 1 calibration – high accuracy 0.2 %																B									
Temperature range installation / ambient temperature range																									
Standard design/ –20 to 60 °C (–4 to 140 °F)																	1								
Nameplate																									
Adhesive																		A							
Signal cable length and type																									
Without signal cable																									
5 m (15 ft.) cable																									
10 m (30 ft.) cable																									
20 m (60 ft.) cable																									
30 m (100 ft.) cable																									
50 m (165 ft.) cable																									
80 m (260 ft.) cable																									
100 m (325 ft.) cable																									
150 m (490 ft.) cable																									
Special length or cable type																									
Explosion protection certification*																									
General purpose (non-Ex design)																									
FM Class 1 Div. 2																									
usFMc Class 1 Div. 2																									
ATEX/UKEX/IECEx Zone 2, 21 & 22																									

Continued on next page...

Product coding field number	1 ... 5	6	7 ... 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	FEW31																				
Flowmeter system – full bore, remote mount	FEW32	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only – for use with WaterMaster transmitter / remote	FEW38																				
Protection class transmitter / protection class sensor																					
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable not fitted and not potted to sensor																1					
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable not fitted and not potted to sensor																2					
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable fitted and potted to sensor																3					
Cable conduits **																					
M20 x 1.5 (plastic)																	A				
NPT ½ in. (blanked when cable not fitted)																	B				
M20 SWA (armored)																	D				
M20 SWA sensor, M20 x 1.5 (plastic) power / output																	F				
Without																	Y				
Power supply																					
Without																		0			
100 to 230 V AC, 50 Hz																		1			
24 V AC or 24 V DC, 50 Hz																		2			
100 to 230 V AC, 60 Hz																		3			
24 V AC or 24 V DC, 60 Hz																		4			
Input and output signal type																					
HART + 20 mA + pulse + contact output																			A		
PROFIBUS DP RS485 physical layer + pulse + contact output																			G		
MODBUS RTU RS485 physical layer + pulse + contact output																			M		
Without																			Y		
Configuration type / diagnostics type																					
Not required																				0	
Factory default / Standard																				1	
Options***																					
Accessories																					
Configuration lead																				AC	
Documentation language																					
German M1																				Chinese M6	
Italian M2																				Swedish M7	
Spanish M3																				Finnish M8	
French M4																				Portuguese MA	
English M5 (default)																				Danish MF	
																				Norwegian MN	
Lay length																					
ISO length – DN10 to 600 (¾ to 24 in.) and 1.25D DN1800 to 2400 (72 to 96 in.)																				JB	
1.3D DN700 to 2400 (28 to 96 in.) – see dimensional pages 28, 29, 30, 31																				JK	
1.0D DN700 to 1600 (28 to 64 in.) – see dimensional pages 32, 33, 34, 35																				JH	
Verification type																					
Without																				V0	
fingerprint																				V3	
VeriMaster																					
Potable water approval																					
WRAS cold water approval																				CWA	
DVGW																				CWD	
WRAS 60 °C (140 °F) water approval																				CWK	
NSF material approval																				CWM	
Without																				CWY	
Power supply frequency (sensor FEW38 only)																					
50 Hz																				F5	
60 Hz																				F6	
Number of testpoints																					
1 Point																				T1	
3 Points																				T3	
5 Points																				T5	

* FM approval in process. FEF product still available with full FM approval

** The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered. For FM or FMC Approved versions, NPT only permitted.

*** Add codes for options.

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For more product information, visit:

www.abb.com/measurement



EN4SD363010S16 / EP3630
EN4SD202010S16 / EP2020

Quality Products. Service Excellence.

Type 4X Stainless Steel Wallmount Enclosure *Eclipse Series*

Hinge Door with Quarter Turn/Handle



Application

- Designed to enclose electrical and/or electronic equipment and protect against harsh, industrial environments for wallmount applications.
- Impressive styling features like hidden hinges and attractive latching systems make the Eclipse a suitable addition to any high-tech equipment installation.
- A wide range of sizes and practical accessories make this product line a complete package.

Standards

- UL 508A Type 3R, 4, 4X and 12
- CSA Type 3R, 4, 4X and 12
- Complies with
 - NEMA 3R, 4, 4X, 12 and 13
 - IEC 60529, IP 66

Construction

- Formed 14 (24x24" and larger) or 16 (24x20" and smaller) gauge stainless steel.
- Continuously welded seams ground smooth.
- Door stiffeners are provided where required for increased strength and rigidity - designed to also permit additional mounting options.
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latching: Type A has stainless steel slotted quarter turns, Type B has stainless steel handle with 3 point latching.
- Doors may be easily removed for modifications and are interchangeable.
- Seamless poured-in place gasket.
- Collar studs provided for mounting inner panel.
- Includes hardware kit with panel mounting nuts and sealing washers for wall mounting holes.
- Bonding stud provided on door and grounding stud installed in enclosure.
- Stainless steel hinge pins and quarter turns.
- Door alignment guide provided on 36" wide enclosures.

Finish

- Cover and enclosure are natural stainless steel with a smooth brushed finish.

Accessories

- Additional Inner Panels
- Swing Frame
- Eclipse DIN Rails
- Mounting Foot Kit
- Drip Shield Kit
- Quarter Turn Assemblies
- Handles
- Swing Panel
- Eclipse DIN Rail Mounting Kit
- Door Stop Kit
- Rear Hole Plugs
- Quarter Turn Inserts and Keys
- Padlock Adaptor
- Replacement Hinge Pins

- Window Kits
- Lighting
- Climate Control
- General Accessories

New and improved PDF part drawing files with more detail now available.

Click part number in table below to access PDF, DXF, and STEP files.

304 S.S. Part No.	316 S.S. Part No.	Enclosure				Optional Inner Panel		
		H	W	D	Latch Type	Part No.	H	W
EN4SD12126SS	EN4SD12126S16	12.00	12.00	6.00	A	EP1212	10.20	10.20
EN4SD16126SS	EN4SD16126S16	16.00	12.00	6.00	A	EP1612	14.20	10.20
EN4SD16166SS	EN4SD16166S16	16.00	16.00	6.00	A	EP1616	14.20	14.20
EN4SD16206SS	-	16.00	20.00	6.00	A	EP1620	14.20	18.20
EN4SD20166SS	EN4SD20166S16	20.00	16.00	6.00	A	EP2016	18.20	14.20
EN4SD20206SS	EN4SD20206S16	20.00	20.00	6.00	A	EP2020	18.20	18.20
EN4SD24206SS	-	24.00	20.00	6.00	A	EP2420	22.20	18.20
EN4SD16128SS	EN4SD16128S16	16.00	12.00	8.00	A	EP1612	14.20	10.20
EN4SD16168SS	EN4SD16168S16	16.00	16.00	8.00	A	EP1616	14.20	14.20
EN4SD16208SS	EN4SD16208S16	16.00	20.00	8.00	A	EP1620	14.20	18.20
EN4SD20168SS	EN4SD20168S16	20.00	16.00	8.00	A	EP2016	18.20	14.20
EN4SD20208SS	EN4SD20208S16	20.00	20.00	8.00	A	EP2020	18.20	18.20
EN4SD20248SS	-	20.00	24.00	8.00	A	EP2024	18.20	22.20
EN4SD24168SS	EN4SD24168S16	24.00	16.00	8.00	A	EP2416	22.20	14.20
EN4SD24208SS	EN4SD24208S16	24.00	20.00	8.00	A	EP2420	22.20	18.20
EN4SD24248SS	EN4SD24248S16	24.00	24.00	8.00	A	EP2424	22.20	22.20
EN4SD24308SS	EN4SD24308S16	24.00	30.00	8.00	A	EP2430	22.20	28.20
EN4SD30208SS	-	30.00	20.00	8.00	A	EP3020	28.20	18.20
EN4SD30248SS	EN4SD30248S16	30.00	24.00	8.00	A	EP3024	28.20	22.20
EN4SD30308SS	EN4SD30308S16	30.00	30.00	8.00	A	EP3030	28.20	28.20
EN4SD36248SS	EN4SD36248S16	36.00	24.00	8.00	A	EP3624	34.20	22.20
EN4SD36308SS	EN4SD36308S16	36.00	30.00	8.00	A	EP3630	34.20	28.20
EN4SD42368SSR	-	42.00	36.00	8.00	A	EP4236	40.20	34.20
EN4SD48368SSR	-	48.00	36.00	8.00	A	EP4836	46.20	34.20
EN4SD161210SS	EN4SD161210S16	16.00	12.00	10.00	A	EP1612	14.20	10.20
EN4SD161610SS	EN4SD161610S16	16.00	16.00	10.00	A	EP1616	14.20	14.20
EN4SD162010SS	EN4SD162010S16	16.00	20.00	10.00	A	EP1620	14.20	18.20
EN4SD201610SS	EN4SD201610S16	20.00	16.00	10.00	A	EP2016	18.20	14.20
EN4SD202010SS	EN4SD202010S16	20.00	20.00	10.00	A	EP2020	18.20	18.20
EN4SD202410SS	EN4SD202410S16	20.00	24.00	10.00	A	EP2024	18.20	22.20
EN4SD241610SS	EN4SD241610S16	24.00	16.00	10.00	A	EP2416	22.20	14.20
EN4SD242010SS	EN4SD242010S16	24.00	20.00	10.00	A	EP2420	22.20	18.20
EN4SD242410SS	EN4SD242410S16	24.00	24.00	10.00	A	EP2424	22.20	22.20
EN4SD243010SS	EN4SD243010S16	24.00	30.00	10.00	A	EP2430	22.20	28.20
EN4SD302010SS	EN4SD302010S16	30.00	20.00	10.00	A	EP3020	28.20	18.20
EN4SD302410SS	EN4SD302410S16	30.00	24.00	10.00	A	EP3024	28.20	22.20
EN4SD303010SS	EN4SD303010S16	30.00	30.00	10.00	A	EP3030	28.20	28.20
EN4SD362410SS	EN4SD362410S16	36.00	24.00	10.00	A	EP3624	34.20	22.20
EN4SD363010SS	EN4SD363010S16	36.00	30.00	10.00	A	EP3630	34.20	28.20
EN4SD363610SSR	EN4SD363610S16R	36.00	36.00	10.00	A	EP3636	34.20	34.20
EN4SD423010SSR	-	42.00	30.00	10.00	A	EP4230	40.20	28.20
EN4SD423610SSR	EN4SD423610S16R	42.00	36.00	10.00	A	EP4236	40.20	34.20
EN4SD482410SS	EN4SD482410S16	48.00	24.00	10.00	B	EP4824	46.20	26.20

2080-LC50-24QBB

2085-IF8

2085-OF4

Micro850® Programmable Logic Controller

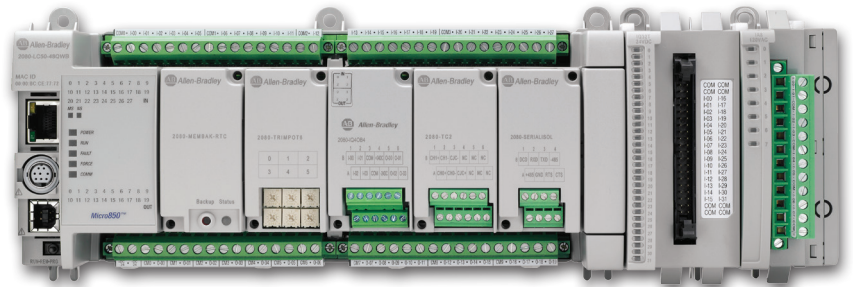
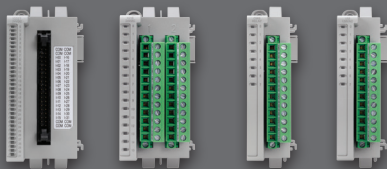


Bulletin 2080 and 2085 Product Profile

Features and Benefits

- Equipped with same form factor, plug-in support, instruction/data size and motion capabilities as Micro830® 24-pt and 48-pt controllers
- EtherNet/IP™ for Connected Components Workbench™ programming, RTU applications and HMI connectivity. Client messaging for controlling drives and communications to other controllers using symbolic addressing.
- Designed for larger standalone machine applications that require higher density, higher precision analog and digital I/O as compared to Micro830 controller
- Expandable to a maximum of 132 digital I/O points on a 48-pt controller with Micro850 Expansion I/O modules
- Supports up to four Micro850 Expansion I/O modules
- Increased flexibility with removable terminal blocks
- Standard version of Connected Components Workbench software available as a free download

Micro850 Expansion I/O modules empower flexibility and greater I/O performance



Machine builders and end users looking for flexibility, personalization, greater I/O performance and space-saving solutions, the expandable Micro850 controller is just the right solution. Designed as the leading controller of the Micro800® family, it also brings Micro800 PLC family to a higher level of flexibility and customization with its space-saving Plug-in, Expansion I/O modules and its removable terminal blocks. Furthermore, Micro850 controller is equipped with the same form factor, Plug-in support, instruction/data size and embedded motion capabilities as the Micro830 24-pt and 48-pt controller. The embedded motion capabilities supports up to 3 axes of motion with TouchProbe instruction that registers position of an axis, more precisely than using interrupts. Especially designed for larger standalone machine applications, Micro850 Expansion I/O module value adds to achieving higher density, higher precision analog and digital I/O as required. Micro850 48-pt controller has the capacity to support up to 4 Expansion I/O modules at a maximum of 132 I/O points.

Connected Components Workbench software is used among the entire Micro800 family of controllers, as well as other component products, such as PanelView Component HMIs and PowerFlex drives. Based on proven Rockwell Automation and Microsoft Visual Studio technology, the new software provides controller programming, device configuration and data sharing with the HMI editor for PanelView Component operator products. In addition, the software supports three standard IEC programming languages: ladder diagram, function block diagram and structured text. For enhanced security, controller password protection is supported for all Micro800 controllers.

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**Rockwell
Automation**

Bulletin 2080 and 2085

Catalog Number	Inputs		Relay	Outputs		Motion Axis [#]	HSC [*]
	120/240V AC	12/24V [^]		24V Sink	24V Source		
2080-LC50-24QWB	-	14	10	-	-	-	4 HSC
2080-LC50-48QWB	-	28	20	-	-	-	6 HSC
2080-LC50-24QBB	-	14	-	-	10	2 PTO	4 HSC
2080-LC50-48QBB	-	28	-	-	20	3 PTO	6 HSC
2080-LC50-24QVB	-	14	-	10	-	2 PTO	4 HSC
2080-LC50-48QVB	-	28	-	20	-	3 PTO	6 HSC
2080-LC50-24AWB	14 (120V AC only)	-	10	-	-	-	-
2080-LC50-48AWB	28 (120V AC only)	-	20	-	-	-	-

Micro850	24-pt	48-pt
Base Unit		
Power Supply	Base Unit has embedded 24V DC Power Supply. Optional External 120/240V AC via Cat. No. 2080-PS120-240VAC	
Base Programming Port	Embedded USB 2.0 (non-isolated) Any standard USB printer cable will work	
Base Ethernet port	EtherNet/IP Class 3, Modbus TCP (10/100Mbps)	
Base Plug-in Slots	3	5
Base 100 KHz HSC* max	4 HSC	6 HSC
I/O		
Digital I/O (In/Out)	24 (14/10)	48 (28/20)
Analog I/O Channels	Via Plug-in Modules or with Expansion I/O Modules	
Expansion I/O Modules	up to 4 modules	
Maximum Digital I/O (via Plug-in & Expansion I/O modules)	132	
Programming		
Software	Connected Components Workbench	
Program Steps (or instructions)	10Ksteps	
Data (bytes)	20Kbytes	
IEC 61131-3 Languages	Ladder Diagram, Function Block, Structured Text	
User Defined Function Blocks	Yes	
Motion Instructions	Yes	
Floating Point Math	32-bit and 64-bit	
PID Loop Control	Yes	
Embedded Serial Port Protocols	RS232/485, Modbus RTU Master/Slave, ASCII, CIP	
Environmentals		
Certifications	c-UL-us CL1DIV2, CE, C-Tick, KC	
Temperature Range	-20°...65°C	
Dimensions (HxWxD, mm)	90 x 145 x 80	90 x 230 x 80

[^] 12/24V DC and 24V AC supported

[#] Each Pulse Train Output Axis is shared with 2 HSC inputs so if max number of PTO is configured then number of HSC is zero

^{*} 2-wire High Speed Counter shown, divide by 2 to get number of 4-wire HSCs

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Supersedes Publication 2080-PP003A-EN-P - September 2012

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Catalog Number	Plug-in Modules
2080-IQ4	4-pt Digital Input, 12/24VDC, Sink/Source, Type3
2080-OB4	4-pt Digital Output, 12/24VDC, Source
2080-OV4	4-pt Digital Output, 12/24VDC, Sink
2080-OW4I	4-pt Relay Output, Individually Isolated, 2A
2080-IQ4OB4	8-pt Combo: 4-pt Digital Input, 12/24VDC, Sink/Source, Type3, and 4-pt Digital Output, 12/24VDC, Source
2080-IQ4OV4	8-pt Combo: 4-pt Digital Input, 12/24VDC, Sink/Source, Type3, and 4-pt Digital Output, 12/24VDC, Sink
2080-IF2, 2080-IF4	2/4-ch Analog Input, 0-20 mA, 0-10V, non-isolated 12-bit
2080-OF2	2-ch Analog Output 0-20 mA, 0-10V, non-isolated 12-bit
2080-SERIALISOL	RS232/485 isolated serial port
2080-TRIMPOT6	6-ch Trimpot Analog Input
2080-RTD2	2-ch RTD, non-isolated, ± 1.0 °C
2080-TC2	2-ch TC, non-isolated, ± 1.0 °C
2080-MEMBAK-RTC	Memory Backup and High Accuracy RTC
2080-MOT-HSC	High Speed Counter, 250 KHz, Differential Line Receiver, 1 Digital Output
2080-DNET20	DeviceNet Scanner, 20 Nodes
Catalog Number	Expansion I/O Modules
2085-IQ16, 2085-IQ32T	16/32-pt Digital Input, 12/24VDC, Sink/Source
2085-OV16	16-pt Digital Output, 12/24VDC, Sink
2085-OB16	16-pt Digital Output, 12/24VDC, Source
2085-OW8, 2085-OW16	8/16-pt Relay output, 2A
2085-IA8	8-pt 120 VAC input
2085-IM8	8-pt 240 VAC input
2085-OA8	8-pt 120/240 VAC output
2085-IF4, 2085-IF8	4/8-ch Analog Input, 0 ~ 20mA, -10V ~ +10V, isolated, 14-bit
2085-OF4	4-ch Analog Output, 0 ~ 20mA, -10V ~ +10V, isolated, 12-bit
2085-IRT4	4-ch RTD and TC, isolated, ± 0.5 °C
2085-ECR	End Cap Terminator
Catalog Number	Accessories
2080-PS120-240VAC	External 120/240V AC power supply

PanelView™ 800



Component Level Human Machine Interface Solutions

Features and Benefits

- Language Support & Switching
 - Provide information in local languages* for operator and support personnel
 - Configure numeric, date and time format for each locale
- Alarming
 - Alert operators with alarm messages that include embedded variables
 - Review alarm status, history and time/date of equipment events even after power cycle
- Recipe
 - Support multiple recipe files
 - Upload and download parameter settings with a single operation
 - Save recipes in .csv format for backup or offline modification
- Communications
 - Communicate to micro controllers (MicroLogix™, Micro800®) and other devices using serial (RS232, RS422/485) protocols and Ethernet
 - Multi-communication protocols include Modbus RTU, Modbus/TCP
- Software
 - Standard Edition of Connected Components Workbench™ software available as a free download

Landscape and Portrait Modes

- Configurable to support both landscape and portrait applications



* Available in French, German, Italian, Portuguese, Spanish and Simplified Chinese.



When you are looking to add value to and reduce the cost of your operator interface for your standalone machine, look to the all-new Allen-Bradley® PanelView 800 family from Rockwell Automation.



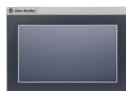

Leverage on the high-speed processor, high-resolution display with LED backlight and internal memory, these helps improve productivity and maintenance, while enjoying the convenience and efficiencies of single-source buying.

Preferred integration with Allen-Bradley micro controllers offers you an ideal control and visualization solution for a wide variety of applications. PanelView 800 offers the fundamental features that you need on a full line of displays ranging from 4 in. to 10 in., and supports Ethernet and serial communications.

PanelView 800 graphic terminals are part of the Connected Components solution which uses single software, Connected Components Workbench™ that provides a common environment for configuring Allen-Bradley HMI, PowerFlex® component-class drives, Guardmaster® configurable safety relays, SMC™ soft starters, Kinetix® 3 servo drive and Micro800 controllers in your standalone machine.

LISTEN.
THINK.
SOLVE.™

PanelView 800 Specifications

Feature	4-inch	7-inch	10-inch
			
Catalog Number	2711R-T4T	2711R-T7T	2711R-T10T
Resolution	480 x 272 WQVGA	800 x 480 WVGA	800 x 600 SVGA
Display Type	TFT touch screen, wide LCD		
Display Hour	40,000 hours		
Colors	65K colors		
Backlight	LED		
Operator Input	Resistive touch and tactile function keys	Resistive touch	
Power Supply	24V DC		
Processor, CPU Speed	800 MHz		
Internal Storage	128 MB	256 MB	
RAM	128 MB DDR	256 MB DDR	
Operation System	Microsoft Windows CE 6.0		
Real-time Clock With Battery	Yes		
Power Requirements (max)	9W	11W	14W
Operating Temperature	0°...50°C		
RS232/RS422/485 (isolated)	Separate RS232 and RS422/RS485 connectors		
Ethernet 10/100 Mbps	1		
USB Host (USB 2.0)	Yes		
microSD™ Slot	Yes		
Product Dimension (mm) (Height x Width x Depth)	116 x 138 x 43	144 x 197 x 54	225 x 287 x 55
Panel Cutout (mm) (Height x Width)	99 X 119	125 X 179	206 X 269
Weight	0.35 kg (0.76 lb)	0.68 kg (1.48 lb)	1.57 kg (3.41 lb)
Front Bezel Protection	IP65, NEMA 4X, 12, 13		
Certifications	cULus listed; Class 1 Div 2, Groups A,B,C,D, T4A, CE, RCM, KC, RoHS		
Software	Connected Components Workbench Software Release 8.00 or later		
Catalog Number	2711R-CSP	2711R-APK7	2711R-APK10
Accessories	Stylus Pen	7" Adapter Plate Kit	10" Adapter Plate Kit

For more information, visit

www.rockwellautomation.com/go/lit/pv800



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www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

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Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Stratix 2000 Industrial Unmanaged Switches

Features and Benefits

Our Stratix® 2000 unmanaged switches offer:

- **Various combinations** of copper and fiber solutions from 5 to 18 ports using SFP for increased network flexibility
- **100 MB and 1 Gb port speeds** to meet network performance requirements
- **Extended temperature range** from -40 °C to 75 °C in select versions to meet a wide variety of applications
- **Compact design** for maximized cabinet space
- **“Plug-and-Play” operation** for easier installation and integration
- **Broadcast storm protection** against unwanted network traffic
- **Rugged metal housing and IP30 rating** for industrial applications
- **Dual power inputs** to help maximize uptime in harsh environments



Rockwell Automation unmanaged switches offer a compact, solution for small applications requiring reliable network connectivity.

With the Allen-Bradley® Stratix 2000 line of unmanaged switches, you get copper and fiber (SFP) ports with 100 MB or 1 Gb speeds for increased network flexibility and performance. With protection against unwanted network traffic, you also get increased reliability when you need it.

The Stratix 2000 unmanaged switches offer an industrial-grade enclosure with an IP-30 rating and extended temperature range for enhanced environmental protection. In addition to these benefits, you get “Plug-and-Play” operation for quick and easy integration.

LISTEN.
THINK.
SOLVE.

Selection Overview

In the table below, you will find the Series B versions of our Stratix unmanaged switches. Select the combination of ports that meet your application requirements, without all of the complexity.



Catalog Number	Total Ports	RJ45 Ports ¹	SFP Ports ¹
1783-US5T	5	5 FE	-
1783-US5TG	5	5 GE	-
1783-US4T1F	5	4 FE	1 FE multimode*
1783-US4T1H	5	4 FE	1 FE singlemode*
1783-US8T	8	8 FE	-
1783-US6T2F	8	6 FE	2 FE multimode*
1783-US6T2H	8	6 FE	2 FE singlemode*
1783-US7T1F	8	7 FE	1 FE multimode*
1783-US7T1H	8	7 FE	1 FE singlemode*
1783-US6T2TG2F	10	6 FE + 2 GE	2 FE multimode*
1783-US6T2TG2H	10	6 FE + 2 GE	2 FE singlemode*
1783-US8TG2GX	10	8 GE	2 GE slots ²
1783-US16T	16	16 FE	-
1783-US16T2S	18	16 FE	2 FE slots ²

¹ FE = Fast Ethernet; GE = Gigabit Ethernet

² SFP modules must be ordered separately

* preinstalled fiber SFP module(s)

Additional Information

<http://ab.rockwellautomation.com/networks-and-communications/stratix-2000-ethernet-switches>

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Power, Control and Information Solutions Headquarters

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Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

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Primary-switched QUINT POWER power supply for DIN rail mounting with SFB (Selective Fuse Breaking) Technology, input: 1-phase, output: 24 V DC/3.5 A

Product Description

QUINT POWER power supplies with maximum functionality

QUINT POWER circuit breakers magnetically and therefore quickly trip at six times the nominal current, for selective and therefore cost-effective system protection. The high level of system availability is additionally ensured, thanks to preventive function monitoring, as it reports critical operating states before errors occur.

Reliable starting of heavy loads takes place via the static power reserve POWER BOOST. Thanks to the adjustable voltage, all ranges between 5 V DC ... 56 V DC are covered.

Your advantages

- ✓ Reliable starting of difficult loads with the static POWER BOOST power reserve with up to 1.5 times the nominal current permanently
- ✓ Fast tripping of standard circuit breakers with dynamic power reserve SFB (selective fuse breaking) technology with up to 6 times the nominal current for 12 ms
- ✓ For superior system availability
- ✓ Preventive function monitoring



Key Commercial Data

Packing unit	1 pc
GTIN	 4 046356 113779
GTIN	4046356113779
Weight per Piece (excluding packing)	880.000 g
Custom tariff number	85044030
Country of origin	Thailand

Technical data

Dimensions

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

Technical data

Dimensions

Width	32 mm
Height	130 mm
Depth	125 mm
Width with alternative assembly	122 mm
Height with alternative assembly	130 mm
Depth with alternative assembly	35 mm

Ambient conditions

Degree of protection	IP20
Ambient temperature (operation)	-25 °C ... 70 °C (> 60 °C Derating: 2.5 %/K)
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Max. permissible relative humidity (operation)	≤ 95 % (at 25 °C, non-condensing)
Climatic class	3K3 (in acc. with EN 60721)
Degree of pollution	2
Installation height	5000 m

Input data

Nominal input voltage range	100 V AC ... 240 V AC
Input voltage range	85 V AC ... 264 V AC
	90 V DC ... 350 V DC
Dielectric strength maximum	300 V AC
AC frequency range	45 Hz ... 65 Hz
Frequency range DC	0 Hz
Discharge current to PE	< 3.5 mA
Current consumption	1.4 A (120 V AC)
	0.8 A (230 V AC)
	0.9 A (110 V DC)
	0.4 A (220 V DC)
Nominal power consumption	180 VA
Inrush current	< 20 A (typical)
Mains buffering time	typ. 20 ms (120 V AC)
	typ. 80 ms (230 V AC)
Input fuse	5 A (slow-blow, internal)
Recommended breaker for input protection	6 A ... 20 A (AC: Characteristics B, C, D, K)
Type of protection	Transient surge protection
Protective circuit/component	Varistor

Output data

Nominal output voltage	24 V DC ±1 %
------------------------	--------------

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

Technical data

Output data

Setting range of the output voltage (U_{Set})	18 V DC ... 29.5 V DC (> 24 V DC, constant capacity restricted)
Nominal output current (I_N)	3.5 A (-25 °C ... 60 °C, $U_{OUT} = 24$ V DC)
POWER BOOST (I_{Boost})	4 A (-25°C ... 40°C permanent, $U_{OUT} = 24$ V DC)
Selective Fuse Breaking (I_{SFB})	15 A (12 ms)
Derating	60 °C ... 70 °C (2.5%/K)
Connection in parallel	Yes, for redundancy and increased capacity
Connection in series	yes
Feedback voltage resistance	max. 35 V DC
Protection against overvoltage at the output (OVP)	< 35 V DC
Control deviation	< 1 % (change in load, static 10 % ... 90 %)
	< 2 % (change in load, dynamic 10 % ... 90 %)
	< 0.1 % (change in input voltage ± 10 %)
Residual ripple	< 50 mV _{PP} (with nominal values)
Output power	84 W
Typical response time	< 0.05 s
Maximum power dissipation in no-load condition	3.5 W
Power loss nominal load max.	11 W

General

Net weight	0.5 kg
Operating voltage display	Green LED
Efficiency	> 88 % (for 230 V AC and nominal values)
Insulation voltage input/output	4 kV AC (type test)
	2 kV AC (routine test)
Insulation voltage input / PE	3.5 kV AC (type test)
	2 kV AC (routine test)
Insulation voltage output / PE	500 V DC (routine test)
Protection class	I
Degree of protection	IP20
MTBF (IEC 61709, SN 29500)	> 1433000 h (25 °C)
	> 820000 h (40 °C)
	> 360000 h (60 °C)
Mounting position	horizontal DIN rail NS 35, EN 60715
Assembly instructions	alignable: $P_N \geq 50\%$, 5 mm horizontally, 15 mm next to active components, 50 mm vertically alignable: $P_N < 50\%$, 0 mm horizontally, 40 mm vertically top, 20 mm vertically bottom

Connection data, input

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

Technical data

Connection data, input

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm ²
Conductor cross section solid max.	2.5 mm ²
Conductor cross section flexible min.	0.2 mm ²
Conductor cross section flexible max.	2.5 mm ²
Conductor cross section AWG min.	20
Conductor cross section AWG max.	12
Stripping length	7 mm
Screw thread	M3

Connection data, output

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm ²
Conductor cross section solid max.	2.5 mm ²
Conductor cross section flexible min.	0.2 mm ²
Conductor cross section flexible max.	2.5 mm ²
Conductor cross section AWG min.	20
Conductor cross section AWG max.	12
Stripping length	7 mm
Screw thread	M3

Connection data for signaling

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm ²
Conductor cross section solid max.	2.5 mm ²
Conductor cross section flexible min.	0.2 mm ²
Conductor cross section flexible max.	2.5 mm ²
Conductor cross section AWG min.	20
Conductor cross section AWG max.	12
Screw thread	M3

Standards and Regulations

Electromagnetic compatibility	Conformance with EMC Directive 2014/30/EU
Noise emission	EN 55011 (EN 55022)
Noise immunity	EN 61000-6-2:2005
Connection in acc. with standard	CSA
Standards/regulations	EN 61000-4-2
Contact discharge	4 kV (Test Level 2)
Standards/regulations	EN 61000-4-3

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

Technical data

Standards and Regulations

Frequency range	80 MHz ... 1 GHz
Test field strength	10 V/m (Test Level 3)
Frequency range	1.4 GHz ... 2 GHz
Test field strength	3 V/m (Test Level 2)
Standards/regulations	EN 61000-4-4
Comments	Criterion B
Standards/regulations	EN 61000-6-3
	EN 61000-4-6
Frequency range	0.15 MHz ... 80 MHz
Voltage	10 V (Test Level 3)
Low Voltage Directive	Conformance with LV directive 2006/95/EC
Standard - Electrical safety	IEC 60950-1/VDE 0805 (SELV)
Standard - Electronic equipment for use in electrical power installations and their assembly into electrical power installations	EN 50178/VDE 0160 (PELV)
Standard - Safety extra-low voltage	IEC 60950-1 (SELV) and EN 60204-1 (PELV)
Standard - Safe isolation	DIN VDE 0100-410
Standard - Protection against shock currents, basic requirements for protective separation in electrical equipment	EN 50178
Standard - Limitation of mains harmonic currents	EN 61000-3-2
Standard - Equipment safety	BG (design tested)
Standard - Approval for medical use	IEC 60601-1, 2 x MOOP
Shipbuilding approval	DNV GL (EMC A), ABS, LR, RINA, NK, BV
UL approvals	UL Listed UL 508
	UL/C-UL Recognized UL 60950-1
	UL ANSI/ISA-12.12.01 Class I, Division 2, Groups A, B, C, D (Hazardous Location)
DeviceNet approval	DeviceNet™ Power Supply Conformance Tested
Shock	18 ms, 30g, in each space direction (according to IEC 60068-2-27)
Vibration (operation)	< 15 Hz, amplitude ±2.5 mm (according to IEC 60068-2-6)
	15 Hz ... 150 Hz, 2.3g, 90 min.
Approval - requirement of the semiconductor industry with regard to mains voltage dips	SEMI F47-0706 Compliance Certificate
Certificate	CB Scheme
Rail applications	EN 50121-4
Overvoltage category (EN 62477-1)	III

Environmental Product Compliance

REACH SVHC	Lead 7439-92-1
China RoHS	Environmentally Friendly Use Period = 25;

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

Technical data

Environmental Product Compliance

	For details about hazardous substances go to tab "Downloads", Category "Manufacturer's declaration"
--	---

Classifications

eCl@ss

eCl@ss 4.0	27040702
eCl@ss 4.1	27040702
eCl@ss 5.0	27242213
eCl@ss 5.1	27242200
eCl@ss 6.0	27049000
eCl@ss 7.0	27049002
eCl@ss 8.0	27049002
eCl@ss 9.0	27040701

ETIM

ETIM 2.0	EC001039
ETIM 3.0	EC001039
ETIM 4.0	EC000599
ETIM 5.0	EC002540
ETIM 6.0	EC002540
ETIM 7.0	EC002540

UNSPSC

UNSPSC 6.01	30211502
UNSPSC 7.0901	39121004
UNSPSC 11	39121004
UNSPSC 12.01	39121004
UNSPSC 13.2	39121004

Approvals

Approvals

Approvals

DNV GL / CSA / BV / LR / NK / ABS / RINA / UL Listed / UL Recognized / cUL Recognized / IECEE CB Scheme / cUL Listed / SEMI F47 / DeviceNet / EAC / EAC / cULus Recognized / cULus Listed









Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747

Approvals

Ex Approvals

UL Listed / cUL Listed / cULus Listed

Approval details

DNV GL		https://approvalfinder.dnvgl.com/	TAE000014W
CSA		http://www.csagroup.org/services-industries/product-listing/	1897767
BV		http://www.veristar.com/portal/veristarinfo/generalinfo/ approved/approvedProducts/equipmentAndMaterials	21004-B0 BV
LR		http://www.lr.org/en	08/20069 E4
NK		http://www.classnk.or.jp/hp/en/	08A039
ABS		http://www.eagle.org/eagleExternalPortalWEB/	15- HG1375463-1-PDA
RINA		http://www.rina.org/en	ELE316517XG
UL Listed		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 123528
UL Recognized		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 211944

Power supply unit - QUINT-PS/1AC/24DC/ 3.5 - 2866747


Approvals

cUL Recognized		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 211944
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IECEE CB Scheme		http://www.iecee.org/	SI-1865 A2
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cUL Listed		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 123528
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SEMI F47			SEMI F47
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DeviceNet		http://www.odva.org	10824/06.01.2010
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EAC			EAC-Zulassung
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EAC			RU C- DE.A*30.B.01082
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cULus Recognized			
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cULus Listed			
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Accessories

Accessories

Assembly adapter



SUBMITTAL REVIEW FORM

To: Camrosa Water District
7385 Santa Rosa Road
Camarillo, CA 93012

From: Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA 93711

Project No.: 02958-20-002

Reviewer: Kevin Berryhill, P.E.

Project: TCP Removal Project for Conejo Wells

Date: 10/21/2021

Submittal No: BIG - 2nd Submittal (tank)

Description: Carbon Dioxide System (tank)

The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the contract plans and specifications or from departures there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

☐

No Exceptions Taken

☐

Submit Specified Item

☐

Make Corrections Noted

☐

Rejected

☒

Revise & Resubmit

☐

For Information Only

Reviewer Comments:

Item	Description	Mfg/Supplier	Action Taken	Comment

Comments:

1. Submit information on material and finish of cabinet and tank supports and outer tank finish
2. Submit information on tank insulation and thermal conductivity
3. Submit anchor bolt requirements and seismic calculations (including for previously submitted pump and dissolution skids.
4. Submittal BOM and drawings do not indicate which vaporizer model is being furnished
5. Ref Thermablock drawing D-21879769, Note 5. BIG shall furnish all necessary pressure relief devices required for a fully functional and code-compliant system.
6. Submit details for electrical control panel associated with instrumentation, refrigeration system, alarm, etc.
7. Provide description of refrigeration coil configuration in the tank
8. Provide interconnection diagram showing all process and electrical interfaces between the storage tank skid and the previously submitted pump and dissolution system skids.
9. Confirm that vaporizer also serves as a vapor heater



Chart Inc.
Projects D&S Americas

DESIGN DOCUMENTATION PACKAGE

HSi-14TON

CARBON DIOXIDE STORAGE SYSTEM

SUBMITTAL 001

SUPPLIER: Chart, Inc.

PO NO.: FY22-0029

SALES ORDER NO.: 1737466

CUSTOMER: Camrosa Water District

DESCRIPTION:

DESIGN DOCUMENTATION PACKAGE



DESIGN DOCUMENTATION PACKAGE

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Johnstone Emerson Flow Controls Refrigeration Solenoid Valves	Page 375
TXV-1 Parker Thermostatic and Automatic Expansion Valves	Page 376

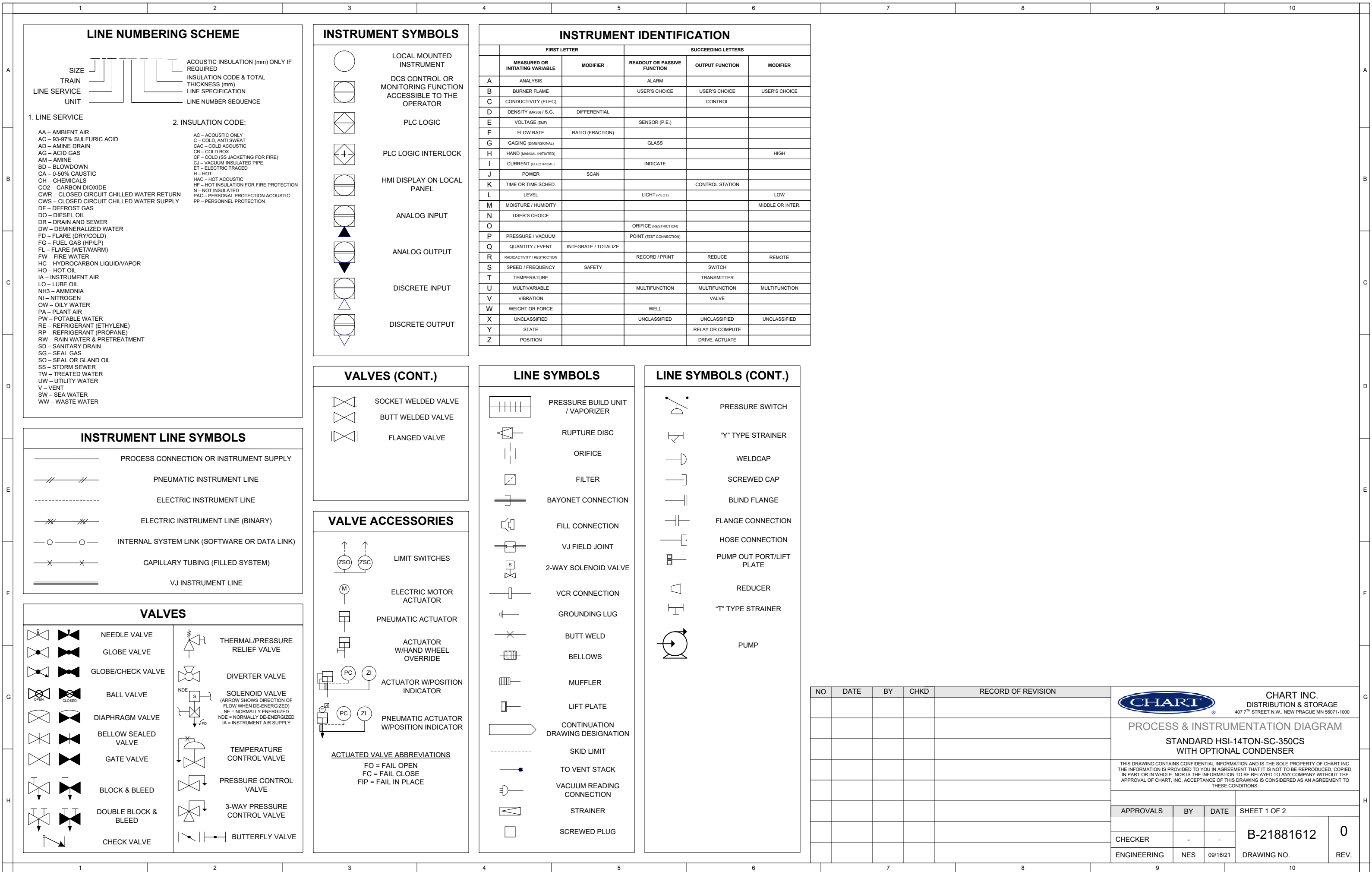


Chart Inc.
Projects D&S Americas

Project Drawings

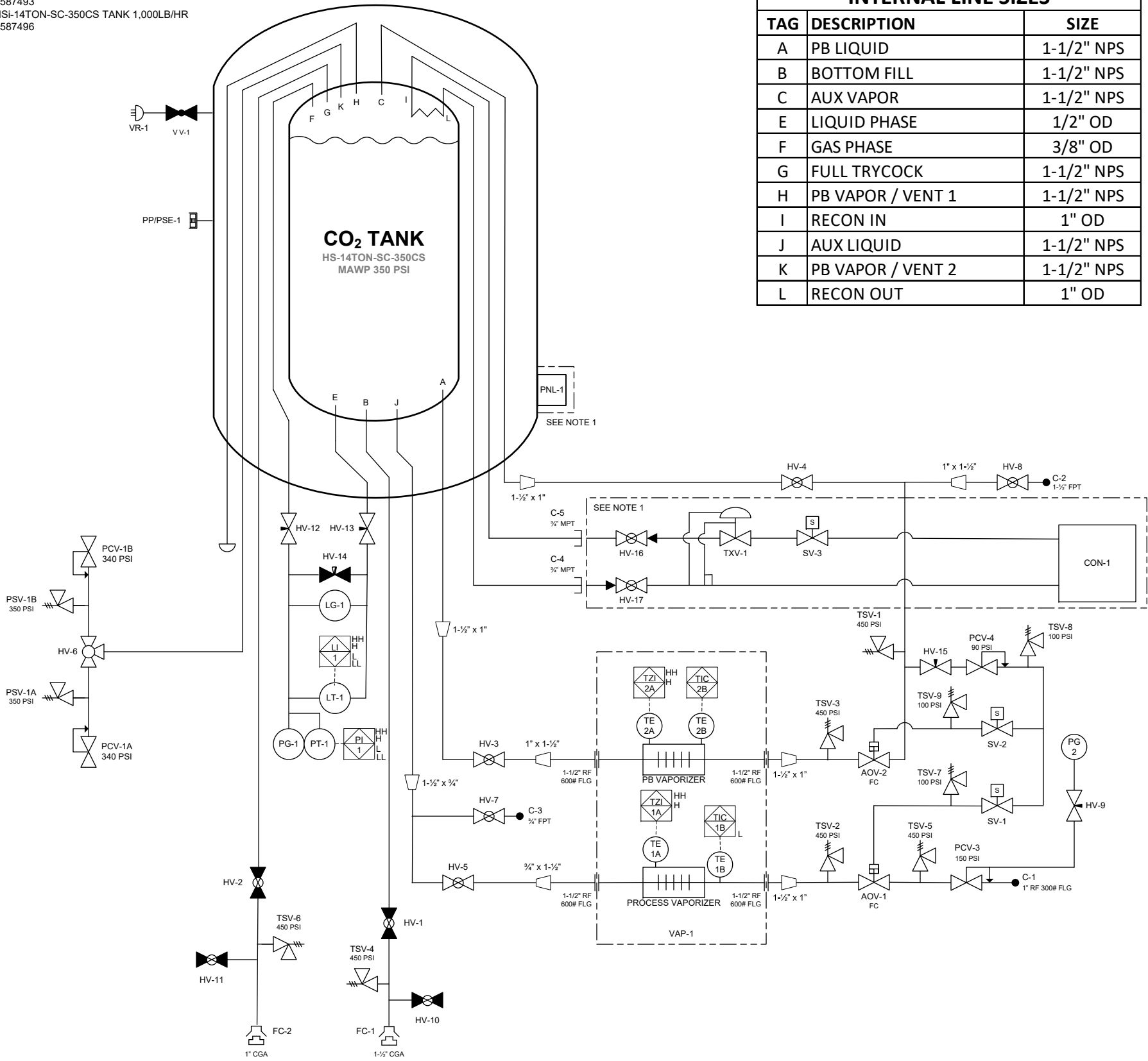
CARBON DIOXIDE STORAGE SYSTEM

Section 1



CO₂ STORAGE TANK

FNL HSi-14TON-SC-350CS TANK 300LB/HR
PN 21876261
FNL HSi-14TON-SC-350CS TANK 600LB/HR
PN 21587493
FNL HSi-14TON-SC-350CS TANK 1,000LB/HR
PN 21587496



INTERNAL LINE SIZES

TAG	DESCRIPTION	SIZE
A	PB LIQUID	1-1/2" NPS
B	BOTTOM FILL	1-1/2" NPS
C	AUX VAPOR	1-1/2" NPS
E	LIQUID PHASE	1/2" OD
F	GAS PHASE	3/8" OD
G	FULL TRYCOCK	1-1/2" NPS
H	PB VAPOR / VENT 1	1-1/2" NPS
I	RECON IN	1" OD
J	AUX LIQUID	1-1/2" NPS
K	PB VAPOR / VENT 2	1-1/2" NPS
L	RECON OUT	1" OD

NOTES:
1. SEE SALES ORDER FOR INFORMATION ON CONTROL PANEL AND OPTIONAL RECONDENSER



CHART INC.
DISTRIBUTION & STORAGE
407 7TH STREET N.W., NEW PRAGUE MN 56071-1000

PROCESS & INSTRUMENTATION DIAGRAM

STANDARD HSi-14TON-SC-350CS
WITH OPTIONAL CONDENSER

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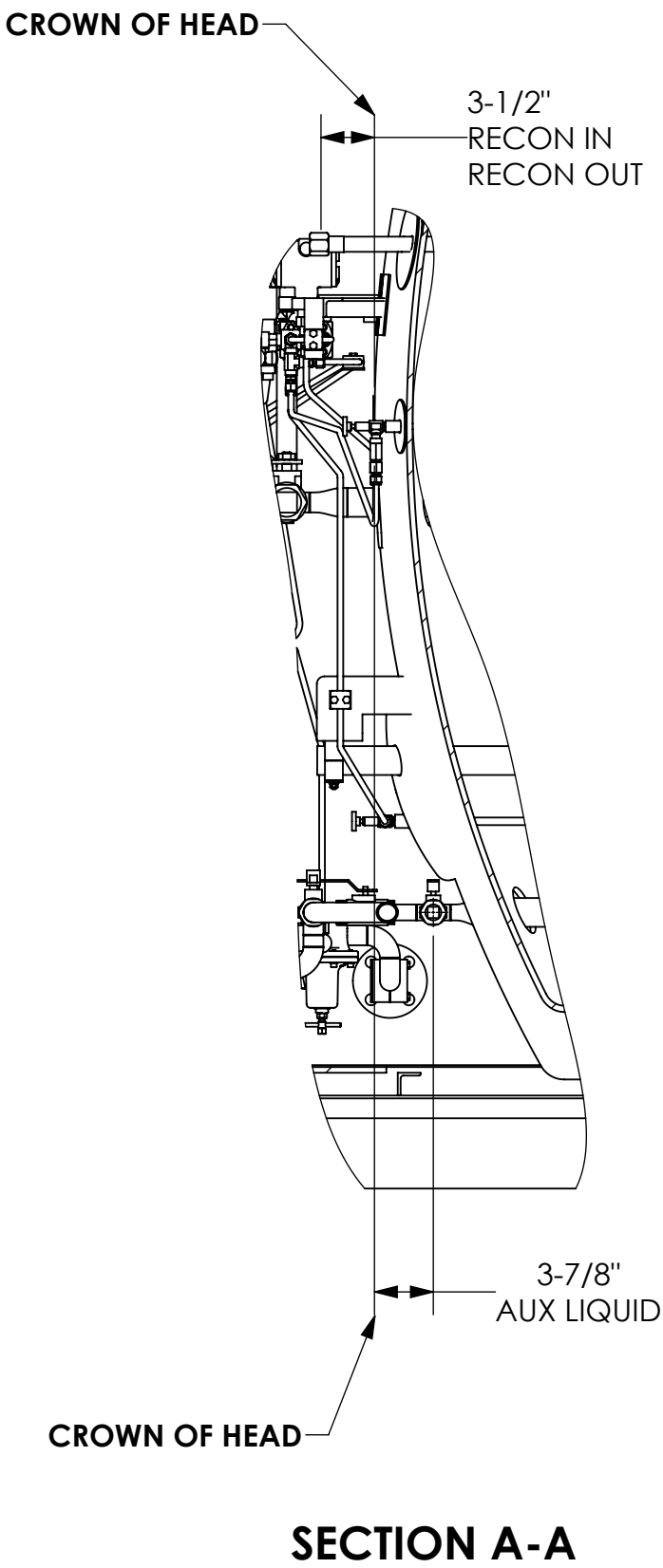
APPROVALS	BY	DATE	SHEET 2 OF 2
CHECKER	-	-	B-21881612
ENGINEERING	NES	09/16/21	DRAWING NO.
			0
			REV.

HSi-14/30/50TON-SC-350CS 300/600/1,000LB/HR

TANK TAG #	TAG NAME	CHART PART #	VENDOR	CATEGORY / TYPE	VENDOR PART NUMBER	SIZE & CONNECTION
AOV-1	LOW TEMP CUTOFF	21197525	JAMESBURY	AUTO VALVE	4A-3600XT/VPVL-100-SR	1" FPT
AOV-2	PRESSURE BUILD VALVE	21197525	JAMESBURY	AUTO VALVE	4A-3600XT/VPVL-100-SR	1" FPT
C-1	GAS DELIVERY CONNECTION	-	-	CONNECTION	-	1" 300# RF FLG
C-2	AUX VAPOR CONNECTION	-	-	CONNECTION	-	1-1/2" FPT
C-3	AUX LIQUID CONNECTION	-	-	CONNECTION	-	3/4" FPT
C-4	RECONDENSER TANK OUT CONNECTION	-	-	CONNECTION	-	3/4" MPT
C-5	RECONDENSER TANK IN CONNECTION	-	-	CONNECTION	-	3/4" MPT
FC-1	BOTTOM FILL CONNECTION	10715026	MEP	FILL CONNECTION	CO2-150	1-1/2" CGA
FC-2	VAPOR BALANCE / FULL TRYCOCK	10715018	MEP	FILL CONNECTION	CO2-100	1" CGA
HV-1	BOTTOM FILL	12930213	JAMESBURY	BALL VALVE	A-EW0013600XTD	1-1/2" FPT
HV-2	FULL TRYCOCK	12930213	JAMESBURY	BALL VALVE	A-EW0013600XTD	1-1/2" FPT
HV-3	PB FEED ISOLATION	12930205	JAMESBURY	BALL VALVE	A-EW0013600XTD	1" FPT
HV-4	PB RETURN ISOLATION	12930205	JAMESBURY	BALL VALVE	A-EW0013600XTD	1" FPT
HV-5	LIQ WITHDRAWAL ISOLATION	12930192	JAMESBURY	BALL VALVE	A-EW0013600XTD	3/4" FPT
HV-6	RELIEF SELECTOR	21883103	HEROSE	DIVERTER BALL VALVE	06510.3260.6127	1-1/2" NPS INLET 3/4" FPT RV PORTS 1" FPT RPD PORTS
HV-7	AUXILIARY LIQUID	12930192	JAMESBURY	BALL VALVE	A-EW0013600XTD	3/4" FPT
HV-8	AUXILIARY VAPOR	12930213	JAMESBURY	BALL VALVE	A-EW0013600XTD	1-1/2" FPT
HV-9	GAUGE ISOLATION	10907239	REGO	NEEDLE VALVE	CMM250A	1/4" MPT
HV-10	BOTTOM FILL HOSE DRAIN	12930184	JAMESBURY	BALL VALVE	A-EW0013600XTD	1/2" FPT
HV-11	TOP FILL HOSE DRAIN	12930184	JAMESBURY	BALL VALVE	A-EW0013600XTD	1/2" FPT
HV-12	VAPOR PHASE ISOLATION	10907239	REGO	NEEDLE VALVE	CMM250A	1/4" MPT
HV-13	LIQUID PHASE ISOLATION	10907239	REGO	NEEDLE VALVE	CMM250A	1/4" MPT
HV-14	GAUGE EQUALIZATION	14817177	REGO	NEEDLE VALVE	CMM250G	1/4" MPT
HV-15	PILOT ISOLATION	10907239	REGO	NEEDLE VALVE	CMM250A	1/4" MPT
LG-1	VESSEL LIQUID LEVEL	21189566	WIKA	DIFF. PRESS. GAUGE	712.15.160 (0 - 28,000 LBS CO2)	1/4" FPT
		21866489			52965538 (0 - 60,000 LBS CO2)	
		21836709			52961244 / 712.15.160 (0 - 100,000 LBS CO2)	
LT-1	VESSEL LEVEL TRANSMITTER	21883079	YOKOGAWA	TRANSMITTER	EJA110E-JMS4G-U12NN/D1 (0-250 IN H2O)	1/2" FPT
PCV-1A	VESSEL REGULATOR A	11068844	REGO	REGULATOR	ECL340 (SET @ 340 PSI)	1/4" FPT
PCV-1B	VESSEL REGULATOR B	11068844	REGO	REGULATOR	ECL340 (SET @ 340 PSI)	1/4" FPT
PCV-3	FINAL LINE REGULATOR	21116278	REGO	REGULATOR	1788CE (SET @ 150 PSI)	1" FPT
PCV-4	PRESSURE REDUCING REGULATOR	21207787	CASH	REGULATOR	19077-0115 TYPE A-32 (SET @ 90 PSI)	1/4" FPT
PG-1	VESSEL VAPOR PRESSURE	21217607	WIKA	PRESSURE GAUGE	52819326 / #212.53 (0-600 PSI)	1/2" FPT
PG-2	SUPPLY VAPOR PRESSURE	20596938	WIKA	PRESSURE GAUGE	52182215 / #212.53 (0-250 PSI)	1/2" FPT

TANK TAG #	TAG NAME	CHART PART #	VENDOR	CATEGORY / TYPE	VENDOR PART NUMBER	SIZE & CONNECTION
PNL-1	ELECTRICAL CONTROL PANEL	21883047	CHART	CONTROL PANEL	W/ TBC20 VAPORIZER	-
		21883046			W/ TBC20 VAPORIZER AND W/ CONDENSER	-
		21883048			W/ TBC40 VAPORIZER	-
		21883049			W/ TBC40 VAPORIZER AND W/ CONDENSER	-
		21883050			W/ TBC60 VAPORIZER	-
		21883051			W/ TBC60 VAPORIZER AND W/ CONDENSER	-
PP-1	PUMPOUT PORT	10826172	CHART	VACUUM PORT	-	-
PSE-1	PRESSURE SAFETY ELEMENT, OUTER	10899110	CHART	LIFT PLATE	ONLY ON 30T AND 50T	-
PSV-1A	SAFETY RELIEF 1A	11065731	REGO	RELIEF VALVE	C-19434B350 (SET @ 350 PSI)	1/2" MPT
PSV-1B	SAFETY RELIEF 1B	11065731	REGO	RELIEF VALVE	C-19434B350 (SET @ 350 PSI)	1/2" MPT
PT-1	VESSEL PRESS TRANSMITTER	21883080	YOKOGAWA	TRANSMITTER	EJA530E-JCS4N-012NN/D1 (0-800 PSI)	1/2" FPT
SV-1	LOW TEMP PILOT VALVE	20898850	ASCO	SOLENOID VALVE	8320G202 3WAY 24VDC	1/4" FPT
SV-2	PB PILOT VALVE	20898850	ASCO	SOLENOID VALVE	8320G202 3WAY 24VDC	1/4" FPT
TE-1A	VAP BLOCK TEMP TC	-	-	THERMOCOUPLE	INTERNAL TO VAP-1	-
TE-1B	VAP PROCESS TEMP TC	-	-	THERMOCOUPLE	INTERNAL TO VAP-1	-
TE-2A	PB BLOCK TEMP TC	-	-	THERMOCOUPLE	INTERNAL TO VAP-1	-
TE-2B	PB BLOCK TEMP TC	-	-	THERMOCOUPLE	INTERNAL TO VAP-1	-
TSV-1	THERMAL SAFETY RELIEF	1811472	REGO	THERMAL RELIEF	PRV9432T450 (SET @ 450 PSI)	1/4" MPT
TSV-2	THERMAL SAFETY RELIEF	1811472	REGO	THERMAL RELIEF	PRV9432T450 (SET @ 450 PSI)	1/4" MPT
TSV-3	THERMAL SAFETY RELIEF	1811472	REGO	THERMAL RELIEF	PRV9432T450 (SET @ 450 PSI)	1/4" MPT
TSV-4	THERMAL SAFETY RELIEF	11708451	REGO	THERMAL RELIEF	PRV9434TP450 (SET @ 450 PSI)	1/2" MPT
TSV-5	THERMAL SAFETY RELIEF	1811472	REGO	THERMAL RELIEF	PRV9432T450 (SET @ 450 PSI)	1/4" MPT
TSV-6	THERMAL SAFETY RELIEF	11708451	REGO	THERMAL RELIEF	PRV9434TP450 (SET @ 450 PSI)	1/2" MPT
TSV-7	THERMAL SAFETY RELIEF	1810042	REGO	THERMAL RELIEF	PRV9432F100 (SET @ 100 PSI)	1/4" MPT
TSV-8	THERMAL SAFETY RELIEF	1810042	REGO	THERMAL RELIEF	PRV9432F100 (SET @ 100 PSI)	1/4" MPT
TSV-9	THERMAL SAFETY RELIEF	1810042	REGO	THERMAL RELIEF	PRV9432F100 (SET @ 100 PSI)	1/4" MPT
VAP-1	GAS DELIVERY VAPORIZER	21863766	CHART	ELECTRIC VAPORIZER	TBC20 HSI / VSI 480 KW W/ JUNCTION BOX	1-1/2" 600# RF FLG
		21863765			TBC40 HSI / VSI 480 KW W/ JUNCTION BOX	1-1/2" 600# RF FLG
		21863764			TBC60 HSI / VSI 480 KW W/ JUNCTION BOX	1-1/2" 600# RF FLG
VR-1	VACUUM GAUGE CONNECTION	4210049	HASTINGS	VACUUM READOUT	DV-6R	1/8" MPT
V V-1	VACUUM GAUGE VALVE	10482381	HOKE	VACUUM VALVE	4111L2B	1/8" NPT

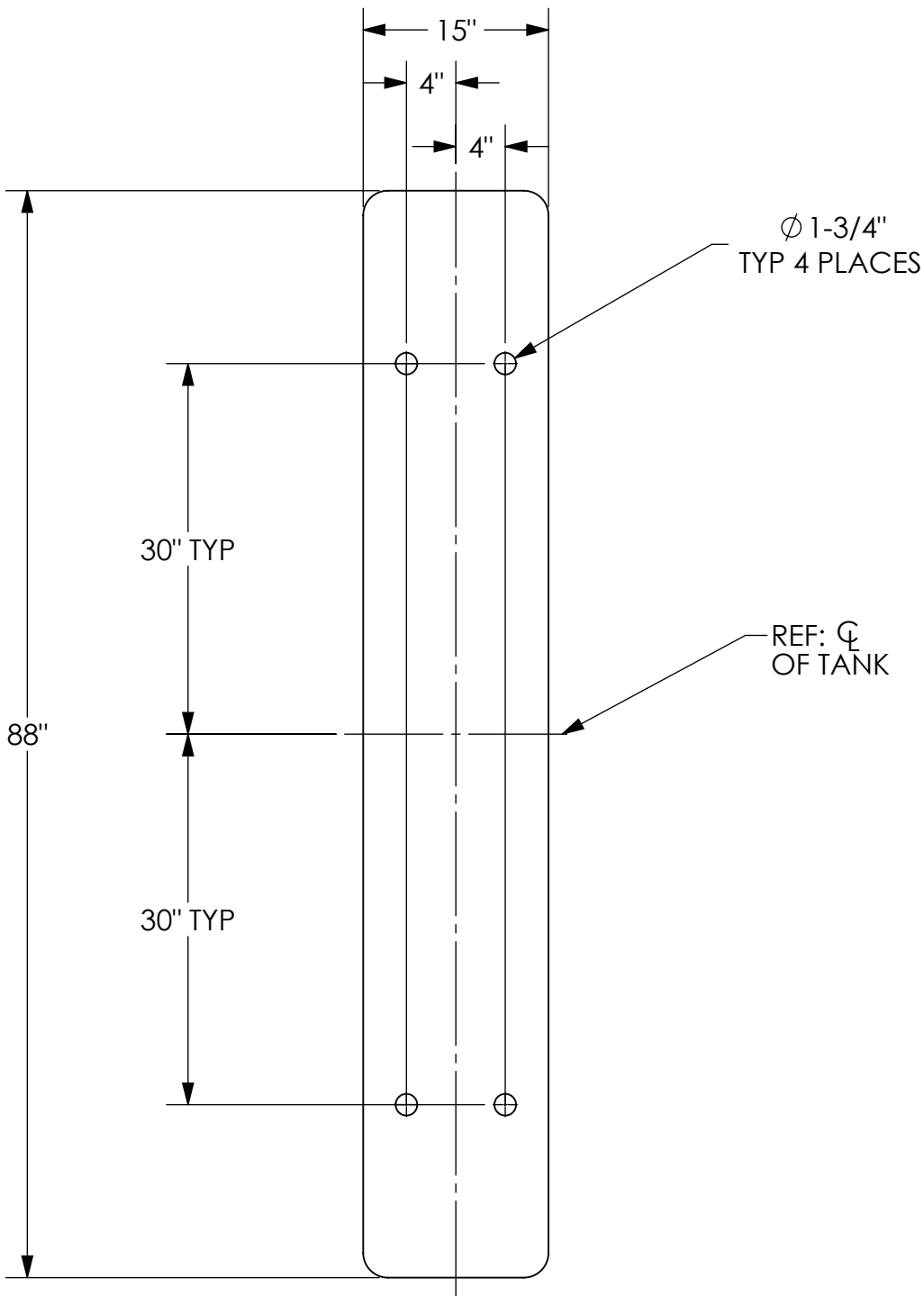
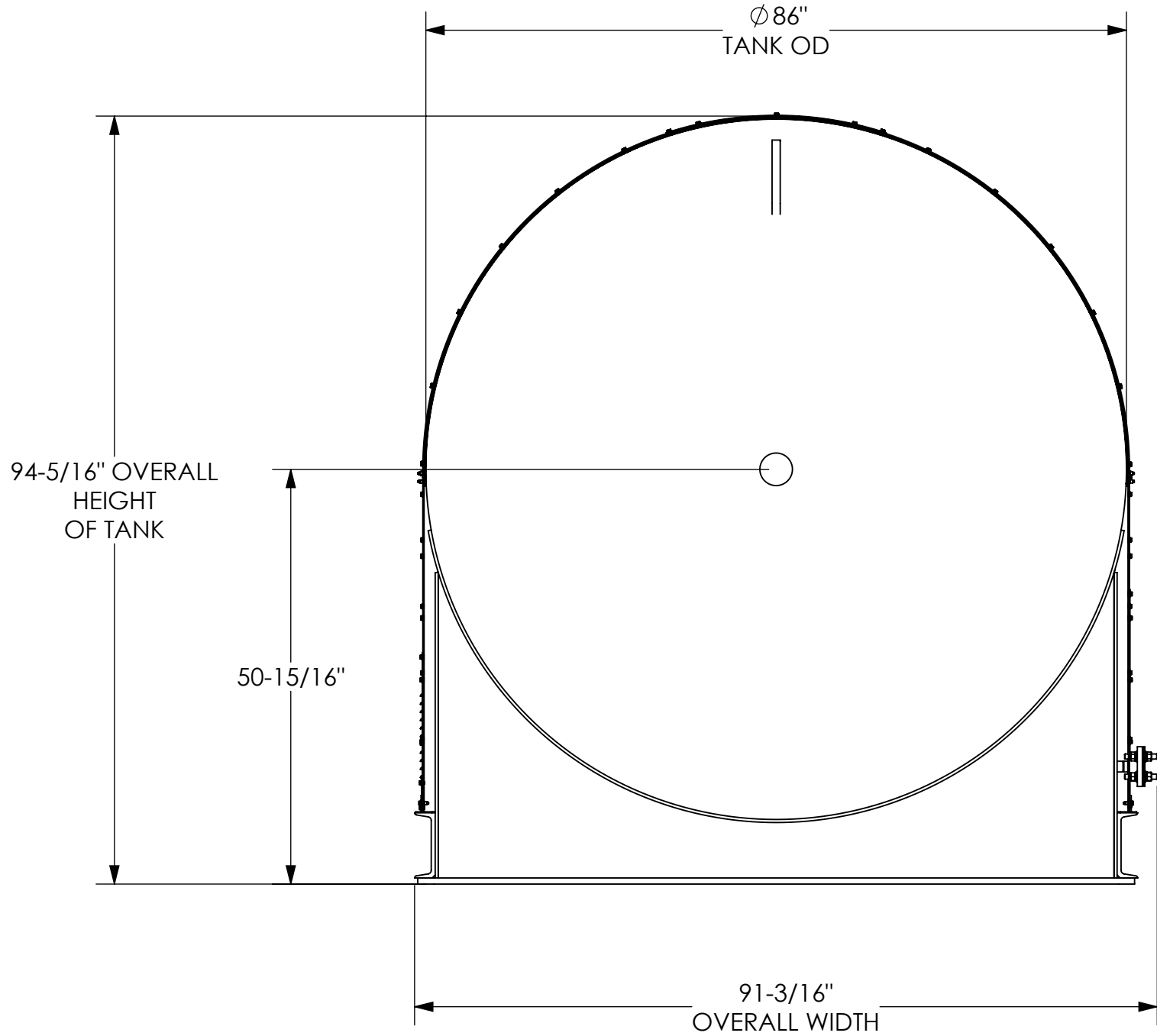
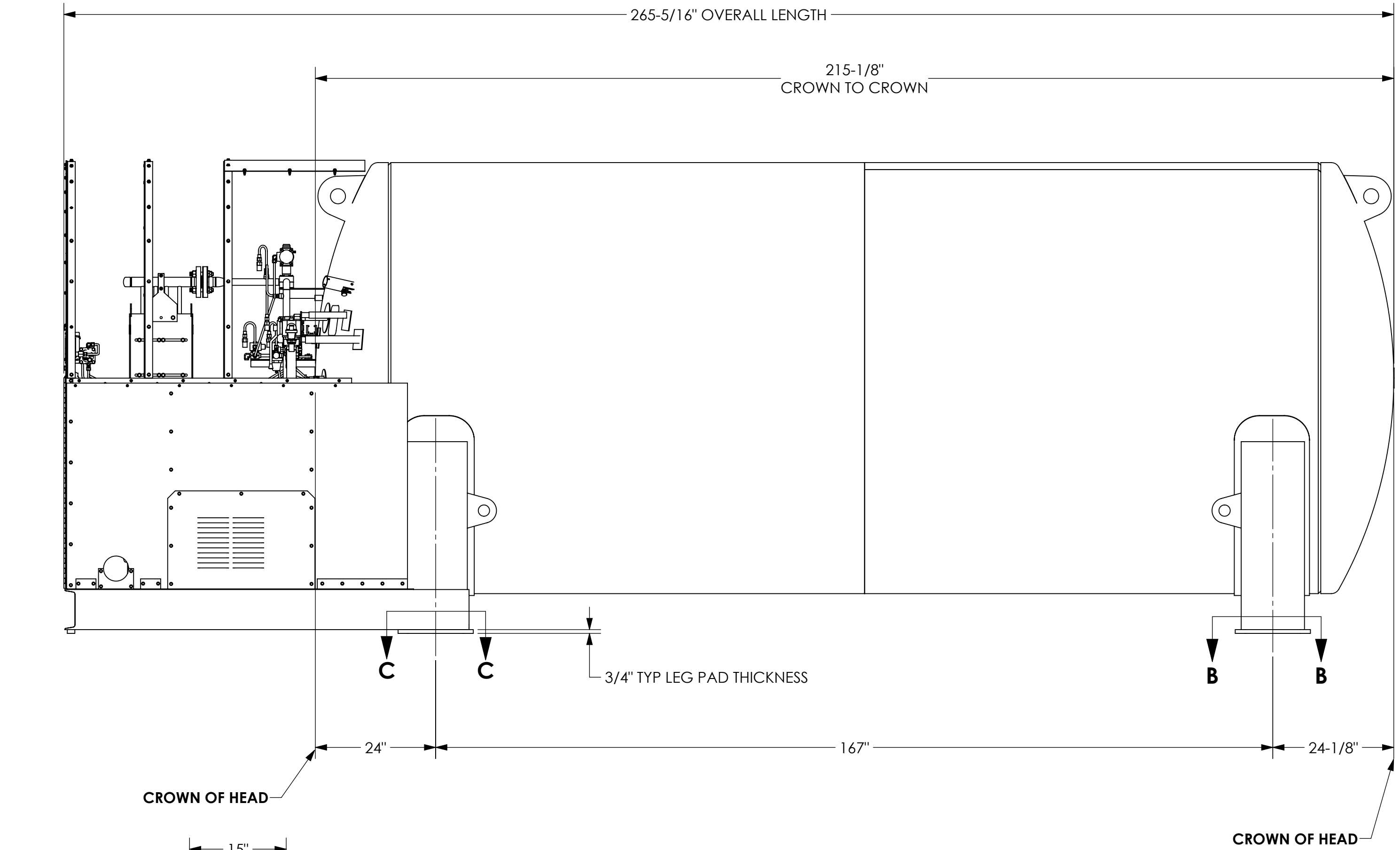
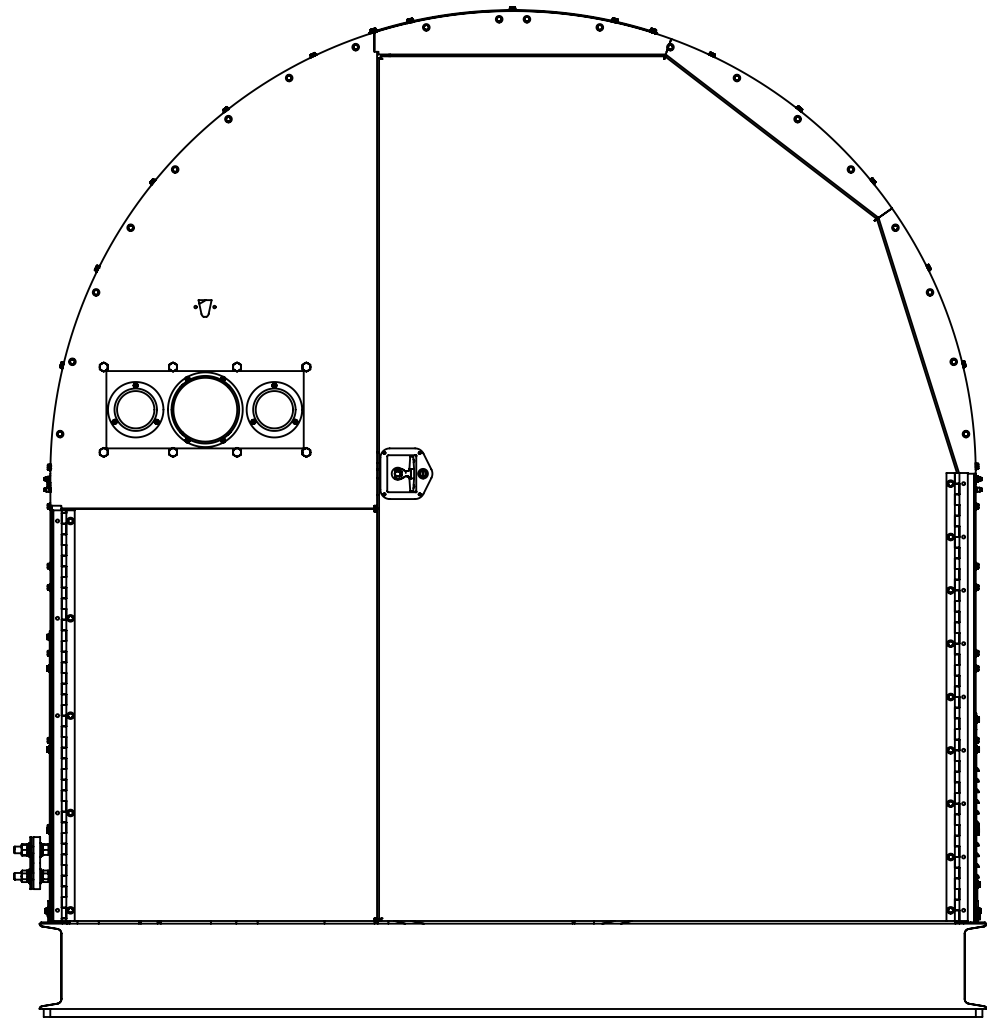
TANK TAG #	TAG NAME	CHART PART #	VENDOR	CATEGORY / TYPE	VENDOR PART NUMBER	SIZE & CONNECTION
CONDENSER OPTION						
CON-1	RECONDENSER	21836701	HEATCRAFT	RECONDENSER	CCH0022LDACZ W/OPT, 2.2 HP 460V, 3PH, 60 HZ	3/8" LIQUID 5/8" SUCTION
HV-16	LIQUID LINE VALVE	21094165	SUPERIOR	BALL VALVE	586WA-6ST	3/8" ODF
HV-17	SUCTION LINE VALVE	21094166	SUPERIOR	BALL VALVE	586WA-10ST	5/8" ODF
SV-3	CONDENSING SYSTEM VALVE	21189788	ALCO	SOLENOID VALVE	200RB3T3/AMG-24VDC	3/8" ODF
TXV-1	THERMAL EXPANSION VALVE	21858793	PARKER	THERMAL EXP. VALVE	ECE-A-SW 3X4S	3/8" ODF X 1/2" ODF
Revision History						
REVISION NO.	DATE	BY	RECORD OF REVISION			
0	9/22/2021	NES	ORIGINAL RELEASE			



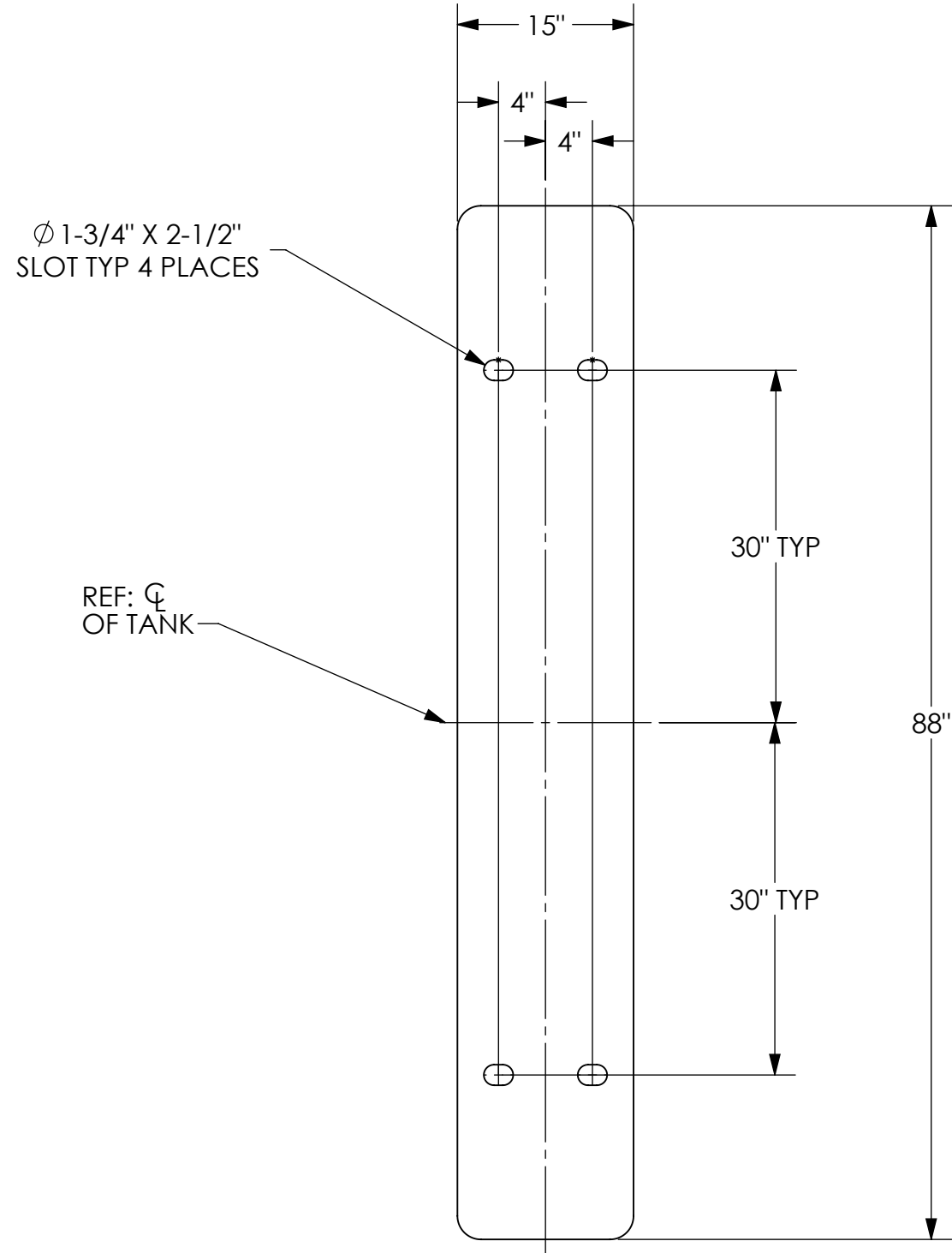
SECTION A-A

WEIGHTS		
MAWP	PSIG	
	barg	
WEIGHT EMPTY	POUNDS	
	KILOGRAMS	
WEIGHT FULL	CO2	POUNDS
		KILOGRAMS

[illegible]



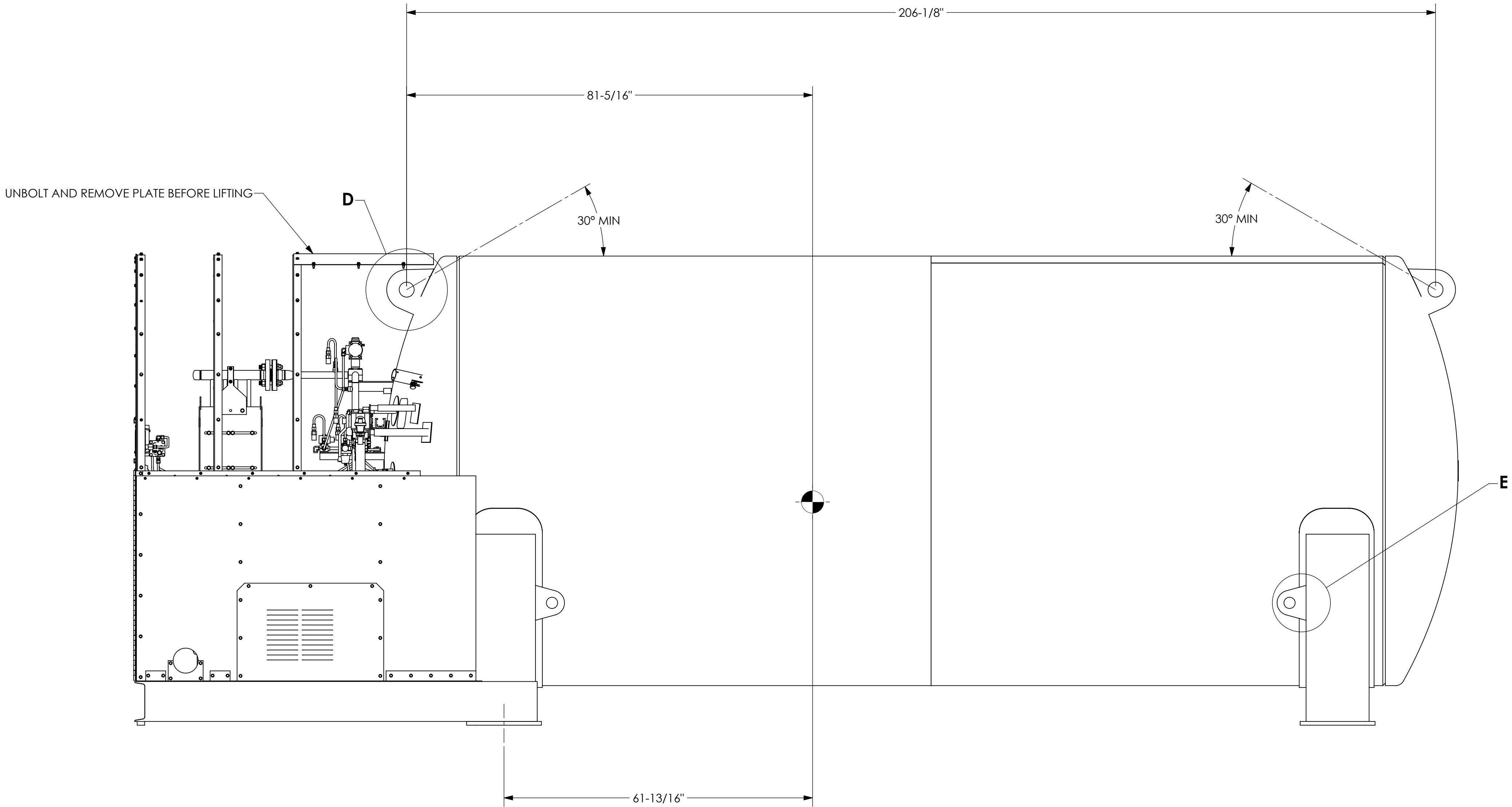
SECTION C-C
FOOT PAD DETAIL
FIXED END
SCALE 1 : 14



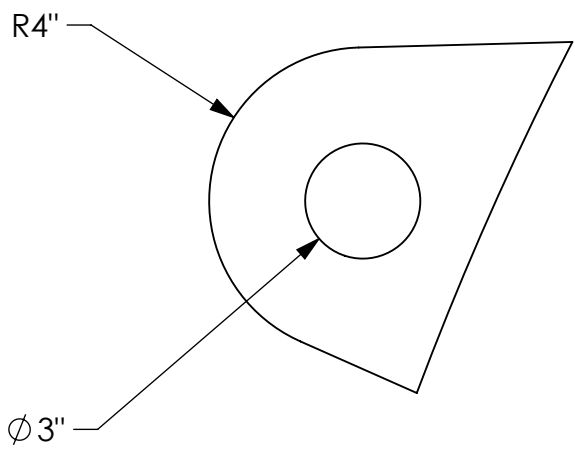
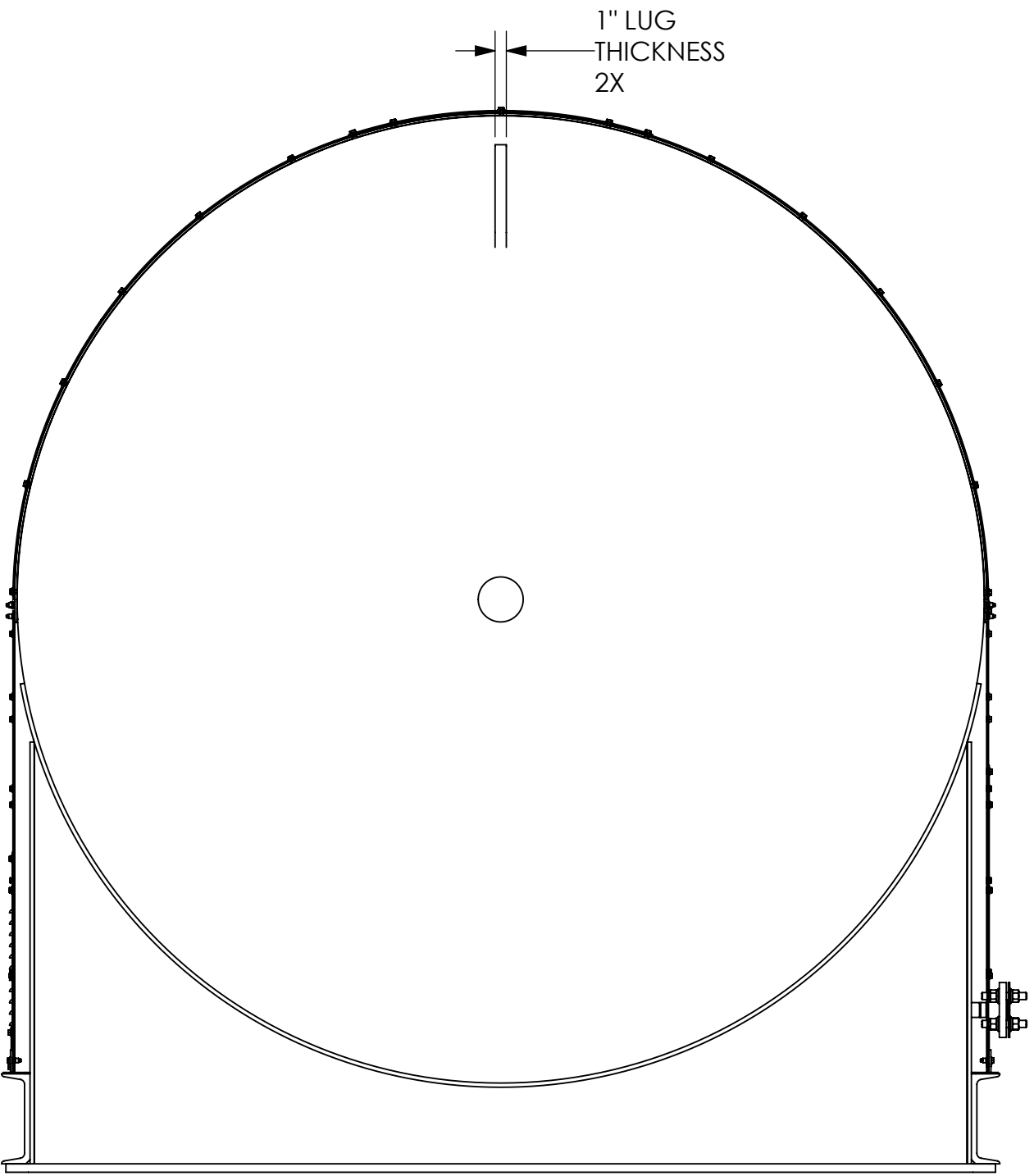
SECTION B-B
FOOT PAD DETAIL
SLIDING END
SCALE 1 : 14

OVERALL SHIPPING SIZE OF VESSEL/FOOTPAD

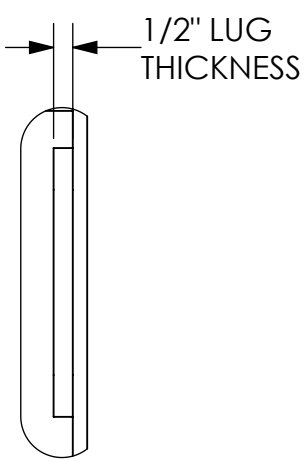
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	SEE BOM UNLESS OTHERWISE STATED			TITLE G/A HSI-14TON-SC-350CS	
				DRAWING NUMBER D-21877516	
				REV A	
		SCALE 1:18		SIZE D	
		SHEET 2		OF 4	



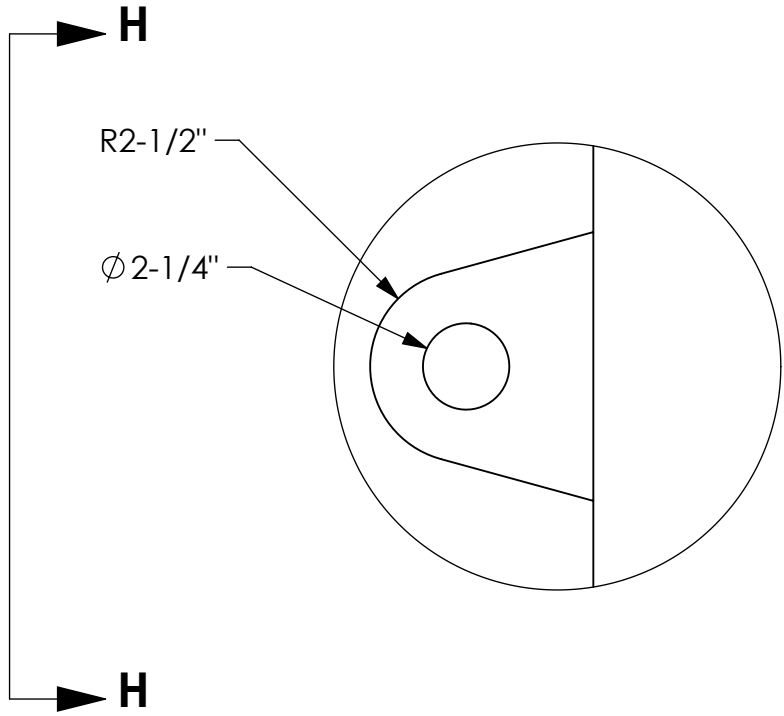
HORIZONTAL LIFT OF TANK



DETAIL D
2 PLACES
SCALE 1 : 5





VEIW H-H
4 PLACES
SCALE 1 : 5



DETAIL E
4 PLACES
SCALE 1 : 5

- CAUTION**
THIS IS A THERMOS BOTTLE. DROPPING ROLLING OR EXCESSIVE ROUGH HANDLING CAN BREAK CONNECTIONS BETWEEN THE INNER VESSEL AND OUTER VESSEL.
- LIFT AT LUGS ONLY- DO NOT ROLL**
1. FOR HORIZONTAL LIFT OFF VEHICLE USING A SINGLE CRANE, HOOK MUST BE OVER CENTER OF GRAVITY (CG) OF VESSEL OR ELSE VESSEL WILL SWING WHEN LIFTED. USE LUGS ON TOP AND BOTTOM.
2. DIAGRAM SHOWS A SINGLE CRANE LIFT. ALTERNATELY, TWO CRANES MAY BE USED, ONE CONNECTED TO TOP LUGS AND ONE CONNECTED TO BOTTOM LUGS.
3. USE SHACKLES ON ALL LIFTING LUGS.
4. TO RAISE VESSEL AND MOVE TO VERTICAL POSITION, USE TOP LIFTING LUGS AND TAIL CRANE WITH HOOK ON BOTTOM LUGS TO BE USED TO ROTATE VESSEL AND MOVE TO VERTICAL POSITION.
5. AFTER RAISING VESSEL TO VERTICAL POSITION, USE TOP LUGS TO MOVE VESSEL INTO FINAL POSITION.
6. A SPREADER BEAM MAY BE USED IN LIEU OF 45° ANGLE BETWEEN CABLES ATTACHED TO TOP LUGS.

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	SEE BOM UNLESS OTHERWISE STATED		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.				TITLE			
			TOLERANCES: FRACTIONS: N/A ANGLES: N/A 2 PLACE DECIMALS: N/A 3 PLACE DECIMALS: N/A				G/A HSI-14TON-SC-350CS			
					DRAWING NUMBER		D-21877516		REV	A
					SCALE		1:14	SIZE	D	SHEET

Project	STD HSI		
Contract / PO #	N/A	ST #	N/A
Contractor / Location	N/A	New Prague, MN	
Work Scope	HSi 14 Ton 350 PSI CO2 Storage Tank with Recondensing Coil and Condenser		
ITP Revision	0	Date	05/14/2021
Activity No.	Activity Description	Control Procedure	Customer Witness
General			
A1	Design Approval - Regulatory	NP-306	
A2	Kick-Off Meeting	NP-502	
A3	Receiving Inspections	NP-021 NP-027	
A4	Parts Cleaning	NP-063	
ASME Inner Vessel			
B1	Inspection of Heads and Shell Plates	NP-027 NP-295	
B2	Visual Inspection of Nozzle Welds (100%)	TM-231	
B3	Long Seam Fitup & Tack	NP-060	
B4	Weld Long Seam	NP-061	
B5	Longitudinal Seam Examination (100%)	NP-202 NP-195	
B6	Circ Seam Fitup, Tack & Prep	NP-062	
B7	Weld Circumferential Seam	NP-064	
B8	Circumferential Seam Examination (100%)	NP-202 NP-195 NP-194	
B9	Inspection of Inner Vessel Prior to Closure	NP-062 NP-063	
B10	Inner Vessel Inspection Prior to Hydrostatic Test	NP-065	
B11	Hydrostatic Test (Cold-Stretch)	NP-426	
B12	Liquid Penetrant Examination (100% Cat. A & Attachment Welds)	NP-196	
Vacuum Jacket / Outer			
C1	Inspection of Heads and Shell Plates	NP-295	
C2	Outer Assembly	NP-059	
C3	Helium Mass Spectrometer Leak Test	NP-059	
C4	Evacuation	NP-188	
C5	Vacuum Retention Test	NP-187	
C6	Blast Inspection	NP-653	

Project	STD HSI		
Contract / PO #	N/A	ST #	N/A
Contractor / Location	N/A	New Prague, MN	
Work Scope	HSi 14 Ton 350 PSI CO2 Storage Tank with Recondensing Coil and Condenser		
ITP Revision	0	Date	05/14/2021
Activity No.	Activity Description	Control Procedure	Customer Witness
C7	Paint Inspection	NP-722	
Piping			
D1	Visual Examination of Piping Welds (100%)	TM-231	
D2	RT or UT of piping butt-welds. In-Process-Examination (per B31.3) can be substituted for RT/UT if desired. (5%)	NP-194 NP-215 NP-471	
D3	Brazed Joint Examination In-Process-Examination (per B31.3) (5%)	NP-471	
D4	Passivation (Piping) (100% External Welds)	NP-595 NP-348	
D5	Pressure & Leak Test (Root Welds to 1.1xTank MAWP, Piping Welds to 1.1xPipe Section MAWP)	NP-475	
D6	P&ID Walkdown	NP-468	
Factory Acceptance Test			
E1	Factory Acceptance Test		
Shipping			
F1	Dew Point at Time of Shipment	NP-078	
F2	Nitrogen Gas Purge	NP-096	
F3	Final / Shipping Inspection	NP-063 NP-096 NP-201	
Documentation			
G1	Manual / Document Package	NP-020	
G2	Document - U-1A		
0	Original	05/14/2021	NES
Revision	Revision Description	Rev Date	Rev By



Chart Inc.
Projects D&S Americas

Component Cut Sheets

CARBON DIOXIDE STORAGE SYSTEM

Section 2

1/2" – 2-1/2" (DN 15 – 65) STANDARD PORT AND 1/2" – 2" (DN 15 – 50) FULL PORT SERIES 4000 BALL VALVES Threaded End – Socket Weld – Butt Weld

The Jamesbury® Series 4000 ball valves offer the three most desirable attributes of high-quality valves: exceptional performance, great versatility, and economical cost.

This valve line includes both standard-port valves (to 2-1/2" [DN 65]) and full-port valves (to 2" [DN 50]) with three available end connections—threaded end, socket weld, and butt weld.

There are two basic groups of Series 4000 valves.

Fire-Tite® Valves

The first consists of *Fire-Tite* valves fire-tested to meet API 607 requirements. They are ideal for handling petroleum products and other flammable or hazardous substances, as well as for an extremely broad range of normal and corrosive services. These Series 4000 valves are available in materials conforming to NACE MR0103 requirements, and specifically prepared for oxygen or high-vacuum service. They are also available to conform to ASME, API, BS, ISO, DIN and MSS standards.

Standard body and trim materials for *Fire-Tite* valves are carbon steel with 316 stainless steel trim and all 316 stainless steel. Seat material options are PTFE (T) and Xtreme® (X) seats for applications involving chemicals, petrochemicals, acids, caustics and steam. Delrin® (R) seats are for higher pressures, while PFA (B) seats resist the effects of polymerizing monomers such as butadiene and styrene. Metal (D) seats are also available for use with high-temperature fluids, saturated steam, and other heat-transfer media at pressures to 300 psi (20.7 bar) and temperatures to 600°F (316°C).

Non Fire-Tite Valves

Non *Fire-Tite* valves are available in the same body and trim materials as *Fire-Tite* valves with a wider range of seat material options. *Xtreme* (X) seats are the standard seat material, while PTFE (T), UHMW (U) polyethylene seats and PEEK (L) seats are also available.



FEATURES AND BENEFITS

- *Xtreme* seat provides longer life, expanded performance boundaries, and greater value.
- Polymeric flexible lip-seat design offers tight shut-off in either direction and extended cycle life with minimum maintenance.
- Available to meet ASME Class 800 standards per B16.34, B31.1, B31.3, and B31.4.
- 3-piece construction facilitates servicing.
- *Fire-Tite* version with non-metallic seats meets API 607.
- NACE MR0103 compliance available.

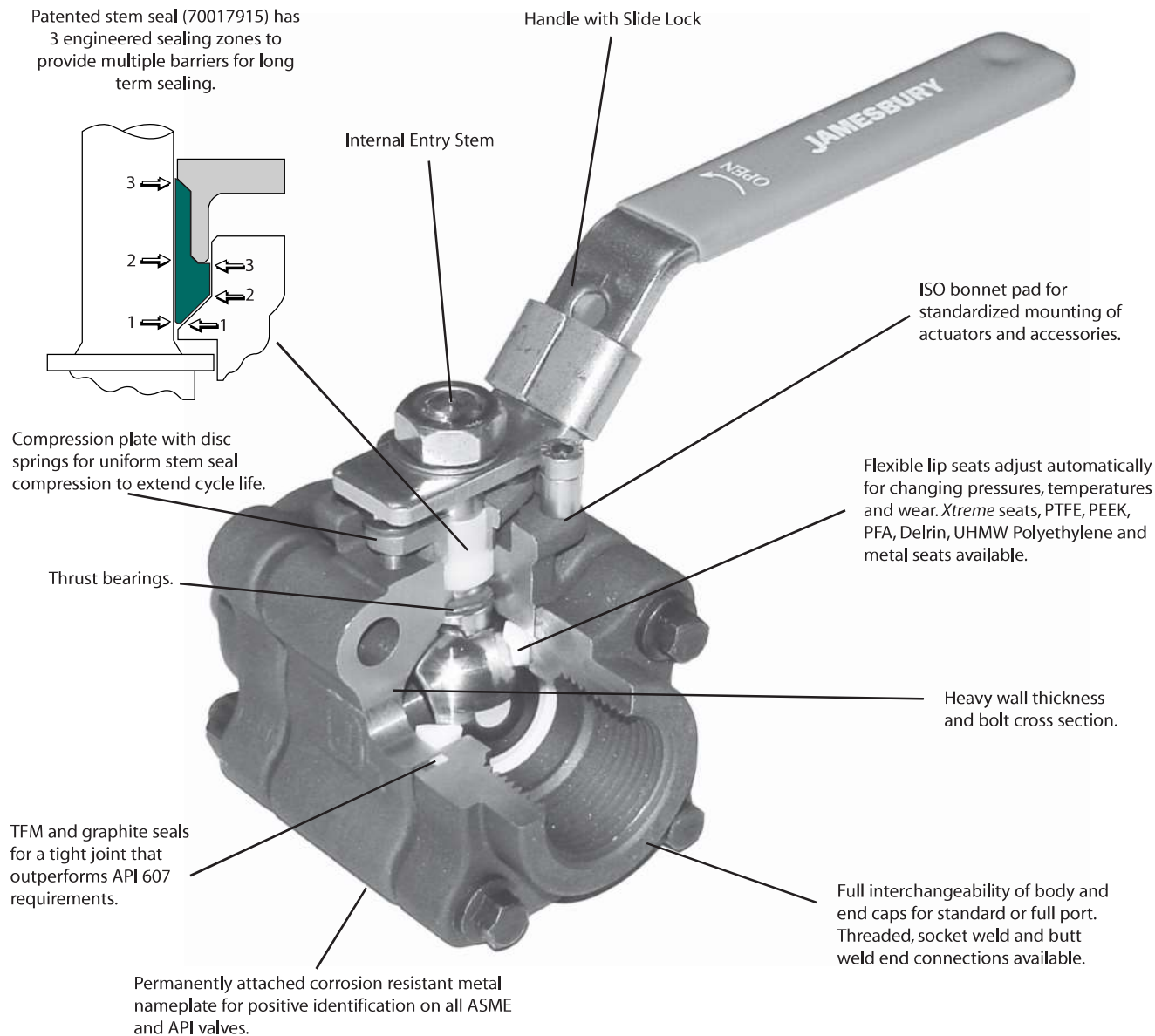
FEATURES AND BENEFITS

For 1/2" – 2" (DN 15 – 50) standard port and 1/2" – 1-1/2" (DN 15 – 40) full port valves

- Patented stem seal system is live loaded and engineered to assure long sealing life.
- ISO 5211 Bonnet for global conformity.
- CE Marking option.
- Stainless steel linkage for VPVL, V-Series and ADC-Series actuators has a guided coupling to align topworks during assembly and eliminate side load stress on stem seals for long life, clean environment and reduced maintenance.
- For most seat materials, weld end valves do not require disassembly before welding in-line. Refer to Installation, Maintenance, and Operating instructions (IMO) for details.

Valve Performance and Value

1/2" – 2" (DN 15 – 50) Standard Port and 1/2" – 1-1/2" (DN 15 – 40) Full Port Valves



For 2" (DN 50) full bore and 2-1/2" (DN 65) standard port, refer to page 6.
All constructions marked comply with MSS SP-25.

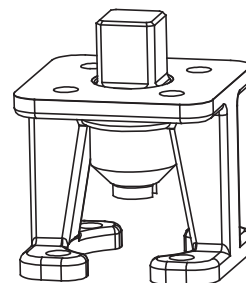
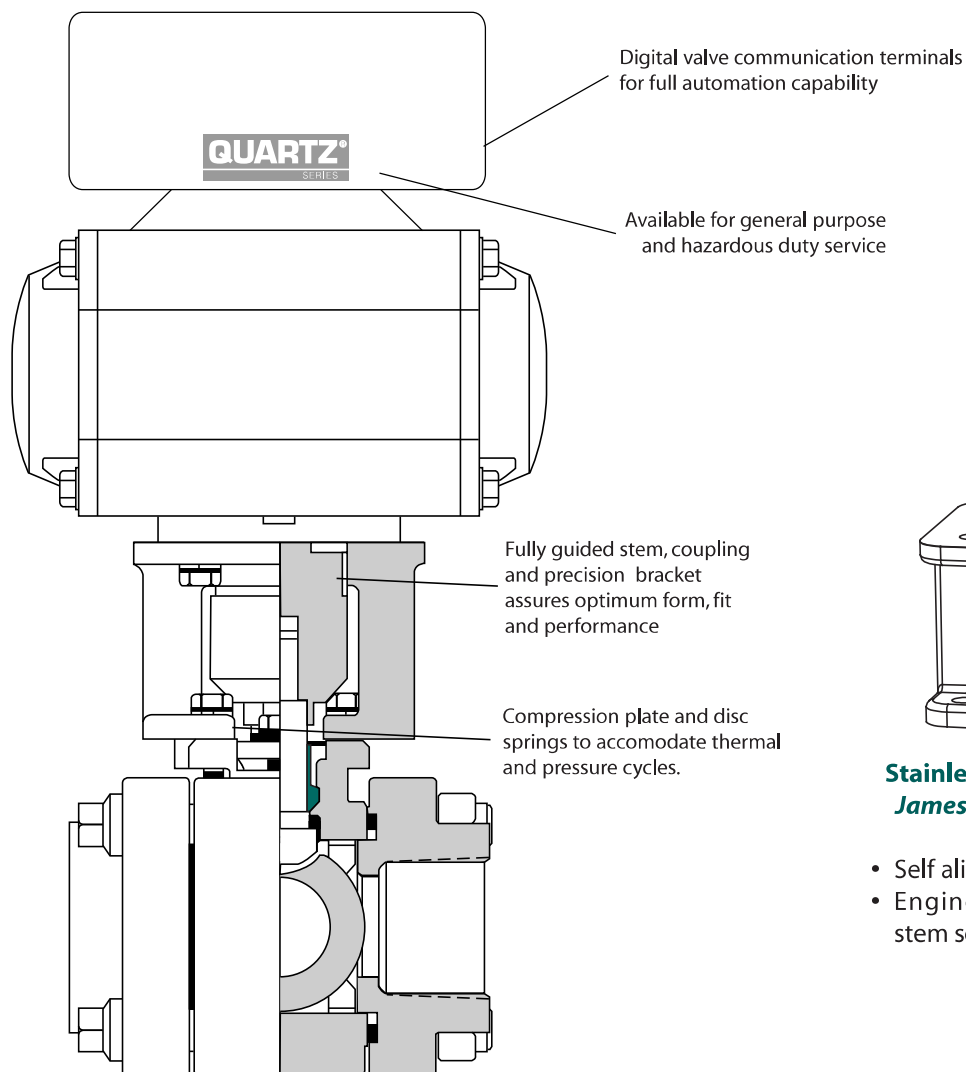
Xtreme Seat Performance and Value

Xtreme seats provide longer life, expanded performance boundaries, and the greatest possible value. *Xtreme* seats are made of a unique material that resulted from a

technological breakthrough in our polymer research lab. The material is a fluoropolymer-based blend proprietary to *Jamesbury* that provides superior quarter-turn performance.

**Jamesbury Valves 'The Ultimate Process Automation Package'
for VPVL Pneumatic Actuators, V-Series and ADC-Series Electric Actuators**

For 1/2" – 2" (DN 15 – 50) Standard Port and 1/2" – 1-1/2" (DN 15 – 40) Full Port Series 4000



**Stainless steel linkages for
Jamesbury ISO Actuators**

- Self aligning
- Engineered for optimum stem seal performance

Automation Performance and Value

Series 4000 valves combined with *Jamesbury* actuators, network capable valve monitors and communication devices offer a total value and performance package. Available with pneumatic Valv-Powr® VPVL actuators,

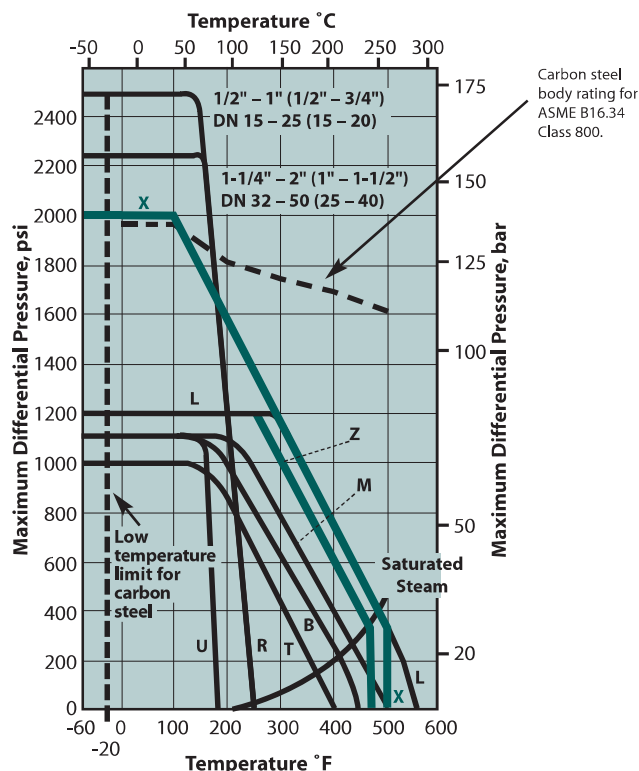
V-Series and ADC-Series electric actuators and with Stonel® Quartz®, Eclipse®, and Hawkeye® digital monitors or VCTs, the packages have a wide range of applications. Visit our website at www.metso.com/valves.

Valve Seat Ratings

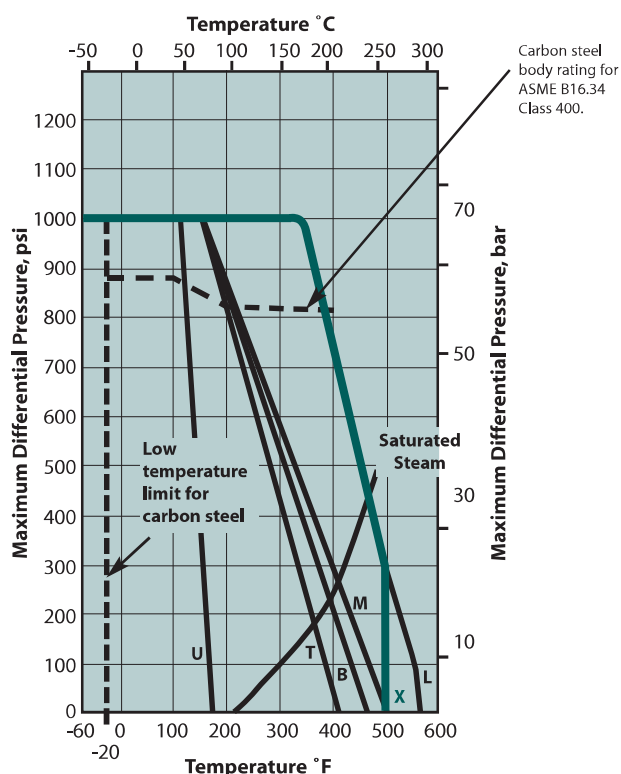
These ratings are based on differential pressure with valve ball in the fully closed position and refer to seats only. Refer to valve body ratings on page 11 to be sure that all components are satisfactory for the application.

Valves in carbon steel are suitable for service to -20°F (-29°C), valves in 316 stainless steel to -60°F (-51°C) or -40°F (-40°C) with Delrin seats. Lower temperature limits for body boltings are B7: -20°F (-29°C), B7M: -50°F (-46°C), L7M: -60°F (-51°C), B8: -60°F (-51°C).

**1/2" – 2" (DN 15-50) Standard Port,
1/2" – 1-1/2" (DN 15-40) Full Port Valves**



**2-1/2" (DN 65) Standard Port,
2" (DN 50) Full Port Valves**

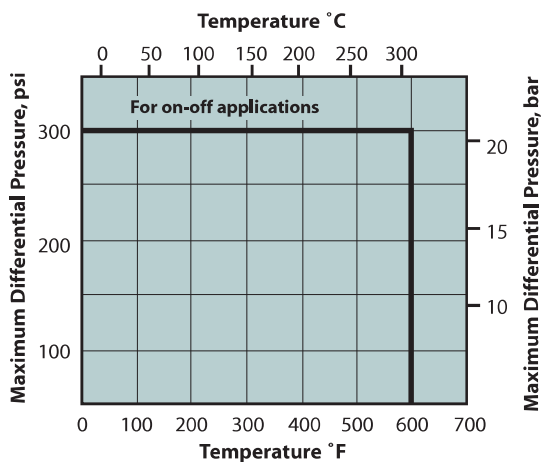


X-Xtreme Seats T-PTFE M-Filled PTFE R-Delrin L-PEEK
U-UHMW polyethylene B-PFA Z-TFM

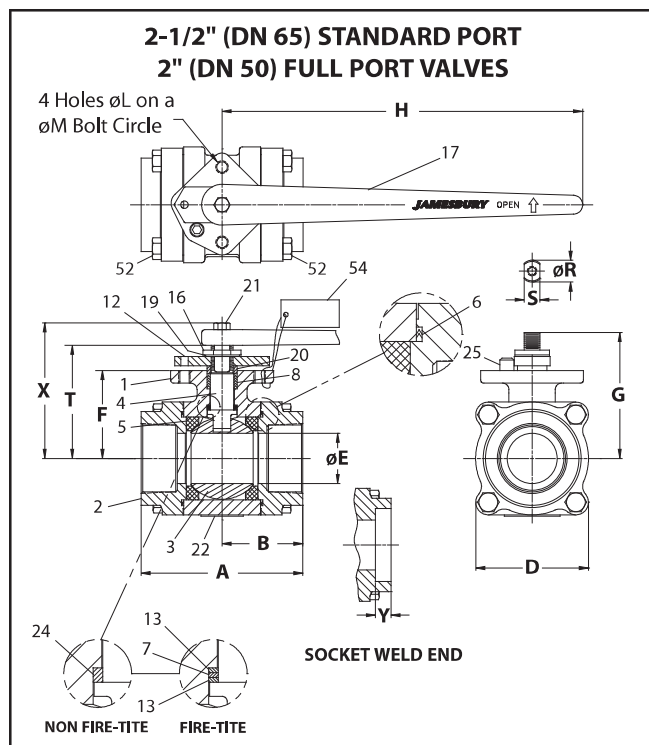
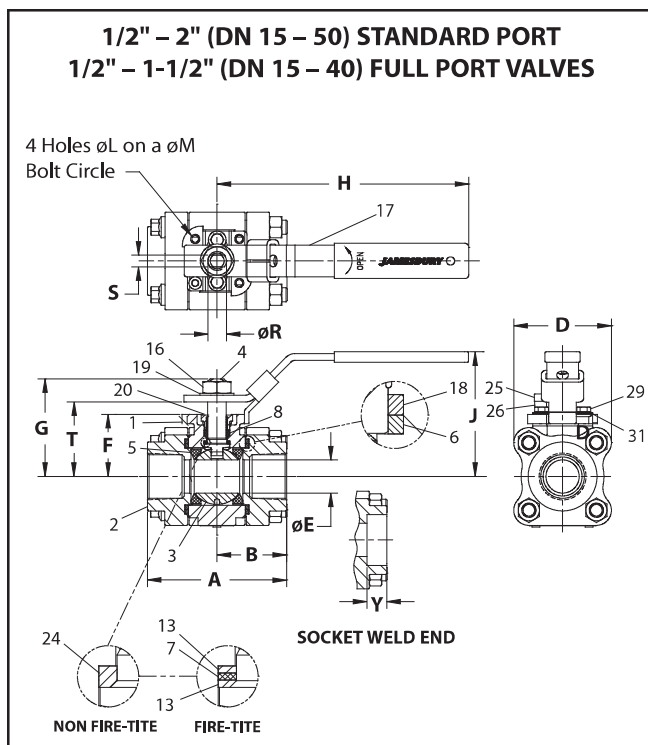
*Full port sizes in parenthesis.

Note: All 1/2" (DN 15) Series 4000 valves have 1/2" (DN 15) port.

Metal-Seated Valves



DIMENSIONS



Approximate Dimensions - Inches																		
Valve Size inches	Screwed End & Socket Weld Valves		Butt Weld Valves		Common Dimensions													Approx. Weight lb
	A	B	A	B	D	E	F	G	H	J	L	M	R	S	T	X	Y	
Standard Port																		
1/2	2.59	1.29	2.80	1.40	2.06	0.50	1.06	1.63	5.00	2.36	M5	1.42	0.31	0.18	1.28	–	0.41	1.9
3/4	3.01	1.50	3.36	1.68	2.25	0.69	1.22	1.79	5.00	2.52	M5	1.42	0.31	0.18	1.43	–	0.53	2.7
1	3.69	1.85	3.90	1.95	2.59	0.88	1.65	2.58	6.50	3.29	M5	1.65	0.50	0.31	1.99	–	0.53	4.8
1-1/4	4.22	2.11	4.56	2.28	2.84	1.00	1.78	2.71	6.50	3.42	M5	1.65	0.50	0.31	2.12	–	0.53	6.3
1-1/2	4.58	2.29	5.40	2.70	3.33	1.25	2.08	3.30	8.00	4.27	M6	1.97	0.62	0.37	2.54	–	0.53	9.8
2	5.11	2.55	5.90	2.95	3.66	1.50	2.26	3.49	8.00	4.46	M6	1.97	0.62	0.37	2.73	–	0.64	12.7
2-1/2	6.47	3.22	–	–	4.50	2.00	3.50	5.00	14.00	–	1/2–13	3.00	0.88	0.63	4.38	5.38	0.64	25.5
Full Port																		
1/2	2.59	1.29	2.80	1.40	2.06	0.50	1.06	1.63	5.00	2.36	M5	1.42	0.31	0.18	1.28	–	0.41	1.9
3/4	3.69	1.85	3.90	1.95	2.59	0.88	1.65	2.58	6.50	3.29	M5	1.65	0.50	0.31	1.99	–	0.53	5.2
1	4.22	2.11	4.56	2.28	2.84	1.00	1.78	2.71	6.50	3.42	M5	1.65	0.50	0.31	2.12	–	0.53	6.8
1-1/4	4.58	2.29	5.40	2.70	3.33	1.25	2.08	3.30	8.00	4.27	M6	1.97	0.62	0.37	2.54	–	0.53	10.3
1-1/2	5.11	2.55	5.90	2.95	3.66	1.50	2.26	3.49	8.00	4.46	M6	1.97	0.62	0.37	2.73	–	0.53	13.7
2	6.19	3.09	6.19	3.09	4.50	2.00	3.50	5.00	14.00	–	1/2–13	3.00	0.88	0.63	4.38	5.38	0.64	25.3

Valve Size DN	Screwed End & Socket Weld Valves		Butt Weld Valves		Approximate Dimensions - mm													Approx. Weight kg
					Common Dimensions													
	A	B	A	B	D	E	F	G	H	J	L	M	R	S	T	X	Y	
Standard Port																		
15	66	33	71	36	52	13	27	41	127	60	M5	36	8	5	33	–	10	0.9
20	76	38	85	43	57	18	31	45	127	64	M5	36	8	5	36	–	13	1.2
25	94	47	99	50	66	22	42	66	165	84	M5	42	13	8	51	–	13	2.2
32	107	54	116	58	72	25	45	69	165	87	M5	42	13	8	54	–	13	2.9
40	116	58	137	69	85	32	53	84	203	108	M6	50	16	9	65	–	13	4.4
50	130	65	150	75	93	38	57	89	203	113	M6	50	16	9	69	–	16	5.8
65	164	82	–	–	114	51	89	127	356	–	1/2-13	76	22	16	111	137	16	11.6
Full Port																		
15	66	33	71	36	52	13	27	41	127	60	M5	36	8	5	33	–	10	0.9
20	94	47	99	50	66	22	42	66	165	84	M5	42	13	8	51	–	13	2.4
25	107	54	116	58	72	25	45	69	165	87	M5	42	13	8	54	–	13	3.1
32	116	58	137	69	85	32	53	84	203	108	M6	50	16	9	65	–	13	4.7
40	130	65	150	75	93	38	57	89	203	113	M6	50	16	9	69	–	13	6.2
50	157	78	157	78	114	51	89	127	356	–	1/2-13	76	22	16	111	137	16	11.5

BILLS OF MATERIALS AND PARTS LIST

Fire-Tite 1/2" – 2" (DN 15 – 50) Standard Port, 1/2" – 1-1/2" (DN 15 – 40) Full Port Valves

Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Body Cap	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF3M
3	Ball	316 Stainless steel, K-Monel, Hastelloy C	
4	Stem	316 Stainless steel, 17-4 PH Stainless steel, K-Monel, Hastelloy C	
5	Seat	Xtreme seats, PTFE, 17-4 PH, PFA, Delrin®, UHMW polyethylene, as specified	
6/18	Body Seals	PTFE & Graphite, Spiral wound 316 Stainless steel graphite/PTFE (with PEEK or metal seats)	
7	Secondary Stem Seal	Graphite	
8	Primary Stem Seal	PTFE, TFM® (Xtreme-Seated Valves), Graphite (w/metal seats), UHMWPE (w/UHMWPE seats)	
10	Stem Guide	PEEK (Metal-Seated Valves)	
13	Stem Bearing	PTFE, Filled PTFE, (PEEK when metal-seated), (Delrin when Delrin-seated or PEEK), UHMWPE (w/UHMWPE seats)	
16	Hex Nut	316 Stainless steel	
17	Handle	Carbon steel (zinc plated)	300 Series Stainless steel
19	Lock Washer	300 Series Stainless steel	
20	Compression Plate	316 Stainless steel	
25	Socket Cap Screw	316 Stainless steel	
26	Handle Stop Spacer	316 Stainless steel	
29	Hex Cap Screw	316 Stainless steel	
31	Disc Springs	Inconel	
52	Body Bolt/Tie Rod	ASTM A193 Gr. B7	ASTM A193 Gr. B8M
53	Hex Nut	ASTM A194 Gr. 2H	ASTM A194 Gr. 8
54	Weld End Tag	Paper	
# Requires 17-4 PH stem			

Non Fire-Tite 1/2" – 1-1/2" (DN 15 – 40) Full Port & 1/2" – 2" (DN 15 – 50) Standard Port Valves

Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Body Cap	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF3M
3	Ball	316 Stainless steel, K-Monel, Hastelloy C	
4	Stem	316 Stainless steel, 17-4 PH Stainless steel, K-Monel, Hastelloy C	
5	Seat	Xtreme seats, PTFE, PEEK #, as specified	
6/18	Body Seal	TFM & Graphite, Spiral wound 316 Stainless steel graphite/PTFE (with PEEK seats)	
8	Primary Stem Seal	PTFE, Graphite (with PEEK seats)	
10	Stem Guide	PEEK (PEEK seated valves)	
13	Stem Bearing	Filled PTFE (PEEK when PEEK-seated)	
16	Hex Nut	316 Stainless steel	
17	Handle	Carbon steel (Zinc plated)	300 Series Stainless steel
19	Lock Washer	300 Series Stainless steel	
20	Compression Plate	316 Stainless steel	
24	Stem Bearing	Filled PTFE (PEEK when PEEK-seated)	
25	Socket Cap Screw	316 Stainless steel	
26	Handle Stop Spacer	316 Stainless steel	
29	Hex Cap Screw	316 Stainless steel	
31	Disc Springs	Inconel	
52	Body Bolt/Tie Rod	ASTM A193 Gr. B7	ASTM A193 Gr. B8M
53	Hex Nut	ASTM A194 Gr. 2H	ASTM A194 Gr. 8
54	Weld End Tag	Paper	
# Requires 17-4 PH stem			

BILLS OF MATERIALS AND PARTS LIST			
Fire-Tite 2" (DN 50) Full Port and 2 1/2" (DN 65) Standard Port Valves			
Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Body Cap	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF3M
3	Ball	316 Stainless steel	
4	Stem	316 Stainless steel or 17-4 PH Stainless steel	
5	Seat	Xtreme seats, PTFE, 17-4 PH, as specified	
6	Body Seal	Spiral wound 316 Stainless steel graphite/PTFE	
7	Secondary Stem Seal	Graphite	
8	Stem Seal	PTFE, TFM (Xtreme-Seated Valves)	
12	Indicator Stop	316 Stainless steel	
16	Stem Nut	Carbon steel	Stainless steel
17	Handle	Ductile Iron	
19	Shakeproof Washer	Carbon steel	
21	Compression Ring	316 Stainless steel	
22	Identification Tag	Stainless steel	
24	Stem Bearing	Filled PTFE (PEEK when metal-seated)	
25	Hex Cap Screw**	ASTM A193 Gr. B7, B7M, A320 Gr. L7M	ASTM A193 Gr. B7, B8, A453 Gr. 660
52	Body Bolt/Tie Rod**	ASTM A193 Gr. B7, B7M, A320 Gr. L7M	ASTM A193 Gr. B7, B8, A453 Gr. 660
53	Hex Nut**	ASTM A194 Gr. 2H, 2M, 7M	ASTM A194 Gr. 2H, 2M, A453 Gr. 660
54	Weld End Tag	Paper	
** A193 Gr. B7 Body Fasteners unless otherwise specified.			

Non Fire-Tite 2" (DN 50) Full Port and 2-1/2" (DN 65) Standard Port Valves			
Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Body Cap	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF3M
3	Ball	316 Stainless steel	
4	Stem	316 Stainless steel or 17-4 PH Stainless steel (PEEK-seated valves)	
5	Seat	Xtreme seats, PTFE, PEEK, UHMW PE, as specified	
6	Body Seal	Spiral wound 316 Stainless steel graphite/PTFE, EPT (UHMWPE seated valves)	
8	Stem Seal	PTFE, TFM (Xtreme-Seated Valves), UHMW PE (UHMW PE-seated valves)	
12	Indicator Stop	316 Stainless steel	
16	Stem Nut	Carbon steel	Stainless steel
17	Handle	Ductile Iron	
19	Shakeproof Washer	Carbon steel	
21	Compression Ring	316 Stainless steel	
22	Identification Tag	Stainless steel	
24	Stem Bearing	Filled PTFE (Xtreme and PTFE seats) same as seat material for PEEK and UHMW PE Seats	
25	Hex Cap Screw**	ASTM A193 Gr. B7, B7M, A320 Gr. L7M	ASTM A193 Gr. B7, B8, A453 Gr. 660
52	Body Bolt/Tie Rod**	ASTM A193 Gr. B7, B7M, A320 Gr. L7M	ASTM A193 Gr. B7, B8, A453 Gr. 660
53	Hex Nut**	ASTM A194 Gr. 2H, 2M, 7M	ASTM A194 Gr. 2H, 2M, A453 Gr. 660
54	Weld End Tag	Paper	
** A193 Gr. B7 Body Fasteners unless otherwise specified.			

VALVE TORQUE DATA

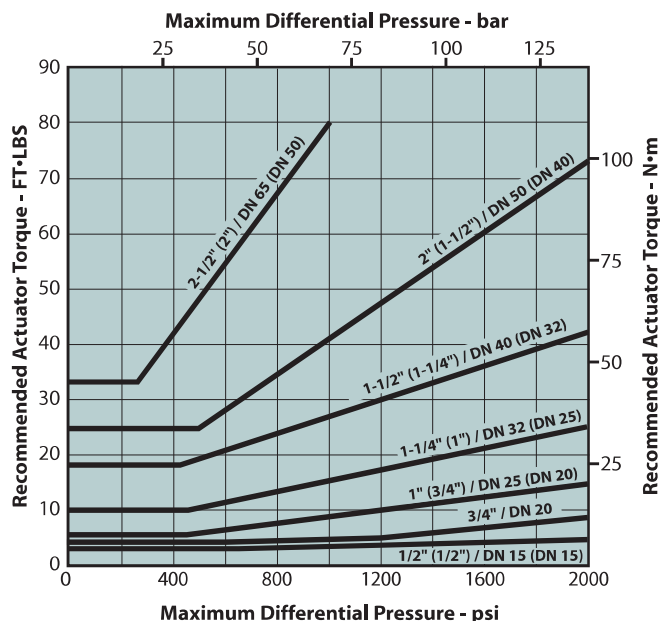
Use these torque charts for Series 4000 valves as a guide for actuator selection. For torque output values and actuator selection tables refer to actuator bulletins.

Additional requirements may be imposed by media characteristics, trim, and frequency of valve operation.

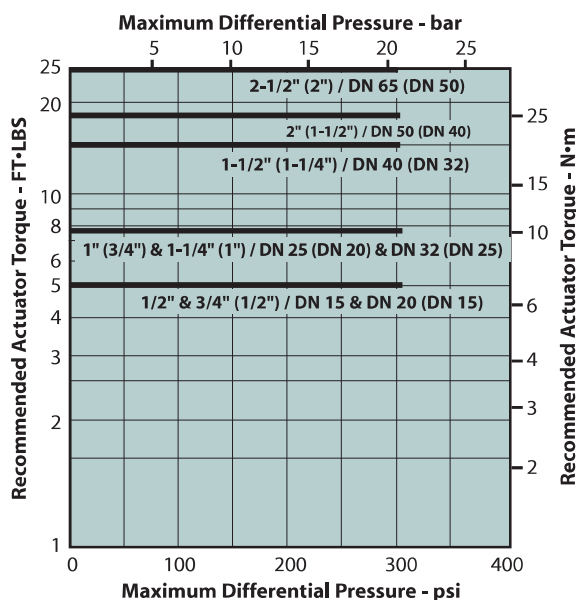
For difficult service (slurries, semi-solids) increase values by 50%. If in doubt, select a larger actuator.

Values shown in the charts are based on using standard factory procedures for valve-actuator assembly.

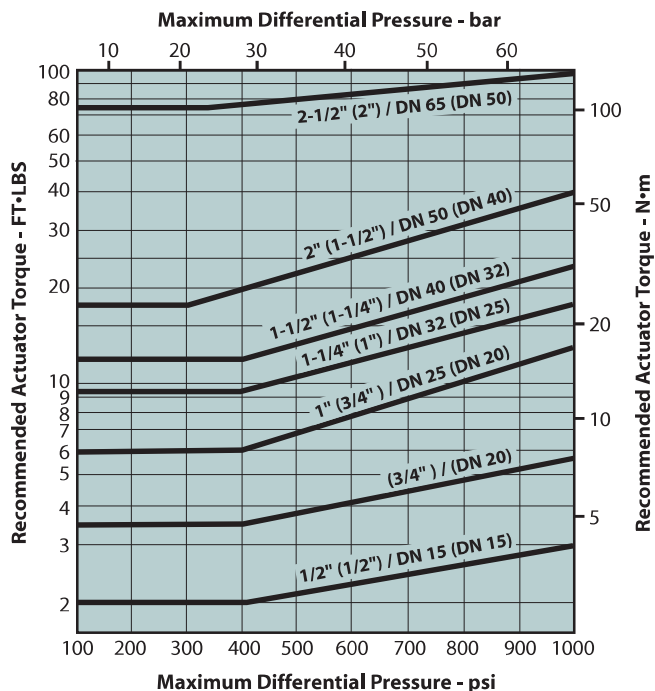
Xtreme (X) and TFM (Z) Seated Standard-Port Valves (Full-port sizes in parentheses)



Metal (D) Seated Standard-Port Valves (Full-port sizes in parentheses)

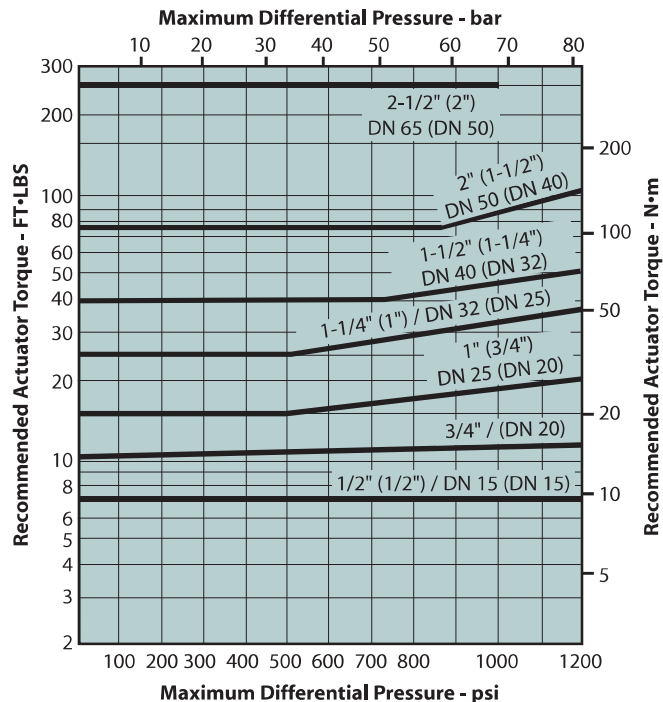


PTFE (T) Seated Standard-Port Valves

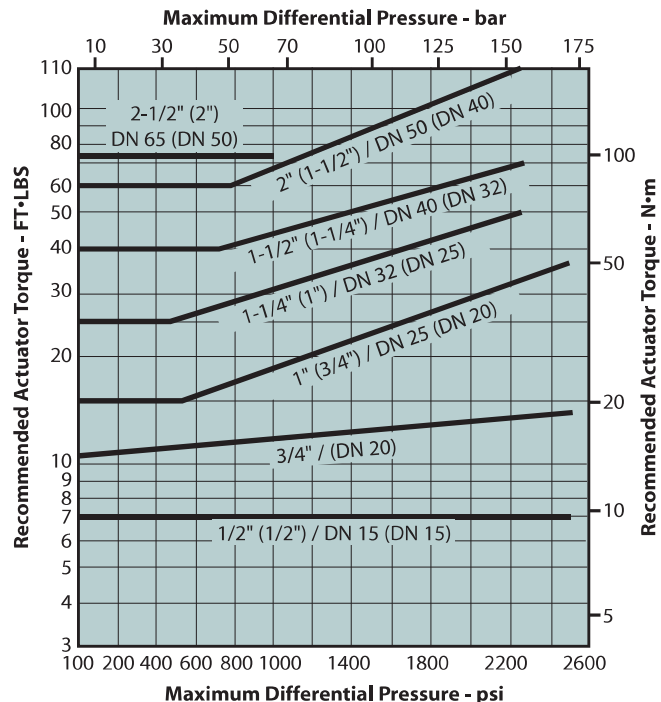


VALVE TORQUE DATA (CONTINUED)

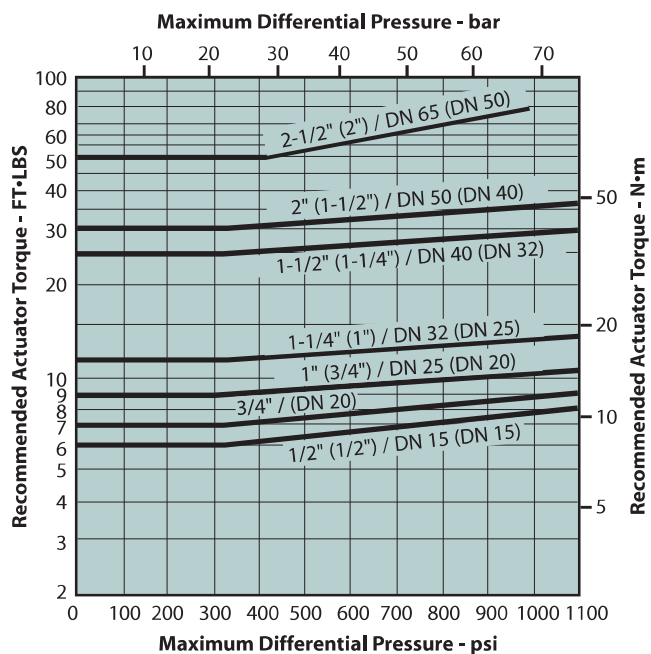
PEEK (L) Seated Standard-Port Valves
(Full-port sizes in parentheses)



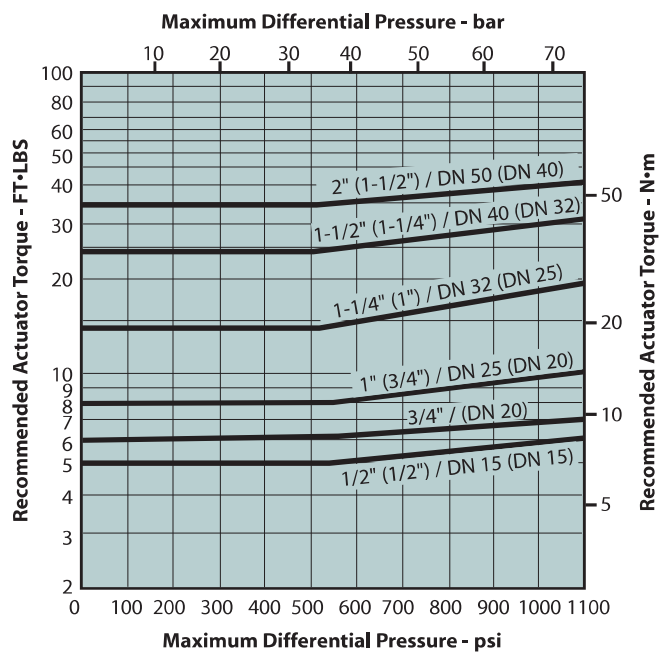
Delrin (R) Seated Standard-Port Valves
(Full-port sizes in parentheses)



UHMW (U) Polyethylene Seated Standard-Port Valves
(Full-port sizes in parentheses)



PFA (B) Seated Standard-Port Valves



ACTUATORS

Metso offers a full line of integrally designed actuators for automated systems and for easier control of inaccessible or remote valves. Pneumatic actuators that include double-acting and spring-return piston, vane, and rack and pinion units, spring-diaphragm types, and electric actuators are available for all valves. Electric actuators are available with both watertight and hazardous location enclosures.

For further information on actuators for Series 4000 valves, see the following:

Type

Quadra-Powr® QPX Spring Diaphragm Actuators
Valv-Powr® VPVL Rack and Pinion Actuators
V-Series Electric Actuators
ADC-Series Electric Actuators

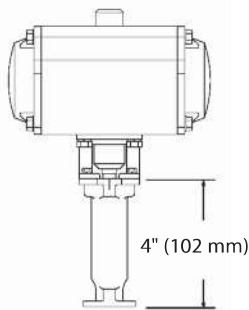
Bulletin

A110-4
A111-5
A200-1
A201-1

ACCESSORIES

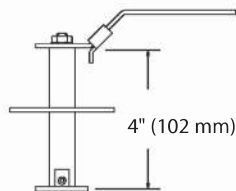
Bonnet Extensions SE-096, 097 & 098

4" (102 mm) bonnet extensions are available for applications that require insulated pipe, which are particularly useful for automated products. Bonnet extensions can also be used to prevent interference between actuators and companion pipelines and equipment. They are ideal for units that require locking lever or locking oval handle capability.



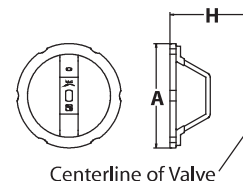
Stem Extensions SE-093, 094 & 095

A standard 4" (102 mm) stem extension is offered for Series 4000 valves (1/2" – 2") for improved accessibility, particularly when used in insulated pipelines. Stem extension kits can be ordered factory-mounted or shipped separately for field mounting.



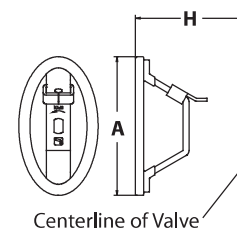
Round Handles

Series 4000 ball valves have optional round handles available. To order handles separately, specify the part number shown in the accessories table below.



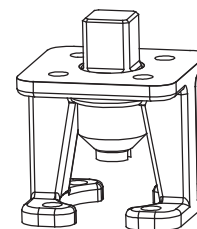
Oval handles with slide-lock

Optional oval handle saves space and may be padlocked to retain the valve in the open or closed position.



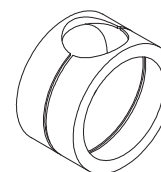
Stainless steel linkages for Jamesbury ISO Actuators

- Self aligning
- Engineered for optimum stem seal performance



Cavity Fillers

Cavity fillers are available in 4000 series valves. The fillers are PTFE material when ordered with a TT seat and seal code and Xtreme material when ordered with a XT seat and seal code. Cavity fillers are used in processes where cross contamination is a concern. Food processing, pharma-chemicals, cosmetics, paints, solvents, finishes and dyes are typical applications where fillers are employed.



Accessories Table - inches (DN/mm)									
Valve Size*		Bonnet/Stem† Extension	Stem Extension	Locking Oval	Round	Round/Oval Handle		Allowable Max. Torque FT•LBS (N•m)	
Standard Port	Full Port					Dimension A	Dimension H	Round	Oval
1/2" (15)	1/2" (15)	SE-096	SE-093	112-0108-30	112-0105-30	4.00 (101.6)	2.96 (75.2)	9 (14)	9 (14)
3/4" (20)	—	SE-096	SE-093	112-0108-30	112-0105-30	4.00 (101.6)	3.11 (79.0)	9 (14)	9 (14)
1" (25)	3/4" (20)	SE-097	SE-094	112-0109-30	112-0106-30	4.50 (114.3)	3.70 (94.0)	18 (25)	18 (25)
1-1/4" (32)	1" (25)	SE-097	SE-094	112-0109-30	112-0106-30	4.50 (114.3)	3.83 (97.3)	18 (25)	18 (25)
1-1/2" (40)	1-1/4" (32)	SE-098	SE-095	112-0110-30	112-0107-30	5.75 (146.0)	4.75 (120.7)	25 (34)	25 (34)
2" (50)	1-1/2" (40)	SE-098	SE-095	112-0110-30	112-0107-30	5.75 (146.0)	4.94 (125.5)	25 (34)	25 (34)
2-1/2" (65)	2" (50)	—	—	—	—	—	—	—	—

* Specify LD 64 when a locking device is required for 2" (DN 50) full bore and 2-1/2" (DN 65) standard port valves.

† For valves with PEEK (L), Delrin (R) or 17-4 PH SS (D) seats.

SPECIFICATIONS

Series 4000 valves are available in types that meet the following industry specifications.

Specification	Description
ASME B1.20.1	Pipe Threads
ASME B16.11	Steel Fitting Socket Welding & Thread
ASME B16.25	Buttwelding Ends
ASME B16.34	Valves-Flanged and Buttwelding Ends
ASME B31.1	Power Piping
ASME B31.3	Chemical Plant & Petroleum Refining Piping
ASME B31.4	Liquid Petroleum Piping
API 598	Valve Inspection & Testing
API 607	Fire Test for Soft-seated Valves (Div. of Refining)
API 608	Metal Ball Valves - Flanged, Threaded and Welding End
BS 21	Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
DIN 2999-1	Pipe threads for tubes and fittings; parallel internal thread and taper external thread; tread dimensions
ISO 17292	Metal Ball Valves for petroleum, petrochemical and allied industries

ISO 7-1

MSS SP-25
MSS SP-55
MSS SP-72
NACE MR0103

ISO 5211

Pipe threads where pressure-tight joints are made on the threads -- Part 1: Dimensions, tolerances and designation
Standard Marking System for Valves
Quality Standard for Steel Fittings for Valves
Ball Valves with Flanged or Buttweld End
Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments
Industrial Valves – Part-turn actuator attachment

Flow Data

The table below provides flow coefficients, Cv, of Series 4000 valves. The Cv values represent the flow of water at +60°F through the valve in U.S. gallons per minute at a pressure drop of 1 psi.

Valve Size		Standard port	Full port
Inches	DN	Cv*	Cv*
1/2	15	13	13
3/4	20	33	40
1	25	44	65
1-1/4	32	46	90
1-1/2	40	95	135
2	50	111	251
2-1/2	65	216	—

*Cv = 1.167 Kv.

Maximum Leakage Rates

All series 4000 valves are factory tested with air. Polymeric seated valves are verified to be bubble tight using 100 psi air. Metal seats are also tested with air to ensure that leakage does not exceed the rates shown below.

Valve Size - inches		Leakage Rate - scfm at Differential Pressure		
Standard Port	Full Port	100 psi	200 psi	300 psi
1/2	1/2	5.0	7.0	8.6
3/4	—	7.0	9.9	12.1
1 - 2	3/4 – 1-1/2	9.0	12.7	15.5
—	2	11.0	14.0	17.0

Valve Size - DN		Leakage Rate - m³/hr Differential Pressure		
Standard Port	Full Port	7 bar	14 bar	20 bar
15	15	8.5	11.9	14.6
20	—	11.9	16.8	20.6
25 – 50	20 – 40	15.3	21.6	26.3
—	50	18.7	23.8	28.8

Standard Version - Body Rating

Valve Size*		Working Pressure - Body Material: Carbon Steel and 316 Stainless Steel	
Inches	DN	psi	bar
1/2 – 1 (1/2 – 3/4)	15 – 25 (15 – 20)	2500	172
1-1/4 – 2 (1 – 1-1/2)	32 – 50 (25 – 40)	2250	155
2-1/2 (2)	65 (50)	1000	69

*Full-port sizes in parentheses

ASME Version - Body Rating

Temperature	ASME Class 800 1/2" – 2" (DN 15 – 50) Standard Port 1/2" – 1-1/2" (DN 15 – 40) Full Port		ASME Class 400 2-1/2" (DN 65) Standard Port 2" (DN 50) Full Port	
	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel
°F	psi	psi	psi	psi
-20 to +100	1973	1920	990	960
200	1810	1653	900	825
300	1747	1493	875	745
400	1688	1368	845	685
500	1608	1275	800	635

Temperature	ASME Class 800 1/2" – 2" (DN 15 – 50) Standard Port 1/2" – 1-1/2" (DN 15 – 40) Full Port		ASME Class 400 2-1/2" (DN 65) Standard Port 2" (DN 50) Full Port	
	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel
°C	bar	bar	bar	bar
-29 to +38	136	132	68.3	66.2
100	124	113	61.9	56.2
150	120	103	60.3	51.2
200	117	95	58.5	47.6
250	112	89	55.7	44.4

HOW TO ORDER SERIES 4000 BALL VALVES

To specify a Series 4000 valve, select the body style, the combination of body and trim material, the proper seat material, and the appropriate body bolts for the application. Code numbers are fully descriptive of a valve. They are made up of size and a figure designation based on the following coding:

EXAMPLE: This order code calls for a 3/4" standard-port NPT *Fire-Tite* valve with carbon steel body, 316 stainless steel ball and stem, *Xtreme* seats and PTFE seals, and ASTM A193 Gr. B7 bolts with ASTM A194 Gr 2H nuts.

1	-	2	3	4	-	5	6	7	-	8	9
3/4		4A	-	-		22	36	XT		B	1

1	Size - 1/2 - 2-1/2 (DN 15-65) Standard Port, 1/2 - 2 (DN 15-50) Full Port						
inches	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2
DN	15	20	25	32	40	50	65

2	Body Style
4A	Standard Port NPT
4B	Full Port NPT
4C	Std. Port socket weld
4D	Full port socket weld
4F	Std. port butt weld Schedule-5
4G	Std. port butt weld Schedule-10
4H	Std. port butt weld Schedule-40
4J	Full port butt weld Schedule-5
4K	Full port butt weld Schedule-10
4L	Full port butt weld Schedule-40
4M	Std. port NPT x soc. weld ends
4N	Full port NPT x soc. weld ends
4P	Full port butt weld Schedule 80
4Q	Std. port butt weld Schedule 80
4R	Std. port ISO 7 Rp (BS21 parallel DIN 2999)
4S	Std. port ISO 7 Rc (BS21 taper)
4T	Full port ISO 7 Rp (BS21 parallel DIN 2999)
4U	Full port ISO 7 Rc (BS21 taper)

3	Configuration
-	(no entry if <i>Fire-Tite</i>)
X	Non- <i>Fire-Tite</i>
B	ASME B16.34 Class 800
M ³ *	ASME B16.34 Class 800 with metric nameplate

4	Special Service
-	(no entry if standard)
N	NACE MR0103 w/exposed body fasteners
O	Oxygen
Q	Cavity Filler (<i>Xtreme</i> w/ XT, PTFE w/ TT)
V	High vacuum
VC	High vacuum certified
C	Chlorine
TG	Top Ground
STGR	Top and Bottom Ground
LA	Standard Emission Pak [®] w/o Leakoff Connection
LL	Standard Emission Pak [®] with Leakoff Connection

5	Body Material
22	Carbon steel
36	316 Stainless steel

6	Ball and Stem Material
00	Same as body (Carbon steel not available)
36	316 Stainless steel
HB	316 Stainless steel ball, 17-4 PH stem (required for RT & LG seats & seals)
71	Monel
73	Hastelloy C (non NACE MR0103 valves)

7	Seat and Seal Material	
	Seats	Seal
Standard <i>Fire-Tite</i> Options		
XT ⁵	<i>Xtreme</i>	TFM & Graphite
TT	PTFE	PTFE & Graphite
DH	17-4 PH Stainless steel	Graphite
UU	UHMW Polyethylene*	UHMW PE & Graphite
RT ^{2,4}	Delrin*	PTFE & Graphite
BT	PFA	PTFE & Graphite
Non <i>Fire-Tite</i> Options		
TT	PTFE	PTFE
UB	UHMW Polyethylene	UHMW Polyethylene & EPT
LG ^{2,4}	PEEK*	PEEK & Graphite
LT ^{2,4}	PEEK**	PTFE & Graphite

8	Valve Model
A	Series 4000 Model A**
B	Series 4000 Model B*

9	Body Fasteners	
	Bolts or Tie Rods	Nuts
1	ASTM A193 Gr. B7	ASTM A194 Gr. 2H
2	ASTM A193 Gr. B8 or B8M2	ASTM A194 Gr. 8, 8C, 8F, 8M, 8MN, 8N, 8P, or 8T
5 ¹	ASTM A193 Gr. B7M	ASTM A194 Gr. 2HM
7 ¹	ASTM A320 Gr. L7M	ASTM A194 Gr. 7M
8 ¹	ASTM A453 Gr. 660	ASTM A453 Gr. 660

* For 1/2" - 2" (DN 15 - 50) standard port and 1/2" - 1-1/2" (DN 15 - 40) full bore valves

** For 2" (DN 50) full bore and 2-1/2" (DN 65) standard port only.

1 Exposed bolting options for NACE MR0103 service.

2 Requires high strength stem.

3 Valves larger than 1" (DN 25) are CE marked.

4 Not a self-relieving seat design.

5 Seats fully rated to CL800 pressure up to 100°F.

TFM is a registered trademark of Dyneon Co.

Delrin is a registered trademark of DuPont Co.

Subject to change without prior notice.

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www.metso.com/valves

NOTE: As the use of the valve is application specific, a number of factors should be taken into account when selecting a valve for a given application. Therefore, some of the applications in which the valves are used are outside the scope of this document. If you have any questions concerning the use, application or compatibility of the valve with the intended service, contact Metso Automation for more information.



VALV-POWR® SERIES VPVL MODEL D DOUBLE-ACTING AND SPRING-RETURN RACK- AND-PINION COMPACT PNEUMATIC ACTUATORS

Valv-Powr – VPVL double-opposed piston actuators combine the benefits of high cycle life, a rugged construction, and an extremely compact and symmetrical design with a unique range of features and options. They are specifically designed for fast efficient operation of ball, butterfly, and other rotary type valves.

FEATURES

Single-Source Responsibility

- Valves, actuators, and accessories are designed to operate as a unit with the highest degree of compatibility.
- Valves, actuators, and accessories can be supplied completely assembled to provide unit responsibility from a single source.

Versatility

- Modular designs with same body and end caps for double-acting and spring-return reduce inventory. Springs can be added in the field to convert double-acting to spring-return or for changes in supply pressure.
- Failure direction can be easily reversed from spring-to-open or spring-to-close orientation simply by inverting the pistons.
- Actuator to valve attachments comply with ISO 5211.
- Solenoid valve and accessory attachments comply with NAMUR VDI/VDE 3845.
- A wide range of optional accessories and control devices that include limit switches, solenoid valves, and mechanical safety lockouts are available to satisfy virtually all automated valve requirements.

High Cycle Life

- Bearings on all sliding and rotating moving parts to ensure long life.
- Dual piston rack-and-pinion mechanism for simple construction, high cycle life, and constant torque.
- Hard-anodized PTFE-coated extruded aluminum body with honed internal surface for strength and lower coefficient of friction.
- Mechanically multi-guided aluminum pistons for precise movement, low friction, and high cycle life.
- Machined teeth on piston racks and pinions for excellent rack and pinion engagement and maximum efficiency.
- Extended temperature range option decreases cycle life.



Corrosion Resistant

- Hard-anodized PTFE-coated body, polyester-coated end caps, and epoxy-coated springs, along with internal and external stainless steel fasteners, provide corrosion resistance in a variety of difficult applications and environments.

Reliability

- Safety-contained multi-spring design with preloaded and heavy-duty coated springs for simpler range versatility, greater safety, and corrosion resistance.
- External adjustable stops in both directions assure flexibility and accuracy when setting the valve in the open and closed positions.
- As an added safety feature, the external adjustment screws are slotted. The slot will indicate the presence of internal pressure. Pressure will begin to vent before the adjustment screws are completely backed out of the actuator.

SPECIFICATIONS

Maximum Supply Range: 116 psi (8 bar)

Temperature Range:

Standard	-40°F to +176°F (-40°C to +80°C)
Options	5°F to +302°F (-15°C to +150°C)
	-60°F to +176°F (-51°C to +80°C)

Rotation Adjustment: Close -5° to +5° from 0°
Open +5° to -5° from 90°

Supply Media: Air, mineral-based hydraulic fluid

STANDARDS

Actuator to valve mounting: ISO 5211

Actuator to solenoid mounting: Namur, VDI/VDE3845*

Actuator to accessory mounting: Namur, VDI/VDE3845

Approved to ATEX 94/9/EC Directive:

IIGD c T95°C for Standard and Low Temperature option
or IIGD c T150°C for the High Temperature option.

* Except VPVL650, 700, 800

ACTUATOR SELECTION

To select an actuator for a particular valve and service, first determine the maximum operating torque that will be required from the applicable valve bulletin. Then refer to the appropriate torque output table and select an actuator that will, at the available supply pressure, provide a torque output no less than the required operating torque for the

valve. For spring-return units, both the spring torque and the air torque must be sufficient. In the event confirmation is desired for the selection of an actuator under specific service conditions, include full details on trim, seat materials, and media characteristics.

Actuator Model		Air Volume						Bore Diam.		Moving Time Seconds ¹		Weight	
		in. ³			ml								
		Opening	Closing	Swept	Opening	Closing	Swept	in.	mm	Opening	Closing	lb.	kg
VPVL051	DA	5.5	9.2	3.4	90.1	150.8	55.5	1.97	50	0.2	0.3	2.2	1.0
	SR		–			–				0.3	0.3	2.4	1.1
VPVL100	DA	9.8	15.9	6.0	160.6	260.6	97.8	2.48	63	0.3	0.3	3.5	1.6
	SR		–			–				0.3	0.4	3.7	1.7
VPVL200	DA	18.9	29.9	11.8	309.7	490	194.1	2.95	75	0.3	0.4	6.0	2.7
	SR		–			–				0.4	0.5	6.8	3.1
VPVL250	DA	31.1	47.6	18.6	509.6	780	305.4	3.46	88	0.4	0.5	8.2	3.7
	SR		–			–				0.5	0.6	9.5	4.3
VPVL300	DA	43.3	67.7	27.1	709.6	1109	443.7	3.94	100	0.5	0.7	11.5	5.2
	SR		–			–				0.6	0.8	13.4	6.1
VPVL350	DA	72.6	109.8	43.8	1190	1799	717.2	4.53	115	0.7	0.9	17.6	8.0
	SR		–			–				0.8	1.1	20.5	9.3
VPVL400	DA	94	143	56	1540	2443	924	4.92	125	0.9	1.2	21.6	9.8
	SR		–			–				1.1	1.4	25.8	11.7
VPVL450	DA	147	231	89	2409	3765	1451	5.71	145	1.2	1.5	31.3	14.2
	SR		–			–				1.4	1.8	38.4	17.4
VPVL500	DA	192	300	116	3146	4916	1893	6.30	160	1.5	1.8	39.9	18.1
	SR		–			–				1.7	2.1	49.2	22.3
VPVL550	DA	260	420	156	4261	6883	2556	7.09	180	2.0	2.4	53.6	24.3
	SR		–			–				2.2	2.8	72.1	32.7
VPVL600	DA	362	577	217	5932	9455	3549	7.87	200	2.7	3.5	75.2	34.1
	SR		–			–				3.2	4.0	92.4	41.9
VPVL650	DA	610	928	364	10000	15200	5963	9.45	240	3.5	4.1	116	52.7
	SR		–			–				4.0	4.6	148	67.3
VPVL700	DA	885	1305	528	14503	21385	8655	10.43	265	4.0	4.5	163	74.0
	SR		–			–				4.5	5.0	205	93.0
VPVL800	DA	1526	2441	917	25000	40000	15032	12.99	330	6.0	7.0	280	127.0
	SR		–			–				7.5	8.5	373	169.0

NOTES:

(1) The above times are based on the following conditions: A) Room temperature, B) Solenoid valve orifice diameter of 4 mm (5/32 in.) and a flow rate capacity of 400 L/min (14.1 cfm), C) Minimum inner piping diameter of 8 mm (5/16 in.), D) 5.5 bar (80 psi) air supply pressure, E) Without valve loading.

ACTUATOR SELECTION (CONTINUED)

SPRING RETURN

Actuator Model	Spring-Return Torque Output		Air Torque Output at Specified Supply Pressure			
	FT•LBS	N•m	FT•LBS, @ 60 psi	N•m @ 4.2 bar	FT•LBS @ 80 psi	N•m @ 5.5 bar
051 SR4/5	4.4	6.0	3.1	4.2		
051 SR6	5.9	8.0			4.1	5.6
100 SR4/5	7.4	10	6.7	9.1		
100 SR6	9.8	13.3			8.9	12
200 SR4/5	14.7	19.9	13	17		
200 SR6	19.6	26.5			17	23
250 SR4/5	24.3	33	18	24		
250 SR6	32.5	44.5			23	32
300 SR4/5	33.6	45.6	29	39		
300 SR6	44.9	60.8			38	52
350 SR4/5	54.4	73.8	44	60		
350 SR6	72.6	98.4			59	80
400 SR4/5	69.7	95	60	81		
400 SR6	93	126			80	108
450 SR4/5	109	148	94	128		
450 SR6	146	198			126	170
500 SR4/5	149	202	126	170		
500 SR6	199	269			168	227
550 SR4/5	210	285	153	208		
550 SR6	280	379			204	277
600 SR4/5	282	383	231	313		
600 SR6	376	510			308	418
650 SR4/5	479	649	399	541		
650 SR6	638	865			532	721
700 SR4/5	724	981	520	705		
700 SR6	966	1308			693	940
800 SR4/5	1221	1656	1105	1499		
800 SR6	1628	2207			1474	1999

DOUBLE ACTING

Actuator Model	Torque Output in FT•LBS - VPVL XXDA Double-Acting Actuator at Specified psi Supply Pressures						
	40 psi	50 psi	60 psi	70 psi	80 psi	90 psi	100 psi
VPVL 051	6.8	8.5	10.1	11.8	13.5	15.2	16.9
VPVL 100	12	14.9	17.9	20.9	23.9	26.8	29.8
VPVL 200	23.7	29.6	35	41	47	53	59
VPVL 250	37.2	46.6	55	65	74	83	93
VPVL 300	54	67.6	81	94	108	122	135
VPVL 350	87.5	109	131	153	175	197	219
VPVL 400	113	141	169	197	225	254	282
VPVL 450	177	221	265	310	354	398	442
VPVL 500	231	289	346	404	462	519	577
VPVL 550	312	390	467	545	623	701	779
VPVL 600	433	541	649	757	866	974	1082
VPVL 650	727	909	1091	1272	1454	1636	1818
VPVL 700	1055	1319	1583	1847	2111	2375	2638
VPVL 800	1833	2291	2749	3207	3665	4123	4581

Actuator Model	Torque Output in N•m - VPVL XXDA Double-Acting Actuator at Specified bar Supply Pressures						
	2.7 bar	3.5 bar	4.2 bar	4.8 bar	5.5 bar	6.2 bar	6.9 bar
VPVL 051	8.9	11.6	14	16	18.3	20.7	23
VPVL 100	16	20.5	24.6	28.1	32	36	40
VPVL 200	31	40	48	55	64	72	80
VPVL 250	48	66	79	90	103	117	130
VPVL 300	68	93	112	128	146	165	184
VPVL 350	115	150	181	207	236	266	296
VPVL 400	143	194	233	266	305	344	383
VPVL 450	224	304	365	417	478	539	600
VPVL 500	293	397	477	545	624	703	782
VPVL 550	395	536	643	735	842	949	1056
VPVL 600	575	745	893	1021	1170	1319	1468
VPVL 650	986	1232	1479	1725	1971	2218	2465
VPVL 700	1338	1815	2179	2490	2853	3216	3579
VPVL 800	2485	3106	3727	4348	4969	5590	6211

OPTIONS

Solenoid Valves

Direct-mounted solenoid valves are available in both 3-way and 4-way configuration, which mount directly to the actuator in accordance with NAMUR and VDI/VDE 3845 standards, excluding the VPVL650, 700 and 800. In general, 3-way solenoids are used for spring-return actuators and 4-way versions for double-acting.

Direct-Mount Solenoid Valves		
Part Number	031-0576-01	031-0580-01
Enclosure	NEMA IV	NEMA VII
Configuration	3 or 4-way	
Pipe Size	1/4" Inlet, 1/8" Exhaust	
Cv	0.7	
Voltage	Standard: 120 VAC 60 Hz (110/50) Optional: 240 VAC 60 Hz, 12 VDC, 24 VDC	
Body Material	Black Anodized Aluminum	
Power Consumption	AC: 6.9 watts or DC: 6.3 watts	
Humidity Resistant	Feature rebreather and are suitable for humid & tropical environment	

NOTE: Please consult factory for other solenoid valves or additional options including special voltages, double solenoids, special electrical connections, etc.

Mechanical Safety Lockout

To comply with the intent of OSHA requirements for locking actuators in position prior to performing maintenance, an actuator can have the mechanical safety lockout option added to it. Design of the stop cam allows for locking the actuator in either the full-open or full-closed position. Actuators equipped with this option have a special lockout screw and a tamperproof cover attached to the housing of the actuator with stainless steel wire. The lockout kits are readily available to permanently lock the actuator in place to prevent unwanted operation.

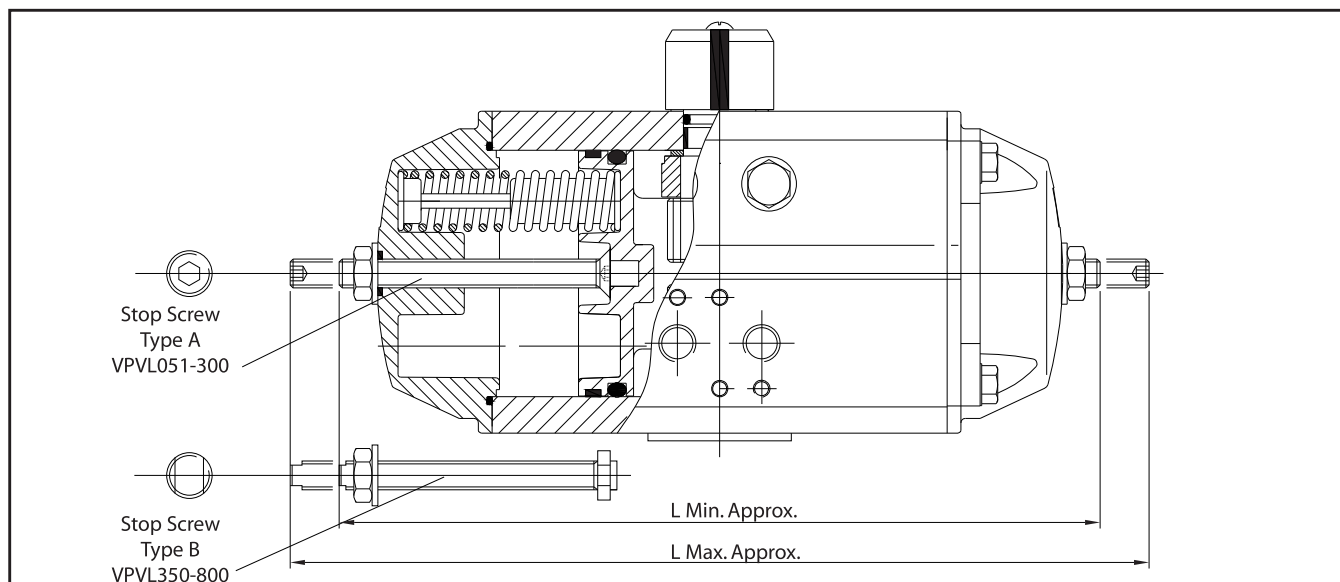
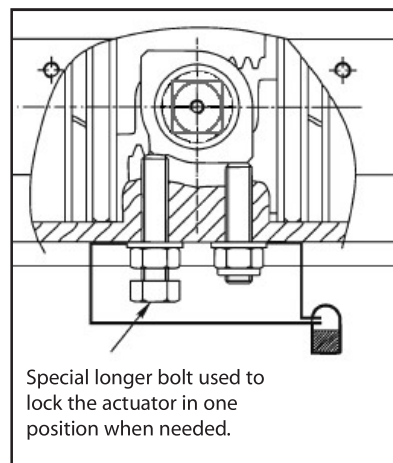
100% Adjustable Travel Stop

To limit the rotation on the stroke beyond the standard VPVL actuator, a stainless steel 100%-adjustable travel stop option can be added. The stops, located in the end caps,

allow the valve position to be set anywhere between full closed and full open. This option limits travel of only the counter-clockwise stroke for standard double-acting and spring-closed units. The 100% Adjustable Stop option is specified in the actuator ordering code.

Actuator	100% Travel Stop Lengths			
	L Min		L Max	
	inch	mm	inch	mm
VPVL051	6.2	158	7.3	186
VPVL100	7.2	184	8.5	216
VPVL200	9.5	242	11.3	286
VPVL250	11.0	280	13.0	330
VPVL300	11.9	303	14.1	359
VPVL350	14.0	356	16.7	424
VPVL400	14.5	368	17.5	444
VPVL450	17.7	449	21.1	537
VPVL500	18.1	461	21.9	555
VPVL550	20.9	531	24.8	631
VPVL600	24.7	628	29.1	739
VPVL650	25.7	653	30.9	785
VPVL700	30.0	762	36.1	918
VPVL800	35.8	910	42.8	1086

Lockout Kits	
VPVL051	LD98
VPVL100	LD99
VPVL200	LD100
VPVL250	LD101
VPVL300	LD102
VPVL350	LD103
VPVL400	LD104
VPVL450	LD105
VPVL500	LD106
VPVL550	LD107
VPVL600	LD108
VPVL650	LD109
VPVL700	LD110
VPVL800	LD111

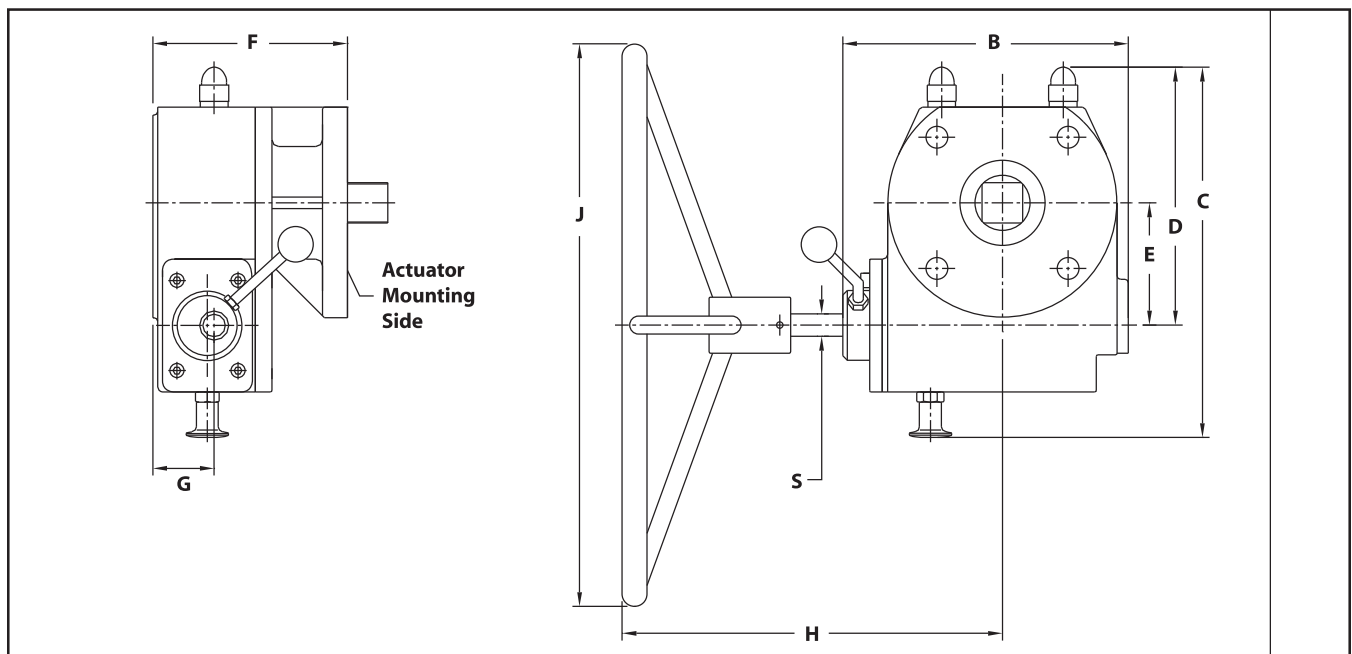


Declutchable Manual Override

A side-declutchable manual override is available for VPVL actuators. It consists of a manual gear actuator mounted between the actuator and the valve. The device is normally disengaged from the shaft. Upon engagement of the override clutch, overriding the actuator is done with ease, aided by the high-reduction ratio of the manual gear unit.



DIMENSIONS



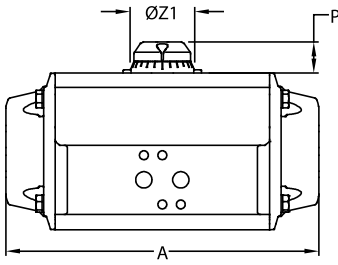
VPVL Actuator Model (DA or SR)	Declutchable Override Kit	Approximate Dimensions - Inches									Approx. Weight lbs.
		B	C	D	E	F	G	H	J	S	
VPVL250 and VPVL300	DO-1	5.75	6.89	5.61	2.36	4.53	1.44	8.94	7.87	0.47	22
VPVL350 and VPVL400	DO-2	7.68	9.49	6.06	2.48	5.63	2.09	10.28	7.87	0.59	40
VPVL450 and VPVL500	DO-3	8.74	11.12	7.46	3.31	6.30	2.48	10.63	11.81	0.79	50
VPVL550 and VPVL600	DO-4	9.84	12.84	9.00	4.23	6.77	2.36	13.31	19.69	0.79	84
VPVL650 and VPVL700*	DO-5	10.87	14.45	10.16	5.00	7.48	2.68	14.41	35.43	0.98	141
VPVL800	DO-6	13.39	16.69	12.32	6.06	8.07	3.07	15.63	39.37	0.98	201

* The VPVL700 DA unit may be used if the air pressure required to produce the needed output torque is lower than 95 psi.

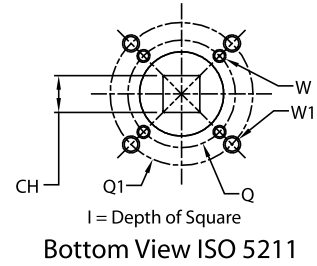
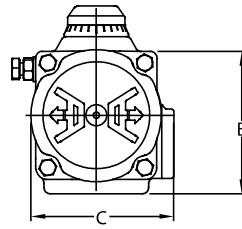
VPVL Actuator Model (DA or SR)	Declutchable Override Kit	Approximate Dimensions - mm									Approx. Weight kgs.
		B	C	D	E	F	G	H	J	S	
VPVL250 and VPVL300	DO-1	146	175	142	60	115	37	227	200	12	10
VPVL350 and VPVL400	DO-2	195	241	154	63	143	53	261	200	15	18
VPVL450 and VPVL500	DO-3	222	282	190	84	160	63	270	300	20	23
VPVL550 and VPVL600	DO-4	250	326	228	107	172	60	338	500	20	38
VPVL650 and VPVL700*	DO-5	276	367	258	127	190	68	366	900	25	64
VPVL800	DO-6	340	424	313	154	205	78	397	1000	25	91

* The VPVL700 DA unit may be used if the air pressure required to produce the needed output torque is lower than 6.5 bar.

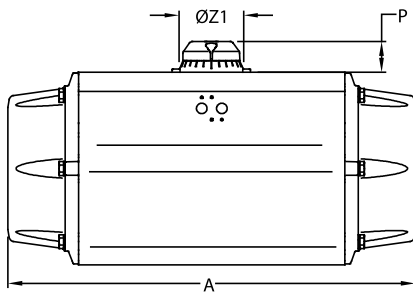
DIMENSIONS



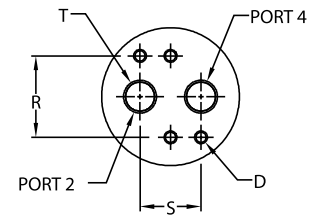
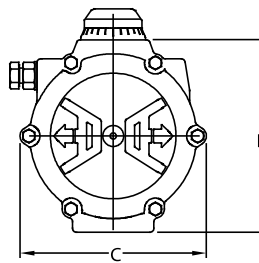
VPVL051 thru VPVL650



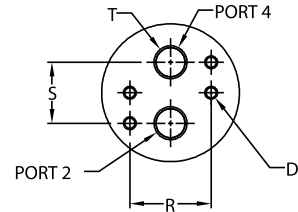
Bottom View ISO 5211



VPVL700

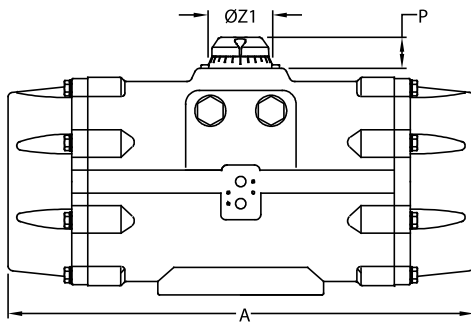


VPVL051 thru VPVL600

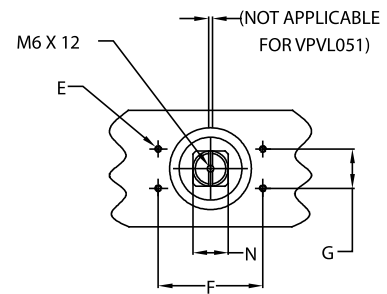
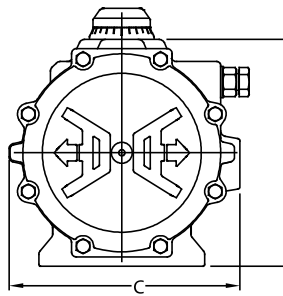


VPVL650 thru VPVL800

4 X 4

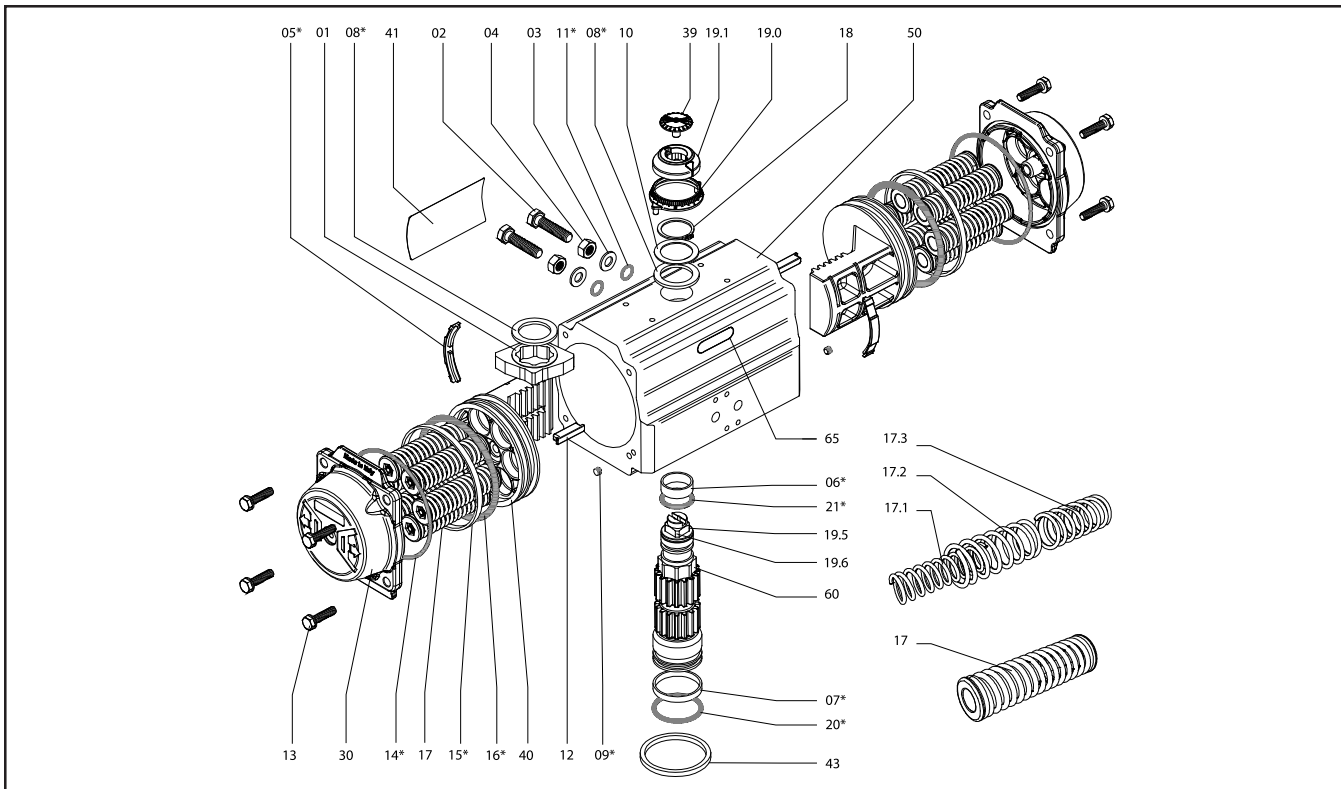


VPVL800



Size	Dimensions - inches																	Weight - pounds				
	A	B	C	D	E	F	G	N	P	R	S	T (NPT)	Z	ISO Flange	Q	Q1	W	W1	CH	I	DA	SR
VPVL051	5.39	2.72	2.83	M5 X 0.31	M5 X 0.31	3.15	1.18	0.43	0.79	1.26	0.94	1/8"	1.65	F03 + F05	1.42	1.97	M5	M6	0.43	0.47	2.2	2.4
VPVL100	6.04	3.35	3.33	M5 X 0.31	M5 X 0.31	3.15	1.18	0.43	0.79	1.26	0.94	1/8"	1.65	F05 + F07	1.97	2.76	M6	M8	0.55	0.63	3.5	3.7
VPVL200	8.01	4.02	3.66	M5 X 0.31	M5 X 0.31	3.15	1.18	0.67	0.79	1.26	0.94	1/8"	1.65	F05 + F07	1.97	2.76	M6	M8	0.55	0.63	6.0	6.8
VPVL250	9.49	4.53	4.06	M5 X 0.31	M5 X 0.31	3.15	1.18	0.67	0.79	1.26	0.94	1/8"	1.65	F05 + F07	1.97	2.76	M6	M8	0.75	0.83	8.2	9.5
VPVL300	10.20	5.00	4.67	M5 X 0.31	M5 X 0.31	3.15	1.18	0.67	0.79	1.26	0.94	1/4"	1.65	F07 + F10	2.76	4.02	M8	M10	0.75	0.83	11.5	13.4
VPVL350	11.97	5.71	5.39	M5 X 0.31	M5 X 0.31	3.15	1.18	1.06	1.18	1.26	0.94	1/4"	2.28	F07 + F10	2.76	4.02	M8	M10	0.87	0.94	17.6	20.5
VPVL400	13.11	6.18	5.79	M5 X 0.31	M5 X 0.31	3.15	1.18	1.06	1.18	1.26	0.94	1/4"	2.28	F07 + F10	2.76	4.02	M8	M10	0.87	0.94	21.6	25.8
VPVL450	15.53	6.97	6.54	M5 X 0.31	M5 X 0.31	3.15	1.18	1.06	1.18	1.26	0.94	1/4"	2.66	F10 + F12	4.02	4.92	M10	M12	1.06	1.38	31.3	38.4
VPVL500	16.63	7.72	7.13	M5 X 0.31	M5 X 0.31	3.15	1.18	1.06	1.18	1.26	0.94	1/4"	2.66	F10 + F12	4.02	4.92	M10	M12	1.06	1.38	39.9	49.2
VPVL550	18.66	8.68	7.87	M5 X 0.31	M5 X 0.31	5.12	1.18	1.42	1.97	1.26	0.94	1/4"	3.15	F14	5.51	5.51	M16	-	1.42	1.57	53.6	72.1
VPVL600	20.79	9.65	8.58	M5 X 0.31	M5 X 0.31	5.12	1.18	1.42	1.97	1.26	0.94	1/4"	3.15	F14	5.51	5.51	M16	-	1.42	1.57	75.2	92.4
VPVL650	23.82	11.75	10.16	M6 X0.39	M5 X 0.31	5.12	1.18	1.42	1.97	1.77	1.57	3/8"	4.53	F16	6.50	6.50	M20	-	1.81	1.89	116.2	148.4
VPVL700	27.95	12.99	12.56	M6 X0.39	M5 X 0.31	5.12	1.18	1.42	1.97	1.77	1.57	1/2"	4.53	F16	6.50	6.50	M20	-	1.81	1.97	163.1	205.0
VPVL800	34.49	16.14	16.46	M6 X0.39	M5 X 0.31	5.12	1.18	1.42	1.97	1.77	1.57	1/2"	4.53	F16 + F25	6.50	10.00	M20	M16	2.17	2.24	280.0	372.6

Size	Dimensions - millimeters																	Weight - kilograms				
	A	B	C	D	E	F	G	N	P	R	S	T (NPT)	Z	ISO Flange	Q	Q1	W	W1	CH	I	DA	SR
VPVL051	137.0	69	72	M5 X 8	M5 X 8	80	30	11	20	32	24	1/8"	42	F03 + F05	36	50	M5	M6	11	12	1.0	1.1
VPVL100	153.5	85	85	M5 X 8	M5 X 8	80	30	11	20	32	24	1/8"	42	F05 + F07	50	70	M6	M8	14	16	1.6	1.7
VPVL200	203.5	102	93	M5 X 8	M5 X 8	80	30	17	20	32	24	1/8"	42	F05 + F07	50	70	M6	M8	14	16	2.7	3.1
VPVL250	241.0	115	103	M5 X 8	M5 X 8	80	30	17	20	32	24	1/8"	42	F05 + F07	50	70	M6	M8	19	21	3.7	4.3
VPVL300	259.0	127	119	M5 X 8	M5 X 8	80	30	17	20	32	24	1/4"	42	F07 + F10	70	102	M8	M10	19	21	5.2	6.1
VPVL350	304.0	145	137	M5 X 8	M5 X 8	80	30	27	30	32	24	1/4"	58	F07 + F10	70	102	M8	M10	22	24	8.0	9.3
VPVL400	333.0	157	147	M5 X 8	M5 X 8	80	30	27	30	32	24	1/4"	58	F07 + F10	70	102	M8	M10	22	24	9.8	11.7
VPVL450	394.5	177	166	M5 X 8	M5 X 8	80	30	27	30	32	24	1/4"	68	F10 + F12	102	125	M10	M12	27	35	14.2	17.4
VPVL500	422.5	196	181	M5 X 8	M5 X 8	80	30	27	30	32	24	1/4"	68	F10 + F12	102	125	M10	M12	27	35	18.1	22.3
VPVL550	474.0	221	200	M5 X 8	M5 X 8	130	30	36	50	32	24	1/4"	80	F14	140	140	M16	-	36	40	24.3	32.7
VPVL600	528.0	245	218	M5 X 8	M5 X 8	130	30	36	50	32	24	1/4"	80	F14	140	140	M16	-	36	40	34.1	41.9
VPVL650	605.0	299	258	M6 X10	M5 X 8	130	30	36	50	45	40	3/8"	115	F16	165	165	M20	-	46	48	52.7	67.3
VPVL700	710.0	330	319	M6 X10	M5 X 8	130	30	36	50	45	40	1/2"	115	F16	165	165	M20	-	46	50	74.0	93.0
VPVL800	876.0	410	418	M6 X10	M5 X 8	130	30	36	50	45	40	1/2"	115	F16 + F25	165	254	M20	M16	55	57	127.0	169.0



BILL OF MATERIALS AND PARTS LIST

No.	Unit Qty	Part Description	Material	Specifications	Corrosion Protection
1	1	Octi-Cam (Stop Arrangement)	Stainless Steel1	EN 10088-3/ISO 10831	
2	2	Stop Cap Screw	Stainless Steel	ASTM A193	
3	2	Washer (Stop Cap Screw)	Stainless Steel	ISO 3506	
4	2	Nut (Stop Cap Screw)	Stainless Steel	ISO 3506	
5*	2	Bearing (Piston Back)	Polyphthalamide	Amodel ET1001HS	
6*	1	Bearing (Pinion Top)	Polyetherimide	Stanyl TW300	
7*	1	Bearing (Pinion Bottom)	Polyetherimide	Stanyl TW300	
8*	2	Thrust Bearing (Pinion)	Polyphthalamide	Amodel ET1001HS	
9*	2	Plug (Transfer Port)	Nitrile Rubber	NBR 70Shore A	
10	1	Thrust Washer (Pinion)	Stainless Steel	EN 10088-3	
11*	2	O-ring (Stop Cap Screw Seal)	Nitrile Rubber	NBR 70Shore A	
12	2	Piston Guide	Polyphthalamide GF	Amodel AS1145	
13	8/12/ 2	Cap Screw (End Cap)	Stainless Steel	ISO 3506	
14*	2	O-ring (End Cap)	Nitrile Rubber	NBR 70Shore A	
15*	2	Bearing (Piston Head)	Polyphthalamide	Amodel ET1001HS	
16*	2	O-ring (Piston)	Nitrile Rubber	NBR 70Shore A	
17	min. 4/ max.12	Spring (Cartridge)	Alloy Steel	DIN 17223 Part2	Epoxy Coated
17.1 17.2 17.3	max.2	Spring	Alloy Steel	DIN 17223 Part2	Epoxy Coated
18	1	Spring Clip (Pinion)	Carbon Steel	DIN 17222	ENP
19	1	Position Indicator3	High-grade Polymer/Stainless Steel		
19.0	1	Graduated Ring	High-grade Polymer		
19.1	1	Position Indicator	High-grade Polymer		
19.5	1	Top Adapter	Extruded Aluminum		
19.6	1	Hex Socket Screw	Stainless Steel		
20*	1	O-ring (Pinion Bottom)	Nitrile Rubber	NBR 70Shore A	
21*	1	O-ring (Pinion Top)	Nitrile Rubber	NBR 70Shore A	
30	1	End Cap	Aluminum	UNI 5075	Polyester-Coated
39	1	Cap Screw (Indicator)	Stainless Steel	ISO 3506	
40	2	Pistons	Aluminum	UNI 5075	Anodized
41	1	Actuator Identification Label	Polyester Aluminum		
50	1	Body	Aluminum	ASTM B221	Anodized PTFE-Coated
60	1	Drive Shaft	Carbon Steel Plated	ASTM A105	ENP
65	1	Plastic Label	High-grade Polymer		

* Suggested spare parts for maintenance

Notes: (1) AISI 420 for models VPVL-051 through 300; GS400-15 for models VPVL-350 through 800

(2) Qty 8 pieces for models VPVL-051 through 650; Qty 12 pieces for model VPVL-700 through 750; Qty 16 pieces for model VPVL800

(3) For models VPVL051 through 100

HOW TO ORDER

To specify a complete **Valv-Powr** Value-Line® Actuator, simply make a selection from the code boxes below.

EXAMPLE: VPVL 400 SR4/5 B AS D, shown below, is a 59 FT•LBS 60-psi (84 N•m @ 4.2 bar) spring-return actuator with spring-to-close rotation, hard-anodized PTFE-coated body, polyester-coated end caps, standard temperature rating, and 100% adjustable travel stops.

1	2	3	4	5	6	7
VPVL	400	SR4/5	B	AS	D	—

NOTE: for multiple options, specify them in order as listed in Item 5, for example: VPVL400 SR4/5 B HT AS Model C.

1	Product Group
VPVL	Valv-Powr Value-Line Double-Opposed Piston Actuator

2	Size
051,	Select from torque table
100, 200,	
250, 300,	
350, 400,	
450, 500,	
550, 600,	
650, 700,	
800	

3	Series+
DA	Valv-Powr Value-Line Double-Opposed Piston Actuator
SR4/5	Spring-Return 60-psi (4.1 bar) Spring-to-Close (CW Rotation)
SR6	Spring-Return 80-psi (5.5 bar) Spring-to-Close (CW Rotation)

+ Other spring rates on application

4	Exterior Protection*
B	Hard-Anodized PTFE-Coated Body & Polyester-Coated End Caps

* Consult factory for other protection options.

5	Options
—	Standard Temperature Rating: -40°F to +176°F (-40°C to +80°C)
HT	High-Temperature Rating: +5°F to +302°F (-15°C to +150°C)
LX	Low-Temperature Rating: -60°F to +176°F (-51°C to +80°C)
FO	Spring-to-Open (CCW Rotation)
AS	100% Travel Stop
LD	Mechanical Safety Lockout

Note* "LX" option must be ordered complete from the factory.

6	Model
D	Model D

7	Modifier Code
—	Standard

Subject to change without prior notice.

Metso Automation Inc.

Europe, Vanha Porvoontie 229, P.O. Box 304, FI-11301 Vantaa, Finland.
Tel. +358 20 483 150. Fax +358 20 483 151

North America, 44 Bowditch Drive, P.O. Box 8044, Shrewsbury, MA 01545, USA.
Tel. +1 508 852 0200. Fax +1 508 852 8172

South America, Av. Independência, 2500- Iporanga, 18087-101, Sorocaba-São Paulo
Brazil. Tel. +55 15 2102 9700. Fax +55 15 2102 9748/49

Asia Pacific, 20 Kallang Avenue, Lobby B, #06-00, PICO Creative Centre, Singapore 339411, Singapore.
Tel. +65 6511 1011. Fax +65 6250 0830

China, 19/F, the Exchange Beijing, No. 118, Jianguo Lu Yi, Chaoyang Dist, 100022 Beijing, China.
Tel. +86-10-6566-6600. Fax +86-10-6566-2575

Middle East, Roundabout 8, Unit AB-07, P.O. Box 17175, Jebel Ali Freezone, Dubai,
United Arab Emirates. Tel. +971 4 883 6974. Fax +971 4 883 6836

www.metso.com/automation




**MECHANICAL ENGINEERING
PRODUCTS COMPANY**

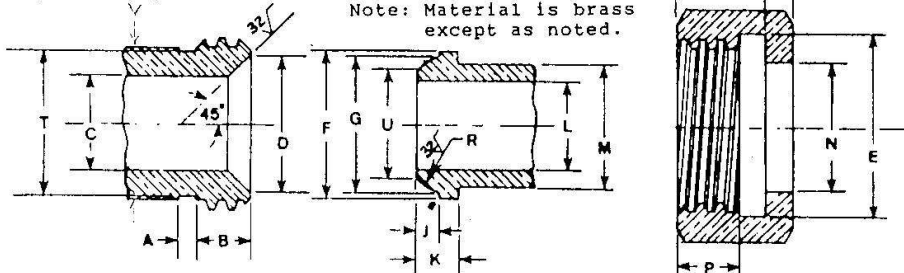
 1319 W. LAKE STREET
CHICAGO, ILLINOIS 60607-1511

CONNECTION NO. CO₂-150
1½" CARBON DIOXIDE CONNECTION

 STANDARD FOR CO₂ LIQUID AND VAPOR TRANSFER

NOTE: CALL FACTORY FOR OTHER OPTIONS

Description	Part #
FIXED END ASSY. -inc. fixed end & dust cap	C02-25100-15
FIXED END	C02-35100-15
DUST CAP	C02-45620-15
HOSE END ASSY. -inc. hose nut, head pc., ret. ring & dust plug	C02-15100-15
HOSE NUT	C02-43100-15
HEADPIECE	C02-47550-15
DUST PLUG	C02-46620-15
RETAINING RING-zinc plated steel	CFC-48601-15
ALUMINUM FIXED END WRENCH 1-3/8" x 2"	CFC-48650-AW
ALUMINUM HOSE NUT WRENCH 2-1/4" x 2-3/4"	CFC-48651-AW

 Note: Material is brass
except as noted.


FIXED END w/1½" mpt. 2-1/2" OAL - 2" flats		HEADPIECE w/1½" mpt. 2-5/8" OAL - 1-11/16" flats		HOSE NUT 2-3/4" Hex	
THREAD	2.250-6 ACME-2G-RH-EXT	THREAD	2.250-6 ACME-2G-RH-INT		
MAJOR DIA.	2.2500-2.2414	MINOR DIA.	2.0830-2.0917		
PITCH DIA.	2.1547-2.1335	PITCH DIA.	2.1667-2.1879		
MINOR DIA.	2.0634-2.0316	MAJOR DIA.	2.2700-2.2900		
A	.187	K	.468		
B	.490-.510	L	1.375 DIA.		
C	1.500 DIA.	M	1.895-1.905 DIA.		
D	1.910-1.930	N	1.920-1.930 DIA.		
E	2.312 MIN.	P	.600-.620		
F	2.065-2.075	R	.500 R		
G	1.955-1.965	S	1.090-1.110		
H	.850-.870	T	1.937 DIA.		
J	.240-.260	U	1.501-1.511 DIA.		
		V	2.250		

 Add'l
Desc.

 NOTE DIMENSIONS ARE SHOWN IN INCHES. UNSPECIFIED TOLERANCES ARE ±.015
FIXED END ASSY. w/1½"mpt., 1/2"mpt. port #C02-25102-15

Additional C02 fixed end listings

Note: assemblies (assy.) consist of fixed end and dust cap

<u>Product Number</u>	<u>Description</u>
C02-35001-10	1" C02 w/1" fpt.
C02-35002-10	1" C02 w-1/2" fpt. port, 1" mpt.
C02-35003-10	1" C02 w-1/2" fpt. port, 1-1/2" mpt.
C02-25002-10	1" C02 assy. w-1/2" fpt. port, 1" mpt.
C02-25003-10	1" C02 assy. w-1/2" fpt. port, 1-1/2" mpt.
ADP-10C02M-10C02M	1" C02 male x male adapter for hose splicing
C02-35101-15	1-1/2" C02 w/1-1/2" fpt.
C02-35102-15	1-1/2" C02 w-1/2" fpt. port, 1-1/2" mpt.
C02-25102-15	1-1/2" C02 assy. w-1/2" port, 1-1/2" mpt.
ADP-15C02M-15C02M	1-1/2" C02 male x male adapter for hose splicing
C02-35201-20	2" C02 w/1-1/2" mpt.
C02-35202-20	2" C02 w-1/2" fpt. port, 1-1/2" mpt.
C02-35203-20	2" C02 w-1/2" fpt. port, 2" mpt.
C02-25202-20	2" C02 assy. w-1/2" fpt. port, 1-1/2" mpt.
C02-25204-20	2" C02 assy. w-1/2" fpt. port, 2" mpt.
20FT-20FT-BH	2" brass hex coupling w/'U' bolt groove


**MECHANICAL ENGINEERING
PRODUCTS COMPANY**

 1319 W. LAKE STREET
CHICAGO, ILLINOIS 60607-1511

MATERIAL ALLOYS OF CO₂ STANDARD CONNECTIONS

CA932 Bearing Bronze for:

-Fixed Ends

-Headpieces

CA 360 Free Cutting Brass For:

-Dust Caps

-Hose Nuts

-Dust Plugs

**LETTER CODE DESCRIPTION FOR DIMENSIONS
ON DRAWINGS OF STANDARD CONNECTIONS**

Letter	Description
A	Clearance Groove Length
B	Fixed End Full Thread
C	Fixed End Bore
D	Inside Diameter Of Leading Edge
E	Clearance Diameter Before and/or After Threads
F	Flange Diameter On Headpiece
G	Diameter At Start Of Cone
H	Leading Edge Of Hose Nut To Inner Surface
I	Not Used
J	Length Of External Cone
K	Leading Edge Of Headpiece To Outer Surface Of Flange
L	Headpiece Bore
M	Headpiece Outside Diameter
N	Hose Nut Bore
O	Not Used
P	Hose Nut Full Thread
Q	Not Used
R	Radius Of External Seating Surface
S	Hose Nut Length
T	Clearance Groove Diameter
U	Diameter At End Of Cone
V	Fixed End Body Diameter

1/4" – 2" (DN 8 – 50) A-STYLE MODEL D THREADED END 2000 CWP BALL VALVE

The A-Style ball valve, brings you the performance and design features you've been looking for – all in a single, low-cost valve.

This ball valve's unique design offers fire-test specifications, rugged actuator mounting and flexible-lip seats for application versatility that surpasses other ball valves.

The A-Style ball valve is available in 1/4" – 2" (DN 8 – 50) sizes rated by the traditional approach for threaded end valves. This approach determines Cold Working Pressure (CWP) based on paragraph UG101 of the ASME Boiler and Pressure Vessel Code. Accordingly, the CWP of this series is as follows:

Valve Size		CWP Rating	
inches	DN	psi	bar
1/4" – 2"	8 – 50	2000	138

A-Style valves are available in carbon and stainless steel and are rated for steam applications with Xtreme® (X), PTFE (T) and Delrin® (R) seats.

FEATURES

Reliable Bi-Directional Shutoff

- New *Xtreme* seat provides longer life, expanded performance boundaries and greater value.



- Polymeric flexible lip-seat design offers tight shut-off in either direction and extended cycle life with minimum maintenance.

Fire-Tested

- Fire-Tite® valves meet API 607 requirements.

NEW FEATURES AND BENEFITS

- New patented stem seal system is live loaded and engineered to assure long sealing life.
- ISO 5211 Bonnet for global conformity.
- New stainless steel linkage for VPVL, V-Series and ADC-Series actuators has a guided coupling to align topworks during assembly and eliminate side load stress on stem seals for long life, clean environment and reduced maintenance.

Rugged Valve/Actuator Interface Simplifies Automation

- Jamesbury® actuators and linkage support up to a 200 lb. load in any direction without causing actuator misalignment and consequent stem seal leakage.

All constructions conform to MSS SP25 marking requirements

ISO bonnet pad for simplified mounting of actuators

Live loaded stem seal includes (3) compression zones for exceptional life cycle

Flexible lip seats compensate for changing pressure and temperature

Handle with slide lock

Graphite secondary seal for Fire-Tite valves

Full length pipe threads to ANSI B1.20.1 assures sealing

XTREME PERFORMANCE & VALUE

Xtreme seats provide longer life, expanded performance boundaries and the greatest possible value. *Xtreme* is a unique material that resulted from a technological breakthrough in our polymer research lab. The material is a fluoropolymer based blend, proprietary to *Jamesbury* that provides superior quarter turn valve performance.

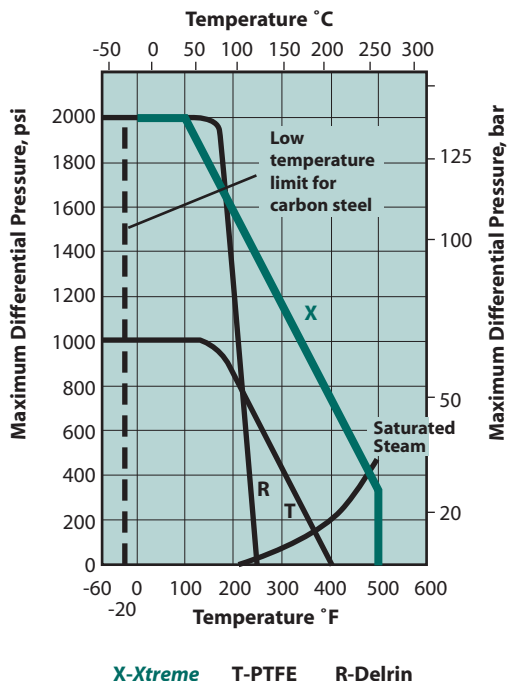
Valve Seat Ratings

These ratings are based on differential pressure with valve in the fully closed position and refer to seats only. Refer to valve body ratings to be sure that all components are satisfactory for the application.

Valve Body Ratings

These are maximum working pressure ratings of the valve body only. Valves in carbon steel are suitable for service to -20°F (-29°C), valves in 316 stainless steel to -60°F (51°C) (to -40°F with Delrin® seats). The preceding seat ratings determine the practical pressure limitation in actual working pressure. Ratings are at -20°F to +100°F (-29°C to +38°C).

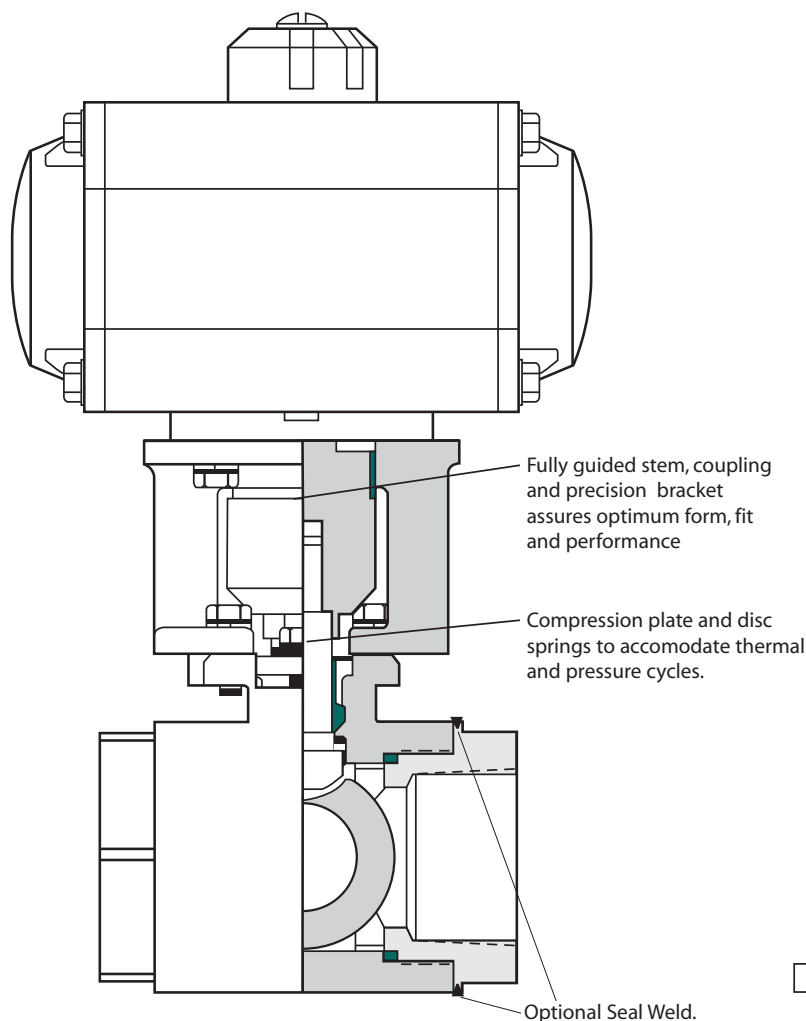
1 1/4" – 2" (DN 8 – 50) Standard Port



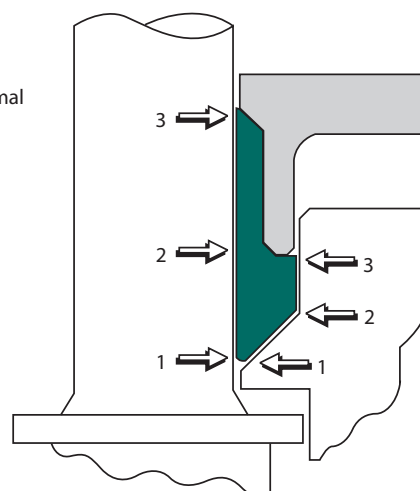
Valve Size Inches	Working Pressure Rating - psi	
	Carbon Steel	Stainless Steel
1/4" – 2"	2000	2000

Valve Size DN	Working Pressure Rating - bar	
	Carbon Steel	Stainless Steel
8 – 20	138	138

**Jamesbury 'The Ultimate Process Automation Package'
for VPVL Pneumatic Actuators, V-Series, ADC-Series, QX-Series and I-Series Electric Actuators**



Patented stem seal (70017915) has 3 engineered sealing zones to provide multiple barriers for long term sealing.

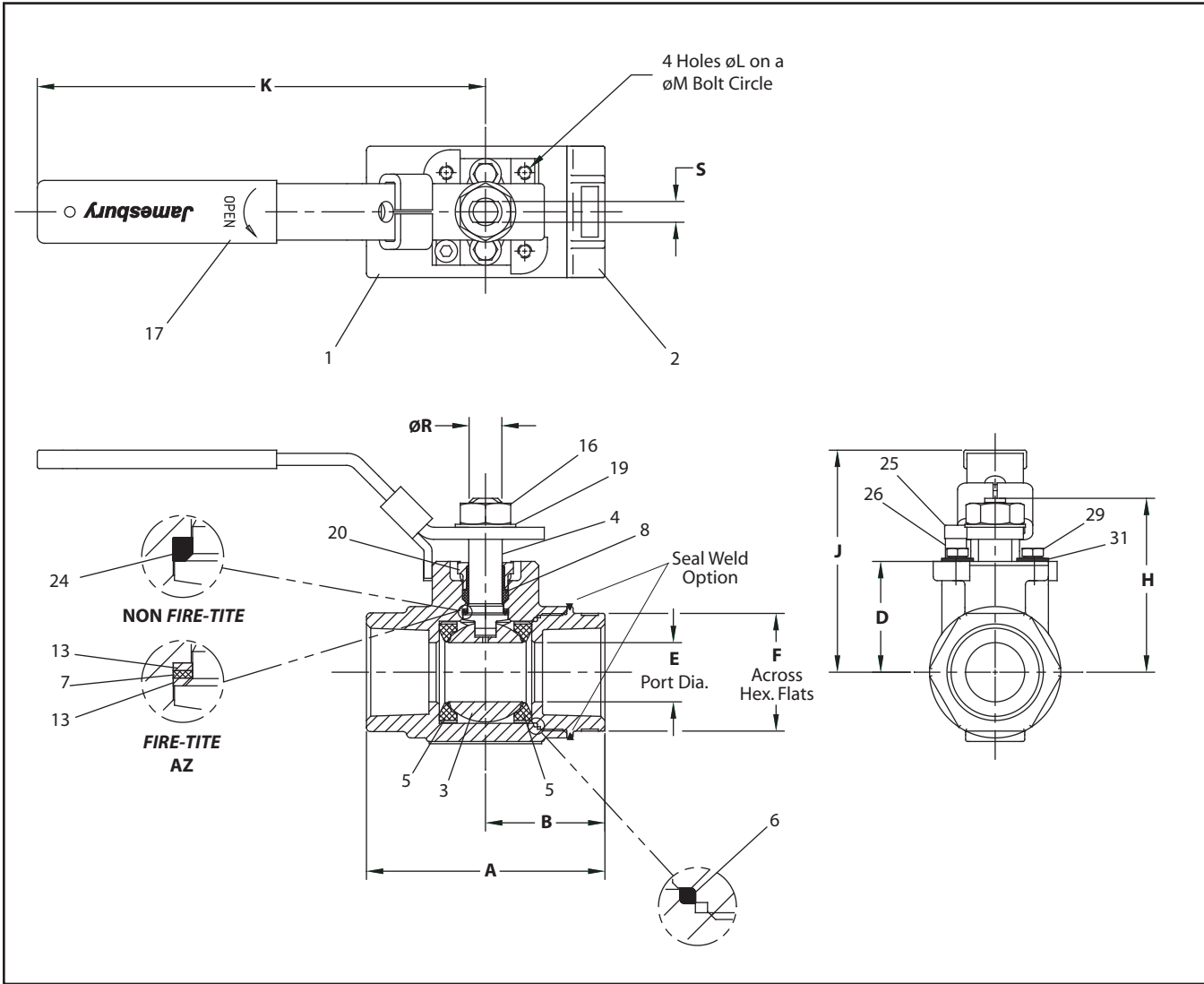


Automation Performance and Value

A-Style valves combined with *Jamesbury* actuators offer a total value and performance package. Available with pneumatic Valv-Powr® VPVL actuators, V-Series, ADC-Series, QX-Series and I-Series electric actuators and with Stonel®

Quartz®, Eclipse®, and Hawkeye® digital monitors or VCTs, the packages have a wide range of applications. Visit our website at www.metso.com/valves.

DIMENSIONS



Valve Size Inches	APPROXIMATE DIMENSIONS - inches													Approx. Weight lbs.
	A	B	D	E	F	H	J	K	L	M	R	S	ISO BONNET	
1/4	2.94	1.66	1.06	0.43	1.13	1.63	2.36	5.00	M5	1.42	0.31	0.18	F03	1.3
3/8	2.94	1.66	1.06	0.43	1.13	1.63	2.36	5.00	M5	1.42	0.31	0.18	F03	1.3
1/2	3.44	2.16	1.06	0.50	1.13	1.63	2.36	5.00	M5	1.42	0.31	0.18	F03	1.5
3/4	3.81	2.31	1.22	0.69	1.38	1.79	2.52	5.00	M5	1.42	0.31	0.18	F03	2.5
1	4.50	2.73	1.65	0.88	1.75	2.58	3.29	6.50	M5	1.65	0.50	0.31	F04	3.5
1-1/4	4.44	2.44	1.78	1.00	2.00	2.71	3.42	6.50	M5	1.65	0.50	0.31	F04	3.8
1-1/2	4.56	2.37	2.08	1.25	2.31	3.30	4.27	8.00	M6	1.97	0.63	0.37	F05	5.4
2	5.00	2.25	2.26	1.50	2.81	3.49	4.46	8.00	M6	1.97	0.63	0.37	F05	7.0

Valve Size DN	APPROXIMATE DIMENSIONS - mm													Approx. Weight kg
	A	B	D	E	F	H	J	K	L	M	R	S	ISO BONNET	
08	75	42	27	11	29	41	60	127	M5	36	08	05	F03	0.6
10	75	42	27	11	29	41	60	127	M5	36	08	05	F03	0.6
15	87	55	27	13	29	41	60	127	M5	36	08	05	F03	0.7
20	97	59	31	18	35	45	64	127	M5	36	08	05	F03	1.1
25	114	69	42	22	44	65	84	165	M5	42	13	08	F04	1.6
32	113	62	45	25	51	69	87	165	M5	42	13	08	F04	1.7
40	116	60	53	32	59	84	108	203	M6	50	16	09	F05	2.4
50	127	57	57	38	71	89	113	203	M6	50	16	09	F05	3.2

BILL OF MATERIALS AND PARTS LIST			
Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Body Cap	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
3	Ball	316 Stainless steel	
4	Stem	316 Stainless steel or 17-4 PH Stainless steel	
5	Seat	PTFE, Xtreme, Delrin®, as specified	
6	Body Seal	TFM®	
7	Secondary Stem Seal	Graphite*	
8	Stem Seal	PTFE, TFM (Xtreme seated valves)	
13	Stem Bearing	Filled PTFE (Delrin when Delrin seated)	
16	Hex Nut	316 Stainless steel	
17	Handle	Carbon steel (Zinc plated)	300 Series Stainless steel
19	Lock Washer	300 Series Stainless steel	
20	Compression Plate	316 Stainless steel	
25	Socket Cap Screw	316 Stainless steel	
26	Handle Stop Spacer	316 Stainless steel	
29	Hex Cap Screw	316 Stainless steel	
31	Disc Spring	17-7 PH Stainless steel	

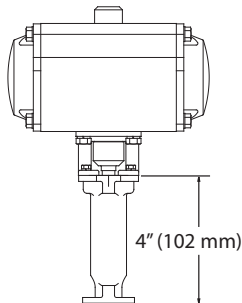
Requires 17-4 PH stem

* Item 7 not applicable in non Fire-Tite valves

ACCESSORIES

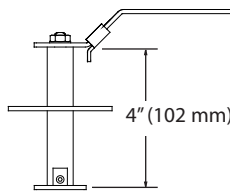
Bonnet Extension SE-096, 097 & 098

4" (102 mm) bonnet extensions are available for applications that require insulated pipe, particularly useful for automated products, bonnet extension can also be used to prevent interference between actuators and companion pipelines and equipment. They are ideal as extension that require locking lever or locking oval handle capability. Stainless steel construction offers the option of using the bonnet extension to enhance the carbon steel stem extension (SE-093, 094 & 095) offerings.



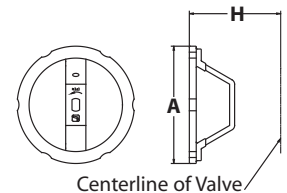
Stem Extensions SE-093, 094 & 095

A standard 4" (102 mm) stem extension is offered for improved accessibility, particularly when used in insulated pipelines. Stem extension kits can be ordered factory-mounted or shipped separately for field mounting.



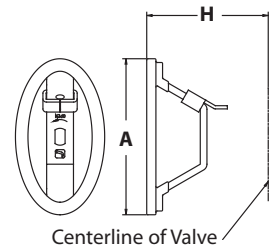
Round Handles

Optional round handles available. To order handles separately, specify the part number shown in the accessories table below.



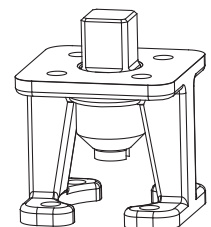
Oval handles with slide-lock

Optional oval handle saves space and may be pad-locked to retain the valve in the open or closed position.



Stainless steel linkages for Jamesbury ISO Actuators

- Self aligning
- Engineered for optimum stem seal performance



Accessories Table - inches (DN/mm)								
Valve Size Standard Bore	Bonnet Ext.*	Stem Ext.	Locking Oval	Round	Round/Oval Handle		Allowable Max. Torque FT•LBS	
					Dimension A	Dimension H	Round	Oval
1/4 – 1/2 (8 – 15)	SE-096	SE-093	112-0108-30	112-0105-30	4.00 (101.6)	2.96 (75.2)	9 (14)	9 (14)
3/4 (20)	SE-096	SE-093	112-0108-30	112-0105-30	4.00 (101.6)	3.11 (79.0)	9 (14)	9 (14)
1 (25)	SE-097	SE-094	112-0109-30	112-0106-30	4.50 (114.3)	3.70 (94.0)	18 (25)	18 (25)
1-1/4 (32)	SE-097	SE-094	112-0109-30	112-0106-30	4.50 (114.3)	3.83 (97.3)	18 (25)	18 (25)
1-1/2 (40)	SE-098	SE-095	112-0110-30	112-0107-30	5.75 (146.0)	4.75 (120.7)	25 (34)	25 (34)
2 (50)	SE-098	SE-095	112-0110-30	112-0107-30	5.75 (146.0)	4.94 (125.5)	25 (34)	25 (34)

* Use with Delrin® seats

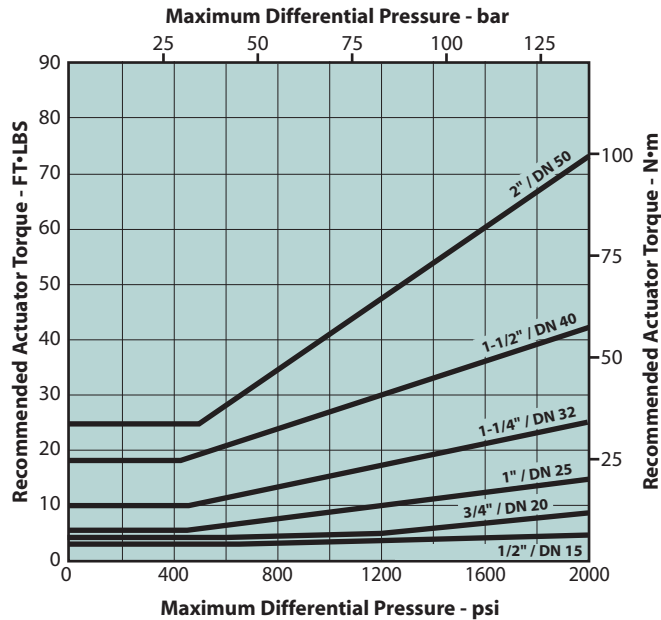
VALVE TORQUE DATA

These torque charts are to be used as a guide for actuator selection. Additional requirements may be imposed by media characteristics, trim, and frequency of valve operation. For clean lubricating fluid service, required torque of Xtreme (X), and PTFE (T) seated valves only may be reduced 20% when the valve is equipped with corrosion

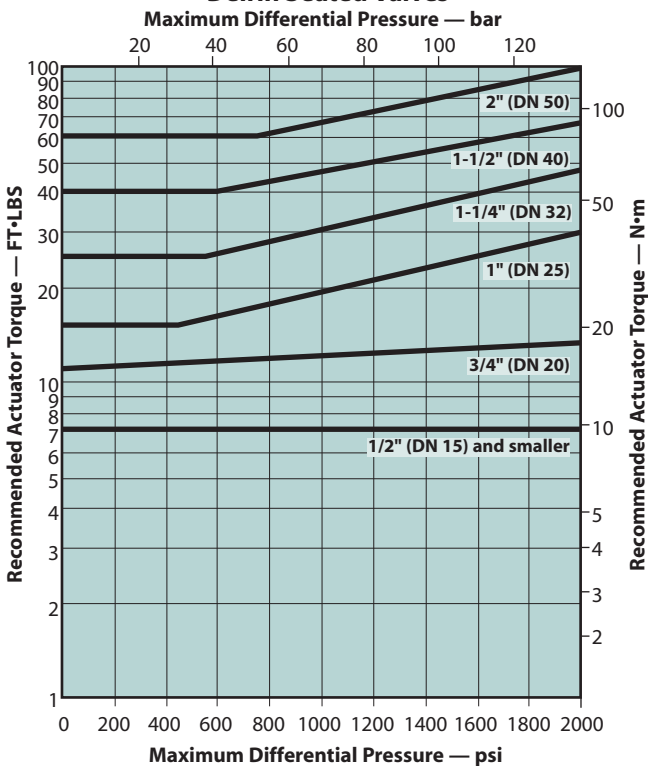
resistant trim. For difficult services such as slurries and semi-solids, and for oxygen, increase values by 50%. *If in doubt, select the larger actuator.*

Torque output values and actuator selection tables for the different types of Jamesbury actuators are contained in the bulletins listed on Page 7.

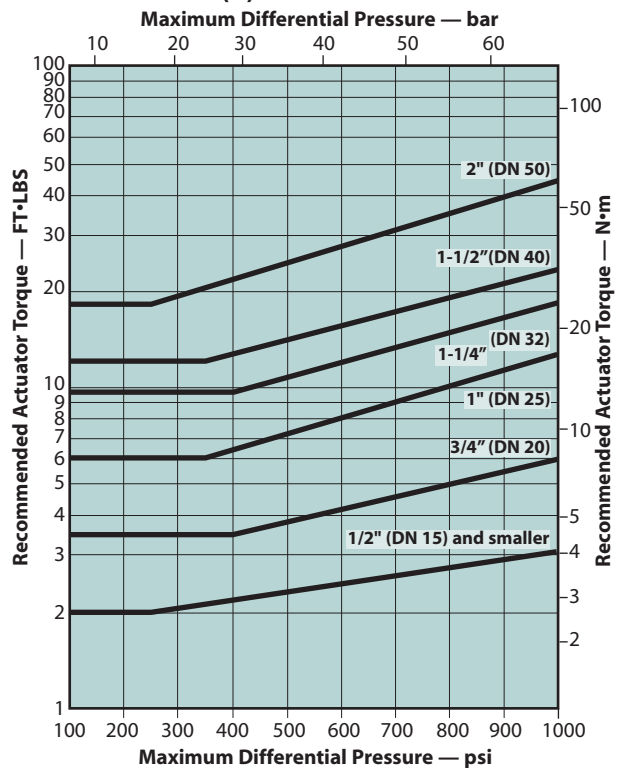
Xtreme (X) Seated Standard-Port Valves



Delrin Seated Valves



PTFE (T) Seated Valves



Actuators

Metso offers a full line of integrally designed actuators for automated systems or for easier control of inaccessible or remote valves. Pneumatic actuators that include double-acting and spring-return piston, vane and rack and pinion units, spring-diaphragm types, and electric actuators are available for all valves. Electric actuators are available in both watertight and hazardous location models.

For further information on actuators for A-Style valves, see the following:

Type	Bulletin
Spring Diaphragm Rotary Actuators	A110-4
Double Opposed Piston Actuators	A111-5
V-Series Electric Actuators	A200-1
ADC-Series Electric Actuators	A201-1
QX-Series Electric Actuators	A207-1
I-Series Electric Actuators	A206-1

Flow Data

The table below provides flow coefficients of reduced port A-Style valves. The C_v values represent the flow of water at +60°F through the valve in gallons per minute at a pressure drop of 1 psi. The metric equivalent, K_v , is the flow of water at 16°C through the valve in cubic meters per hour at a pressure drop of 1 kg/cm². To convert C_v to K_v multiply by 0.8569.

Valve Size		Cv	Equivalent length of pipe - ft.
Inches	DN		
1/4	8	6	.33
3/8	10	10	.61
1/2	15	13	1.5
3/4	20	33	1.1
1	25	44	2.1
1-1/4	32	46	8.4
1-1/2	40	95	4.5
2	50	111	12.0

HOW TO ORDER A-STYLE BALL VALVES

To specify a valve select the body style, the combination of body and trim material and the proper seat material for the application.

1	2	3	4	5	6	7	8
1-1/2	A	Z	—	22	36	XT	D

Example: This example is for a 1-1/2" *Fire-Tite* 2000 CWP NPT ball valve constructed of carbon steel body, stainless steel ball and stem, *Xtreme* seats, TFM seals and Model Code D.

1	Valve Size	
	Inches	DN
1/4	1/4	8
3/8	3/8	10
1/2	1/2	15
3/4	3/4	20
1	1	25
1-1/4	1-1/4	32
1-1/2	1-1/2	40
2	2	50

2	Body Style
A	1/4 – 2" (DN 8 – 50)

3	Conformance
—	Non <i>Fire-Tite</i>
Z	<i>Fire-Tite</i> to API 607

4	Special Application/Construction or Service
—	Standard
O	Oxygen
C	Chlorine
V	High Vacuum
VC	High Vacuum Certified
TG	Top Ground
STGR	Top & Bottom Ground
W	Seal Welded

Delrin® is a registered trademark of DuPont Co.

Monel® is a registered trademark of Inco

TFM® is a registered trademark of Dyneon Co.

5	Body Material
22	Carbon Steel (WCB)
36	316 Stainless Steel (CF8M)

6	Ball & Stem Material
00	Same as Body (Carbon Steel not Available)
36	316 Stainless Steel (CF8M)
HB	316 SS Ball, 17-4PH Stem
71	Monel

7	Seat & Seal Material	
	Seats	Seal (Stem & Body)
Standard		
TT	PTFE	PTFE & Graphite & TFM
XT	<i>Xtreme</i>	TFM & Graphite & TFM
Non <i>Fire-Tite</i> Only		
RT**	Delrin	PTFE & TFM

8	Model Code
D	A-Style Model D (Not Required for Ordering)

** Exclusively for Standard Construction. 17-4 PH stem required.
Not a self-relieving seat design.

Subject to change without prior notice.

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www.metso.com/valves



Changeover Valves

Type 06510 - Diverter Valve



Cryogenic Diverter Valves, bronze, PN50

for the installation of two safety valves,
provided for bursting disc connections,
"cleaned and degreased for oxygen service"

Part No. 06510.X.0120

Female thread connection (G) acc. to ISO 228/1

Part No. 06510.X.6000

Female thread connection NPT acc. to ANSI B 1.20.1

3212/3214

3210



Available Options - on request only:

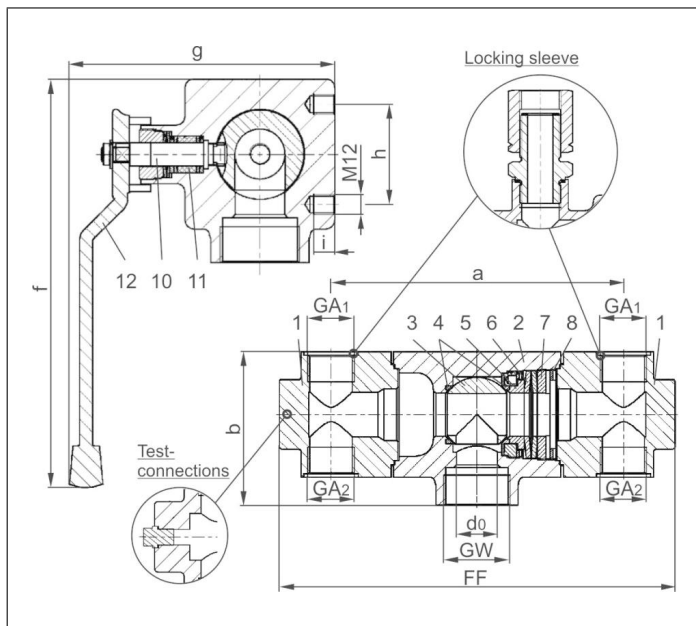
- Inlet with union type braze or butt weld fitting
- Two extra test connections 1/4" edgeways
- Outlet GA₁ with installed locking sleeve for easy positioning of safety valves
- Combination of different outlet threads GA₁ - GA₂
- **Safety lock (Part No. 55394.0049.0765)**

Applications:

Approved for air gases, vapours and cryogenic liquefied gases incl. LNG.

Working temperature: -196°C / -321°F (77K) up to +120°C / +248°F (393K)

Materials	DIN EN	ASTM
1 Body I	CC491K	B 62 UNS C83600
2 Body II	CC491K	B 62 UNS C83600
3 Ball	1.4571	A 276 Grade 316Ti
4 Seat rings	PCTFE	
5 Bush	CW614N	B 283 UNS C38500
6 Spring plates	1.4571	A 313 Grade 316Ti
7 Spring clamp	CW614N	B 283 UNS C38500
8 Thread ring	CW614N	B 283 UNS C38500
10 Stem	1.4301	A 276 Grade 304
11 Gland packing	Graphit / PTFE	
12 Lever	CC491K	B 62 UNS C83600



Standard marking acc. to Pressure Equipment Directive 2014/68/EU (PED).



Type 06510 - Standard design	Technical data			
Nominal size	DN	32	32	32
Dimension code	.X.	3210	3212	3214
Flow diameter	d ₀	30	30	30
Inlet	GW	1-1/2	1-1/2	1-1/2
Outlet	GA ₁	1	1-1/4	1-1/2
Outlet	GA ₂	1	1-1/4	1-1/2
Face-to-face dimension	FF	300	284	284
Length	a	210	210	210
Height	b	110	145	145
Length	f	245	245	245
Length	g	160	160	160
Length	h	60	60	60
Thread depth	i	12.5	12.5	12.5
Weight	ca. kg	12.2	13.5	13.5
Kvs - Value, one side open	m ³ /h	16.7	16.7	16.7
Cv - Value, one side open	gal /min	19.4	19.4	19.4

Dimensions in mm.

Important:

The valves must be fixed at the provided threads M12.

Needle Valves CMM250 Series and CFF250 Series

Application

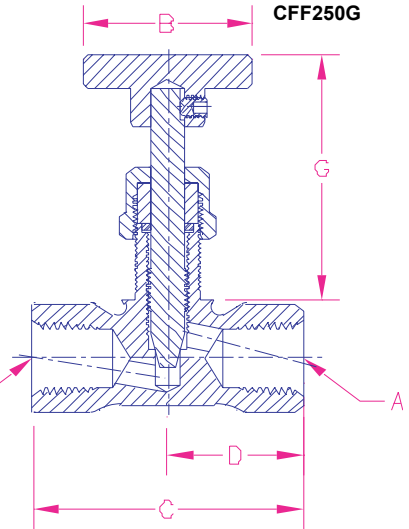
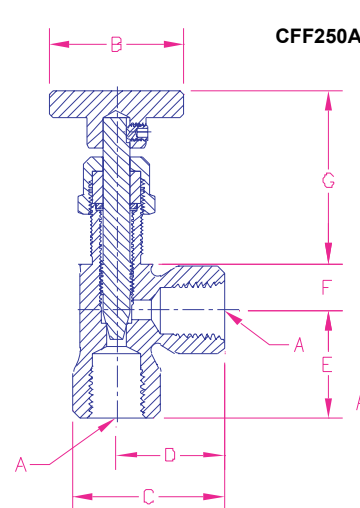
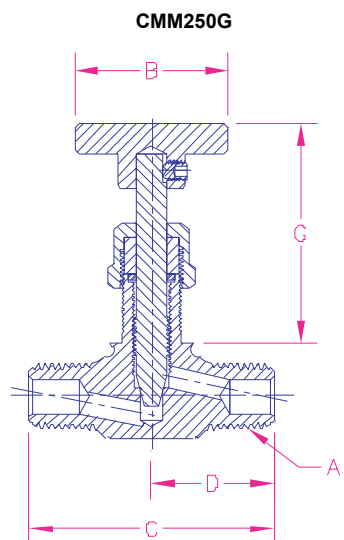
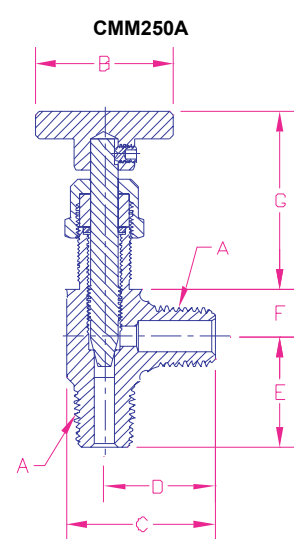
Ideal for use as a gauge isolation valve or applications requiring accurate throttling of pressure.

Features

- Compact design provides easy installation.
- Fine stem threading and long taper allow precise metering and leak-free shut-off.
- Internal stop prevents the stem from being accidentally unscrewed from the body.
- Rugged forged brass bodies withstand higher pressures.
- Unbreakable brass handwheel.
- Valves come equipped for panel mounting.
- Working temperature range is -40°F to +165°F. (-40°C to +74°C)
- Maximum operating pressure: 2000 psig air. (137.9 Bar)
- Cleaned for oxygen service per CGA G-4.1.
- Female ports available - consult factory.

Materials

Body	ASTM B283 Brass
Stem	Brass
Knob	Brass
Bonnet Nut.....	Brass
Panel Mount Nut (Optional).....	Brass
Set Screw	Steel
Stem Packing	PTFE with Brass Gland



Ordering Information

Part Number	A (NPT)	B (In.)	C (In.)	D (In.)	E (In.)	F (In.)	G (In.) Open	G (In.) Closed	Cv
CMM250A	1/4	1 1/4	1 11/32	1	1	7/16	2 5/32	1 19/32	.7
CMM250G	1/4	1 1/4	2	7/8		7/16	2 5/32	1 19/32	.5
CFF250A	1/4	1 1/4	1 13/32	3/4	1	7/16	2 3/16	1 5/8	.7
CFF250G	1/4	1 1/4	2	1		7/16	2 3/8	1 13/16	.5

Differential pressure gauge

Cryo Gauge, copper alloy or stainless steel, NS 160

Models 712.15.160 and 732.15.160

WIKA data sheet PM 07.30



for further approvals see
page 4

Cryo Gauge

Applications

- Level measurements in closed tanks, particularly in cryotechnology
- Filter monitoring
- Pump monitoring and control
- For gaseous and liquid media that are not highly viscous or crystallising and have no suspended solids

Special features

- Differential pressure measuring ranges from 0 ... 40 mbar to 0 ... 4,000 mbar
- High working pressure (static pressure) of 50 bar
- Overpressure safety either side up to 50 bar
- Scalable measuring ranges (maximum turndown of 1 : 3.5)
- Compact valve manifold with working pressure indication (optional)



Fig. top: Differential pressure gauge model 712.15.160

Fig. centre: Option valve manifold with working pressure indication

Fig. bottom: Option adapter for flange mounting

Description

These high-quality differential pressure gauges are notable for their compact and robust design and are primarily used for level measurement on liquid gas tanks.

With 6 different measuring cells, all usual tank sizes in cryotechnology are covered. The large overlap in measuring ranges of the measuring cells enables the setting for gas types such as Ar, O₂, N₂ or CO₂ over the entire scale with 270 angular degrees. The span adjustment is accessible from outside and does not affect the zero point.

The mechanical display and the integrated transmitter with 4 ... 20 mA output signal (optional) are calibrated simultaneously and easily. An optional valve manifold for flange mounting makes the central level measurement and working pressure indication possible in the one instrument. Switch contacts for level and working pressure, as well as a transmitter for the working pressure can be retrofitted on-site.

The standard centre distance of 37 mm between the process connections can be adapted to a custom centre distance of 31 mm or 54 mm using adapters for flange mounting.

Specifications

Models 712.15.160 and 732.15.160		
Nominal size in mm	160	
Accuracy class	2.5 Option: ■ 1.6 ■ 1.0	
Scale ranges	Measuring cell 140 mbar: Setting range 0 ... 40 mbar to 0 ... 140 mbar Measuring cell 280 mbar: Setting range 0 ... 80 mbar to 0 ... 280 mbar Measuring cell 560 mbar: Setting range 0 ... 160 mbar to 0 ... 560 mbar Measuring cell 1,130 mbar: Setting range 0 ... 320 mbar to 0 ... 1,130 mbar Measuring cell 2,300 mbar: Setting range 0 ... 650 mbar to 0 ... 2,300 mbar Measuring cell 4,000 mbar: Setting range 0 ... 1,150 mbar to 0 ... 4,000 mbar	
Scale	Single scale Option: Individual scale design	
Zero point setting	By means of adjustable pointer	
Overload safety and max. working pressure (static pressure)	Either side max. 50 bar	
Connection location	Lower mount (radial)	
Process connection	■ 2 x G ¼, female, centre distance 37 mm ■ 2 x ¼ NPT, female, centre distance 37 mm others on request Option: Adapter for process connection, see page 6	
Wetted materials		
Measuring cell flanges	Model 712.15: Copper alloy CW614N (CuZn39Pb3) Model 732.15: Stainless steel 316L	
Compression spring	Stainless steel 1.4310	
Separating diaphragm	NBR	
Transmission parts	Stainless steel 1.4301 and 1.4305	
Non-wetted materials		
Case	Stainless steel	
Bayonet ring	Stainless steel	
Movement	Stainless steel	
Dial	Aluminium, white	
Pointer	Adjustable pointer, black aluminium	
Window	Polycarbonate (PC)	
Ingress protection per IEC/EN 60529	IP65	
Mounting	According to affixed symbols ⊕ high pressure, ⊖ low pressure	

Permissible temperature ranges

	Non-Ex version: Models 712.15.160 and 732.15.160 optionally with model 891.44 ¹⁾	Ex version: Models 712.15.160 and 732.15.160 with model 892.44 ¹⁾
Ambient	-40 ... +60 °C with oxygen -40 ... +80 °C	-40 ... +60 °C for temperature class T6 and T5 -40 ... +80 °C for temperature class T4
Medium	-40 ... +60 °C with oxygen -40 ... +80 °C	-40 ... +60 °C with oxygen -40 ... +60 °C for temperature class T6 and T5 -40 ... +80 °C for temperature class T4

1) Integrated transmitter electronics see page 7

Design and operating principle

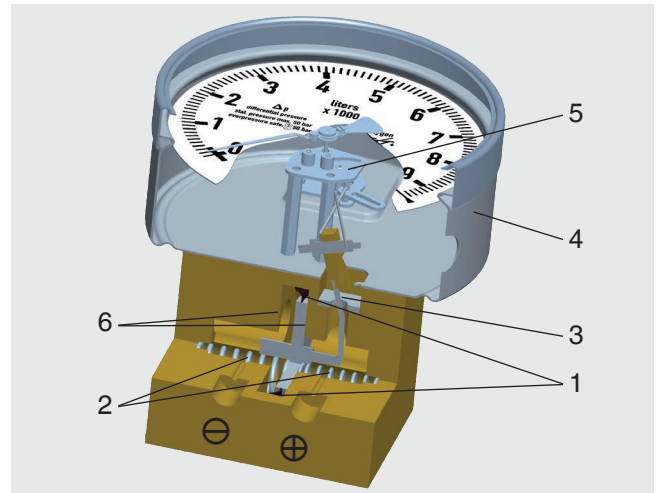
Pressures p_1 and p_2 act on the media chambers \oplus and \ominus , which are separated by an elastic diaphragm (1).

The differential pressure ($\Delta p = p_1 - p_2$) leads to an axial deflection of the diaphragm against the measuring range spring (2).

The deflection, which is proportional to the differential pressure, is transmitted to the movement (5) in the indicating case (4) via a pressure-tight and low friction lever mechanism (3).

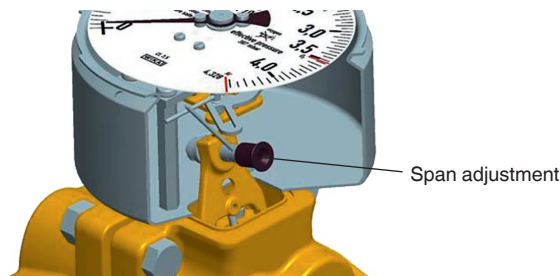
Overload safety is provided by metal bolsters (6) resting against the elastic diaphragm.

Illustration of the principle



Span adjustment

The measuring span of the differential pressure gauge can, depending on the measuring cell, be adjusted within the setting range specified to the left. Ideally, this adjustment to the setting range should be made on a test bench, though it can also be carried out at the measuring point using a hand test pump.












The span adjustment, situated at the 4 o'clock point on the case circumference, is accessible by removing the sealing cap. Pressurise the instrument with the required nominal pressure and, with a hexagon screwdriver (SW 3 mm) inserted into the funnel guide, adjust the pointer to the end value by turning it clockwise (smaller measuring range) or anti-clockwise (larger measuring range). If the instrument is equipped with a model 89x.44 transmitter, then this procedure will also adjust the output signal to the new measuring range. The instrument will then be fully adjusted to the required measuring range. After completing the adjustment the instrument should be re-sealed with the sealing cap.

Scale designs

The dials can be made to customer's requirements and also with multiple scales.

These can be printed with all usual units on them, e.g. kg, litre, m^3 , mmH_2O , $inchH_2O$, %, etc. Red marks for maximum fill level, customer logos and other custom printing are likewise possible. If desired, we can carry out the calculation for the tank fuel level from drawings of the tank geometry, and then make the appropriate scales.

Approvals

Logo	Description	Country
 	EU declaration of conformity <ul style="list-style-type: none"> ■ EMC directive ■ Pressure equipment directive ■ ATEX directive (option) ¹⁾ Hazardous areas - Ex ia Gas [II 2G Ex ia IIC T6/T5/T4 Gb]	European Union
 	IECEx (option) ¹⁾ Hazardous areas - Ex ia Gas [Ex ia IIC T6/T5/T4 Gb]	International
	EAC (option) <ul style="list-style-type: none"> ■ EMC directive ■ Pressure equipment directive ■ Low voltage directive ■ Hazardous areas ¹⁾ 	Eurasian Economic Community
	GOST (option) Metrology, measurement technology	Russia
	KazInMetr (option) Metrology, measurement technology	Kazakhstan
-	MTSCHS (option) Permission for commissioning	Kazakhstan
	BelGIM (option) Metrology, measurement technology	Belarus
	Uzstandard (option) Metrology, measurement technology	Uzbekistan
-	CPA Metrology, measurement technology	China
-	CRN Safety (e.g. electr. safety, overpressure, ...)	Canada
	BAM Oxygen application	Germany

¹⁾ Only for instruments with integrated transmitter model 892.44

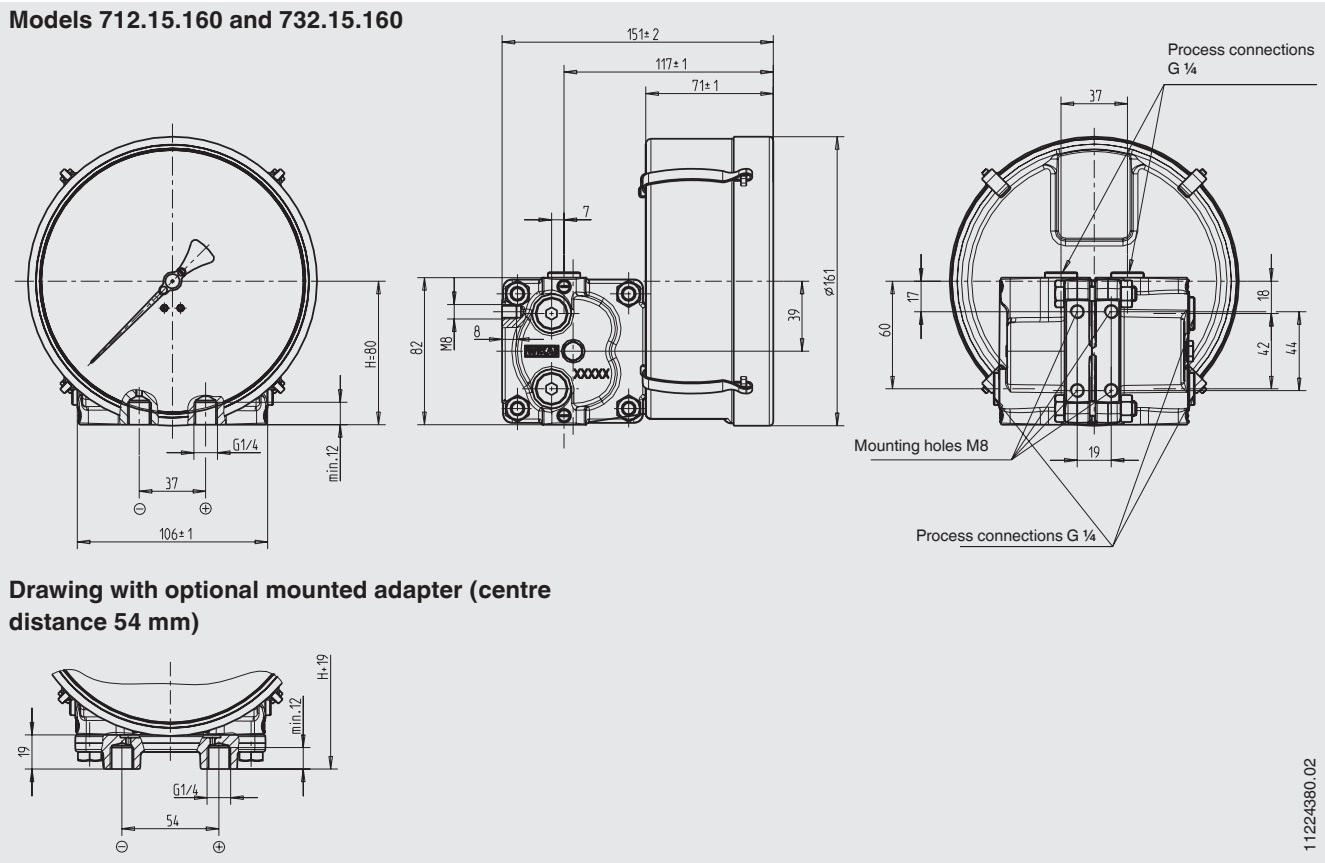
Certificates (option)

- 2.2 test report per EN 10204 (e.g. state-of-the-art manufacturing, indication accuracy)
- 3.1 inspection certificate per EN 10204 (e.g. indication accuracy)

Approvals and certificates, see website

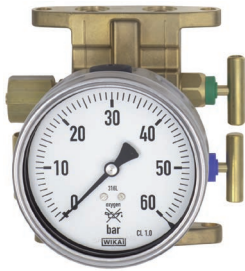
Dimensions in mm

Models 712.15.160 and 732.15.160



Option

Valve manifold (wetted) with working pressure indication



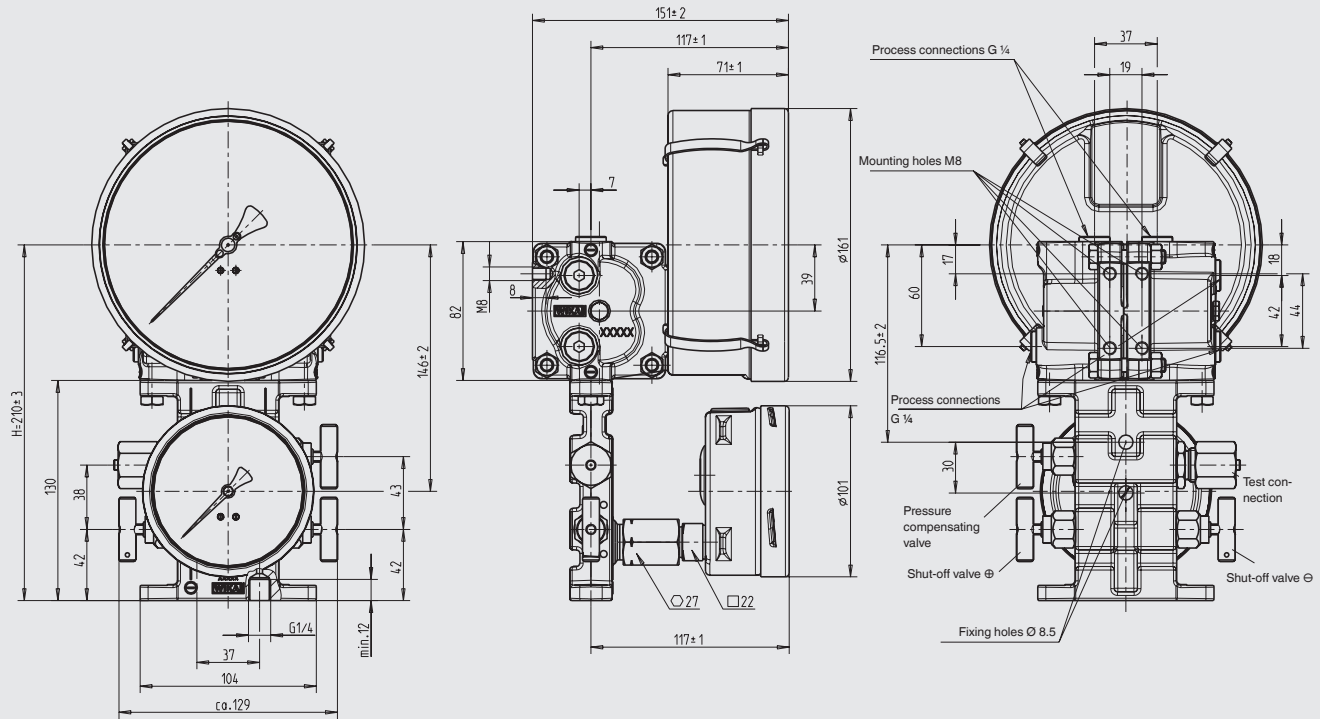
Specifications	
Valves	2 x shut-off valve, 1 x pressure compensating valve
Test connection	M20 x 1.5 with sealing cap (DIN 16287-A)
Valve body	<ul style="list-style-type: none"> ■ Copper alloy CW614N (CuZn39Pb3) for model 712.15 ■ Stainless steel 316L for model 732.15
Spindle with conical nipple	<ul style="list-style-type: none"> ■ Copper alloy for model 712.15 ■ Stainless steel 316L for model 732.15
Packing/sealing	NBR/PTFE With the valve fully-opened, the spindle area is isolated from the process by a metallic seal, the packing is not loaded and the spindle thread is not in contact with the measured media.
Working pressure indication	<ul style="list-style-type: none"> ■ Bourdon tube pressure gauge, copper alloy; model 212.20.100; see data sheet PM 02.01 ■ Bourdon tube pressure gauge, stainless steel, model 232.50.100, see data sheet PM 02.02 ■ Bourdon tube pressure gauge, stainless steel, safety version; model 232.30.100; see data sheet PM 02.04

All parts necessary for installation are included in the scope of delivery:

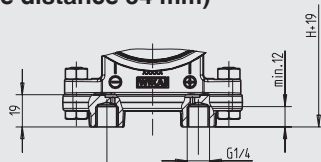
- 4 x hexagon screws M8 x 16
- 2 x O-ring sealing

Dimensions in mm

Models 712.15.160 or 732.15.160 mounted to the valve manifold with working pressure indication (option)



Drawing with optional mounted adapter (centre distance 54 mm)



Option

Adapter for process connection



The adapters can be flange-mounted either directly to the differential pressure gauge or to the valve manifold.

Specifications	
Material	<ul style="list-style-type: none"> ■ Copper alloy CW614N (CuZn39Pb3) for model 712.15 ■ Stainless steel 316L for model 732.15
Process connections (wetted)	2 x G 1/4, female, centre distance 31 mm or 54 mm or 2 x 1/4 NPT, female, centre distance 31 mm or 54 mm

All parts necessary for installation are included in the scope of delivery:

- 2 x hexagon screws M8 x 16
- 2 x hexagon screws M8 x 28
- 2 x nut M8
- 2 x O-ring sealing

Option

Integrated transmitter electronics

Non-Ex version: Model 891.44

Ex version: Model 892.44

WIKA differential pressure gauges with an integrated model 89x.44 transmitter combine all the advantages of an on-site mechanical display with the demands modern industry makes for electrical signal transmission for the detection of measured values.

The transmitter electronics are integrated into the case of the level indicator. The measuring span (electrical output signal) is adjusted automatically with the mechanical display, i.e. the scale over 270 angular degrees corresponds to 4 ... 20 mA.

The output signal can be changed over to the desired gas type by rotating the optional BCD switch (accessible through a sealing cap on the left side of the case) using a screwdriver.



Specifications	Models 891.44 and 892.44 (Ex version)
Output signal	4 ... 20 mA, 2-wire
Supply voltage U_B	Non-Ex version, model 891.44: DC 12 V < U_B ≤ 30 V Ex version, model 892.44: DC 14 V < U_B ≤ 30 V
Influence of supply voltage	≤ 0.1 % of full scale/10 V
Permissible residual ripple	≤ 10 % ss
Permissible max. load R_A	$R_A \leq (U_B - 12 \text{ V})/0.02 \text{ A}$ with R_A in Ω and U_B in V, however max. 600 Ω
Effect of load	≤ 0.1 % of full scale
Adjustability	
Zero point, electrical	Adjustment of the zero point through brief bridging of terminals 5 and 6 or using the "scale selection switch" option, selectable via button ¹⁾
Scale selection	4 scales selectable via BCD switch
Linear error	≤ 1.0 % of span (terminal method)
Compensated temperature range	-40 ... +80 °C
Temperature coefficients in the compensated temperature range	
Mean TC zero point	≤ 0.3 % of span/10 K
Mean TC span	≤ 0.3 % of span/10 K
Electrical connection	Cable socket PA 6, black Per VDE 0110 insulation group C/250 V Cable gland M20 x 1.5 Strain relief 6 screw terminals + PE for conductor cross-section 2.5 mm ²
Electrical safety	Protection against reverse polarity and overvoltage
Ingress protection	IP65 per EN/IEC 60529
Safety-related maximum values for Ex version, model 892.44	
Supply voltage U_i	DC 14 ... 30 V
Short-circuit current I_i	≤ 100 mA
Power P_i	≤ 720 mW
Internal capacitance C_i	≤ 17.5 nF
Internal inductance L_i	negligible
Designation of connection terminals, 2-wire	<div> <p>Do not use this terminal</p> <p>UB+/Sig</p> <p>+0 V/Sig-</p> <p>Terminals 3, 4, 5 and 6: For internal use only</p> <p>Connection ① must not be used for equipotential bonding. The instrument must be incorporated in the equipotential bonding via the process connection.</p> </div>

1) Only possible within 30 seconds of connecting the supply voltage

Option

Pressure sensor for working pressure

Non-Ex version: Model A-10

Ex version: Model IS-3

Pressure sensor for
working pressure

The pressure sensors for the working pressure are screwed into the minus media chamber on the left side and can also be mounted on-site, if required.

Process connection, pressure sensor: G 1/4 male

Specifications	A-10	IS-3
Data sheet	PE 81.60	PE 81.58
Ex version	No	Yes, intrinsically safe
Measuring ranges	0 ... 2.5 bar to 0 ... 60 bar	0 ... 2.5 bar to 0 ... 60 bar
Outputs	4 ... 20 mA	4 ... 20 mA (repeater power supply required)
Medium temperature	-30 ... +100 °C	-20 ... +60 °C
Ambient temperature	-30 ... +80 °C	-20 ... +60 °C
Wetted parts	Stainless steel	Stainless steel
Supply voltage U_B	DC 10 V < U_B ≤ 30 V	DC 10 V < U_B ≤ 30 V
Permissible max. load R_A	$R_A \leq (U_B - 8 \text{ V}) / 0.02 \text{ A}$	$R_A \leq (U_B - 10 \text{ V}) / 0.02 \text{ A}$
Accuracy, best fit straight line, BFSL	≤ 0.5 % of span	≤ 0.2 % of span
Compensated temperature range	0 ... +80 °C	0 ... +60 °C
Designation of connection terminals, 2-wire		

For dimensions see page 10

Option

Switch contacts

Single and double magnetic snap-action contact, model 828
1) for level indicator and/or working pressure.

A modular system of electromechanical switch contacts with plug connection, also suitable for retrofitting on-site, can be fitted both to the level indicator and to the working pressure indicator. The add-on unit can be fitted in just a few minutes to any pointer measuring instrument. The connection to the actual value pointer is made by means of a special yoke so that a carrier pin at the pointer itself is not needed.

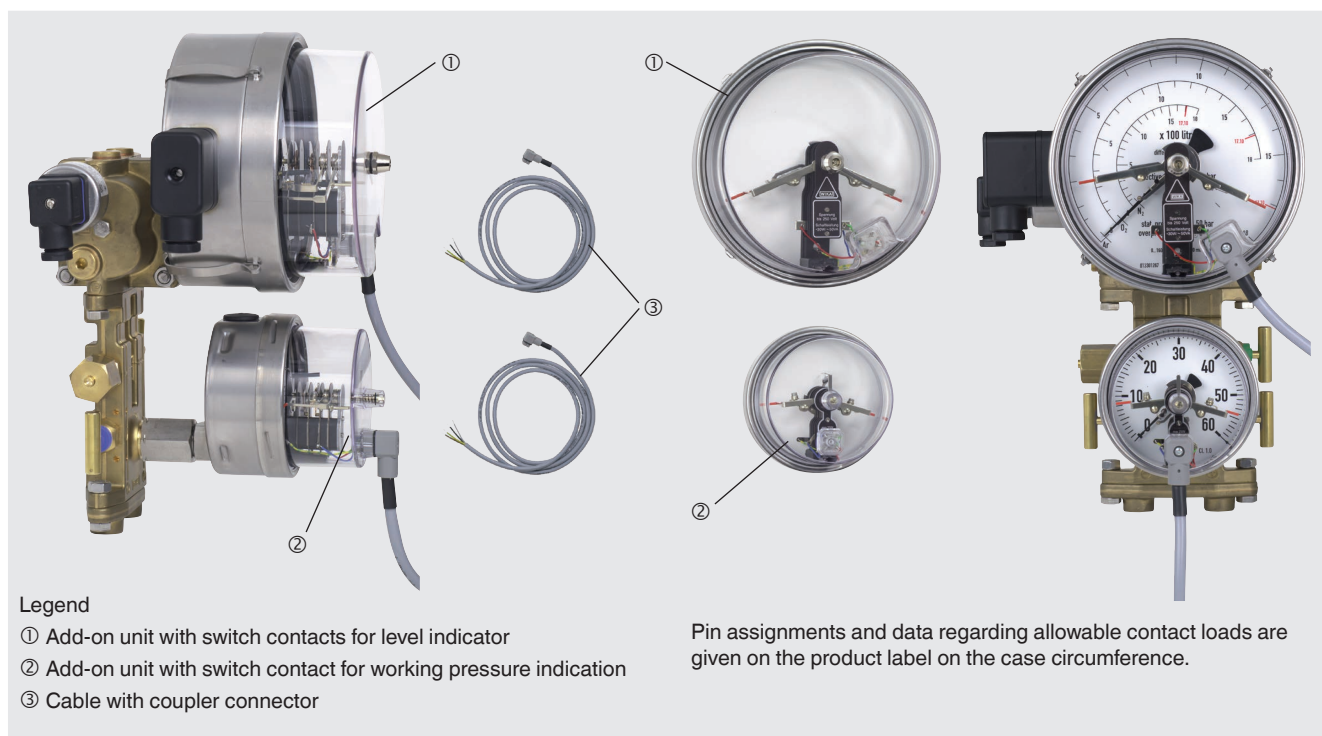
The set value pointer of the installed switch contacts are adjusted, from the outside, to the value at which the switching operation is to take place, using the adjustment lock with a separate or integral key.

1) For specifications and further information, see data sheet AC 08.01 under the identically constructed magnetic snap-action contact, model 821

Switching functions

- Index 1** behind the contact model no. means: **Contact makes** the circuit when the set point is exceeded.
- Index 2** behind the contact model no. means: **Contact breaks** the circuit when the set point is exceeded.
- Index 3** behind the contact model no. means: When the set value is exceeded, one circuit breaks and one circuit makes **simultaneously** (change-over contact).

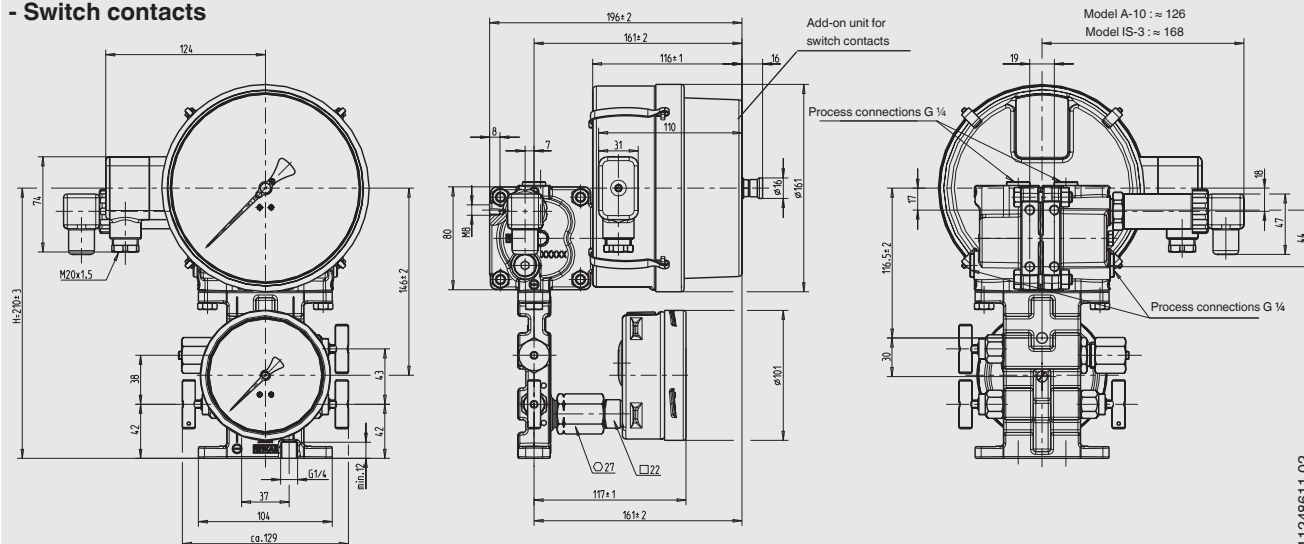
The switching functions are based on a clockwise rotational motion of the instrument pointer.



All parts necessary for installation are included in the scope of delivery:

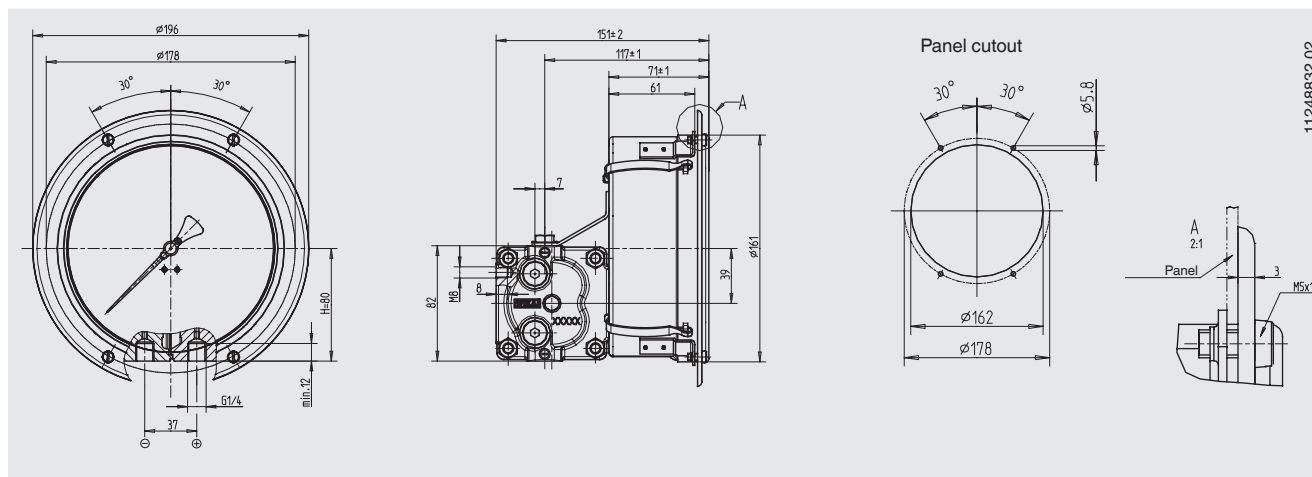
- Cable with coupler connector
- Centring screw M3 x 20
- Sealing

- Valve block with working pressure indication
- Pressure sensor for working pressure
- Switch contacts



Option

Panel mounting



Ordering information

Model / Scale range (measuring cell) / Scale design / Process connections with centre distance / Options

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We reserve the right to make modifications to the specifications and materials.

General Specifications

EJA110E Differential Pressure Transmitter

DP harp **EJA**

GS 01C31B01-01EN

The high performance differential pressure transmitter EJA110E features single crystal silicon resonant sensor and is suitable to measure liquid, gas, or steam flow as well as liquid level, density and pressure. EJA110E outputs a 4 to 20 mA DC signal corresponding to the measured differential pressure. Its accurate and stable sensor can also measure the static pressure which can be shown on the integral indicator or remotely monitored via BRAIN or HART communications. Other key features include quick response, remote set-up using communications and self-diagnostics. FOUNDATION Fieldbus, PROFIBUS PA and 1 to 5 V DC with HART (Low Power) protocol types are also available. All EJA-E series models in their standard configuration, with the exception of the Fieldbus, PROFIBUS and Low Power types, are certified as complying with SIL 2 for safety requirement.



■ STANDARD SPECIFICATIONS

Refer to GS 01C31T02-01EN for Fieldbus communication type and GS 01C31T04-01EN for PROFIBUS PA communication type for the items marked with "◇."

□ SPAN AND RANGE LIMITS

Measurement Span/Range	kPa	inH ₂ O (/D1)	mbar (/D3)	mmH ₂ O (/D4)
F*	Span	0.5 to 5	2.0 to 20	5 to 50
	Range	-5 to 5	-20 to 20	-50 to 50
L*	Span	0.5 to 10	2.0 to 40	5 to 100
	Range	-10 to 10	-40 to 40	-100 to 100
M	Span	1 to 100	4 to 400	10 to 1000
	Range	-100 to 100	-400 to 400	-1000 to 1000
H	Span	5 to 500	20 to 2000	50 to 5000
	Range	-500 to 500	-2000 to 2000	-5000 to 5000
V	Span	0.14 to 14 MPa	20 to 2000 psi	1.4 to 140 kgf/cm ²
	Range	-0.5 to 14 MPa	-71 to 2000	-5 to 140 kgf/cm ²

*: F capsule is applicable for wetted parts material code S.
L capsule is applicable for wetted parts material code other than S.

□ PERFORMANCE SPECIFICATIONS

Zero-based calibrated span, linear output, wetted parts material code S and silicone oil, unless otherwise mentioned.
For Fieldbus and PROFIBUS PA communication types, use calibrated range instead of span in the following specifications.

Specification Conformance

EJA-E series ensures specification conformance to at least $\pm 3\sigma$.

Reference Accuracy of Calibrated Span

(includes terminal-based linearity, hysteresis, and repeatability)

Measurement span	F
Reference accuracy	X ≤ span $\pm 0.055\%$ of Span
	X > span $\pm (0.005 + 0.02 \text{ URL}/\text{span})\%$ of Span
X	2 kPa (8 inH ₂ O)
URL (upper range limit)	5 kPa (20 inH ₂ O)

Measurement span	M
Reference accuracy	X ≤ span $\pm 0.055\%$ of Span
	X > span $\pm (0.005 + 0.0025 \text{ URL}/\text{span})\%$ of Span
X	5 kPa (20 inH ₂ O)
URL (upper range limit)	100 kPa (400 inH ₂ O)

Measurement span	H
Reference accuracy	X ≤ span $\pm 0.055\%$ of Span
	X > span $\pm (0.005 + 0.01 \text{ URL}/\text{span})\%$ of Span
X	100 kPa (400 inH ₂ O)
URL (upper range limit)	500 kPa (2000 inH ₂ O)

Measurement span	V
Reference accuracy	X ≤ span $\pm 0.055\%$ of Span
	X > span $\pm (0.005 + 0.005 \text{ URL}/\text{span})\%$ of Span
X	1.4 MPa (200 psi)
URL (upper range limit)	14 MPa (2000 psi)

[When /HAC is specified]

Measurement span		M
Reference accuracy	X ≤ span	±0.04% of Span
	X > span	±(0.002+0.0019 URL/span)% of Span
X		5 kPa (20 inH ₂ O)
URL (upper range limit)		100 kPa (400 inH ₂ O)

Measurement span		H
Reference accuracy	X ≤ span	±0.04% of Span
	X > span	±(0.005+0.0049 URL/span)% of Span
X		70 kPa (280 inH ₂ O)
URL (upper range limit)		500 kPa (2000 inH ₂ O)

Measurement span		V
Reference accuracy	X ≤ span	±0.04% of Span
	X > span	±(0.005+0.0013 URL/span)% of Span
X		500 kPa (2000 inH ₂ O)
URL (upper range limit)		14 MPa (2000 psi)

● Total Probable Error (M capsule)

±0.20% of Span @1:1 to 5:1 Rangedown
Total probable error, known as a measure of the total performance of the transmitters under the condition of fixed line pressure.

$$\text{Total Probable Error} = \pm \sqrt{E_1^2 + E_2^2 + E_3^2}$$

E1: Reference Accuracy of Calibrated Span
E2: Ambient Temperature Effects per 28°C change
E3: Static Span Effects per 6.9 MPa change

● Total Accuracy (M capsule)

±0.17% of Span @1:1 Rangedown
±0.33% of Span @ 5:1 Rangedown
Total accuracy is a comprehensive measure of transmitter total performance, covering all major factors in actual installation, that cause errors in measurement.

As a standard measure, YOKOGAWA uses this to evaluate transmitter performance.

$$\text{Total Accuracy} = \pm \sqrt{E_1^2 + E_2^2 + (E_3 + E_4)^2 + E_5^2}$$

E1: Reference Accuracy of Calibrated Span
E2: Ambient Temperature Effects per 28°C change
E3: Static Span Effects per 6.9 MPa change
E4: Static Zero Effects per 6.9 MPa change
E5: Overpressure Effects upto overpressure 16MPa

Not only a day-to-day changes in temperature can affect the measurement and lead to unnoticed errors; fluctuation of line pressure, incorrect operation of three/five valve manifold leading to over-pressure events, and other phenomena can have the similar result. Total Accuracy factors in such changes and errors and provides much comprehensive and practical determination of how a transmitter will perform under actual plant operation.

Square Root Output Accuracy

The square root accuracy is a percent of flow span.

Output	Accuracy
50% or Greater	Same as reference accuracy
50% to Dropout point	$\frac{\text{Reference accuracy} \times 50}{\text{Square root output (\%)}}$

Ambient Temperature Effects per 28°C (50°F) Change

Capsule	Effect
F	±(0.08% Span + 0.18% URL)
M	±(0.07% Span + 0.02% URL)
H	±(0.07% Span + 0.015% URL)
V	±(0.07% Span + 0.03% URL)

Static Pressure Effects per 6.9 MPa (1000 psi) Change**Span Effects**

F, M, H and V capsules

±0.1% of span

Effect on Zero

Capsule	Effect
F	±(0.04% span+0.208% URL)
M, H, V	±0.028% URL

Overpressure Effects

Overpressure condition: up to maximum working pressure

M, H and V capsules

±0.03% of URL

Stability (All normal operating condition, including overpressure effects)

M, H and V capsules

±0.1% of URL per 10 years

F capsule

±0.2% of URL per one year

Power Supply Effects(Output signal code D and J)

±0.005 % per Volt (from 21.6 to 32 V DC, 350Ω)

Vibration Effects

Amplifier housing code 1 and 3:

Less than 0.1% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10-60 Hz, 0.21 mm displacement/60-2000 Hz 3 g)

Amplifier housing code 2:

Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field with general application or pipeline with low vibration level (10-60 Hz 0.15mm displacement /60-500 Hz 2g)

Mounting Position Effects

Rotation in diaphragm plane has no effect. Tilting up to 90 degree will cause zero shift up to 0.4 kPa (1.6 inH₂O) which can be corrected by the zero adjustment.

Response Time (Differential pressure) “◇”

90 ms for Wetted Parts material code S, except for Measurement span code F. 150 ms for Wetted Parts Material Code H, M, T, A, B, D and W or Measurement span code F.

When amplifier damping is set to zero and including dead time of 45 ms (nominal)

Static Pressure Signal Range and Accuracy (For monitoring via communication or on indicator. Includes terminal-based linearity, hysteresis, and repeatability)

Range

Upper Range Value and Lower Range Value of the static pressure can be set in the range between 0 and Maximum Working Pressure(MWP). The upper range value must be greater than the lower range value. Minimum setting span is 0.5 MPa(73 psi). Measuring either the pressure of high pressure side or low pressure side is user-selectable.

Accuracy

Absolute Pressure

1 MPa or higher: $\pm 0.5\%$ of span

Less than 1 MPa: $\pm 0.5\% \times (1 \text{ MPa}/\text{span})$ of span

Gauge Pressure Reference

Gauge pressure reference is 1013 hPa (1 atm)

Note: Gauge pressure variable is based on the above fixed reference and thus subject to be affected by the change of atmospheric pressure.

□ FUNCTIONAL SPECIFICATIONS

Output “◇”

For 4 to 20 mA HART / BRAIN (Output signal code D and J)

Two wire 4 to 20 mA DC output with digital communications, linear or square root programmable. BRAIN or HART FSK protocol are superimposed on the 4 to 20 mA signal.

Output range: 3.6 mA to 21.6 mA

Output limits conforming to NAMUR NE43 can be pre-set by option code C2 or C3.

For 1 to 5 V HART

(Output signal code Q)

Three or four wire low power 1 to 5 V DC output with HART, linear or square root programmable.

HART protocol are superimposed on the 1 to 5 V DC signal.

Output range: 0.9 V to 5.4 V DC

Failure Alarm

For 4 to 20 mA HART / BRAIN (Output signal code D and J)

Analog output status at CPU failure and hardware error;

Up-scale: 110%, 21.6 mA DC or more (standard)

Down-scale: -5%, 3.2 mA DC or less

For 1 to 5 V HART

(Output signal code Q)

Analog output status at CPU failure and hardware error;

Up-scale: 110%, 5.4 V DC or more (standard)

Down-scale: -5%, 0.8 V DC or less

Damping Time Constant (1st order)

Amplifier damping time constant is adjustable from 0.00 to 100.00 s by software and added to response time.

Note: For BRAIN protocol type, when amplifier software damping is set to less than 0.5 s, communication may occasionally be unavailable during the operation, especially while output changes dynamically. The default setting of damping ensures stable communication.

Update Period “◇”

Differential pressure: 45 ms

Static pressure: 360 ms

Zero Adjustment Limits

Zero can be fully elevated or suppressed, within the lower and upper range limits of the capsule.

External Zero Adjustment

External zero is continuously adjustable with 0.01% incremental resolution of span. Re-range can be done locally using the digital indicator with rangesetting switch.

Integral Indicator (LCD display, optional) “◇”

5-digit numerical display, 6-digit unit display and bar graph.

The indicator is configurable to display one or up to four of the following variables periodically;

Measured differential pressure, differential pressure in %, scaled differential pressure, measured static pressure. See also “Factory Setting.”

Local Parameter Setting

(Output signal code D, J and Q)

Parameter configuration by the external zero adjustment screw and push button (Integral indicator code E) offers easy and quick setup for parameters of Tag number, Unit, LRV, URV, Damping, Output mode (linear/square root), Display out 1, and Re-range by applying actual pressure (LRV/URV).

Burst Pressure Limits

69 MPa (10,000 psi) for wetted parts material S, except for Measurement span F.

47 MPa (6,800 psi) for wetted parts material other than S or Measurement span F.

Self Diagnostics

CPU failure, hardware failure, configuration error, and over-range error for differential pressure, static pressure and capsule temperature.

User-configurable process high/low alarm for differential pressure and static pressure is also available.

Signal Characterizer (Output signal code D, J and Q)

User-configurable 10-segment signal characterizer for 4 to 20 mA output.

SIL Certification

EJA-E series transmitters except Fieldbus, PROFIBUS PA and 1-5V DC with HART (Low Power) communication types are certified in compliance with the following standards;

IEC 61508: 2000; Part1 to Part 7

Functional Safety of Electrical/electronic/programmable electronic related systems; SIL 2 capability for single transmitter use, SIL 3 capability for dual transmitter use.

□ NORMAL OPERATING CONDITION (Optional features or approval codes may affect limits.)

Ambient Temperature Limits

-40 to 85°C (-40 to 185°F)

-30 to 80°C (-22 to 176°F) with LCD display

Process Temperature Limits

-40 to 120°C (-40 to 248°F)

Ambient Humidity Limits

0 to 100% RH

Working Pressure Limits (Silicone oil)

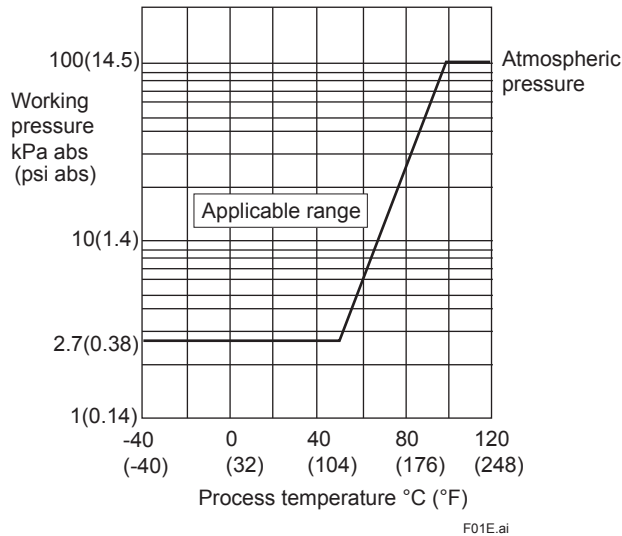
Maximum Pressure Limits (MWP)

16 MPa (2300 psi)

25 MPa (3600 psi) for option code /HG

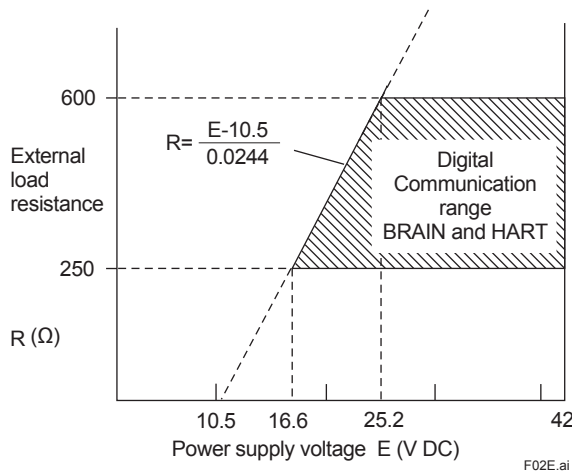
Minimum Pressure Limit

See graph below

**Figure 1. Working Pressure and Process Temperature****Supply & Load Requirements**

(Output signal code D and J. Optional features or approval codes may affect electrical requirements.)

With 24 V DC supply, up to a 550Ω load can be used. See graph below.

**Figure 2. Relationship Between Power Supply Voltage and External Load Resistance (Output signal code D and J)****Supply Voltage “◇”**

For 4 to 20 mA HART / BRAIN (Output signal code D and J)

10.5 to 42 V DC for general use and flameproof type.
10.5 to 32 V DC for lightning protector (option code /A.)

10.5 to 30 V DC for intrinsically safe, type n, or nonincendive.

Minimum voltage limited at 16.6 V DC for digital communications, BRAIN and HART

For 1 to 5 V HART

(Output signal code Q)

Power supply :

9 to 28 V DC for general use and flame proof type.

Power Consumption :

0.96 mA to 3 mA, 27 mW

Load for 4 to 20 mA HART / BRAIN

(Output signal code D and J)

0 to 1290Ω for operation

250 to 600Ω for digital communication

Output Load for 1 to 5 V HART

(Output signal code Q)

1 MΩ or greater (meter input impedance)

Note that with three-wire connection, the cable length may affect the measurement accuracy of the output signal.

Communication Requirements “◇”

(Approval codes may affect electrical requirements.)

BRAIN**Communication Distance**

Up to 2 km (1.25 miles) when using CEV polyethylene-insulated PVC-sheathed cables. Communication distance varies depending on type of cable used.

Load Capacitance

0.22 μF or less

Load Inductance

3.3 mH or less

Input Impedance of communicating device

10 kΩ or more at 2.4 kHz.

EMC Conformity Standards

EN 61326-1 Class A, Table2 (For use in industrial locations)

EN 61326-2-3

EN 61326-2-5 (for fieldbus)

European Pressure Equipment Directive

2014/68/EU

Sound Engineering Practice (for all capsules)

With option code /PE3 and /HG (for M, H and V capsules and wetted parts material code S.)

CE₀₀₃₈

Category III, Module H, Type of Equipment: Pressure Accessory-Vessel, Type of Fluid: Liquid and Gas, Group of Fluid: 1 and 2

Safety Requirement Standards

EN 61010-1, C22.2 No.61010-1

- Altitude of installation site: Max. 2,000 m above sea level
- Installation category: I (Anticipated transient overvoltage 330 V)
- Pollution degree: 2
- Indoor/Outdoor use

□ PHYSICAL SPECIFICATIONS

Wetted Parts Materials

Diaphragm, Cover Flange, Process Connector, Capsule Gasket, and Vent/Drain Plug

Refer to "MODEL AND SUFFIX CODES."

Process Connector Gasket

PTFE Teflon

Fluorinated rubber for option code N2 and N3

Non-wetted Parts Materials

Bolting

B7 carbon steel, 316L SST or 660 SST

Housing

Low copper cast aluminum alloy with polyurethane, deep sea moss green paint (Munsell 0.6GY3.1/2.0 or its equivalent), or ASTM CF-8M Stainless Steel

Degrees of Protection

IP66/IP67, Type 4X

Cover O-rings

Buna-N, fluoro-rubber (optional)

Name plate and tag

316 SST

Fill Fluid

Silicone, fluorinated oil (optional)

Weight

[Installation code 7, 8 and 9]

2.8 kg (6.2 lb) for measurement span code M, H and V, wetted parts material code S without integral indicator, mounting bracket, and process connector.

3.7 kg (8.2 lb) for measurement span code F without integral indicator, mounting bracket, and process connector.

Add 1.5 kg (3.3lb) for Amplifier housing code 2.

Connections

Refer to "MODEL AND SUFFIX CODES."

Process connection of cover flange: IEC61518

< Related Instruments >

FieldMate Versatile Device Management Wizard:

Refer to GS 01R01A01-01E.

BRAIN TERMINAL: Refer to GS 01C00A11-00E

Power Distributor: Refer to GS 01B04T01-02E or GS 01B04T02-02E

< Reference >

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 - FieldMate; Trademark of Yokogawa Electric Corporation.
 - Teflon; Trademark of E.I. DuPont de Nemours & Co.
 - Hastelloy; Trademark of Haynes International Inc.
 - HART®: Registered trademark of the FieldComm Group.
 - FOUNDATION Fieldbus; Trademark of the FieldComm Group.
 - PROFIBUS; Registered trademark of Profibus Nutzerorganisation e.v., Karlsruhe, Germany.
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■ MODEL AND SUFFIX CODES

Model	Suffix Codes	Description
EJA110E	Differential pressure transmitter
Output signal	-D -J -F -G -Q	4 to 20 mA DC with digital communication (BRAIN protocol) 4 to 20 mA DC with digital communication (HART 5/HART 7 protocol)*1 Digital communication (FOUNDATION Fieldbus protocol, refer to GS 01C31T02-01EN) Digital communication (PROFIBUS PA protocol, refer to GS 01C31T04-01EN) Low Power, 1 to 5 V DC with digital communication (HART 7 protocol)
Measurement span (capsule)	F L M H V	0.5 to 5 kPa (2.0 to 20 inH ₂ O) (For Wetted parts material code S) 0.5 to 10 kPa (2.0 to 40 inH ₂ O) (For Wetted parts material code M, H, T, A, D, B and W) 1 to 100 kPa (4 to 400 inH ₂ O) 5 to 500 kPa (20 to 2000 inH ₂ O) 0.14 to 14 MPa (20 to 2000 psi)
Wetted parts material *2	<input type="checkbox"/>	Refer to "Wetted Parts Material" Table.
Process connections	0 1 2 3 4 5	without process connector (Rc1/4 female on the cover flanges) with Rc1/4 female process connector with Rc1/2 female process connector with 1/4 NPT female process connector with 1/2 NPT female process connector without process connector (1/4 NPT female on the cover flanges)
Bolts and nuts materia	J G C	B7 carbon steel 316L SST 660 SST
Installation	-7 -8 -9 -B -U	Vertical piping, left side high pressure, and process connection downside Horizontal piping and right side high pressure Horizontal piping and left side high pressure Bottom Process Connection, left side high pressure*3 Universal flange*3
Amplifier housing	1 3 2	Cast aluminum alloy Cast aluminum alloy with corrosion resistance properties*5 ASTM CF-8M stainless steel*6
Electrical connection	0 2 4 5 7 9 A C D	G1/2 female, one electrical connection without blind plugs 1/2 NPT female, two electrical connections without blind plugs M20 female, two electrical connections without blind plugs G1/2 female, two electrical connections and a blind plug*7 1/2 NPT female, two electrical connections and a blind plug*7 M20 female, two electrical connections and a blind plug*7 G1/2 female, two electrical connections and a SUS316 blind plug 1/2 NPT female, two electrical connections and a SUS316 blind plug M20 female, two electrical connections and a SUS316 blind plug
Integral indicator	D E N	Digital indicator*8 Digital indicator with the range setting switch (push button)*9 None
Mounting bracket	B D J K M N	304 SST 2-inch pipe mounting, flat type (for horizontal piping) 304 SST or SCS13A 2-inch pipe mounting, L type (for vertical piping) 316 SST 2-inch pipe mounting, flat type (for horizontal piping) 316 SST or SCS14A 2-inch pipe mounting, L type (for vertical piping) 316 SST or SCS14A 2-inch pipe mounting (for bottom process connection type) None
Optional Codes		<input type="checkbox"/> Optional specification

The "►" marks indicate the most typical selection for each specification.

*1: HART 5 or HART 7 is selectable. Specify upon ordering.

*2: ⚠ Users must consider the characteristics of selected wetted parts material and the influence of process fluids. The use of inappropriate materials can result in the leakage of corrosive process fluids and cause injury to personnel and/or damage to plant facilities. It is also possible that the diaphragm itself can be damaged and that material from the broken diaphragm and the fill fluid can contaminate the user's process fluids.
Be very careful with highly corrosive process fluids such as hydrochloric acid, sulfuric acid, hydrogen sulfide, sodium hypochlorite, and high-temperature steam (150°C [302°F] or above). Contact Yokogawa for detailed information of the wetted parts material.

*3: Only applicable for Wetted parts material code S.

*4: Not applicable for measurement span code F.

*5: Not applicable for electrical connection code 0, 5, 7, 9 and A. Content rate of copper in the material is 0.03% or less and content rate of iron is 0.15% or less.

*6: Not applicable for electrical connection code 0, 5, 7 and 9.

*7: Material of a blind plug is aluminum alloy or 304 SST.

*8: Not applicable for output signal code G.

*9: Not applicable for output signal code F.

Table. Wetted Parts Materials

Wetted parts material code	Cover flange and process connector	Capsule	Capsule gasket	Vent/Drain plug
S #	ASTM CF-8M *1	Hastelloy C-276 *2 (Diaphragm) F316L SST, 316L SST (Others)	Teflon-coated 316L SST	316 SST
H #	ASTM CF-8M *1	Hastelloy C-276 *2	PTFE Teflon	316 SST
M #	ASTM CF-8M *1	Monel	PTFE Teflon	316 SST
T	ASTM CF-8M *1	Tantalum	PTFE Teflon	316 SST
A #	Hastelloy C-276 equivalent *3	Hastelloy C-276 *2	PTFE Teflon	Hastelloy C-276 *2
D #	Hastelloy C-276 equivalent *3	Tantalum	PTFE Teflon	Hastelloy C-276 *2
B #	Monel equivalent *4	Monel	PTFE Teflon	Monel
W #	Super Duplex SST equivalent *5	Hastelloy C-276 *2	PTFE Teflon	Super Duplex SST *6

*1: Cast version of 316 SST. Equivalent to SCS14A.

*2: Hastelloy C-276 or ASTM N10276.

*3: Indicated material is equivalent to ASTM CW-12MW.

*4: Indicated material is equivalent to ASTM M35-2.

*5: Indicated material is equivalent to ASTM A995 Grade5A.

*6: ASTM S32750 or EN 10272 1.4410.

The '#' marks indicate the construction materials conform to NACE material recommendations per MR0175/ISO15156.

Please refer to the latest standards for details. Selected materials also conform to NACE MR0103.

■ OPTIONAL SPECIFICATIONS (For Explosion Protected type) “◇”

For other agency approvals and marine approvals, please refer to GS 01C25A20-01EN.

Item	Description	Code
Factory Mutual (FM)	FM Explosionproof Approval *1 Applicable Standard: FM3600, FM3615, FM3810, ANSI/NEMA 250 Explosionproof for Class I, Division 1, Groups B, C and D, Dust-ignitionproof for Class II/III, Division 1, Groups E, F and G, in Hazardous locations, indoors and outdoors (Enclosure: Type 4X) “FACTORY SEALED, CONDUIT SEAL NOT REQUIRED.” Temperature class: T6, Amb. Temp.: -40 to 60°C (-40 to 140°F)	FF1
	FM Intrinsically safe Approval *1 *3 Applicable Standard: FM3600, FM3610, FM3611, FM3810 Intrinsically Safe for Class I, Division 1, Groups A, B, C & D, Class II, Division 1, Groups E, F & G and Class III, Division 1, Class I, Zone 0, in Hazardous Locations, AEx ia IIC Nonincendive for Class I, Division 2, Groups A, B, C & D, Class II, Division 2, Groups F & G, Class I, Zone 2, Group IIC, in Hazardous Locations Enclosure: Type 4X, Temp. Class: T4, Amb. Temp.: -60 to 60°C (-75 to 140°F) Intrinsically Safe Apparatus Parameters [Groups A, B, C, D, E, F and G] Vmax=30 V, Imax=200 mA, Pmax=1 W, Ci=6 nF, Li=0 µH [Groups C, D, E, F and G] Vmax=30 V, Imax=225 mA, Pmax=1 W, Ci=6 nF, Li=0 µH	FS1
	Combined FF1 and FS1 *1 *3	FU1
ATEX	ATEX Flameproof Approval *1 Applicable Standard: EN 60079-0:2012/A11:2013, EN 60079-1:2007, EN 60079-31:2009 Certificate: KEMA 07ATEX0109 X II 2G, 2D Ex d IIC T6...T4 Gb, Ex tb IIIC T85°C Db Degree of protection: IP66/IP67 Amb. Temp. (Tamb) for gas-proof: T4: -50 to 75°C (-58 to 167°F), T5: -50 to 80°C (-58 to 176°F), T6: -50 to 75°C (-58 to 167°F) Process Temp. for gas-proof (Tp): T4: -50 to 120°C (-58 to 248°F), T5: -50 to 100°C (-58 to 212°F), T6: -50 to 85°C (-58 to 185°F) Max. surface Temp. for dust-proof: T85°C (Tamb: -30 to 75°C, Tp: -30 to 85°C) *2	KF22
	ATEX Intrinsically safe Approval *1 *3 Applicable Standard: EN 60079-0:2012/A11:2013, EN 60079-11:2012, EN 60079-26:2007 Certificate: DEKRA 11ATEX0228 X II 1G, 2D Ex ia IIC T4 Ga, Ex ia IIIC T85°C T100°C T120°C Db Degree of protection: IP66/IP67 Amb. Temp. (Tamb) for EPL Ga: -50 to 60°C (-58 to 140°F) Maximum Process Temp. (Tp) for EPL Ga: 120°C Electrical data: Ui=30 V, Ii=200 mA, Pi=0.9 W, Ci=27.6 nF, Li=0 µH Amb. Temp. for EPL Db: -30 to 60°C *2 Max. surface Temp. for EPL Db: T85°C (Tp: 80°C), T100°C (Tp: 100°C), T120°C (Tp: 120°C)	KS21
	Combined KF22, KS21 and ATEX Intrinsically safe Ex ic *1 *3 [ATEX Intrinsically safe Ex ic] Applicable Standard: EN 60079-0:2012, EN 60079-11:2012 II 3G Ex ic IIC T4 Gc, Amb. Temp.: -30 to 60°C (-22 to 140°F) *2 Ui=30 V, Ci=27.6 nF, Li=0 µH	KU22

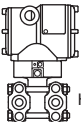
Item	Description	Code
Canadian Standards Association (CSA)	<p>CSA Explosionproof Approval *1 Certificate: 2014354 Applicable Standard: C22.2 No.0, C22.2 No.0.4, C22.2 No.0.5, C22.2 No.25, C22.2 No.30, C22.2 No.94, C22.2 No.60079-0, C22.2 No.60079-1, C22.2 No.61010-1, C22.2 No.61010-2-030 Explosion-proof for Class I, Groups B, C and D. Dustignition-proof for Class II/III, Groups E, F and G. When installed in Division 2, "SEAL NOT REQUIRED" Enclosure: Type 4X, Temp. Code: T6...T4 Ex d IIC T6...T4 Enclosure: IP66/IP67 Max.Process Temp.: T4;120°C(248°F), T5;100°C(212°F), T6; 85°C(185°F) Amb.Temp.: -50 to 75°C(-58 to 167°F) for T4, -50 to 80°C(-58 to 176°F) for T5, -50 to 75°C(-58 to 167°F) for T6 *2 Process Sealing Certification Dual Seal Certified by CSA to the requirement of ANSI/ISA 12.27.01 No additional sealing required Primary seal failure annunciation: at the zero adjustment screw</p>	CF1
	<p>CSA Intrinsically safe Approval *1 *3 Certificate: 1606623 [For CSA C22.2] Applicable Standard: C22.2 No.0, C22.2 No.0.4, C22.2 No.25, C22.2 No.94, C22.2 No.157, C22.2 No.213, C22.2 No.61010-1, C22.2 No.60079-0, C22.2 No.61010-2-030 Intrinsically Safe for Class I, Division 1, Groups A, B, C & D, Class II, Division 1, Groups E, F & G, Class III, Division 1, Nonincendive for Class I, Division 2, Groups A, B, C & D, Class II, Division 2, Groups F & G, Class III, Division 1 Enclosure: Type 4X, Temp. Code: T4 Amb. Temp.: -50 to 60°C(-58 to 140°F) *2 Electrical Parameters: [Intrinsically Safe] Vmax=30V, Imax=200mA, Pmax=0.9W, Ci=10nF, Li=0 µH [Nonincendive] Vmax=30V, Ci=10nF, Li=0 µH [For CSA E60079] Applicable Standard: CAN/CSA E60079-11, CAN/CSA E60079-15, IEC 60529:2001 Ex ia IIC T4, Ex nL IIC T4 Enclosure: IP66/IP67 Amb. Temp.: -50 to 60°C(-58 to 140°F) *2, Max. Process Temp.: 120°C(248°F) Electrical Parameters: [Ex ia] Ui=30V, Ii=200mA, Pi=0.9W, Ci=10nF, Li=0 µH [Ex nL] Ui=30V, Ci=10nF, Li=0 µH Process Sealing Certification Dual Seal Certified by CSA to the requirement of ANSI/ISA 12.27.01 No additional sealing required Primary seal failure annunciation: at the zero adjustment screw</p>	CS1
	Combined CF1 and CS1 *1 *3	CU1
IECEX	<p>IECEX Flameproof Approval *1 Applicable Standard: IEC 60079-0:2011, IEC60079-1:2007-4 Certificate: IECEX CSA 07.0008 Flameproof for Zone 1, Ex d IIC T6...T4 Gb Enclosure: IP66/IP67 Max.Process Temp.: T4;120°C(248°F), T5;100°C(212°F), T6; 85°C(185°F) Amb.Temp.: -50 to 75°C(-58 to 167°F) for T4, -50 to 80°C(-58 to 176°F) for T5, -50 to 75°C(-58 to 167°F) for T6</p>	SF2
	<p>IECEX Intrinsically safe and Flameproof Approval *1 *3 Intrinsically safe Ex ia Certificate: IECEX DEK 11.0081X Applicable Standard: IEC 60079-0:2011, IEC 60079-11:2011, IEC 60079-26:2006 Ex ia IIC T4 Ga Amb. Temp.: -50 to 60 °C(-58 to 140 °F), Max. Process Temp.: 120 °C(248 °F) Electrical Parameters: Ui=30 V, Ii=200 mA, Pi=0.9 W, Ci=27.6 nF, Li=0 µH Intrinsically safe Ex ic Certificate: IECEX DEK 13.0061X Applicable Standard: IEC 60079-0:2011, IEC 60079-11:2011 Ex ic IIC T4 Gc IP code: IP66 Amb. Temp.: -30 to 60°C(-22 to 140°F) *2, Max. Process Temp.: 120°C(248°F) Electrical Parameters: Ui=30V,Ci=27.6 nF, Li=0 µH Flameproof Certificate: IECEX CSA 07.0008 Applicable Standard: IEC 60079-0:2011, IEC60079-1:2007-4 Flameproof for Zone 1, Ex d IIC T6...T4 Gb Enclosure: IP66/IP67 Max.Process Temp.: T4;120°C(248°F), T5;100°C(212°F), T6; 85°C(185°F) Amb.Temp.: -50 to 75°C(-58 to 167°F) for T4, -50 to 80°C(-58 to 176°F) for T5, -50 to 75°C(-58 to 167°F) for T6</p>	SU21

*1: Applicable for Electrical connection code 2, 4, 7, 9, C and D.

*2: Lower limit of ambient temperature is -15°C (5°F) when option code HE is specified.

*3: Not applicable for output signal code Q.

■ OPTIONAL SPECIFICATIONS

Item		Description	Code
High accuracy type *1*20		High accuracy	HAC
High pressure-proof structure		Maximum working pressure for differential pressure measurement: 25MPa *18	HG
Painting	Color change	Amplifier cover only*2	P□
		Amplifier cover and terminal cover, Munsell 7.5 R4/14	PR
	Coating change	Anti-corrosion coating*2*3	X2
316 SST exterior parts		316 SST zero-adjustment screw and setscrews*4	HC
Fluoro-rubber O-ring		All O-rings of amplifier housing. Lower limit of ambient temperature: -15°C (5°F)	HE
Lightning protector		Transmitter power supply voltage: 10.5 to 32 V DC (10.5 to 30 V DC for intrinsically safe type.) Allowable current: Max. 6000 A (1×40 μs), Repeating 1000 A (1×40 μs) 100 times Applicable Standards: IEC 61000-4-4, IEC 61000-4-5	A
Oil-prohibited use*5		Degrease cleansing treatment	K1
		Degrease cleansing treatment and fluorinated oilfilled capsule. Operating temperature -20 to 80°C (-4 to 176°F)	K2
Oil-prohibited use with dehydrating treatment*5		Degrease cleansing and dehydrating treatment	K5
		Degrease cleansing and dehydrating treatment with fluorinated oilfilled capsule. Operating temperature -20 to 80°C (-4 to 176°F)	K6
Capsule fill fluid		Fluorinated oil filled in capsule Operating temperature -20 to 80°C (-4 to 176°F)	K3
Calibration units*6	P calibration (psi unit)		D1
	bar calibration (bar unit)		(See Table for Span and Range Limits.) D3
	M calibration (kgf/cm ² unit)		D4
Long vent*7		Total length: 119 mm (standard: 34 mm); Total length when combining with option code K1, K2, K5, and K6: 130 mm. Material: 316 SST	U1
Gold-plated capsule gasket *8		Gold-plated 316L SST capsule gasket. Without drain and vent plugs.	GS
Gold-plated diaphragm *9		Surface of isolating diaphragms are gold plated, effective for hydrogen permeation. Overpressure effects for M, H and V capsules: ±0.06% of URL	A1
Output limits and failure operation*10		Failure alarm down-scale: Output status at CPU failure and hardware error is -5%, 3.2mA DC or less for 4 to 20 mA output type and -5%, 0.8V DC or less for 1 to 5 V output type.	C1
		NAMUR NE43 Compliant Output signal limits: 3.8 mA to 20.5 mA*21	Failure alarm down-scale: Output status at CPU failure and hardware error is -5%, 3.2 mA DC or less. C2
			Failure alarm up-scale: Output status at CPU failure and hardware error is 110%, 21.6 mA or more. C3
<div><div>Terminal Side</div><div>L H</div><div>F03E.ai</div></div>	Right side high pressure, without drain and vent plugs		N1
	N1 and Process connection, based on IEC61518 with female thread on both sides of cover flange, with blind kidney flanges on back.		N2
	N2, and Material certificate for cover flange, diaphragm, capsule body, and blind kidney flange		N3
Wired tag plate		316 SST tag plate wired onto transmitter	N4
Data configuration at factory*12		Data configuration for HART communication type	Software damping, Descriptor, Message CA
		Data configuration for BRAIN communication type	Software damping CB
European Pressure Equipment Directive*19		PED 2014/68/EU Category III, Module H, Type of Equipment: Pressure Accessory-Vessel, Type of Fluid: Liquid and Gas, Group of Fluid: 1 and 2 Lower limit of ambient and process temperature: -29°C	PE3
Material certificate*13		Cover flange *14	M01
		Cover flange, Process connector *15	M11
Pressure test/ Leak test certificate*16		Test Pressure: 16 MPa(2300 psi)	Nitrogen(N ₂) Gas*17 Retention time: one minute T12
		Test Pressure: 25 MPa(3600 psi) for option code HG	T13

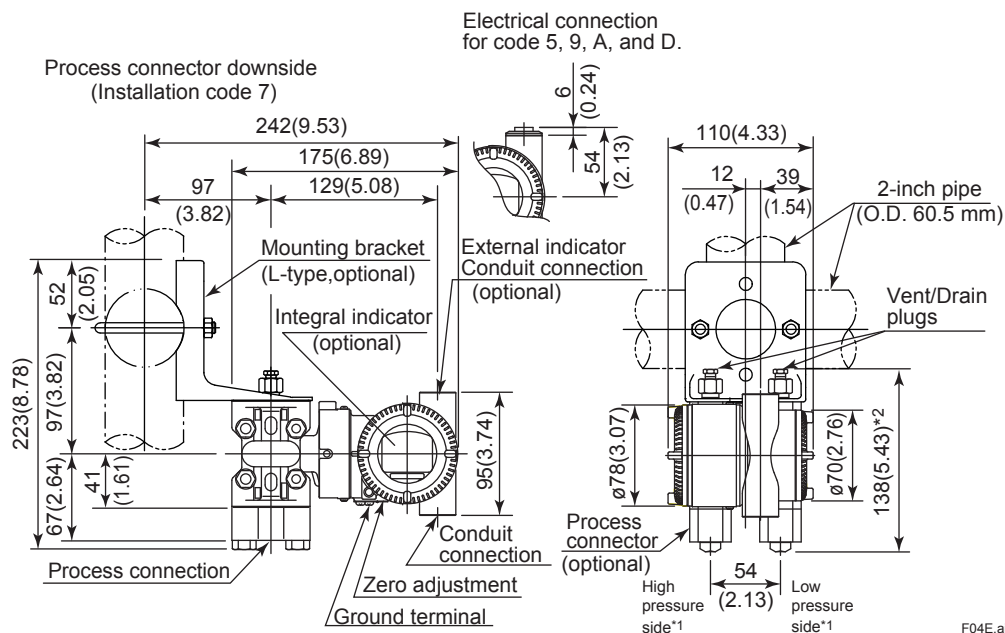
- *1: Applicable for capsule code M, H and V when combined with wetted parts material code S.
- *2: Not applicable for amplifier housing code 2 and 3.
- *3: Not applicable with color change option.
- *4: 316 or 316L SST. The specification is included in amplifier housing code 2.
- *5: Applicable for Wetted parts material code S, M, H and T.
- *6: The unit of MWP (Max. working pressure) on the name plate of a housing is the same unit as specified by option codes D1, D3, and D4.
- *7: Applicable for vertical impulse piping type (Installation code 7) and Wetted parts material code S, H, M and T.
- *8: Applicable for wetted parts material code S; process connection code 0 and 5; and installation code 8 and 9.
- *9: Not applicable for option code U1, N2, N3 and M11. No PTFE is used for wetted parts.
- *9: Applicable for wetted parts material code S.
- *10: Applicable for output signal codes D and J. The hardware error indicates faulty amplifier or capsule.
- *11: Applicable for wetted parts material code S, M, H and T; process connection codes 3, 4, and 5; installation code 9; and mounting bracket code N. Process connection faces on the other side of zero adjustment screw.
- *12: Also see 'Ordering Information'.
- *13: Material traceability certification, per EN 10204 3.1B.
- *14: Applicable for process connections codes 0 and 5.
- *15: Applicable for process connections codes 1, 2, 3, and 4.
- *16: The unit on the certificate is always Pa unit regardless of selection of option code D1, D3 or D4.
- *17: Pure nitrogen gas is used for oil-prohibited use (option codes K1, K2, K5, and K6).
- *18: Applicable for Measurement span code M, H, and V; and wetted parts material code S. The URL of static pressure range is also extended to 25 MPa.
- *19: Applicable for measurement span code M, H and V and wetted parts material code S. If compliance with category III is needed, specify this option code with HG.
- *20: Not applicable for output signal code Q.
- *21: The 1 to 5 V voltage output corresponding to 4 to 20 mA current output is applied to output signal code Q which is non-compliant to NAMUR NE43.

DIMENSIONS

Unit: mm (approx.inch)

Vertical Impulse Piping Type (INSTALLATION CODE '7')

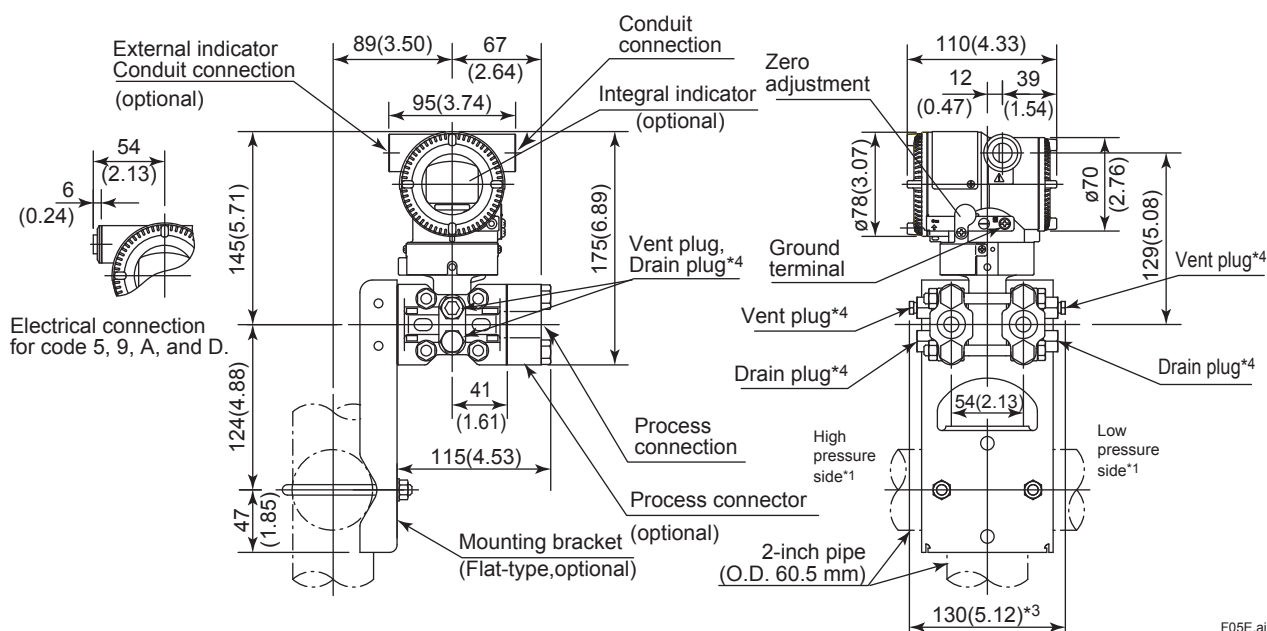
Wetted Parts Material code: S (except for Measurement Span code F)



Horizontal Impulse Piping Type (INSTALLATION CODE '9')

(For CODE '8', refer to the notes below.)

Wetted Parts Material code: S (except for Measurement Span code F)



*1: When installation code 8 is selected, high and low pressure side on above figure are reversed. (i.e. High pressure side is on the right side.)

*2: When option code K1, K2, K5 or K6 is selected, add 15 mm (0.59 inch) to the value in the figure.

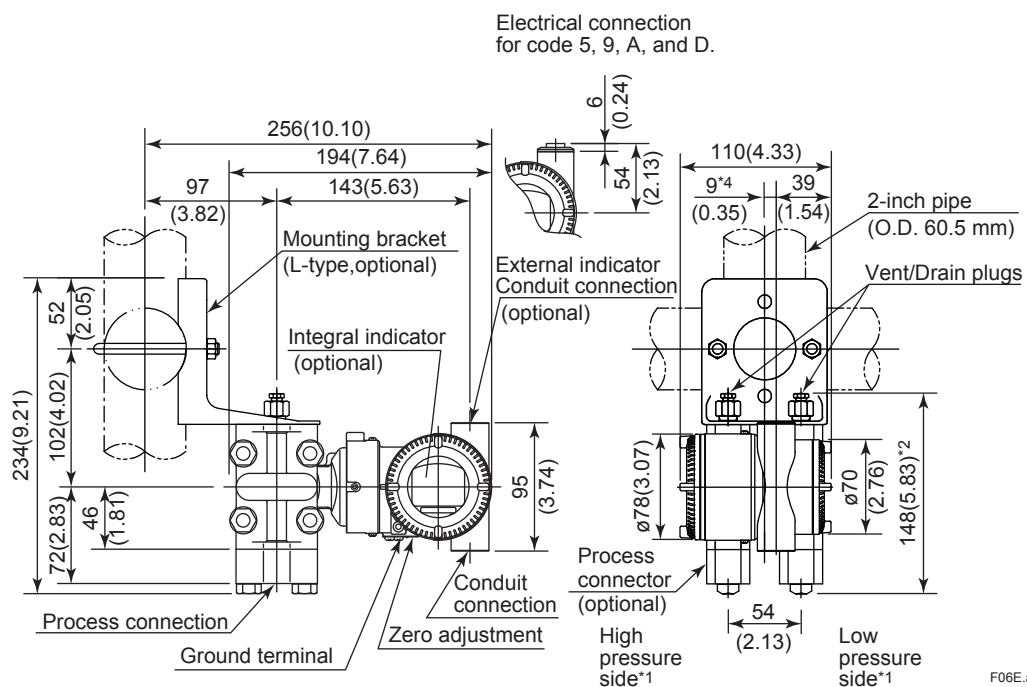
*3: When option code K1, K2, K5 or K6 is selected, add 30 mm (1.18 inch) to the value in the figure.

*4: Not available when option code GS is selected.

Unit: mm (approx.inch)

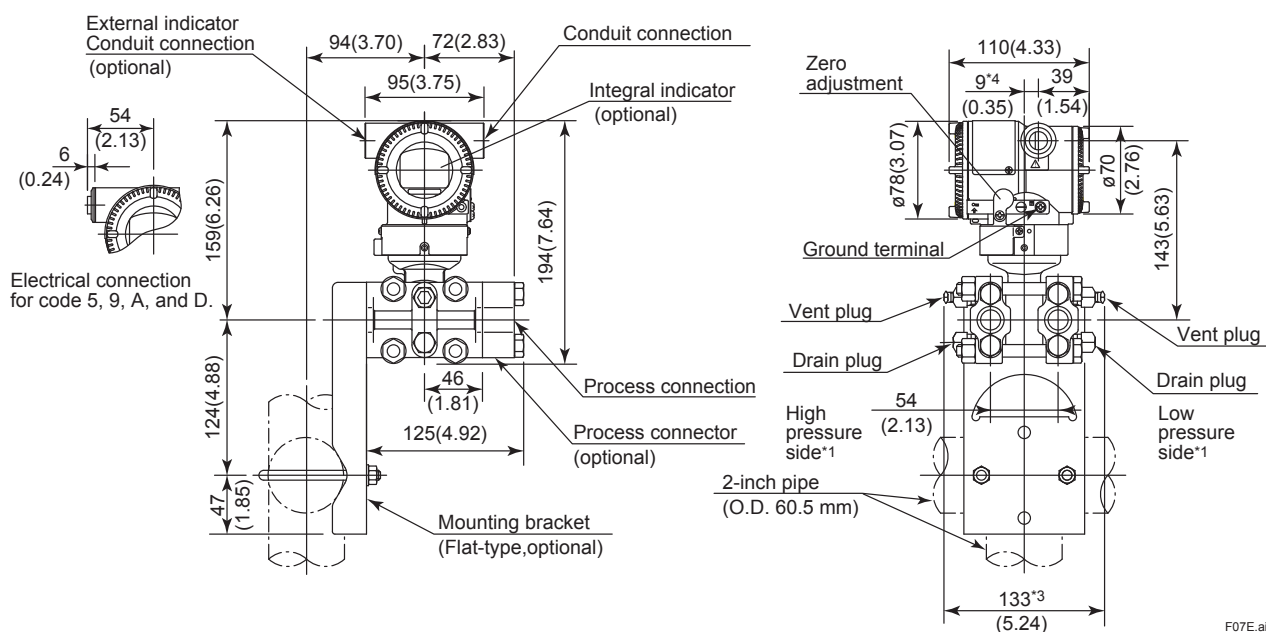
• Vertical Impulse Piping Type (INSTALLATION CODE '7')

Wetted Parts Material code: H, M, T, A, B, D and W or Measurement Span code F



• Horizontal Impulse Piping Type (INSTALLATION CODE '9') (For CODE '8', refer to the notes below.)

Wetted Parts Material code: H, M, T, A, B, D and W or Measurement Span code F



*1: When Installation code 8 is selected, high and low pressure side on above figure are reversed.
(i.e. High pressure side is on the right side.)

*2: When Option code K1, K2, K5, or K6 is selected, add 15 mm (0.59 inch) to the value in the figure.

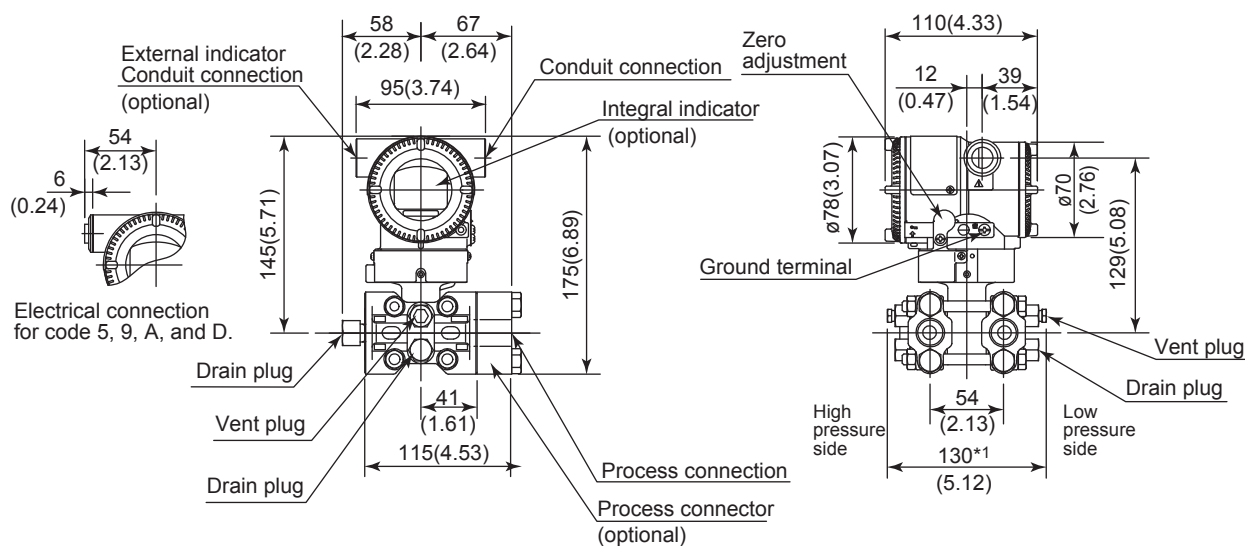
*3: When Option code K1, K2, K5, or K6 is selected, add 30 mm (1.18 inch) to the value in the figure.

*4: 15 mm (0.59 inch) for right side high pressure.

Unit: mm (approx.inch)

• Universal Flange (INSTALLATION CODE 'U')

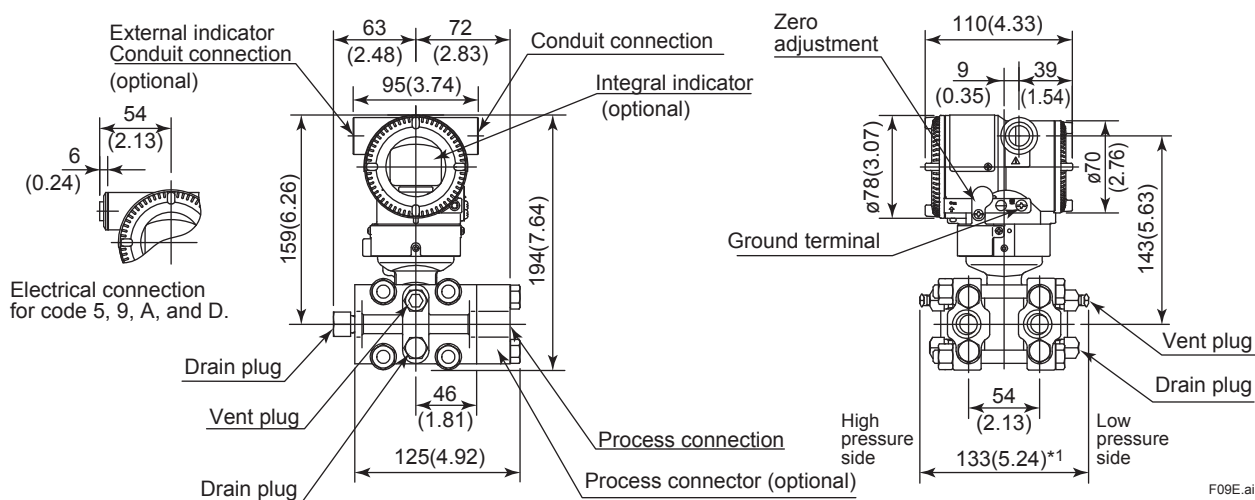
Measurement Span code M, H and V



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• Universal Flange (INSTALLATION CODE 'U')

Measurement Span code F



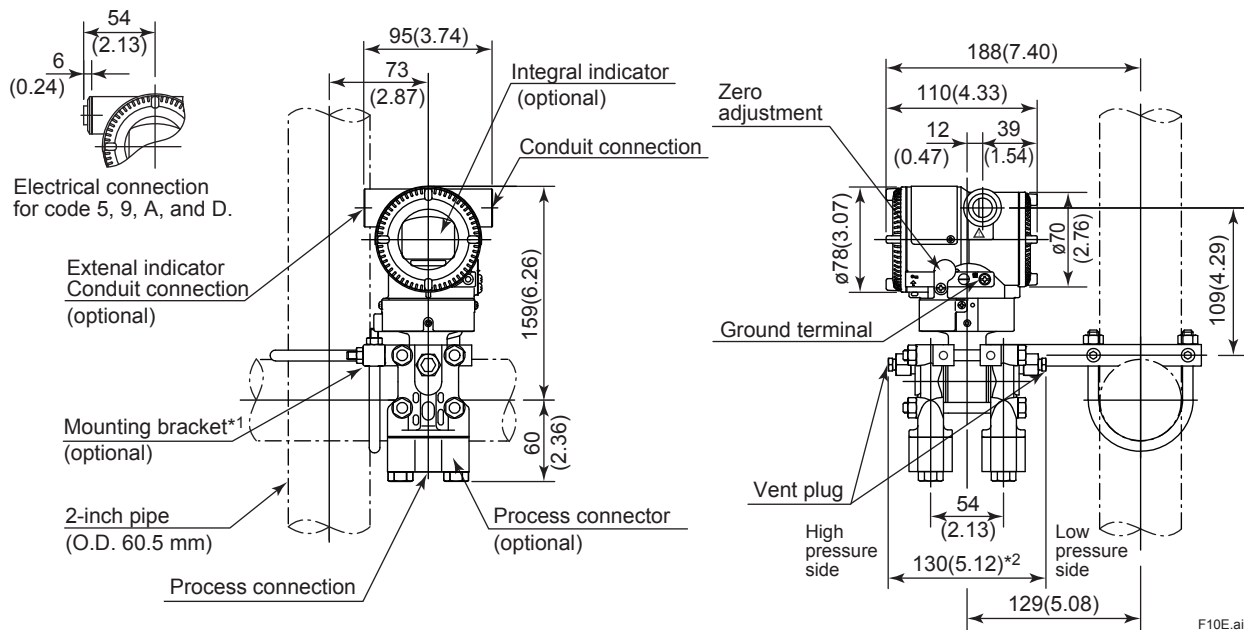
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*1: When Option code K1, K2, K5, or K6 is selected, add 30 mm (1.18 inch) to the value.

Unit: mm (approx.inch)

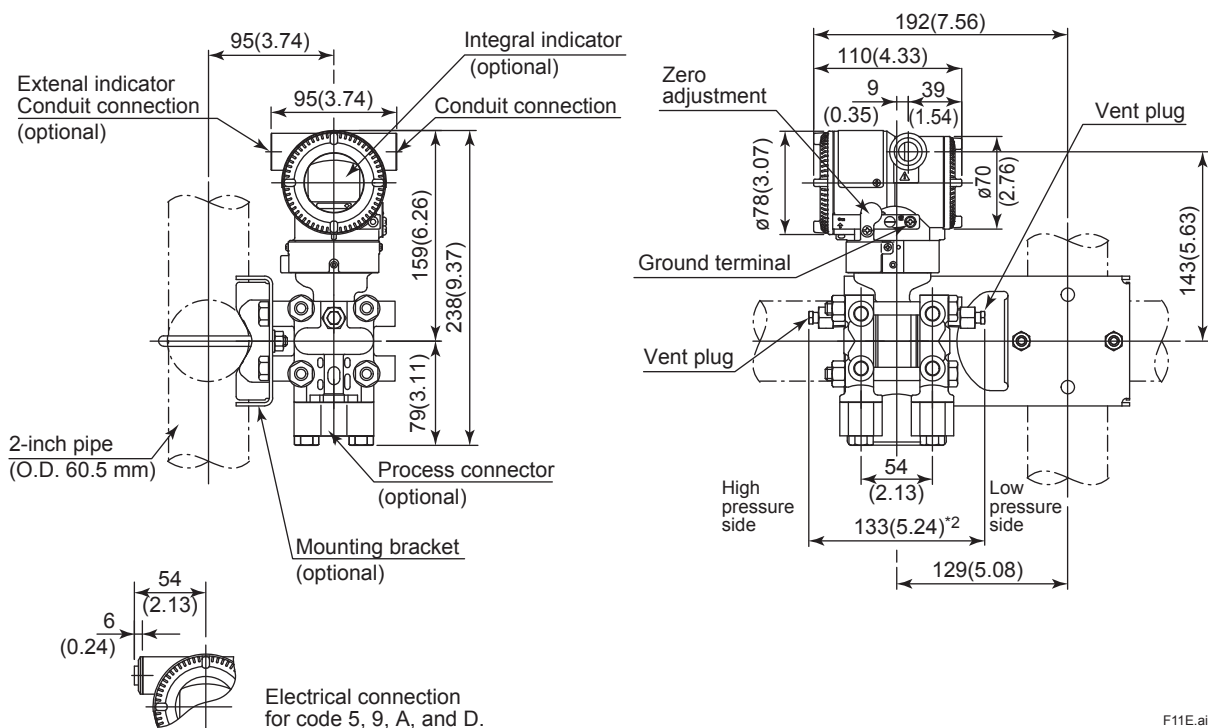
• Bottom Process Connection Type (INSTALLATION CODE 'B')

Measurement span code M, H and V



• Bottom Process Connection Type (INSTALLATION CODE 'B')

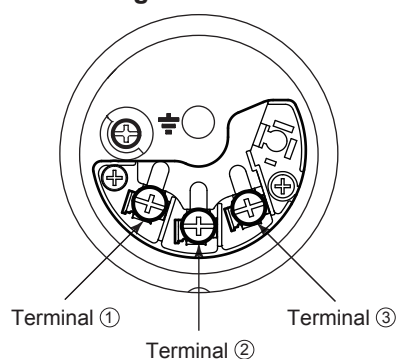
Measurement span code F



*1: A transmitter with SST housing is not applicable for mounting to horizontal 2-inch pipe.

*2: When Option code K1, K2, K5, or K6 is selected, add 30 mm (1.18 inch) to the value.

- **Terminal Configuration**



- **Terminal Wiring for 4 to 20 mA output, FOUNDATION Fieldbus and PROFIBUS PA communication types**

SUPPLY	+	①	Power supply and output terminals
	-	②	
CHECK	+	③	External indicator (ammeter) terminals**2
	-	②	
			Ground terminal

*1: When using an external indicator or check meter, the internal resistance must be 10 Ω or less.

*2: Not available for FOUNDATION Fieldbus and PROFIBUS PA communication types.

- **Terminal Wiring for 1 to 5 V output**

SUPPLY	+	①	Power supply terminals
	-	②	
VOUT	+	③	1 to 5 V DC with HART communication terminals
	-	②	
			Ground terminal

Three or four wire connection. For four wire connection, both supply and signal lines use SUPPLY - terminal.

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< Ordering Information > “◇”

Specify the following when ordering

1. Model, suffix codes, and option codes
2. Calibration range and units
 - 1) Calibration range can be specified with range value specifications up to 5 digits (excluding any decimal point) for low or high range limits within the range of -32000 to 32000. When reverse range is designated, specify Lower Range Value(LRV) as greater than Upper Range Value(URV). When square root output mode is specified, LRV must be “0 (zero) ”.
 - 2) Specify only one unit from the table, ‘Factory setting.’
3. Select linear or square root for output mode and display mode.
Note: If not specified, the instrument is shipped set for linear mode.
4. Display scale and units (for transmitters equipped with the integral indicator only)
Specify either 0 to 100 % or ‘Range and Unit’ for engineering units scale:
Scale range can be specified with range limit specifications up to 5 digits (excluding any decimal point) for low or high range limits within the range of -32000 to 32000. Unit display consists of 6-digit, therefore, if the specified scaling unit excluding ‘/’ is longer than 6-characters , the first 6 characters will be displayed on the unit display.
5. HART PROTOCOL
When output signal code is “J”, specify the HART protocol revision “5” or “7”.
6. TAG NO (if required)
Specified characters (up to 16 characters) are engraved on the stainless steel tag plate fixed on the housing.
7. SOFTWARE TAG (for HART only. if required)
Specified characters (up to 32 characters) are set as “Tag” (the first 8 characters) and “Long tag”^{*1} (32 characters) in the amplifier memory. Use alphanumeric capital letters.
When the “SOFTWARE TAG” is not specified, specified “TAG NO” is set as “Tag” (the first 8 characters) and “Long tag”^{*1} (22 characters) in the amplifier memory.
^{*1}: applicable only when HART 7 is selected.
8. Other factory configurations (if required)
Specifying option code **CA** or **CB** will allow further configuration at factory. Following are configurable items and setting range.
[/CA : For HART communication type]
 - 1) Descriptor (up to 16 characters)
 - 2) Message (up to 30 characters)
 - 3) Software damping in second (0.00 to 100.00)
[/CB : For BRAIN communication type]
 - 1) Software damping in second (0.00 to 100.00)

< Factory Setting > “◇”

Tag number	As specified in order
Software damping *1	‘2.00 s’ or as specified in order
Output mode	‘Linear’ unless otherwise specified in order
Calibration range lower range value	As specified in order
Calibration range upper range value	As specified in order
Calibration range unit	Selected from mmH ₂ O, mmH ₂ O(68°F), mmAq ^{*2} , mmWG ^{*2} , mmHg, Pa, hPa ^{*2} , kPa, MPa, mbar, bar, gf/cm ² , kgf/cm ² , inH ₂ O, inH ₂ O(68°F), inHg, ftH ₂ O, ftH ₂ O(68°F) or psi. (Only one unit can be specified.)
Display setting	Designated differential pressure value specified in order. (% or user scaled value.) Display mode ‘Linear’ or ‘Square root’ is also as specified in order.
Static pressure display range	‘0 to 16 MPa (25 MPa ^{*3})’ absolute value. Measuring high pressure side.

*1: To specify these items at factory, option code **CA** or **CB** is required.

*2: Not available for HART protocol type.

*3: Applicable for option code **HG**.

< Material Cross Reference >

ASTM	JIS
316	SUS316
F316	SUSF316
316L	SUS316L
F316L	SUSF316L
304	SUS304
F304	SUSF304
660	SUH660
B7	SNB7
CF-8M	SCS14A



Application

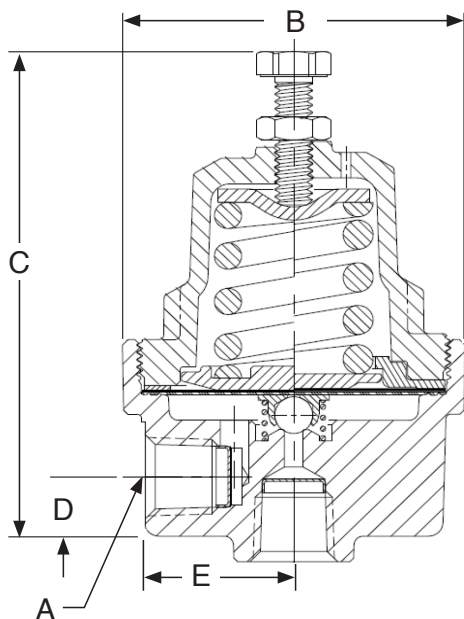
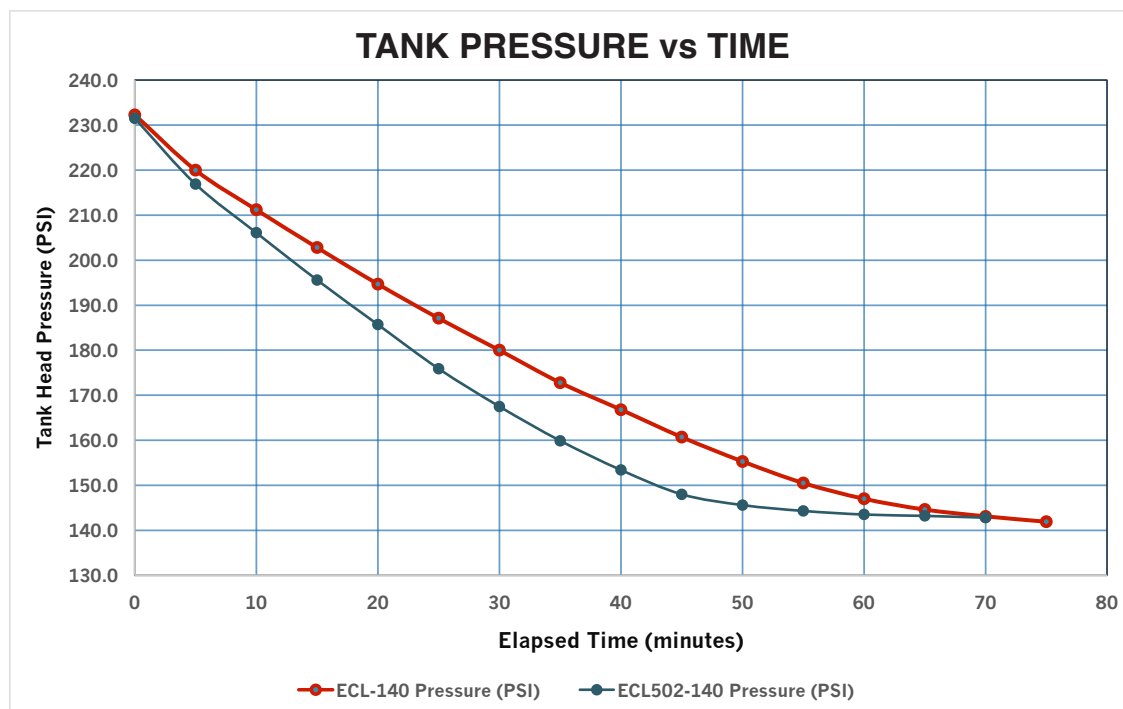
ECL502 series cryogenic economizers are designed to be used as pressure reducing valves to automatically maintain a constant inlet or back pressure, normally closed at pressures below its set point and open at pressures above its set point. The ECL502 is primarily designed to assist in maintaining a desired system pressure ideal for Nitrogen, Oxygen, Argon and other cryogenic cylinder applications with a 100% performance improvement over RegO's ECLXXX series. ECL502 series offers outstanding performance for maintaining LNG fuel line pressure.

Features

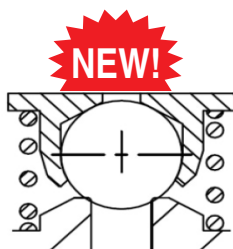
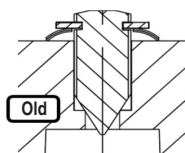
- ECL502 series design provides premium flow characteristics allowing for fast pressure reduction while maintaining sensitive flow control at lower pressure settings.
- All materials of construction- copper alloy, PTFE and stainless steel were selected for compatibility with cryogenic service.
- PTFE diaphragm liner vastly improves bubble-tight sealing performance for adherence to stringent external leakage requirements.
- 150 count mesh Monel screens installed into the inlet and outlet ports prevent debris from entering or damaging any downstream components.
- Interchangeable with existing cryogenic economizer units.
- Bi-directional flow for LNG fuel systems
- Temperature range: -320°F to +165°F (-196°C to +74°C)
- Max inlet pressure:
 - Low Pressure Models ≤ 175 : 375 PSIG (25.9 Bar)
 - High Pressure Models > 175 : 550 PSIG (37.9 Bar)
- Pressure setting range: 10-350 PSIG (0.7-24 Bar)
- Clean for oxygen service per CGA G-4.1
- Design in accordance with ECE R110

Materials

Body	Brass
Spring Guide.....	Brass
Poppet Spring.....	Stainless Steel
Diaphragm Liner.....	PTFE
Ball.....	Stainless Steel
Adjusting Screw.....	Stainless Steel
Locknut.....	Stainless Steel
Bonnet.....	Brass
Screen	Monel
Diaphragm.....	Bronze
Slip Ring	Brass
Diaphragm Plate.....	Brass
Spring	Stainless Steel
Spring Button.....	Stainless Steel



New ball poppet has approximately 300% increase in flow area of the old poppet.



ORDERING INFORMATION

Part Number	Inlet/Outlet Connections A	Width B	Height C	D	E	Pressure Setting	Operating Range
ECL502-022	1/4" FNPT	2.25" 57 mm	3.5" 89 mm	0.58" 15 mm	1.0" 25mm	22 psi 1.5 bar	10-60 psi 0.7-4.1 bar
ECL502-100						100 psi 6.9 bar	50-175 psi 3.4-12.1 bar
ECL502-123						123 psi 8.5 bar	
ECL502-140						140 psi 9.7 bar	
ECL502-175						175 psi 12.1 bar	
ECL502-325						325 psi 22.4bar	150-350 psi 10.3-24.1 bar

*Contact sales representative for additional settings.

Heavy Duty Gas Line Regulator 1780 Series

Application

The 1780 Series Regulators are designed for final line pressure regulation on gas distribution systems. They are suitable for a variety of gases in medical or industrial applications. The 1780 Series Regulators have a balanced seat, are constructed with oxygen compatible materials, and have the same valve design, brass body, and internal parts as the premium BR-1780 Series. Flow performance is equal to the BR-1780 Series.

Features

- Maintains a steady downstream pressure across a range of inlet pressures commonly provided by a cryogenic bulk tank.
- Large seat and diaphragm areas provide high capacity with sensitive control of delivery pressure with low falloff.
- Two 1/4" FNPT delivery pressure gauge ports are located (plugged) on each side of the valve.
- Two bonnet drain/vent holes to allow for different mounting orientation.
- T-handle adjusting screw.
- Maximum inlet pressure is 500 psig (34 Bar).
- Available in four delivery pressure ranges (A-D).
- Temperature range: -40° F to +165° F. (-40°C to +74°C)
- Cleaned per CGA G-4.1 for oxygen service.
- 100% Factory Tested

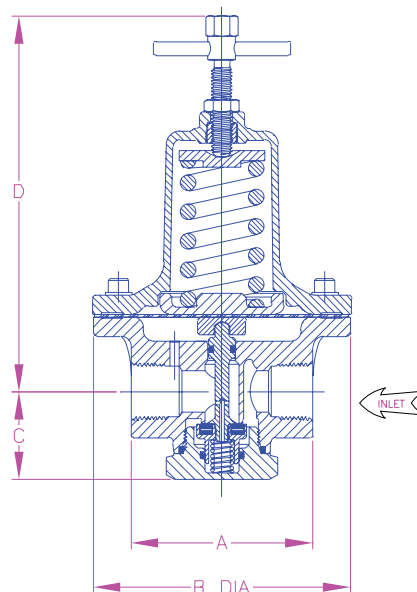
Materials

Body Forged Brass
Bonnet Nickel Plated Aluminum
Diaphragm Nitrile with PTFE liner
Springs and Fasteners Stainless Steel
Other valve parts Brass
Seat Disc & O-Rings Viton is standard

For Carbon Dioxide or Nitrous Oxide service: Specify EPDM material for seat disc and O-rings, add "E" to end of part number.



1780 Series



1780 SER

Ordering Information

Part Number	Delivery Pressure Range	Pressure Gauge*		Inlet & Outlet (F.N.P.T.)	Dimensions				C _v
		Range (PSI)	P/N		"A"	"B"	"C"	"D"	
1784A	5-55 psig	1-100	1286	½"	2.82"	3.62"	1.38"	5.47"	3.1
1784B	40-110 psig	1-200	S1679						
1784C	100-200 psig	1-400	15578						
1784D	175-300 psig								
1786A	5-55 psig	1-100	1286	¾"	3.31"	4.69"	1.60"	6.84"	4.8
1786B	40-110 psig	1-200	S1679						
1786C	100-200 psig	1-400	15578						
1786D	175-275 psig								
1788A	5-55 psig	1-100	1286	1"	3.31"	4.69"	1.60"	6.84"	5.5
1788B	40-110 psig	1-200	S1679						
1788C	100-200 psig	1-400	15578						
1788D	175-275 psig								

*Regulator sold without gauge. Order gauge separately.

CASH VALVES CRYOGENIC VALVES AND CONTROLS

A broad range of pressure build regulators, pressure reducing valves, final line gas valves and combination pressure build economizer valves for cryogenic service.



FEATURES

- Six models for pressure reducing or pressure build-up service.
- Five models for back-pressure service on economizer circuit.
- Three models for combined pressure building and economizer functions.
- Low temperature cut-off valves.
- Two models for final line gas service.
- High purity regulating valves for pressure reducing, back pressure and differential services.
- All parts commercially cleaned for cryogenic/oxygen service or high purity gas compatibility.
- Complementary 'Y' pattern strainers reduce maintenance costs.
- Cryogenic safety and shut-off valves also available.

GENERAL APPLICATION

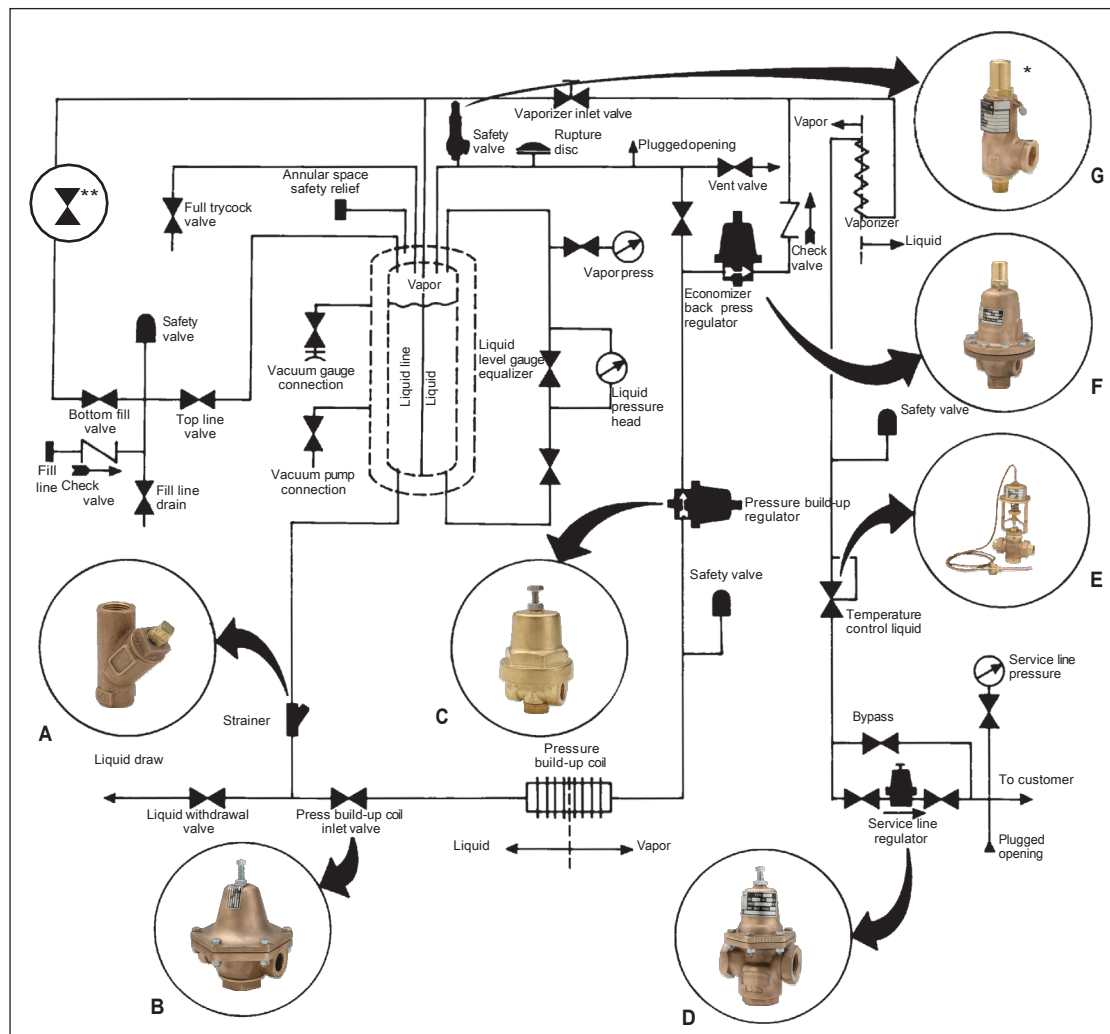
A variety of controls for cryogenic systems including liquid and gas line-pressure build-up regulators, economizer (heat leak) back pressure valves, temperature safety valves, combination valves, shut-off valves and final-line/service-line regulators.

TECHNICAL DATA

Materials:	Bronze, brass and stainless steel
Sizes:	¼" to 2" (7 to 50 mm)
Connections:	Threaded NPTF (BSP optional on some models)
Max initial pressure:	650 psi (45.7 kg/cm ²)
Temperature ranges	
Standard range:	+150° to -320°F (339 to 78K)
High purity valves:	+400° to -425°F (478 to 19K)

CASH VALVES CRYOGENIC VALVES AND CONTROLS

LIQUID-GAS DISTRIBUTION SYSTEM SCHEMATIC DIAGRAM



- A. Type SY-70C
- B. Type B
- C. Type A-32**
- D. Type E-55
- E. Type LTC
- F. Type FR
- G. Type C-776

* C-776 cryogenics safety relief valve - for additional information, write or call for data sheet VCTDS-00515.

** Shut-off valve - for additional information, see page 17.

OVERVIEW

Cryogenics - the science of materials at extremely low temperatures - has become increasingly important to industry. One important aspect of this field is the liquification of normally gaseous elements which are used widely throughout the industry, including:

Oxygen	- used extensively in BOF furnaces in the steel industry, for metal cutting, as a rocket fuel and in medicine.
Acetylene	- widely used in welding.
Nitrogen	- used in refrigeration systems, for metal degassing, in aerosol packaging and in cryogenicsurgery.
Hydrogen	- used as a rocket propellant and in the production of several metals.
Argon	- widely used in incandescent lamps and fluorescent tubes.
Helium	- used for arc welding, in the manufacture of electron tubes and in cryogenic research.
Carbon Dioxide	- used in refrigeration, to make aerosol tanks and in fire fighting.

Other cryogenic fluids include liquefied natural gas, fluorine, krypton, neon, methane and ethane.

The extensive range of Cash valves and controls is suitable for use in all the major areas of cryogenic converters, or 'dewars', which are either stationary or installed in over-the-road transport vehicles.

CASH VALVES CRYOGENIC VALVES AND CONTROLS

THE PRESSURE BUILD-UP CIRCUIT

The build-up circuit in the converter maintains a pressure of approximately 25 psi (1.76 kg/cm²) above that required to drive the liquid to the final vaporizer and a pressure differential of approximately 25 psi (1.76 kg/cm²) or higher across the service line regulator. To do this, liquid is drawn into the pressure build-up coil, where it is warmed by ambient air and vaporized. The gas then passes through the pressure build-up regulator and into the top of the tank, where it begins to build up pressure because expansion is limited by the fixed volume. When this pressure reaches the pressure build-up regulator's set point, the regulator cuts off, stopping vaporization and pressure build-up. As liquid is forced from the tank to the final vaporizer, pressure in the tank begins to drop and the pressure build-up regulator returns to operation.

The pressure build-up regulator may be located in the liquid line before the pressure build-up coil. As it is now used for liquid rather than gas service, it may have a smaller orifice or be a smaller-sized valve. Its operation is the same as that of a gas regulator with the exception that it regulates the liquid flow before the pressure build-up coil rather than the gas flow after the coil. When pressure in the tank drops, the liquid pressure build-up regulator opens, allowing liquid to flow through the pressure build-up coil and vaporize.

Pressure build-up regulators are available for most cryogenic system applications. The Type A-32 is a small 1/4" (8 mm) pressure build-up valve; the larger Type B, Type G-60 and Type E-55 can be used for either liquid or gas.

The Type B is available in sizes from 1/4" to 2" (8 mm to 50 mm), the G-60 from 1/4" to 1 1/2" (8 mm to 40 mm) and the Type E-55 from 1 1/4" to 2" (32 mm to 50 mm).

A-32 PRESSURE REDUCING OR PRESSURE BUILD-UP SERVICE

Construction

Brass forged body and spring chamber; bronze trim and diaphragms; PTFE seat disc and diaphragm gasket; stainless steel pressure spring. All parts are commercially cleaned for cryogenic service.

Note: Also available in stainless steel and special construction for hi-purity service. Contact your sales representative.

Temperature rating: +150°F to -320°F (339K to 78K)

Maximum initial pressure: 600 psi (42.18 kg/cm²)

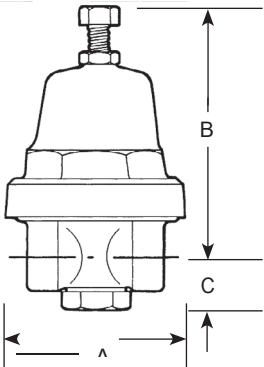
REDUCED PRESSURE RANGES

Maximum working pressure	
psi	(kg/sq cm)
2-25	(0.14-1.76)
15-65	(1.05-4.57)
40-100	(2.81-7.03)
50-150	(3.52-10.55)
75-175	(5.27-12.30)
100-250	(7.03-17.58)
200-400	(14.06-28.12)
300-600	(21.09-42.18)



DIMENSIONS

		Dimensions						Shipping weight	
Size		A		B		C			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
1/4	(8)	2 1/4	(57.15)	3 3/16	(80.96)	5/8	(15.88)	1 1/8	(0.51)
3/8	(10)	2 1/4	(57.15)	3 3/16	(80.96)	5/8	(15.88)	1 1/8	(0.51)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

A-36 PRESSURE REDUCING OR PRESSURE BUILD-UP SERVICE

Construction

Brass forged body and bronze spring chamber; bronze trim and diaphragms; PTFE seat disc and gaskets; stainless steel pressure spring. All parts are commercially cleaned for cryogenic service.

Note: Also available in stainless steel and special construction for hi-purity service.
Contact your sales representative.

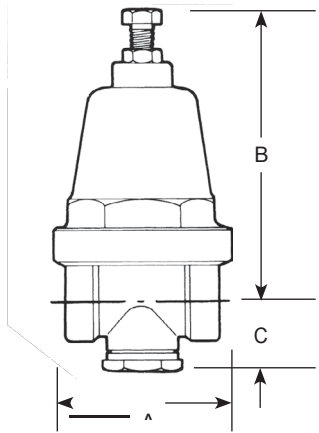
Temperature rating: +150°F to -320°F (339K to 78K)
Maximum initial pressure: 600 psi (42.18kg/cm²)

REDUCED PRESSURE RANGES

Maximum working ranges	
psi	(kg/sq cm)
10-30	(0.70-2.11)
20-50	(1.41-3.52)
40-80	(2.81-5.62)
75-150	(5.27-10.55)
100-250	(7.03-17.58)
High pressure construction only	
200-400	14.06-28.12

DIMENSIONS

		Dimensions							
Size		A		B		C		Shipping weight	
		inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
¾	(10)	2⅞	(61.91)	4½	(114.30)	1	(25.40)	2½	(1.13)
¾	(10)	2⅞	(61.91)	4½	(114.30)	1	(25.40)	2½	(1.13)



A-401 PRESSURE REDUCING OR PRESSURE BUILD-UP SERVICE

Construction

Bronze body and bronze spring chamber; bronze trim and neoprene/nylon diaphragms; FKM seat disc and gaskets; stainless steel pressure spring. All parts are commercially cleaned for cryogenic service.

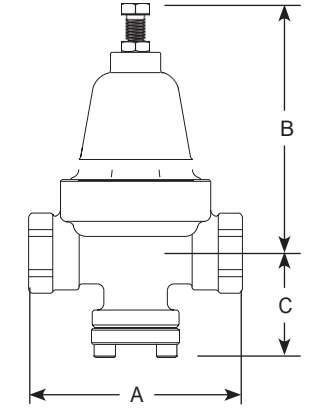
Temperature rating: +150°F to -320°F (339K to 78K)
Maximum initial pressure: 600 psi (42.18kg/cm²)

REDUCED PRESSURE RANGES

Maximum working ranges	
psi	(kg/sq cm)
20 to 60	(1.41 to 4.22)
40 to 80	(2.81 to 5.62)
75 to 125	(5.27 to 8.79)
100 to 250	(7.03 to 17.58)
200 to 400	(14.06 to 28.12)
High pressure construction only	
300 to 600	(21.09 to 42.18)

DIMENSIONS

Size		Dimensions						Shippingweight	
		A		B		C			
		inches	(mm)	inches	(mm)	inches	(mm)		
½	(15)	4	(101.6)	4.64	(117.80)	1.95	(49.6)	4½	(1.68)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

MODELS A36, A401 SELECTION GUIDE

Example:	A36Z	B	C	S	Z	S	Z	T	H	01	-	E	0015
Model													
A36Z A36 (Bronze body)													
A36G A36 (SST body)													
A401 A401													
Size													
B 3/8" (A36)													
C 1/2" (A401)													
Service													
C Cryogenic													
F Final line gas (A401)													
Body/connection style													
S Side inlet/side outlet - straight thru NPT													
B Side inlet/side outlet - straight thru BSPT													
Spring chamber material													
Z Bronze spring chamber													
Spring chamber style													
S Standard													
V Vented													
Diaphragm material													
G 316 SST (A36)													
T Neoprene w/PTFE liner (A401 final line only)													
Z Bronze													
Seat material													
T PTFE													
V FKM (A401 final line only)													
Pressure screw style													
H Hex													
Variations													
01 Standard													
Designrevision													
(-) Original design													
Spring material													
E Stainless steel													
Set pressure													
0005 5 psi													
0015 15 psi													
0100 100 psi													

Standard spring ranges - must specify during order process						
A 36 (**)	10-30	20-50	40-80	75-150	100-250	200-400 300-600
A401 (**)	20-60	40-80	75-125	100-250	200-400	300-600

Note: (**) Stainless steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

B PRESSURE REDUCING OR PRESSURE BUILD-UP SERVICE

Construction

Bronze body, spring chamber, trim and diaphragms; PTFE seat and diaphragm gasket; stainless steel pressure spring; stainless steel bolts and nuts; PTFE bottom-plug gasket; Monel® strainer screen. All parts are commercially cleaned for cryogenic service. Also available with BSP threads.

Temperature rating: +150°F to -320°F (339K to 78K)
Maximum initial pressure: 400 psi (28.12kg/cm²)

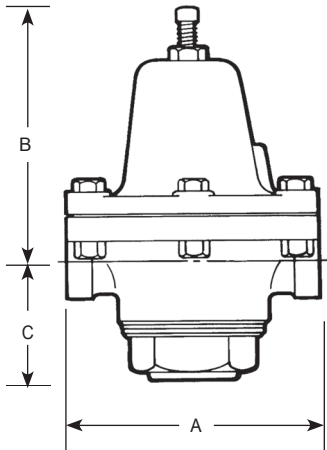
Note: Type B95 available in stainless steel construction ½" thru 1" (15 to 25 mm) size.

REDUCED PRESSURE RANGES

Valve size		Maximum working ranges	
Inches	(mm)	psi	(kg/sq cm)
¼	(8)	10-30	(0.70-2.11)
		25-100	(1.76-7.03)
		50-200	(3.52-14.06)
		100-250	(7.03-17.58)
⅜	(10)	10-50	(0.70-3.52)
		40-150	(2.81-10.55)
		100-250	(7.03-17.58)
½	(15)	10-30	(0.70-2.11)
		20-75	(1.41-5.27)
		25-125	(1.76-8.79)
		100-200	(7.03-14.06)
		150-250	(10.55-17.58)
¾	(20)	10-30	(0.70-2.11)
		20-70	(1.41-4.92)
		30-100	(2.11-7.03)
		50-150	(3.52-10.55)
		100-225	(7.03-15.82)
		150-250	(10.55-17.58)
1	(25)	10-35	(0.70-2.46)
		20-60	(1.41-4.22)
		50-100	(3.52-7.03)
		100-250	(7.03-17.58)
1¼	(32)	10-30	(0.70-2.11)
		20-40	(1.41-2.81)
		35-80	(2.46-5.62)
		75-150	(5.27-10.55)
1½	(40)	10-30	(0.70-2.11)
		20-40	(1.41-2.81)
		35-80	(2.46-5.62)
		75-150	(5.27-10.55)
2	(50)	5-20	(0.35-1.41)
		10-50	(0.70-3.52)

DIMENSIONS

Size		Dimensions						Shipping weight	
inches	(mm)	A		B		C		lbs	(kgs)
¼	(8)	3	(76.2)	2⅞	(73.03)	1¼	(44.45)	3	(1.35)
⅜	(10)	3⅞	(98.43)	4⅞	(104.78)	1¼	(44.45)	5½	(2.47)
½	(15)	4½	(114.3)	4½	(114.3)	2½	(53.98)	8	(3.6)
¾	(20)	5⅞	(130.18)	4⅞	(117.48)	2½	(53.98)	10	(4.5)
1	(25)	5⅞	(149.23)	5⅞	(136.53)	2½	(66.68)	16	(7.2)
1¼	(32)	6¾	(171.45)	6⅞	(155.58)	2½	(66.68)	20	(9.0)
1½	(40)	6¾	(171.45)	6⅞	(155.58)	3¼	(82.55)	20	(9.0)
2	(50)	9¼	(234.95)	8½	(215.9)	3½	(88.90)	37	(16.65)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE B SELECTION GUIDE

Example	B	Z	A	C	S	S	Z	T	S	01	-	E	0025
Model													
B B valve													
Material of construction													
Z Bronze													
Valve size													
A ¼"													
B ⅜"													
C ½"													
D ¾"													
E 1"													
F 1¼"													
G 1½"													
H 2"													
Service													
C Cryogenic													
F Final line gas (O ₂ clean adder required)													
Body style/connection style													
S Side inlet/side outlet - straight thru w/NPT connections													
B Side inlet/side outlet - straight thru w/BSPT connections													
C Side inlet/side outlet - straight thru w/copper tube connections (⅜" only)													
Spring chamber style													
S Standard													
D w/pressure screw cap and differential connection													
Diaphragm material													
B NBR (final line)													
Z Bronze (cryo)													
Seat material													
B NBR (final line)													
T PTFE (cryo)													
Pressure screw style													
S Standard													
Variation													
01 Standard													
Design revision													
(-) Indicates original design													
Spring material													
D Steel (final line gas)													
E SST (cryo)													
Set pressure													
0005 5 psig													
0025 25 psig													
0150 150 psig													

Standard spring ranges - must specify during order process					
B ¼" (**)	10-30	25-100	50-200	100-250	
B ⅜" (**)	10-50	40-150	100-250		
B ½" (**)	10-30	20-75	25-125	100-200	150-250
B ¾" (**)	10-30	20-70	30-100	50-150	100-225 150-250
B 1" (**)	10-35	20-60	50-100	50-150	100-250
B 1¼" & 1½" (**)	10-30	20-40	35-80	75-150	
B 2" (**)	5-20	10-50	20-100		
Final line only					
B ¼" (*)	2-25	20-60	30-100	50-150	
B ⅜" (*)	2-30	20-70	40-110	90-150	
B ½" (*)	2-30	10-50	30-125	50-150	
B ¾" (*)	2-20	10-35	30-75	50-110	105-150
B 1" (*)	2-20	10-45	20-60	55-100	90-150
B 1¼" & 1½" (*)	2-15	10-30	20-50	45-100	90-150
B 2" (*)	2-20	10-60	20-100	90-150	

Note: (**) Stainless steel (*) Steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE B95 SELECTION GUIDE

Example:	B95	G	C	C	S	S	G	T	S	01	-	E	0025
Model													
B95 B95 valve													
Material of construction													
G 316 SST body and chamber													
Valve size													
C ½"													
D ¾"													
E 1"													
Service													
C Cryogenic													
Body style/connection style													
S Sideinlet/side outlet- straightthru w/NPT connections													
Spring chamber style													
S Standard													
K w/pressure screw cap and differential connection													
Diaphragm material													
G 316 SST (cryo)													
Seat material													
T PTFE (cryo)													
Pressure screw style													
S Standard													
Variation													
01 Standard													
Designrevision													
(-) Indicates original design													
Spring material													
E Stainless steel													
Set pressure													
0005 5 psig													
0025 25 psig													
0150 150 psig													

Standard spring ranges - must specify during order process							
B95 ½" (**)	10-30	20-75	25-125	100-200	150-250	250-400	200-600
B95 ¾" (**)	10-30	20-70	30-100	50-150	100-225	150-250	
B95 1" (**)	10-35	20-60	50-100	50-150	100-250	200-400	

Note: (**) Stainless steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

G-60 PRESSURE REDUCING OR PRESSURE BUILD-UP SERVICE

Construction

Threaded ends; bronze body, spring chamber, diaphragms and trim; stainless steel pressure spring and body seat; PTFE seat and gaskets; stainless steel bolts. Closing cap over screw provided.

Also available with all system exposed internal parts in stainless steel. All parts are commercially cleaned for cryogenic service. Also available with BSP threads.

Note: Also available in stainless steel and special construction for hi-purity service. Contact your sales representative.

Temperature rating: +150°F to -320°F (339K to 78K)
Maximum initial pressure: 600 psi (42.18 kg/cm²)

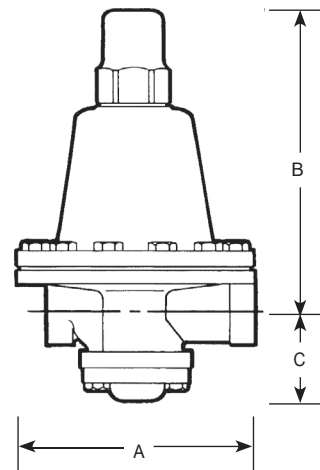
REDUCED PRESSURE RANGES

Valve size		Maximum working ranges	
Inches	(mm)	psi	(kg/sq cm)
¼ & ⅜	(8 & 10)	5-30	(0.35-2.11)
		15-65	(1.05-4.57)
		30-110	(2.11-7.73)
		75-200	(5.27-14.06)
		100-400*	(7.03-28.12*)
		100-600*	(7.03-42.18*)
½	(15)	0-7	(0-0.49)
		5-70	(0.35-4.92)
		50-150	(3.52-10.55)
		50-250	(3.52-17.58)
¾	(20)	200-500	(14.06-35.16)
		0-10	(0-0.70)
		5-75	(0.35-5.27)
		50-200	(3.52-14.06)
1	(25)	100-600*	(7.03-42.18)
		10-50	(0.70-3.52)
		50-200	(3.52-14.06)
		100-600*	(7.03-42.18)
1¼ & 1½	(32 & 40)	5-15	(0.35-1.05)
		10-50	(0.70-3.52)
		30-75	(2.11-5.27)
		50-120	(3.52-8.44)
		75-150	(5.27-10.55)
		100-400*	(7.03-28.12)

* **Note:** higher ranges are attained by modifying standard valve and/or using a different pressure spring. Contact your sales representative.

DIMENSIONS

Size		Dimensions						Shipping weight	
		A		B		C			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
¼	(8)	4	(101.60)	6⅝	(168.28)	2⅜ ₁₆	(55.55)	9	(4.05)
⅜	(10)	4	(101.60)	6⅝	(168.28)	2⅜ ₁₆	(55.55)	9	(4.05)
½	(15)	4¾	(120.65)	7⅝	(193.68)	2⅝ ₁₆	(58.72)	16	(7.20)
¾	(20)	5⅝	(142.88)	10	(254.00)	2⅞	(66.68)	24	(10.80)
1	(25)	6½	(165.10)	10¾	(273.05)	2⅞	(73.03)	35	(15.75)
1¼	(32)	8	(203.20)	12⅝ ₁₆	(312.74)	3⅞ ₁₆	(90.49)	63	(28.35)
1½	(40)	8	(203.20)	12⅝ ₁₆	(312.74)	3⅞ ₁₆	(90.49)	63	(28.35)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE G60 SELECTION GUIDE

Example:	G60Z	A	W	S	S	Z	Z	B	S	01	-	E	0015
Model													
G60Z G60 w/bronze body													
G60G G60 w/316 stainless steel body													
Valve size													
A ¼"													
B ¾"													
C ½"													
D ¾"													
Service													
C Cryogenic service													
F Final line gas (O ₂ clean but not used in cryo service)													
Body/connection style													
S Side inlet/side outlet - straight thru w/NPT connections													
Spring chamber style													
S Standard													
C w/pressure screw cap													
D w/pressure screw cap and differential connection													
V Vented													
W Vented w/pressure screw cap													
Spring chamber material													
Z Bronze													
G 316 stainless steel													
Diaphragm material													
B NBR (final line gas)													
Z Bronze (cryo)													
G 316 stainless steel (cryo)													
L NBR w/PTFE liner (final line gas)													
Seat material													
B NBR (final line gas)													
T PTFE (cryo)													
V FKM (final line gas)													
Pressure screw style													
S Standard													
Variation													
01 Standard (303 stainless steel trim) (303 SST seat ring, 303 SST pusher post button, 303 SST pusher post, 303 SST guide bushing, 303 SST piston and 316 SST bottom cap)													
31 Brass trim (303 SST seat ring, brass pusher post button, brass pusher post, 303 SST guide bushing, brass piston and bronze bottom cap)													
Design revision													
(-) Indicates original design													
Spring material													
E Stainless steel													
Set pressure													
0005 5 psig													
0025 25 psig													
0300 300 psig													

Standard spring ranges - must specify during order process						
¼" & ¾" (**)	5-30	15-65	30-110	75-200	100-400	100-600
½" (**)	0-7	5-70	50-150	50-250	100-400	200-500
¾" (**)	0-10	5-75	50-200	100-400	100-600	
1" (**)	10-50	50-200	100-400	100-600		
1¼" & 1½" (**)	5-15	10-50	30-75	50-120	75-150	100-400

Note: (**) Stainless steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

E-55 PRESSURE REDUCING, PRESSURE BUILD-UP OR FINAL-LINE GAS SERVICE

Construction - for pressure reducing or pressure build-up service

Bronze body, spring chamber, trim; stainless steel body seat and pressure spring; PTFE seat, O-rings and bottom plug gasket; Monel® diaphragms and strainer screen; stainless steel bolts. All parts are commercially cleaned for cryogenic service. Also available with BSP threads.

Size range: 1¼", 1½", 2" (32, 40, 50 mm)
Temperature rating: +150°F to -320°F (339K to 78K)
Maximum initial pressure: 400 psi (28.12 kg/cm²)

Construction - for final-line gas service

Bronze body, spring chamber and trim; stainless steel body seat and pressure spring; FKM seat disc and PTFE bottom plug gasket; FKM O-ring and neoprene diaphragm with FKM liner; Monel® strainer screen. All parts are commercially cleaned for oxygen service. Also available with BSP threads.

Size range: ½", ¾", 1", 1¼", 1½", 2" (15, 20, 25, 32, 40, 50 mm)
Temperature rating: +150°F to 0°F (339K to 255K)
Maximum initial pressure: 400 psi (28.12 kg/cm²)

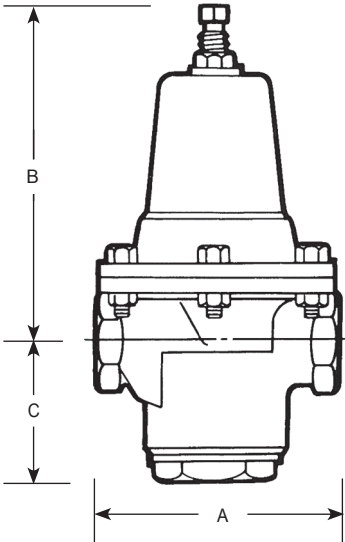
Note: Specification for final-line gas service is not for use on cold gas or liquid (less than 0°F).

REDUCED PRESSURE RANGES

Valve size		Maximum working ranges	
Inches	(mm)	psi	(kg/sq cm)
½", ¾", 1"	(15, 20, 25)	10-35	(0.70-2.46)
		20-75	(1.41-5.27)
		75-125	(5.27-8.79)
		125-175	(8.79-12.30)
		75-250	(5.27-17.58)
1¼", 1½", 2"	(32, 40, 50)	20-70	(1.41-4.92)
		50-150	(3.52-10.55)
		75-200	(5.27-14.06)
		150-300	(10.55-21.09)

DIMENSIONS

Size		Dimensions						Shipping weight	
		A		B	C				
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
½	(15)	4	(101.6)	7¼	(184.15)	2¼	(57.15)	6	(2.7)
¾	(20)	4	(101.6)	7¼	(184.15)	2¼	(57.15)	6	(2.7)
1	(25)	4	(101.6)	7¼	(184.15)	2¼	(57.15)	6	(2.7)
1¼	(32)	5½	(142.88)	11½	(282.58)	3¼	(82.55)	17	(7.7)
1½	(40)	5½	(142.88)	11½	(282.58)	3¼	(82.55)	17	(7.7)
2	(50)	5¾	(146.05)	11½	(288.93)	2½	(73.03)	17	(7.7)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE E-55 SELECTION GUIDE

Example:	E55	C	C	S	G	T	01	-	E	0025
Model										
E55 E-55 valve w/bronze body and spring chamber										
Valve size										
C	½"	F	1¼"							
D	¾"	G	1½"							
E	1"	H	2"							
Service										
C	Cryo (1¼" - 2")									
F	Final line gas (all sizes)									
Body style/connection style										
S	Side inlet/side outlet - straight thru w/NPT connections									
B	Side inlet/side outlet - straight thru w/BSPT connections									
C	Side inlet/side outlet - straight thru w/NPT connections (enlarged port) 1" E-55 only									
D	Side inlet/side outlet - straight thru w/BSPT connections (enlarged port) 1" E-55 only									
Diaphragm material										
G	316 SST (cryo) (1¼" - 2")									
N	Neoprene w/FKM diaphragm liner (final gas line)									
Seat material										
T	PTFE (cryo)									
V	FKM (final line gas)									
Variation										
01	Standard									
Design revision										
(-)	Indicates original design									
Spring material										
E	SST									
Set pressure										
0005	5 psig									
0025	25 psig									
0150	150 psig									

Standard spring ranges - must specify during order process				
Sizes C, D, E (**)	10-35	20-75	75-125	125-175
Sizes F, G, H (**)	20-70	50-150	75-200	150-300

Note: (**) Stainless steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

THE ECONOMIZER CIRCUIT

The economizer back pressure regulator is set from 10 to 25 psi (.70 to 1.76 kg/sq cm) above the set pressure of the pressure build-up regulator. When no gas is being used and heat leakage in the tank causes a gas pressure build-up, the excess pressure is by-passed into the final vaporizer line to conserve gas rather than allow the safety valve in the pressure build-up circuit to relieve the excess gas into the atmosphere.

Five types of back pressure valves are available for this circuit: the Type FRM, low flows, max. 600 psi (42.18 kg/cm²); FRM-2, medium flows, max. 250 psi (17.58 kg/cm²); FRM-2 (HP) high pressure, medium flows, max. 400 psi (28.12 kg/cm²); FR, large flows, max. 400 psi (28.12 kg/cm²) and the FR-6, max. 600 psi (42.18 kg/cm²).

FRM BACK PRESSURE OR ECONOMIZER SERVICE

Construction

Threaded ends; 2-way, side inlet-side outlet; 2-way, side inlet-bottom outlet; 3-way, 2 side inlets-bottom outlet; forged bronze body; bronze diaphragms; stainless steel seat disc, seat ring and pressure spring; PTFE diaphragm gasket. All parts commercially cleaned for cryogenic service.

Note: Also available in stainless steel and special construction for hi-purity service.
Contact your sales representative.

Temperature rating: +150°F to -320°F (339K to 78K)
Maximum set pressure: 600 psi (42.18 kg/cm²)

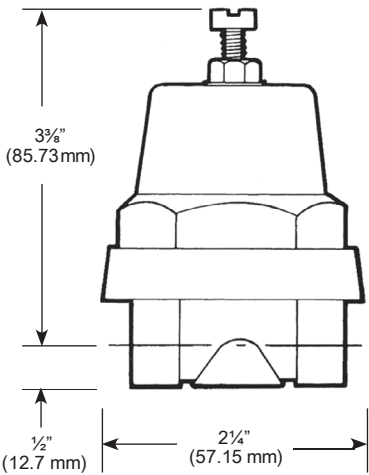
PRESSURE RANGES

Maximum working ranges	
psi	(kg/sq cm)
2-25	(0.14-1.76)
15-65	(1.05-4.57)
40-100	(2.81-7.03)
75-175	(5.27-12.30)
100-250	(7.03-17.58)
200-400	(14.06-28.12)
300-600	(21.09-42.18)

DIMENSIONS

Description	Size		Shipping weight	
	inches	(mm)	lbs	(kgs)
Side inlet, side outlet	¼	(8)	1⅞	(0.51)
Side inlet, side outlet	⅜	(10)	1⅞	(0.51)
Side inlet, bottom outlet	¼	(8)	1⅞	(0.51)
Side inlet, bottom outlet	⅜	(10)	1⅞	(0.51)
2 Side inlets, bottom outlet	¼	(8)	1⅞	(0.51)

* Use valve numbers for pressures to 175 psi only. Consult factory for other numbers.



CASH VALVES CRYOGENIC VALVES AND CONTROLS

FRM-2, FRM-2 (HP) BACK PRESSURE OR ECONOMIZER SERVICE

Construction

Threaded ends; 2-way, side inlet-side outlet; 2-way, side inlet-bottom outlet; 3-way, 2 side inlets-bottom outlet; forged bronze body; cast bronze spring chamber; stainless steel seat disc, seat ring and pressure spring; bronze diaphragms; PTFE diaphragm gasket. All parts commercially cleaned for cryogenic service.

Note: FRM-2 available in stainless steel and special construction for hi-purity service.
Contact your sales representative.

Temperature rating: +150°F to -320°F (339K to 78K)

Maximum set pressure

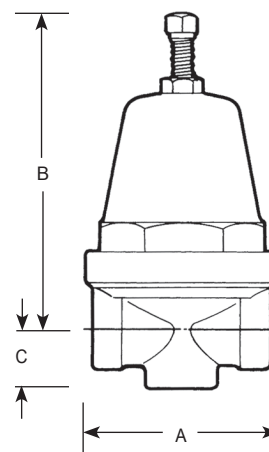
FRM-2: 250 psi (17.58 kg/cm²)

FRM-2HP: 400 psi (28.12 kg/cm²)



PRESSURE RANGES

Size	Maximum working ranges	
	psi	(kg/sq cm)
FRM-2		
All sizes	0-30	(0-2.11)
All sizes	20-50	(1.41-3.52)
All sizes	40-80	(2.81-5.62)
All sizes	75-150	(5.27-10.55)
All sizes	100-275	(7.03-19.34)
FRM-2HP		
All sizes	200-400	(14.06-28.12)



DIMENSIONS

Size			Dimensions						Shipping weight	
			A		B		C			
Description	inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
FRM-2										
Side inlet, side outlet	¼	(8)	2 ^{11/16}	(68.26)	4½	(114.3)	¾	(19.05)	2½	(1.13)
Side inlet, side outlet	⅜	(10)	2 ^{11/16}	(68.26)	4½	(114.3)	¾	(19.05)	2½	(1.13)
Side inlet, side outlet	½	(15)	2 ^{7/8}	(73.03)	4½	(114.3)	1⅞	(28.58)	3½	(1.58)
Side inlet, bottom outlet	¼	(8)	2 ^{11/16}	(68.26)	4½	(114.3)	¾	(19.05)	2½	(1.13)
Side inlet, bottom outlet	⅜	(10)	2 ^{11/16}	(68.26)	4½	(114.3)	¾	(19.05)	2½	(1.13)
Side inlet, bottom outlet	½	(15)	2 ^{7/8}	(73.03)	4½	(114.3)	1⅞	(28.58)	3½	(1.58)
2 Side inlets, bottom outlet	¼	(8)	2 ^{11/16}	(68.26)	4½	(114.3)	¾	(19.05)	2½	(1.13)
2 Side inlets, bottom outlet	⅜	(10)	2 ^{11/16}	(68.26)	4½	(114.3)	¾	(19.05)	2½	(1.13)
2 Side inlets, bottom outlet	½	(15)	2 ^{7/8}	(73.03)	4½	(114.3)	1⅞	(28.58)	3½	(1.58)
FRM-2HP										
Side inlet, side outlet	¼	(8)	2 ^{11/16}	(68.26)	4½	(114.3)	25/32	(19.84)	2½	(1.13)
Side inlet, bottom outlet	¼	(8)	2 ^{11/16}	(68.26)	4½	(114.3)	25/32	(19.84)	2½	(1.13)
Side inlet, side outlet	⅜	(10)	2 ^{11/16}	(68.26)	4½	(114.3)	25/32	(19.84)	2½	(1.13)
Side inlet, bottom outlet	⅜	(10)	2 ^{11/16}	(68.26)	4½	(114.3)	25/32	(19.84)	2½	(1.13)
Side inlet, side outlet	½	(15)	2 ^{11/16}	(68.26)	4½	(114.3)	1⅞	(28.58)	3½	(1.58)
Side inlet, bottom outlet	½	(15)	2 ^{11/16}	(68.26)	4½	(114.3)	25/32	(19.84)	3½	(1.58)

CASH VALVES CRYOGENIC VALVES AND CONTROLS

FRM, FRM-2 SELECTION GUIDE

Example:	FRM-	A	W	Z	S	A	S	B	F	02	-	D	0005
Model													
FRM- FRM													
FRM2 FRM-2													
Size													
A ¼" (all)													
B ⅜" (all)													
C ½" (FRM-2)													
Service													
C Cryogenic (FRM & FRM-2)													
Material of construction													
Z Brass													
G 316 SST (FRM & FRM-2)													
E 303 SST (FRM)													
Body/connection style													
S Side inlet/side outlet (all) NPT													
R 2 side inlets/bottom outlet (FRM & FRM-2) NPT													
E Side inlet/bottom outlet (FRM & FRM-2) NPT													
B Side inlet/side outlet (BSPT)													
P Side inlet/side outlet ¼" NPS - .082 wall pipe (FRM-2)													
T Side inlet/side outlet ⅜" NPS - .035 wall pipe (FRM-2)													
V Side inlet/side outlet ½" NPS - .049 wall pipe (FRM-2)													
Spring chamber material													
Z Brass spring chamber													
G SST spring chamber (FRM-2)													
C Chrome plated													
Spring chamber style													
S Standard													
W Without vent hole													
Diaphragm material													
G 316 SST													
Z Bronze													
Pressure screw style													
F Fillister (FRM only)													
H Hex													
T T-handle (FRM)													
Variations													
03 303 Stainless steel trim w/PTFE diaphragm gasket (metal diaphragms only)													
04 303 Stainless steel trim w/6 x 0.005 thick bronze diaphragms													
05 303 Stainless steel trim w/nylon inserted locknut													
13 316 Stainless steel trim w/PTFE diaphragm gasket (metal diaphragms only)													
23 Monel trim w/PTFE diaphragm gasket (metal diaphragms only)													
32 Remote sensing													
Design revision													
(-) Original design													
Spring material													
E Stainless steel (FRM-2)													
Set pressure													
0005 5 psig													
0015 15 psig													
0100 100 psig													

Standard spring ranges - must specify during order process									
FRM (**)	2-25	15-65	40-100	50-150	75-175	100-250	200-400	200-600	300-600
FRM-2 (**)	0-30	20-50	40-80	75-150	100-275	200-400	300-600		

Note: (**) Stainless steel only

CASH VALVES CRYOGENIC VALVES AND CONTROLS

FR, FR-6 BACK PRESSURE OR ECONOMIZER SERVICE

Construction

Threaded ends; 3-way, 2 side inlets-bottom outlet; bronze body, spring chamber and diaphragms; brass body seat; stainless steel seat disc, seat ring and pressure spring; PTFE O-ring and diaphragm gasket; stainless steel bolts; pressure-tight closing cap. All parts are commercially cleaned for cryogenic service. Also available with BSP threads.

FR Series valves are available in various pressure control and temperature ranges and are designated as follows:

- Type FR has a bronze body as standard, is suitable for pressure of 0 to 400 psig (0 to 27.6 barg) and maximum temperatures 200°F to 600°F (93°C to 316°C)*.
- Type FR-6 incorporates a diaphragm ring mounted above the diaphragm to accommodate higher back pressure ranges: 200 to 600 psig (13.8-41 barg); 200°F to 600°F (93°C to 316°C)*.

Note: Also available in stainless steel and special construction for hi-purity systems.
Contact your sales representative.

Temperature rating: +150°F to -320°F (339K to 78K)

MAXIMUM INITIAL PRESSURE

Type	psi	kg/cm ²
FR	250	17.58
FR-½"	400	28.12
FR-¾"	265	18.64
FR-1"-2"	250	17.58
FR-6	400	28.12
	600	42.18 on ½"

Maximum set pressure: See below. For higher pressures, contact your sales representative.

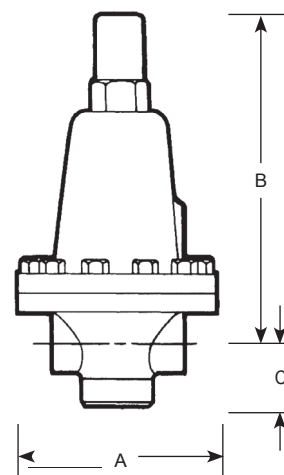
DIMENSIONS

Size	Dimensions					Shipping weight
	A	B	C			
in. (mm)	in. (mm)	in. (mm)	in. (mm)			lbs (kgs)
½ (15)	4¾ (120.65)	6¾ (171.45)	1¾ (41.28)			9½ (4.27)
¾ (20)	5¾ (142.88)	8 (203.20)	2 (50.80)			14¾ (6.64)
1 (25)	6½ (165.1)	10 ^{5/16} (261.94)	2¼ (57.15)			23½ (10.58)
1¼ (32)	6½ (165.1)	10¾ (276.23)	2¾ (60.33)			24½ (11.03)
1½ (40)	7½ (190.5)	10¾ (273.05)	2¾ (66.68)			33 (14.85)
2 (50)	7½ (190.5)	11 (279.40)	2¾ (66.68)			35½ (15.98)

PRESSURE RANGES

Valve size		Maximum working ranges		Valve size		Maximum working ranges	
inches	(mm)	psi	(kg/sq cm)	inches	(mm)	psi	(kg/sq cm)
½	(15)	0-20	(0-1.41)	1¼	(15)	0-15	(0-1.06)
		10-50	(0.70-3.52)			20-85	(1.41-5.98)
		40-90	(2.81-6.33)			40-125	(2.81-8.79)
		75-200	(5.27-14.06)			50-250	(3.52-17.58)
		100-400	(7.03-28.12)			200-400*	(14.06-28.12)*
		300-600	(21.09-42.18)				
¾	(20)	0-10	(0-.70)	1½	(40)	0-15	(0-1.06)
		10-70	(0.70-4.92)			10-55	(0.70-3.87)
		50-175	(3.52-12.30)			30-100	(2.11-7.03)
		100-265	(7.03-18.63)			40-160	(2.81-11.25)
		200-400*	(14.06-28.12)*			100-250	(7.03-17.58)
						200-400*	(14.06-28.12)*
1	(25)	0-15	(0-1.06)	2	(50)	0-15	(0-1.06)
		20-75	(1.41-5.27)			10-55	(0.70-3.87)
		40-200	(2.81-14.06)			30-100	(2.11-7.03)
		50-250	(3.51-17.58)			40-160	(2.81-11.25)
		200-400*	(14.06-28.12)*			100-250	(7.03-17.58)
						200-400*	(14.06-28.12)*

* **Note:** requires special diaphragm ring and pressure plate.



CASH VALVES CRYOGENIC VALVES AND CONTROLS

FR SERIES SELECTION GUIDE

Example	FR-	Z	A	W	S	S	Z	Z	B	H	01	-	E	0015
Model														
FR- FR														
FR6 FR-6														
Material of construction														
Z Bronze (FR, FR-6)														
G 316 SST (FR, FR-6)														
Valve size														
C ½"														
D ¾"														
E 1"														
F 1¼"														
G 1½"														
H 2"														
Service														
C Cryogenic service														
Body/connection style														
S 2 side inlets/bottom outlet - w/NPT connections														
Spring chamber style														
S Standard														
C w/pressure screw cap														
D w/differential connection														
V Vented														
W Vented w/pressure screw cap														
Spring chamber material														
Z Bronze														
G 316 Stainless steel														
Diaphragm material														
Z Bronze (cryo)														
G 316 Stainless steel (cryo)														
Body seat material														
E 303 Stainless steel														
G 316 Stainless steel														
Z Brass														
Pressure screw style														
S Standard														
Variation (Trim consists of ball seat and seat ring)														
04 303 Stainless steel trim w/PTFE O-ring and PTFE diaphragm gasket														
14 316 Stainless steel trim w/PTFE O-ring and PTFE diaphragm gasket														
Design revision														
(-) Indicates original design														
Spring material														
E Stainless steel														
Set pressure														
0005 5 psig														
0025 25 psig														
0300 300 psig														

Standard spring ranges - must specify during order process						
FR ½" (**)	0-20	10-50	40-90	75-200	100-300	100-400
FR ¾" (**)	0-10	0-15	10-70	50-175	100-265	
FR 1" (**)	0-15	10-35	20-75	40-200	50-250	
FR 1¼" (**)	0-15	10-30	20-85	40-125	50-250	
FR 1½" & 2" (**)	0-15	5-20	10-55	30-100	40-160	100-250
FR -6 ½" (**)	200-600					
FR-6 ¾" (**)	200-400					
FR-6 1" (**)	200-400					
FR-6 1¼" (**)	200-400					
FR-6 1½" & 2" (**)	200-400					

Note: (**) Stainless steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

COMBINATION PRESSURE BUILDER-ECONOMIZER

PBE Series regulators combine the pressure building and economizer functions into one unit. The economizer phase starts at the point at which the pressure build level is reached, assuring a smooth transition between the two functions. For sizing information, please request engineering data sheets 1074 (PBE-1A) and 1077 (PBE-2).

PBE-1A COMBINATION PRESSURE BUILDER-ECONOMIZER

Construction

Forged brass body and spring chamber; brass and stainless steel trim; PTFE/Armalon or bronze diaphragm; stainless steel pressure spring. All parts are commercially cleaned for oxygen service.

Temperature rating: +150°F to -320°F
(339K to 78K)
Maximum initial pressure: 600 psi
(42.18 kg/cm²)

PRESSURE RANGES

Max. working pressure	
psi	(kg/sq cm)
50-175	(3.52-12.32)
150-350	(10.55-24.61)

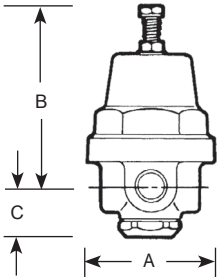


DIMENSIONS

Size inches (mm)		Dimensions						Shipping weight lbs (kg)	
		A		B		C			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)		
¼	(8)	2¼	(57.15)	3⅞	(79.38)	⅞	(22.29)	1.4	(0.65)

Low pressure - ranges to 175 psig

High pressure - ranges 150-350 psig



CAPACITY INFORMATION

Inlet - psig	Outlet - psig	Air (S FM)	
		10% Droop	20% Droop
25	15	4.1	5.8
45	20	4.3	7.0
	30	4.6	7.6
75	50	7.0	11.1
	65	8.0	12.0
125	50	8.3	14.7
	75	9.4	17.4
175	50	9.6	19.4
	75	11.2	21.6
	100	11.9	22.8
225	150	39.3	56.7
	200	31.1	48.0
275	150	42.4	66.7
	225	40.2	64.5
325	150	46.1	75.5
	275	44.0	75.3
475	275	47.8	79.2
	400	47.8	73.9
575	275	55.2	96.0
	500	54.6	89.6

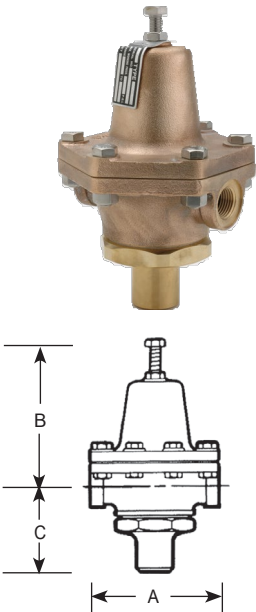
CASH VALVES CRYOGENIC VALVES AND CONTROLS

PBE-2 COMBINATION PRESSURE BUILDER-ECONOMIZER

Construction Bronze body, spring chamber, trim and diaphragms; PTFE seat and diaphragm gasket; stainless steel economizer seat; stainless steel spring, nuts and bolts. All parts are commercially cleaned for oxygen service.	PRESSURE RANGES	
	Max. working pressure	
	psi	(kg/sq cm)
	10-30	(0.70-2.11)
	20-75	(1.41-5.27)
	25-125	(1.76-8.79)
Temperature rating: +150°F to -320°F (339K to 78K)	100-200	(7.03-14.06)
	150-250	(10.55-17.58)
Maximum initial pressure: 400 psi (28.12 kg/cm²)		

DIMENSIONS									
Size		Dimensions						Shipping weight	
		A		B		C			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
½	(15)	4½	(114.30)	5¼	(133.35)	3	(76.20)	9	(4.08)

Inlet - psig		Air (S FM)	
		Outlet - psig	10% Droop
15		10	8.7
30		10	9.7
		20	12.4
		25	13.7
55		25	25.8
		50	25.5
75		25	27.3
		65	37.6
100		50	41.7
		75	48.5
125		50	42.5
		75	54.9
		100	61.5
150		125	77.5
200		125	90.8
		150	96.4
250		175	103.1
		225	119.3



CASH VALVES CRYOGENIC VALVES AND CONTROLS

PBE-5 COMBINATION PRESSURE BUILDER-ECONOMIZER

Construction

Forged brass body, bronze spring chamber; brass and stainless steel trim; bronze diaphragms; stainless steel pressure spring; graduated adjustment screw. All parts are commercially cleaned for oxygen service.

Temperature rating: +150°F to -320°F
(339K to 78K)
Maximum initial pressure: 650 psi
(45.7 kg/cm²)

PRESSURE RANGES

Max. working pressure	
psi	(kg/sqcm)
0 - 30	(0.00 - 2.11)
20 - 50	(1.41 - 3.52)
40 - 80	(2.81 - 5.62)
75 - 150	(5.27 - 10.55)
100 - 275	(7.03 - 19.33)
200 - 350	(14.06 - 24.61)
300 - 600	(21.09 - 42.18)

DIMENSIONS

Size		Dimensions						Shipping weight	
		A		B		C			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kg)
NPTF									
½	(15)	5.19	(131.8)	5.23	(132.9)	2.76	(70.2)	7	(3.2)
½	(15)	5.19	(131.8)	5.23	(132.9)	2.76	(70.2)	7	(3.2)

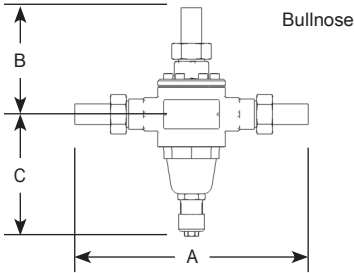
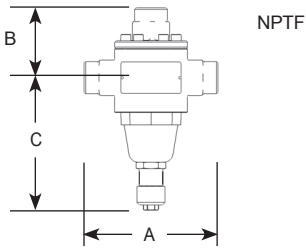
Note: 300 to 600 psi range, high pressure
Ranges to 350 psi, low pressure

Bullnose									
0.839	(21.3)	9.81	(149.2)	5.13	(130.3)	4.48	(113.8)	8	(3.6)
0.839	(21.3)	9.81	(149.2)	5.13	(130.3)	4.48	(113.8)	8	(3.6)

Note: 300-600 psi range, high pressure
Ranges to 350 psi, low pressure

CAPACITY INFORMATION

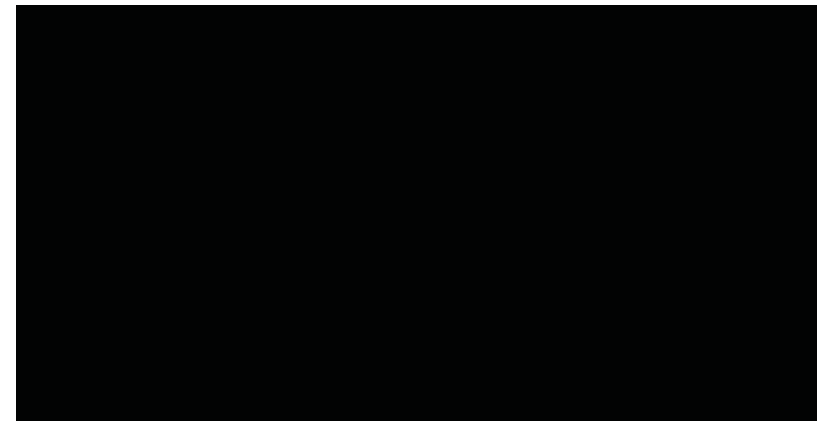
Inlet - psig	Outlet - psig	Air (S FM)	
		10% Droop	20% Droop
10	2	0.4	0.5
	5	0.4	0.5
30	20	2.7	3.6
50	20	3.1	4.4
	25	3.4	4.8
	40	8.6	11.5
75	40	10.4	13.7
	60	11.3	16.5
100	75	20.9	28.9
150	75	29.4	40.9
	100	39.4	55.6
	125	32.9	48.8
200	100	50.5	67.8
	125	53.3	76.5
	150	55.9	80.4
250	125	65.5	90.1
	150	71.2	99.6
	200	78.5	118.4
300	200	94.1	133.3
	250	94.5	136.8
600	300	169.9	258.1
	500	183.1	298.9



CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPES PBE-1, PBE-2, PBE-5 SELECTION GUIDE

Example:	PBE1	A	Z	3	S	01	-	E	0015
Model									
PBE1	PBE-1A valve								
PBE2	PBE-2 valve								
PBE5	PBE-5 valve								
Valve size									
A	¼" (PBE-1A)								
C	½" (PBE-2; PBE-5)								
Body and spring chamber									
Z	Brass/bronze (all)								
G	316 SST (PBE-2)								
Economizer outlet side (see diagram below)									
2	Left hand (PBE-1A)								
3	Right hand; PB out l/h (PBE-1A)								
B	Bottom (PBE-2; PBE-5)								
Option									
S	Standard								
C	with check (PBE-5)								
Variation									
01	Standard								
02	With tube end connections (PBE-5)								
Design revision									
(-)	Indicates original design (PBE-2; PBE-5)								
B	With active economizer (PBE-1A)								
Spring material									
E	Stainless steel								
Set pressure									
0005	5 psig								
0025	25 psig								
0300	300 psig								



Standard spring ranges - must specify during order process							
PBE-1	15-65	50-175	150-350	300-600			
PBE-2	10-30	20-75	25-125	100-200	150-250	200-400	
PBE-5	0-30	20-50	40-80	75-150	100-275	200-350	300-600

CASH VALVES CRYOGENIC VALVES AND CONTROLS

LOW TEMPERATURE CUT-OFF VALVES

The temperature control valve between the vaporizer and service line regulator is designed to cut off the gas flow if the gas temperature drops below a pre-determined point, usually -20°F (144.4K), often caused by a rapid or quick gas draw. If the temperature drops below the temperature control valve's setting, the valve closes to prevent excessively cold gas from reaching the service end of the system. In particular, the cold gas is prevented from contacting the final-line regulator, which is not constructed or intended for such low-temperature conditions. The valve opens automatically when gas temperature rises above the set point.

The Type LTC temperature control valve is a double-port valve with a range of 0°F to -40°F (255K to 233K) for low temperature cut-off. As it is subject to ambient temperature under normal conditions, it will normally be in a wide-open position. A copper well is recommended for each installation, which allows the removal of the capillary bulb without depressurizing the system.

Note: Valve seat closure may take several seconds under normal operating conditions. In addition, Type LTC fails in the closed position.

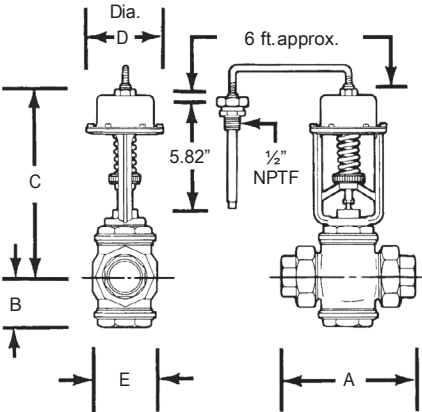
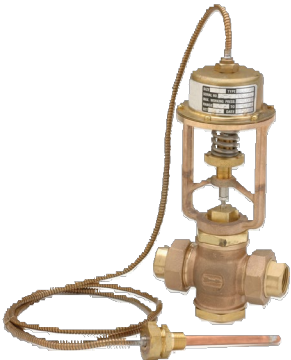
LTC REVERSE-ACTING TEMPERATURE REGULATOR FOR CRYOGENIC SERVICE

Construction

Brass union ends; bronze body and trim; copper capillary armor and bellows; PTFE gasket and packing; stainless steel spring; copper bulb and capillary.
Copper bulb is 1/2" x 5.82" (15 mm x 147.83 mm). All parts are commercially cleaned for oxygen service. A copper well is available as an option and is recommended for each cryogenic application.

Maximum operating limits

Operating temperature range is 0°F to -40°F (255K to 233K); standard setting is -20°F (244K).
Maximum temperature limit is 300°F (408K); minimum temperature limit is -320°F (78K).
Maximum body pressure on all sizes is 400 psi (28.12 kg/cm²); however, for proper operation, maximum pressure differentials as shown on page 21 must be observed.



DIMENSIONS

Size		Dimensions							
		A		B		C		D	
in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
1/2	(15)	6.04	(153.42)	2.08	(52.84)	9.80	(248.92)	4.31	(109.48)
3/4	(20)	6.04	(153.42)	2.08	(52.84)	9.80	(248.92)	4.31	(109.48)
1	(25)	6.04	(153.42)	2.08	(52.84)	9.80	(248.92)	4.31	(109.48)
1 1/4	(32)	7.61	(193.30)	2.75	(69.85)	10.47	(265.94)	4.31	(109.48)
1 1/2	(40)	7.61	(193.30)	2.75	(69.85)	10.47	(265.94)	4.31	(109.48)
2	(50)	8.58	(217.43)	3.12	(79.25)	10.84	(275.34)	4.31	(109.48)

Note: Also available: Separable well - ask for part number 17960.
Thermal system repair kit - ask for part number 18052.

CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE LTC MAXIMUM PRESSURE DIFFERENTIALS

Valve size		Temperature setting					
		0°F	(255°K)	-20°F	(244.4°K)	-40°F	(233°K)
inches	(mm)	psi	(kg/sq cm)	psi	(kg/sq cm)	psi	(kg/sq cm)
½ - ¾	(15-20)	400	(28.12)	400	(28.12)	400	(28.12)
1	(25)	275	(19.33)	400	(28.12)	400	(28.12)
1¼ - 1½	(32-40)	275	(19.33)	350	(24.61)	350	(24.61)
2	(50)	275	(19.33)	275	(19.33)	300	(21.09)

Note: It requires approximately 15°F change in temperature to fully close valve.

TYPE LTC CAPACITY INFORMATION (SCFH) OXYGEN SERVICE - 50 PSI AND 100 PSI LEVELS

Size	C _v	50 psi level				100 psi level			
		1 psid	2 psid	5 psid	10 psid	1 psid	2 psid	5 psid	10 psid
½"	9.0	4109	5788	9044	12530	5480	7734	12147	16986
¾"	9.0	4109	5788	9044	12530	5480	7734	12147	16986
1"	13.0	5935	8361	13064	18100	7916	11171	17546	24535
1¼"	37.5	17122	24119	37684	52211	22835	32223	50612	70775
1½"	37.5	17122	24119	37684	52211	22835	32223	50612	70775
2"	52.5	23970	33767	52757	73095	31969	45113	70857	99085

TYPE LTC CAPACITY INFORMATION (SCFH) OXYGEN SERVICE - 150 PSI AND 200 PSI LEVELS

Size	C _v	150 psi level				200 psi level			
		1 psid	2 psid	5 psid	10 psid	1 psid	2 psid	5 psid	10 psid
½"	9.0	6572	9280	14605	20495	7506	10602	16705	23485
¾"	9.0	6572	9280	14605	20495	7506	10602	16705	23485
1"	13.0	9492	13404	21096	29603	10842	15315	24129	33922
1¼"	37.5	27382	38665	60853	85394	31274	44177	69604	97853
1½"	37.5	27382	38665	60853	85394	31274	44177	69604	97853
2"	52.5	38334	54130	85195	119552	43784	61847	97445	136994

Note: psid values are pressure drops across valve.

TO DETERMINE CAPACITY

Determine operating pressure level at the valve and the maximum allowable pressure drop across the valve. Then refer to table above reading down the appropriate column to the selected pipe size. As an example: you are operating at a 150 psi pressure level and the maximum allowable pressure drop across the valve is 2 psi. Look at the second table under the 150 psi level and 2 psid column. For a 1¼" pipe size, the capacity would be 38,665 SCFH. Note: the values shown in the table are for oxygen gas; all capacity figures are standard cubic feet per hour. To determine capacity figures for other gases, consult the conversion chart below and multiply the chart capacities by the factor given.

GAS CONVERSION FACTORS

Gas	Oxygen	Nitrogen	Hydrogen	Helium	Argon
Factor	1.000	1.075	4.000	2.860	0.893

CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE LTC SELECTION GUIDE

Example:		LTC	C	S	-	01	A
Model							
LTC LTC valve							
Valve size							
C	1/2"						
D	3/4"						
E	1"						
F	1 1/4"						
G	1 1/2"						
H	2"						
Connection type							
S	NPT threaded union ends						
B	BSPT threaded union ends						
Design revision							
(-) Indicates original design							
Variation							
01	Catalog standard						
02	With Thermowell						
Temperature range							
A	-40°F to 0°F						

CASH VALVES CRYOGENIC VALVES AND CONTROLS

FINAL LINE CIRCUIT (HOUSE LINE)

Liquid is forced into the vaporizer through the liquid line by the action of the vapor pressure in the tank. The liquid in the vaporizer is warmed by ambient air (or sometimes by steam) and changed into gas, which is then distributed through the final-line regulator. As the gas is at or near ambient temperature, the diaphragm and seat in the regulator can be furnished in standard rubber materials.

A-31 PRESSURE REDUCING VALVE FOR FINAL-LINE GAS SERVICE

Construction

Brass forged body, brass piston; NBR seat disc and diaphragm; aluminum spring chamber; stainless steel spring. All parts are commercially cleaned for oxygen service. Standard valve has side inlet-side outlet connections. Also available with side gauge connections.

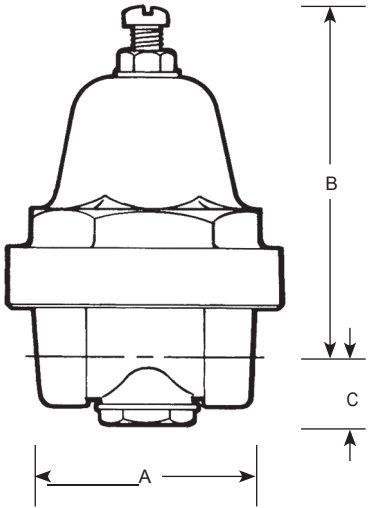
Temperature rating: +150°F to 0°F (339K to 255K)
Maximum initial pressure: 400 psi (28.12 kg/cm²)

REDUCED PRESSURE RANGES

Maximum working ranges	
psi	(kg/sq cm)
2-25	(0.14-1.76)
15-65	(1.05-4.57)
40-100	(2.81-7.03)
50-150	(3.52-10.55)
75-175	(5.27-12.30)

DIMENSIONS

Size		Dimensions						Shipping weight	
		A		B		C			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
¼	(8)	2¼	(57.15)	3¾	(80.96)	⅝	(15.88)	1⅞	(0.51)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

A16, A31, A31S, A31VR, A32, A32S SELECTION GUIDE

Example:	A16-	A	W	S	A	S	B	B	F	02	-	D	0005
Model													
A16- A16													
A31- A31													
A31S A31S													
A31V A31VR													
Size													
Y 1/8" (A31, A31S)													
A 1/4" (A16, A31, A31S, A31VR, A32, A32S)													
B 3/8" (A16, A31, A31S, A32)													
Service													
W Water/air													
C Cryogenic (A32Z, A32E)													
F Final line gas (A31)													
V Vacuum service (A32VR)													
Body/connection style													
S Side inlet/side outlet - straight thru (A16, A31, A32)													
R Side inlet/side outlet - straight thru w/right side gauge port (A31S)													
L Side inlet/side outlet - straight thru w/left side gauge port (A16, A31S)													
B Side inlet/bottom outlet w/straight thru gauge connection (A31VR)													
Spring chamber material													
A Aluminum spring chamber (A16, A31, A31S, A32, A32S)													
Z Brass spring chamber (A31, A32, A31VR only)													
C Brass chrome plate spring chamber (A32 only)													
Spring chamber style													
S Standard													
N Non-vented													
P Panel mount													
Diaphragm material													
B NBR (A16, A31, A31S, A32S)													
L NBR w/ PTFE liner (A31, A31S)													
G 316 SST (A32)													
N Neoprene (A31, A31S)													
T Neoprene w/PTFE liner (A31, A31S)													
Z Bronze (A32 only)													
R EPDM (A31VR, A32S)													
F EPDM w/ PTFE liner (A31VR)													
Seat material													
B NBR (A16, A31, A31S, A32S)													
T PTFE (A31, A32, A32S)													
V FKM (A31, A31S)													
S Silicone (A31VR)													
K Kalrez (A31VR)													
Pressure screw style													
F Fillister (A16, A31, A31S, A32, A32S)													
T T-handle (A31, A31S)													
H Hex (A31, A31S, A32)													
Knurled (A31VR)													
Handwheel plastic (A21)													
Variations													
01 Standard													
11 Standard variation w/inlet screen (A31, A32)													
02 Balanced piston (A31, A31S)													
12 Balanced piston w/inlet screen (A31)													
Design revision													
(-) Original design													
Spring material													
D Carbon steel (Industrial or final line gas service only)													
E Stainless steel													
Set pressure													
0005 5 psig													
0015 15 psig													
0100 100 psig													

Standard spring ranges - must specify during order process									
A16 (*)	2-30	10-50	25-90	80-120	100-180				
A31, A31S & A32 (*)	2-30	10-50	30-90	80-120	100-180				
A31 & A32 (**)	2-15	2-25	15-65	40-100	50-150	75-175	100-250	200-400 (A32)	300-600 (A32)
A31S (**)	2-15								
A31VR (*) in/hg	0-15	10-30							

Note: (*) Steel (**) Stainless steel

CASH VALVES CRYOGENIC VALVES AND CONTROLS

HIGH PURITY REGULATING VALVES

A line of high purity regulating valves for electronic grade and other high purity gases is also available. This includes pressure reducing valves, back pressure valves and valves suitable for differential service.

Valve bodies are investment cast 316L stainless steel, with internal trim 316L bar stock. Interior (wetted) surface finish is 15 micro inch or better. The finish is electropolished. Also, all maintenance may be carried out without removing the valve from the line.

Sizes are ½" to 1½", butt weld ends, 0.065 wall (½" size, 0.049 wall). Spring ranges are typically up to 400 psig (28.12 kg/cm²) control.

Temperature limits are 400°F [478K] to -425°F [19K]. All valves are cleaned for high purity gas compatibility.

Contact your sales representative for additional information and pricing.

Reference:

G60HP-pressure build service

FRHP-economizer service



C-776 SAFETY VALVE

Type C-776 cryogenic safety valves are available in sizes from ½" thru 2" (15 to 50 mm).

Request data sheet VCTDS-00515 for details.



2300 SHUT-OFF VALVE

Type 2300 is a brass shut-off globe style valve with ¼", ⅜", and ½" (7, 10.5 and 15 mm) NPTF connections. It offers the option of a stainless steel stub end inlet connection with a ⅜" (10.5 mm) NPTF outlet connection.

Temperature rating: +150°F to -320°F [339K to 78K]

Maximum inlet pressure: 700 psig (49.2 kg/cm²)



CASH VALVES CRYOGENIC VALVES AND CONTROLS

TYPE 2300 SELECTION GUIDE

Example:	2300	A	S	P	-	01
Model						
2300 2300 shut-off valve						
Valve size						
A 1/4"						
B 3/8"						
C 1/2"						
Body connection						
S Side in/side out w/NPT connections						
B Side in/side out w/BSPP connections						
1 Inlet 3/8" sch.10 x 1.125 long pipe/outlet 3/8" NPT						
2 Inlet 3/8" sch.10 x 2.125 long pipe/outlet 3/8" NPT						
3 Inlet 3/8" sch.10 x 3.375 long pipe/outlet 3/8" NPT						
4 Inlet and outlet 3/8" sch.10 x 1.125 long pipe						
5 Inlet 1/2" sch.5S x 2.125 long pipe/outlet 1/2" NPT						
Handwheel colors						
P Plain						
B Blue						
G Green						
R Red						
Design revision						
(-) Indicates original design						
Variation						
01 Standard						
02 With 4" extended stem						

CASH VALVES CRYOGENIC VALVES AND CONTROLS

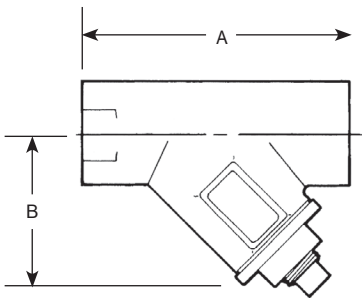
SY-70C ‘Y’ PATTERN STRAINERS

These strainers are suited for most cryogenic applications. Installed in the line ahead of automatic regulators, they protect valve seats, gauges, meters, regulators and other equipment from most foreign material to reduce maintenance costs and replacement expense.

Construction

ASTM B62 high-tensile cast bronze body, 100 mesh Monel® strainer screen; a brass blowoff plug is shipped with each strainer. All parts are commercially cleaned for cryogenic service.

Temperature rating: +150°F to -320°F (339K to 78K)
Maximum set pressure: 400 psi (28.12kg/cm²)



DIMENSIONS

				Dimensions					
Strainer size		Blow off plug size		A		B		Shipping weight	
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)	lbs	(kgs)
½	(15)	¼	(8)	2 ¹⁵ / ₁₆	(74.68)	1 ²⁷ / ₃₂	(46.99)	0.6	(0.27)
¾	(20)	¼	(8)	3 ⁵ / ₈	(91.95)	1 ¹⁵ / ₁₆	(49.53)	1.3	(0.59)
1	(25)	¾	(10)	4½	(114.30)	2¾	(69.85)	2	(0.91)
1¼	(32)	¾	(10)	5½	(130.30)	3 ¹¹ / ₃₂	(85.09)	3.1	(1.41)
1½	(40)	½	(15)	5 ¹³ / ₁₆	(147.58)	3¾	(95.25)	4.1	(1.86)
2*	(50)	¾	(20)	6 ¹³ / ₁₆	(172.58)	4 ¹³ / ₁₆	(122.68)	9	(4.08)

Capacity information

Capacity information is available on request. Write to the factory supplying full valve and application specifications.

NOTE

NPTF, also referred to as 'Dryseal' thread, is designed to provide a more leak-free seal without the use of PTFE tape or other sealant compound. NPTF threads are interchangeable with NPT threads and are standard on all Cash Valve products.

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Emerson.com/FinalControl

BourdonTube Pressure Gauge Model 233.55 LBM, All Stainless Steel Construction Panel Builder Gauge

WIKA Datasheet 233.55

Applications

- Panel builder and control industry
- Suitable for corrosive environments with 316 stainless steel wetted parts
- Used in gaseous and liquid media

Special features

- Equipped with socket restrictor and glycerine filled case
- Off-set case liquid filling port
- LBM process connection
- Crimped tamper-proof bezel ring

Standard version

Design

ASME B40.100

Size

4"

Accuracy class

2½" ± ASME B40.100 Grade A 2/1/2%

Bourdon Tube

Material: 316L Stainless Steel
30" Hg (Vac) to 1000 PSI C-type
1500 PSI to 20,000 PSI helical type

Socket Material

316Ti Stainless Steel

Movement

Stainless Steel

Dial

White aluminum with black lettering; stop pin

Pointer

Black aluminum

Case

304 Stainless Steel with vent plug and SS crimping ring.
Welded case/socket connection

Front Flange

300 series Stainless Steel, polished



Panel Builder Gauge 233.55

Scale ranges (all ranges not stocked)

Vacuum/Compound to 30" HG/0/200 PSI
Pressure from 15 PSI to 20,000 PSI
or other equivalent units of pressure or vacuum

Working Range

Steady: ¼ of full scale value
Fluctuating: 2/3 of full scale value
Short time: full scale value

Operating Temperature

Ambient: -4°F to 140°F (-20°C to 60°C) ^{Note 1}
Media: 212°F (+100°C) maximum

Temperature error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Weather protection

Weather-tight (NEMA 4X/IP 65)

Vent Plug

Flat rubber - over 300 PSI
Field cuttable nipple - vacuum through 300 PSI
With yellow vent lever- available

Restrictor

316 Stainless Steel; 0.023" (0.6mm) orifice, standard

Pressure connection

Material: 316 Stainless Steel
Lower back mount (LBM)
1/4" NPT limited to wrench flat area

Standard scale

PSI, PSI/BAR, PSI/KPA, PSI/KG/CM²

Window gasket

Buna-N

Case Filling

Glycerine-1000 Centistoke, standard

Window

Safety glass

Optional Extras

- Custom dial layout
- Silicone or inert case fill
- Special connections limited to wrench flat area
- Other pressure scales available
- Cleaned to ASME level IV (without glycerine case fill)

Recommendations

- Hole panel cutout= 2.56
- Installation screw= #6 flat head screw; threaded into panel, or back nut attachment (3-required).

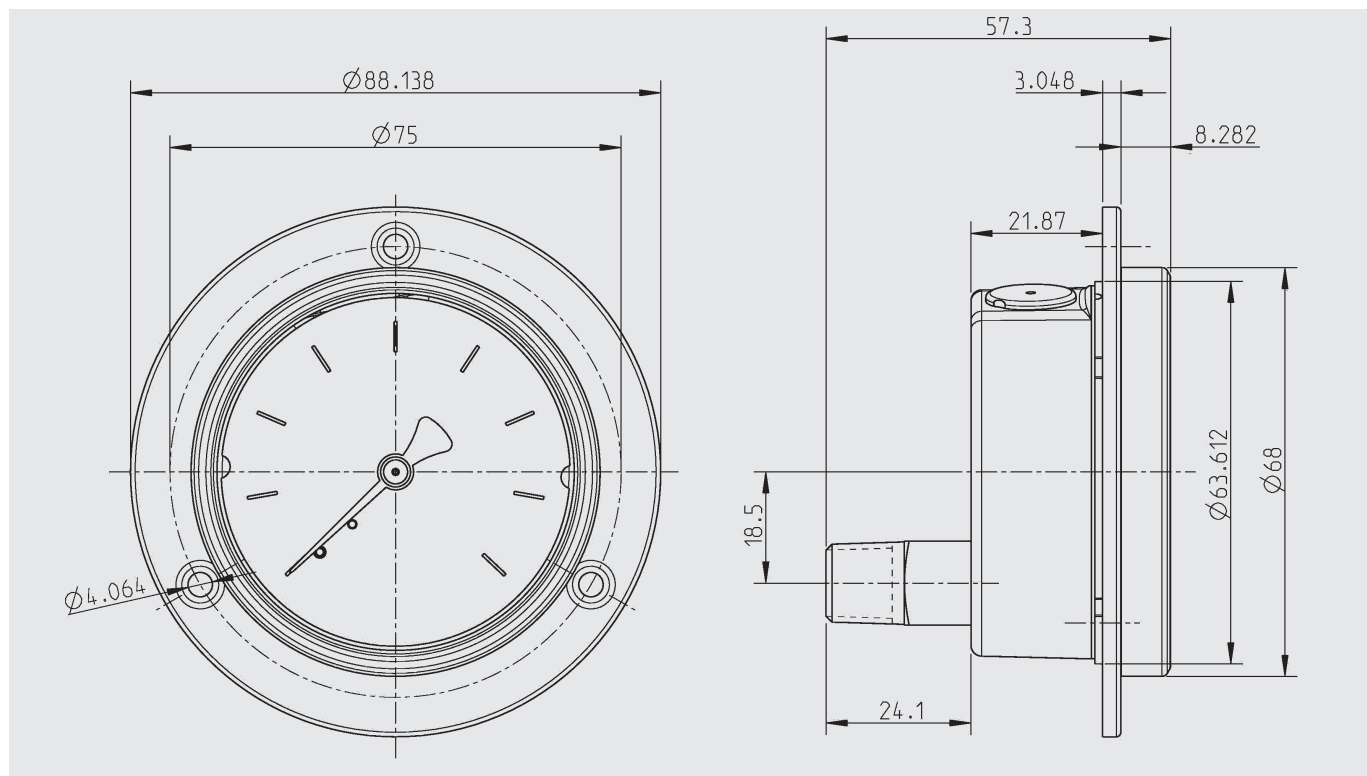
Note¹ Temperature ranges (liquid filled gauges)

Glycerine: -4°F to 140°F (-20°C to 60°C)

Silicone: -40°F to 140°F (-40°C to 60°C)

Dimensions

Standard versions



Ordering information

State computer part number (if available) /type number/size/range/connection size and locations/options required. WIKA reserves the right to make changes without prior notice.



WIKAL Instrument Corporation

1000 Wiegand Boulevard
Lawrenceville, GA 30043
1-888-WIKA-USA /770-513-8200 (in GA)
Fax 770-338-5118
info@wika.com www.wika.com

ASME Relief Valves for Gas & Cryogenic Systems

PRV 19430 Series Brass Relief Valves & PRV 29430 Series Stainless Steel Relief Valves

Application

The 19430 and 29430 relief valves are designed for oxygen and other industrial gases and for cryogenic service. Apply on piping systems, liquid cylinders or mini-bulk cryogenic containers where an ASME relief valve is required.

Features

- A.S.M.E. rated, National Board Certified.
- Bubble tight at 95% of set pressure.
- Full flow at 110% at set pressure.
- Repeatable performance.
- 100% factory tested.
- Temperatures Range -320° F to 165° F. (-196°C TO +74°C)
- Cleaned and packaged for oxygen service per CGA G-4.1.
- Rated for vapor service only.

Materials SS Style

Body	Stainless Steel
Spring	Stainless Steel
Seat Retainer.....	Stainless Steel
Pipe-Away Adapter	Stainless Steel

Materials PRV and B-Style

Body	Brass
Spring	Stainless Steel
Seat Retainer.....	Brass
Pipe-Away Adapter	Brass

Flow Performance

PRV19430 and PRV29430 Series: 0.783 SCFM of air per PSIA of flow pressure. Flow pressure per ASME is 10% above set pressure.

Ordering Information

Fill in the blanks with options below.

Example: PRV019432T350

PRV	9432	T	Blank or "P"	350	Blank or "P"
Style	Size	Seat Material	Drain Hole	Set Pressure	Pipe Away Option

Seat Material

F for Fluorosilicone for 90 to 139 psig set.

T for PTFE for 140-600 psig

Drain Hole

Leave blank for relief with drain hole. Insert P if no drain hole.

Set Pressure

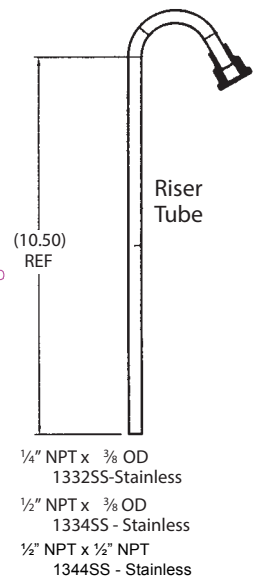
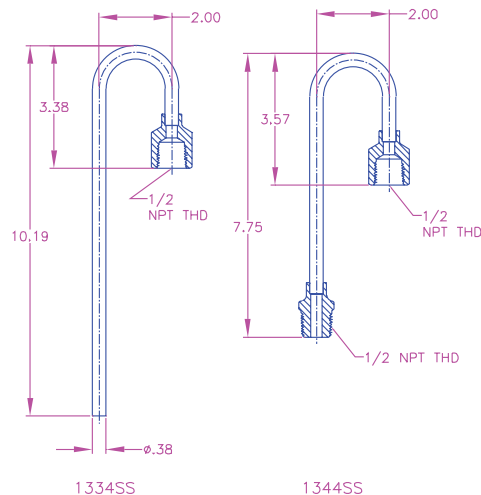
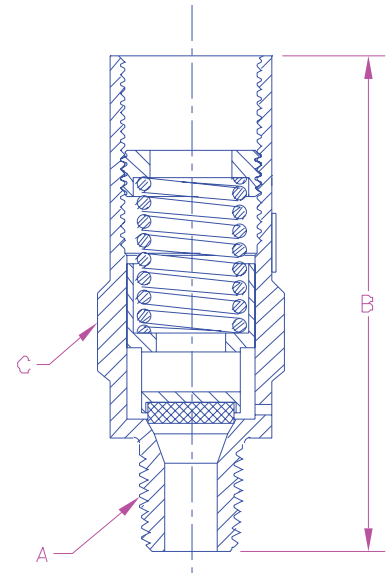
Enter number for set pressure in PSIG from 90 to 600.

Ordering Information

Part Number	Inlet A	Height B	Wrenching Hex C	Orifice Size
PRV 19432	1/4"	2.6	7/8"	.062 sq. inch
PRV29432				
PRV 19433	3/8"	2.6	7/8"	.062 sq. inch
PRV29433				
PRV 19434	1/2"	2.8	7/8"	.062 sq. inch
PRV29434				



1943 Series



WARNING: Inspection and maintenance of pressure relief valves is very important. Failure to properly inspect and maintain pressure relief valves could result in personal injuries or property damage. The useful safe service life of a pressure relief valve may be significantly affected by the service environment.

General Specifications

EJA510E and EJA530E Absolute and Gauge Pressure Transmitter

DPHarp **EJA**

GS 01C31F01-01EN

The high performance absolute and gauge pressure transmitter EJA510E and EJA530E feature single crystal silicon resonant sensor and are suitable to measure liquid, gas, or steam pressure. EJA510E and EJA530E output a 4 to 20 mA DC signal corresponding to the measured pressure. It also features quick response, remote setup and monitoring via BRAIN or HART communications and self-diagnostics. FOUNDATION Fieldbus, PROFIBUS PA and 1 to 5 V DC with HART (Low Power) protocol types are also available.

All EJA-E series models in their standard configuration, with the exception of the Fieldbus, PROFIBUS and Low Power types, are certified as complying with SIL 2 for safety requirement.

■ STANDARD SPECIFICATIONS

Refer to GS 01C31T02-01EN for Fieldbus communication type and GS 01C31T04-01EN for PROFIBUS PA communication type for the items marked with "◇."

□ SPAN AND RANGE LIMITS

(For EJA510E, values are in absolute and lower range limits are 0.)

Measurement Span/Range	MPa	psi (/D1)	bar (/D3)	kg/cm ² (/D4)
A	Span	10 to 200 kPa	1.45 to 29	0.1 to 2
	Range	-100 to 200 kPa	-14.5 to 29	-1 to 2
B	Span	0.1 to 2	14.5 to 290	1 to 20
	Range	-0.1 to 2	-14.5 to 290	-1 to 20
C	Span	0.5 to 10	72.5 to 1450	5 to 100
	Range	-0.1 to 10	-14.5 to 1450	-1 to 100
D	Span *	5 to 50	720 to 7200	50 to 500
	Range *	-0.1 to 50	-14.5 to 7200	-1 to 500

*: Maximum value shall be 70 MPa, 10150 psi, 700 bar or 700 kgf/cm² respectively when /HG is specified.

□ PERFORMANCE SPECIFICATIONS

Zero-based calibrated span, linear output, wetted parts material code 'S' and silicone oil, unless otherwise mentioned.

For Fieldbus and PROFIBUS PA communication types, use calibrated range instead of span in the following specifications.



Specification Conformance

EJA-E series ensures specification conformance to at least $\pm 3\sigma$.

Reference Accuracy of Calibrated Span

(includes the effects of terminal-based linearity, hysteresis, and repeatability)

Measurement span	Reference Accuracy	
	Span \geq X	Span<X
A	$\pm 0.055\%$ of Span	$\pm(0.0055 \text{ URL/ span})\%$ of Span
B		
C		
D		$\pm(0.0088 * 50 \text{ MPa/ span})\%$ of Span

[When /HAC is specified]

Measurement span	Reference Accuracy	
	Span \geq X	Span<X
A	$\pm 0.04\%$ of Span	$\pm(0.004 \text{ URL/ span})\%$ of Span
B		$\pm(0.005+0.0035 \text{ URL/ span})\%$ of Span
C		
D		$\pm(0.0064 * 50 \text{ MPa/ span})\%$ of Span

Measurement span	A	B	C	D
X	20 kPa (2.9 psi)	0.2 MPa (29 psi)	1 MPa (145 psi)	8 MPa (1160 psi)
URL (Upper range limit)	200 kPa (29 psi)	2 MPa (290 psi)	10 MPa (1450 psi)	50 MPa (7200 psi)

Ambient Temperature Effects per 28°C (50°F) Change

±(0.15% of Span + 0.15% of URL) for A, B and C capsule.
 ±(0.15% of Span + 0.15% of 50 MPa) for D capsule.

Stability (All normal operating condition)

EJA530E: ±0.1% of URL for 7 years
 EJA510E: ±0.2% of URL for 7 years

Power Supply Effects

±0.005 % per Volt (from 21.6 to 32 V DC, 350Ω)

Vibration EffectsAmplifier housing code 1 and 3:

Less than 0.1% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10-60 Hz, 0.21 mm displacement/60-2000 Hz 3 g)

Amplifier housing code 2:

Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field with general application or pipeline with low vibration level (10-60 Hz 0.15mm displacement /60-500 Hz 2g)

Mounting Position Effects

Rotation in diaphragm plane has no effect. Tilting up to 90 degree will cause zero shift up to 0.21 kPa (0.84 inH₂O) which can be corrected by the zero adjustment.

Response Time (All capsules) “◇”

90 ms

When software damping is set to zero and including dead time of 45 ms (nominal)

□ FUNCTIONAL SPECIFICATIONS**Output****For 4 to 20 mA HART / BRAIN****(Output signal code D and J)**

Two wire 4 to 20 mA DC output with digital communications, linear or square root programmable. BRAIN or HART FSK protocol are superimposed on the 4 to 20 mA signal.

Output range: 3.6 mA to 21.6 mA

Output limits conforming to NAMUR NE43 can be pre-set by option code C2 or C3.

For 1 to 5 V HART**(Output signal code Q)**

Three or four wire low power 1 to 5 V DC output with HART, linear or square root programmable.

HART protocol are superimposed on the 1 to 5 V DC signal.

Output range: 0.9 V to 5.4 V DC

Failure Alarm (Output signal code D and J)**For 4 to 20 mA HART / BRAIN****(Output signal code D and J)**

Output status at CPU failure and hardware error;
 Up-scale: 110%, 21.6 mA DC or more (standard)
 Down-scale: -5%, 3.2 mA DC or less

For 1 to 5 V HART**(Output signal code Q)**

Analog output status at CPU failure and hardware error;

Up-scale: 110%, 5.4 V DC or more (standard)

Down-scale: -5%, 0.8 V DC or less

Damping Time Constant (1st order)

Amplifier's damping time constant is adjustable from 0.00 to 100.00 s by software and added to response time.

Note: For BRAIN protocol type, when the software damping is set to less than 0.5 s, communication may occasionally be unavailable during the operation, especially while output changes dynamically. The default setting of damping ensures stable communication.

Update Period “◇”

Pressure: 45 ms

Zero Adjustment Limits

Zero can be fully elevated or suppressed, within the lower and upper range limits of the capsule.

External Zero Adjustment

External zero is continuously adjustable with 0.01% incremental resolution of span. Re-range can be done locally using the digital indicator with rangesetting switch.

Integral Indicator (LCD display, optional) “◇”

5-digit numerical display, 6-digit unit display and bar graph.

The indicator is configurable to display one or up to three of the following variables periodically; pressure in %, scaled pressure, measured pressure.

See also “Factory Settings.”

Local Parameter Setting**(Output signal code D, J and Q)**

Parameter configuration by the external zero adjustment screw and push button (Integral indicator code E) offers easy and quick setup for parameters of Tag number, Unit, LRV, URV, Damping, Output mode (linear/square root), Display out 1, and Re-range by applying actual pressure (LRV/URV).

Burst Pressure Limits

A, B and C capsule: 30 MPa

D capsule: 132 MPa

Self Diagnostics

CPU failure, hardware failure, configuration error, process alarm for pressure or capsule temperature. User-configurable process high/low alarm for pressure is also available

Signal Characterizer (Output signal code D, J and Q)

User-configurable 10-segment signal characterizer for 4 to 20 mA output.

SIL Certification

EJA-E series transmitters except Fieldbus, PROFIBUS PA and 1-5V DC with HART(Low Power) communication types are certified in compliance with the following standards;
 IEC 61508: 2000; Part1 to Part 7
 Functional Safety of Electrical/electronic/programmable electronic related systems; SIL 2 capability for single transmitter use, SIL 3 capability for dual transmitter use.

□ NORMAL OPERATING CONDITION (Optional features or approval codes may affect limits.)**Ambient Temperature Limits**

-40 to 85°C (-40 to 185°F)

-30 to 80°C (-22 to 176°F) with LCD display

Process Temperature Limits

-40 to 120°C (-40 to 248°F)

Ambient Humidity Limits

0 to 100% RH

Maximum Over Pressure

Capsule	Pressure	
	EJA510E	EJA530E
A and B	4 MPa abs (580 psia)	4 MPa (580 psig)
C	20 MPa abs (2900 psia)	20 MPa (2900 psig)
D	60 MPa abs (8700 psia) *	60 MPa (8700 psig) *

*: 105 MPa (15200 psi) when /HG is specified.

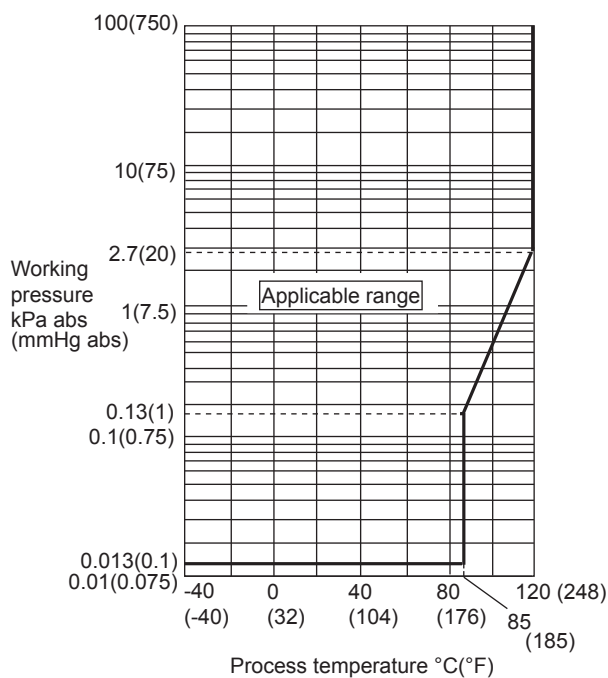
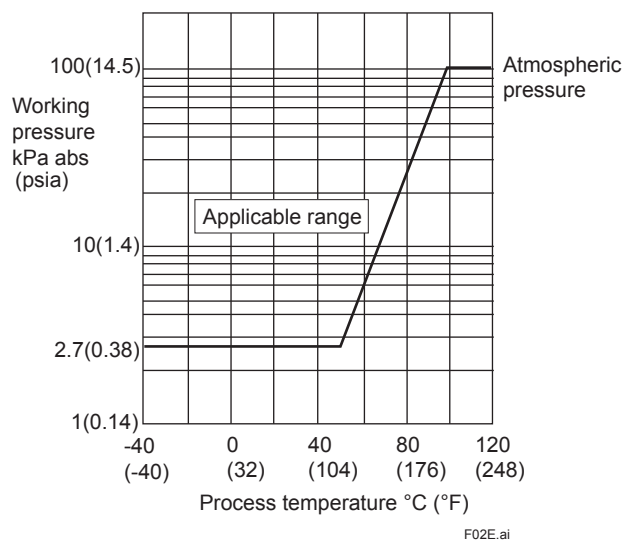
Working Pressure Limits (Silicone oil)**Maximum Pressure Limits**

Capsule	Pressure	
	EJA510E	EJA530E
A	200 kPa abs (29 psia)	200 kPa (29 psig)
B	2 MPa abs (290 psia)	2 MPa (290 psig)
C	10 MPa abs (1450 psia)	10 MPa (1450 psig)
D	50 MPa abs (7200 psia) *	50 MPa (7200 psig) *

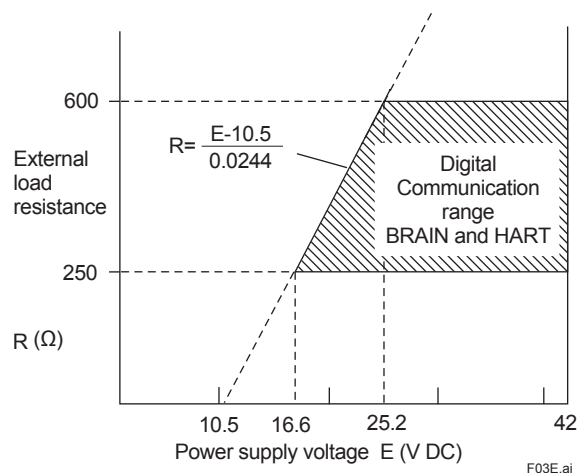
*: 70 MPa (10150 psi) when /HG is specified.

Minimum Pressure Limit

See graph below

**Figure 1-1. Working Pressure and Process Temperature [For EJA510E]****Figure 1-2. Working Pressure and Process Temperature [For EJA530E]****Supply & Load Requirements****(Output signal code D and J. Optional features or approval codes may affect electrical requirements.)**

With 24 V DC supply, up to a 550Ω load can be used. See graph below.

**Figure 2. Relationship Between Power Supply Voltage and External Load Resistance (Output signal code D and J)****Supply Voltage “◇”****For 4 to 20 mA HART / BRAIN (Output signal code D and J)**

10.5 to 42 V DC for general use and flameproof type.

10.5 to 32 V DC for lightning protector

(option code A).

10.5 to 30 V DC for intrinsically safe, type n, non-incendive or non-sparking type.

Minimum voltage limited at 16.6 V DC for digital communications, BRAIN and HART

**For 1 to 5 V HART
(Output signal code Q)**

Power supply :

9 to 28 V DC for general use and flame proof type.

Power Consumption :

0.96 mA to 3 mA, 27 mW

Load for 4 to 20 mA HART / BRAIN**(Output signal code D and J)**

0 to 1290Ω for operation

250 to 600Ω for digital communication

Output Load for 1 to 5 V HART**(Output signal code Q)**

1 MΩ or greater (meter input impedance)

Note that with three-wire connection, the cable length may affect the measurement accuracy of the output signal.

Communication Requirements “◇”

(Approval codes may affect electrical requirements.)

BRAIN**Communication Distance**

Up to 2 km (1.25 miles) when using CEV polyethylene-insulated PVC-sheathed cables.

Communication distance varies depending on type of cable used.

Load Capacitance

0.22 μF or less

Load Inductance

3.3 mH or less

Input Impedance of communicating device

10 kΩ or more at 2.4 kHz.

EMC Conformity Standards

EN 61326-1 Class A, Table2 (For use in industrial locations)

EN 61326-2-3

EN 61326-2-5 (for fieldbus)

European Pressure Equipment Directive**97/23/EC (until 18th July, 2016)****2014/68/EU (from 19th July, 2016)**

Sound Engineering Practice (for all capsules)

With option code /PE3 (for D capsule)**CE**₀₀₃₈

Category III, Module H, Type of Equipment: Pressure Accessory-Vessel, Type of Fluid: Liquid and Gas, Group of Fluid: 1 and 2

Safety Requirement Standards

EN 61010-1, EN 61010-2-030

C22.2 No.61010-1, C22.2 No.61010-2-030

- Altitude of installation site: Max. 2,000 m above sea level
- Installation category: I
(Anticipated transient overvoltage 330 V)
- Pollution degree: 2
- Indoor/Outdoor use

□ PHYSICAL SPECIFICATIONS**Wetted Parts Materials****Diaphragm, Process Connector**

Refer to “MODEL AND SUFFIX CODES.”

Non-wetted Parts Materials**Housing**

Low copper cast aluminum alloy with polyurethane, deep sea moss green paint (Munsell 0.6GY3.1/2.0 or its equivalent), or ASTM CF-8M Stainless Steel

Degrees of Protection

IP66/IP67, Type 4X

Pipe

Polypropylene

Cover O-rings

Buna-N, fluoro-rubber (optional)

Name plate and tag

316 SST

Fill Fluid

Silicone, Fluorinated oil (optional)

Weight

Capsule A, B and C: 1.2 kg (2.6 lb)*

Capsule D: 1.4 kg (3.1 lb)*

*: Without integral indicator and mounting bracket.

Add 1.5 kg (3.3 lb) for Amplifier housing code 2.

Connections

Refer to “MODEL AND SUFFIX CODES.”

< Related Instruments >

Power Distributor: Refer to GS 01B04T01-02E or GS 01B04T02-02E

BRAIN TERMINAL: Refer to GS 01C00A11-00E

< Reference >

- *DPHarp EJA* is a registered trademark of Yokogawa Electric Corporation.
 - FieldMate; Trademark of Yokogawa Electric Corporation.
 - Hastelloy; Trademark of Haynes International Inc.
 - HART; Trademark of the HART Communication Foundation.
 - FOUNDATION Fieldbus; Trademark of Fieldbus Foundation.
 - PROFIBUS; Registered trademark of Profibus Nutzerorganisation e.v., Karlsruhe, Germany.
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■ MODEL AND SUFFIX CODES

Model	Suffix Codes	Description									
EJA510E EJA530E	Absolute pressure transmitter Gauge pressure transmitter									
Output signal	-D -J -F -G -Q	4 to 20 mA DC Output with digital communication (BRAIN protocol) 4 to 20 mA DC Output with digital communication (HART 5/HART 7 protocol) ^{*1} Digital communication (FOUNDATION Fieldbus protocol, refer to GS 01C31T02-01EN) Digital communication (PROFIBUS PA protocol, refer to GS 01C31T04-01EN) Low Power, 1 to 5 V DC with digital communication (HART 7 protocol)									
Measurement span (capsule)	A B C D	10 to 200 kPa (1.45 to 29 psi) 0.1 to 2 MPa (14.5 to 290 psi) 0.5 to 10 MPa (72.5 to 1450 psi) 5 to 50 MPa (720 to 7200 psi) ^{*10}									
Wetted parts material ^{*2}	S H	<table> <tr> <th>Process connector</th><th>Diaphragm</th><th>Others</th></tr> <tr> <td>316L SST #</td><td>Hastelloy C-276 ^{*3#}</td><td>316L SST #</td></tr> <tr> <td>Hastelloy C-276 ^{*3#}</td><td>Hastelloy C-276 ^{*3#}</td><td>Hastelloy C-276 ^{*3#}</td></tr> </table>	Process connector	Diaphragm	Others	316L SST #	Hastelloy C-276 ^{*3#}	316L SST #	Hastelloy C-276 ^{*3#}	Hastelloy C-276 ^{*3#}	Hastelloy C-276 ^{*3#}
Process connector	Diaphragm	Others									
316L SST #	Hastelloy C-276 ^{*3#}	316L SST #									
Hastelloy C-276 ^{*3#}	Hastelloy C-276 ^{*3#}	Hastelloy C-276 ^{*3#}									
Process connections * For a diaphragm seal system, refer to process connections code table (p.6).	4 7 8 9	1/2 NPT female 1/2 NPT male G1/2 DIN 16 288 male ^{*4} M20×1.5 DIN 16 288 male ^{*4}									
—	N	Always N									
—	-0	Always 0									
Amplifier housing	1 3 2	Cast aluminum alloy Cast aluminum alloy with corrosion resistance properties ^{*5} ASTM CF-8M stainless steel ^{*6}									
Electrical connection	0 2 4 5 7 9 A C D	G1/2 female, one electrical connection without blind plugs 1/2 NPT female, two electrical connections without blind plugs M20 female, two electrical connections without blind plugs G1/2 female, two electrical connections with a blind plug ^{*7} 1/2 NPT female, two electrical connections with a blind plug ^{*7} M20 female, two electrical connections with a blind plug ^{*7} G1/2 female, two electrical connections and a 316 SST blind plug 1/2 NPT female, two electrical connections and a 316 SST blind plug M20 female, two electrical connections and a 316 SST blind plug									
Integral indicator	D E N	Digital indicator ^{*8} Digital indicator with the range setting switch (push button) ^{*9} (None)									
Mounting bracket	L N	316 SST 2-inch pipe mounting None									
Optional Codes		<input type="checkbox"/> Optional specification									

The “►” marks indicates the most typical selection for each specification. Example: EJA530E-DAS4N-012NN/□.

*1: HART 5 or HART 7 is selectable. Specify upon ordering.

*2: ⚠ Users must consider the characteristics of selected wetted parts material and the influence of process fluids. The use of inappropriate materials can result in the leakage of corrosive process fluids and cause injury to personnel and/or damage to plant facilities. It is also possible that the diaphragm itself can be damaged and that material from the broken diaphragm and the fill fluid can contaminate the user's process fluids. Be very careful with highly corrosive process fluids such as hydrochloric acid, sulfuric acid, hydrogen sulfide, sodium hypochlorite, and high-temperature steam (150°C [302°F] or above). Contact Yokogawa for detailed information of the wetted parts material.

*3: Hastelloy C-276 or ASTM N10276.

*4: Not applicable for combination of capsule code D and wetted parts material code H. Threads are based on the withdrawn DIN 16 288.

*5: Not applicable for electrical connection code 0, 5, 7, 9 and A. Content rate of copper in the material is 0.03% or less and content rate of iron is 0.15% or less.

*6: Not applicable for electrical connection code 0, 5, 7 or 9.

*7: Material of a blind plug is aluminum alloy or 304 SST.

*8: Not applicable for output signal code G.

*9: Not applicable for output signal code F.

*10: 5 to 70 MPa (720 to 10150 psi) when /HG is specified.

The ‘#’ marks indicate the construction materials conform to NACE material recommendations per MR0175/ISO 15156.

Please refer to the latest standards for details. Selected materials also conform to NACE MR0103.

[Process Connections Code for Diaphragm Seal System]

Following table shows the code dedicated for EJAC50E Diaphragm Seal System. The code cannot be specified without a diaphragm seal system. Please also refer to the GS 01C25W01-01EN for EJAC50E.

Process Connections Code	Description
P	Direct Mount Diaphragm seal system

■ OPTIONAL SPECIFICATIONS (For Explosion Protected type) “◇”

For other agency approvals and marine approvals, please refer to GS 01C25A20-01EN.

Item	Description	Code
Factory Mutual (FM)	FM Explosionproof Approval *1 Applicable Standard: FM3600, FM3615, FM3810, ANSI/NEMA 250 Explosionproof for Class I, Division 1, Groups B, C and D, Dust-ignitionproof for Class II/III, Division 1, Groups E, F and G, in Hazardous locations, indoors and outdoors (Enclosure: Type 4X) “FACTORY SEALED, CONDUIT SEAL NOT REQUIRED.” Temperature class: T6, Amb. Temp.: -40 to 60°C (-40 to 140°F)	FF1
	FM Intrinsically safe Approval *1*3 Applicable Standard: FM3600, FM3610, FM3611, FM3810 Intrinsically Safe for Class I, Division 1, Groups A, B, C & D, Class II, Division 1, Groups E, F & G and Class III, Division 1, Class I, Zone 0, in Hazardous Locations, AEx ia IIC Nonincendive for Class I, Division 2, Groups A, B, C & D, Class II, Division. 2, Groups F & G, Class I, Zone 2, Group IIC, in Hazardous Locations Enclosure: Type 4X, Temp. Class: T4, Amb. Temp.: -60 to 60°C (-75 to 140°F) Intrinsically Safe Apparatus Parameters [Groups A, B, C, D, E, F and G] Vmax=30 V, Imax=200 mA, Pmax=1 W, Ci=6 nF, Li=0 μH [Groups C, D, E, F and G] Vmax=30 V, Imax=225 mA, Pmax=1 W, Ci=6 nF, Li=0 μH	FS1
	Combined FF1 and FS1 *1*3	FU1
ATEX	ATEX Flameproof Approval *1 Applicable Standard: EN 60079-0:2012/A11:2013, EN 60079-1:2007, EN 60079-31:2009 Certificate: KEMA 07ATEX0109 X II 2G, 2D Ex d IIC T6...T4 Gb, Ex tb IIIC T85°C Db Degree of protection: IP66/IP67 Amb. Temp. (Tamb) for gas-proof : T4; -50 to 75°C (-58 to 167°F), T5; -50 to 80°C (-58 to 176°F), T6; -50 to 75°C (-58 to 167°F) Process Temp. for gas-proof (Tp): T4; -50 to 120°C (-58 to 248°F), T5; -50 to 100°C (-58 to 212°F), T6; -50 to 85°C (-58 to 185°F) Max. surface Temp. for dust-proof: T85°C (Tamb: -30 to 75°C, Tp: -30 to 85°C) *2	KF22
	ATEX Intrinsically safe Approval *1*3 Applicable Standard: EN 60079-0:2012/A11:2013, EN 60079-11:2012, EN 60079-26:2007 Certificate: DEKRA 11ATEX0228 X II 1G, 2D Ex ia IIC T4 Ga, Ex ia IIIC T85°C T100°C T120°C Db Degree of protection: IP66/IP67 Amb. Temp. (Tamb) for EPL Ga: -50 to 60°C (-58 to 140°F) Maximum Process Temp. (Tp) for EPL Ga: 120°C Electrical data: Ui=30 V, Ii=200 mA, Pi=0.9 W, Ci=27.6 nF, Li=0 μH Amb. Temp. for EPL Db: -30 to 60°C *2 Max. surface Temp. for EPL Db: T85°C (Tp: 80°C), T100°C (Tp: 100°C), T120°C (Tp: 120°C)	KS21
	Combined KF22, KS21 and ATEX Intrinsically safe Ex ic *1*3 [ATEX Intrinsically safe Ex ic] Applicable Standard: EN 60079-0:2012, EN 60079-11:2012 II 3G Ex ic IIC T4 Gc, Amb. Temp.: -30 to 60°C (-22 to 140°F) *2 Ui=30 V, Ci=27.6 nF, Li=0 μH	KU22

Item	Description	Code
Canadian Standards Association (CSA)	<p>CSA Explosionproof Approval *1 Certificate: 2014354 Applicable Standard: C22.2 No.0, C22.2 No.0.4, C22.2 No.0.5, C22.2 No.25, C22.2 No.30, C22.2 No.94, C22.2 No.60079-0, C22.2 No.60079-1, C22.2 No.61010-1, C22.2 No.61010-2-030 Explosion-proof for Class I, Groups B, C and D. Dustignition-proof for Class II/III, Groups E, F and G. When installed in Division 2, "SEAL NOT REQUIRED" Enclosure: Type 4X, Temp. Code: T6...T4 Ex d IIC T6...T4 Enclosure: IP66/IP67 Max.Process Temp.: T4;120°C(248°F), T5;100°C(212°F), T6; 85°C(185°F) Amb.Temp.: -50 to 75°C(-58 to 167°F) for T4, -50 to 80°C(-58 to 176°F) for T5, -50 to 75°C(-58 to 167°F) for T6 *2 Process Sealing Certification Dual Seal Certified by CSA to the requirement of ANSI/ISA 12.27.01 No additional sealing required Primary seal failure annunciation: at the zero adjustment screw</p>	CF1
	<p>CSA Intrinsically safe Approval *1*3 Certificate: 1606623 [For CSA C22.2] Applicable Standard: C22.2 No.0, C22.2 No.0.4, C22.2 No.25, C22.2 No.94, C22.2 No.157, C22.2 No.213, C22.2 No.61010-1, C22.2 No.60079-0, C22.2 No.61010-2-030 Intrinsically Safe for Class I, Division 1, Groups A, B, C & D, Class II, Division 1, Groups E, F & G, Class III, Division 1, Nonincendive for Class I, Division 2, Groups A, B, C & D, Class II, Division 2, Groups F & G, Class III, Division 1 Enclosure: Type 4X, Temp. Code: T4 Amb. Temp.: -50 to 60°C(-58 to 140°F) *2 Electrical Parameters: [Intrinsically Safe] Vmax=30V, Imax=200mA, Pmax=0.9W, Ci=10nF, Li=0 µH [Nonincendive] Vmax=30V, Ci=10nF, Li=0 µH [For CSA E60079] Applicable Standard: CAN/CSA E60079-11, CAN/CSA E60079-15, IEC 60529:2001 Ex ia IIC T4, Ex nL IIC T4 Enclosure: IP66/IP67 Amb. Temp.: -50 to 60°C(-58 to 140°F) *2, Max. Process Temp.: 120°C(248°F) Electrical Parameters: [Ex ia] Ui=30V, Ii=200mA, Pi=0.9W, Ci=10nF, Li=0 µH [Ex nL] Ui=30V, Ci=10nF, Li=0 µH Process Sealing Certification Dual Seal Certified by CSA to the requirement of ANSI/ISA 12.27.01 No additional sealing required Primary seal failure annunciation: at the zero adjustment screw</p>	CS1
	Combined CF1 and CS1 *1*3	CU1
IECEX	<p>IECEX Flameproof Approval *1 Applicable Standard: IEC 60079-0:2011, IEC60079-1:2007-4 Certificate: IECEX CSA 07.0008 Flameproof for Zone 1, Ex d IIC T6...T4 Gb Enclosure: IP66/IP67 Max.Process Temp.: T4;120°C(248°F), T5;100°C(212°F), T6; 85°C(185°F) Amb.Temp.: -50 to 75°C(-58 to 167°F) for T4, -50 to 80°C(-58 to 176°F) for T5, -50 to 75°C(-58 to 167°F) for T6</p>	SF2
	<p>IECEX Intrinsically safe and Flameproof Approval *1*3 Intrinsically safe Ex ia Certificate: IECEX DEK 11.0081X Applicable Standard: IEC 60079-0:2011, IEC 60079-11:2011, IEC 60079-26:2006 Ex ia IIC T4 Ga Amb. Temp.: -50 to 60 °C(-58 to 140 °F), Max. Process Temp.: 120 °C(248 °F) Electrical Parameters: Ui=30 V, Ii=200 mA, Pi=0.9 W, Ci=27.6 nF, Li=0 µH Intrinsically safe Ex ic Certificate: IECEX DEK 13.0061X Applicable Standard: IEC 60079-0:2011, IEC 60079-11:2011 Ex ic IIC T4 Gc IP code: IP66 Amb. Temp.: -30 to 60°C(-22 to 140°F) *2, Max. Process Temp.: 120°C(248°F) Electrical Parameters: Ui=30V,Ci=27.6 nF, Li=0 µH Flameproof Certificate: IECEX CSA 07.0008 Applicable Standard: IEC 60079-0:2011, IEC60079-1:2007-4 Flameproof for Zone 1, Ex d IIC T6...T4 Gb Enclosure: IP66/IP67 Max.Process Temp.: T4;120°C(248°F), T5;100°C(212°F), T6; 85°C(185°F) Amb.Temp.: -50 to 75°C(-58 to 167°F) for T4, -50 to 80°C(-58 to 176°F) for T5, -50 to 75°C(-58 to 167°F) for T6</p>	SU21

*1: Applicable for Electrical connection code 2, 4, 7, 9, C and D.

*2: Lower limit of ambient temperature is -15°C (5°F) when /HE is specified.

*3: Not applicable for output signal code Q.

■ OPTIONAL SPECIFICATIONS

Item		Description	Code
High accuracy type ^{*16}		High accuracy	HAC
Painting	Color change	Amplifier cover only ^{*2}	P□
		Amplifier cover and terminal cover, Munsell 7.5 R4/14	PR
	Coating change	Anti-corrosion coating ^{*12}	X2
316 SST exterior parts		316 SST zero-adjustment screw and setscrews ^{*14}	HC
Fluoro-rubber O-ring		All O-rings of amplifier housing. Lower limit of ambient temperature: -15°C (5°F)	HE
Lightning protector		Transmitter power supply voltage: 10.5 to 32 V DC (10.5 to 30 V DC for intrinsically safe type, 9 to 32 V DC for Fieldbus communication type.) Allowable current: Max. 6000 A (1×40 μs), Repeating 1000 A (1×40 μs) 100 times Applicable Standards: IEC 61000-4-4, IEC 61000-4-5	A
Oil-prohibited use		Degrease cleansing treatment	K1
		Degrease cleansing treatment with fluorinated oilfilled capsule. Operating temperature -20 to 80°C (-4 to 176°F)	K2
Capsule fill fluid		Flourinated oil filled in capsule Operating temperature -20 to 80°C (-4 to 176°F)	K3
Calibration units ^{*3}	P calibration (psi unit)		D1
	bar calibration (bar unit)		(See Table for Span and Range Limits.) D3
	M calibration (kgf/cm ² unit)		D4
Output limits and failure operation ^{*4}	Failure alarm down-scale : Output status at CPU failure and hardware error is -5%, 3.2mA DC or less for 4 to 20 mA output type and -5%, 0.8V DC or less for 1 to 5 V output type.		C1
	NAMUR NE43 Compliant Output signal limits: 3.8 mA to 20.5 mA ^{*17}	Failure alarm down-scale: Output status at CPU failure and hardware error is -5%, 3.2 mA DC or less.	C2
		Failure alarm up-scale: Output status at CPU failure and hardware error is 110%, 21.6 mA or more.	C3
Gold-plated diaphragm ^{*13}		Surface of isolating diaphragms are gold plated, effective for hydrogen permeation.	A1
Wired tag plate		316 SST tag plate wired onto transmitter	N4
Data configuration at factory ^{*5}	Data configuration for HART communication type		Software damping, Descriptor, Message CA
	Data configuration for BRAIN communication type		Software damping CB
European Pressure Equipment Directive ^{*15*16}		PED 97/23/EC (until 18th July, 2016) PED 2014/68/EU (from 19th July, 2016) Category: III, Module: H, Type of Equipment: Pressure Accessory-Vessel, Type of Fluid: Liquid and Gas, Group of Fluid: 1 and 2	PE3
Material certificate ^{*6}		Process Connector	M15
Pressure test/ Leak test certificate ^{*12}	Test Pressure: 200 kPa (29 psi) ^{*7}		T05
	Test Pressure: 2 MPa (290 psi) ^{*8}		T06
	Test Pressure: 10 MPa (1450 psi) ^{*9}		T07
	Test Pressure: 50 MPa (7200 psi) ^{*10}		T08
	Test Pressure: 70 MPa (10150 psi) ^{*19}		T15
High Pressure-proof structure ^{*18}		Maximum pressure limit and maximum span : 70 MPa.	HG

*1: Not applicable with color change option.

*2: Not applicable for amplifier housing code 2 and 3.

*3: The unit of MWP (Max. working pressure) on the name plate of a housing is the same unit as specified by option codes D1, D3, and D4.

*4: Applicable for output signal codes D and J. The hardware error indicates faulty amplifier or capsule.

*5: Also see 'Ordering Information'.

*6: Material traceability certification, per EN 10204 3.1 B.

*7: Applicable for capsule code A.

*8: Applicable for capsule code B.

*9: Applicable for capsule code C.

*10: Applicable for capsule code D without /HG.

*11: Pure nitrogen gas or pure water is used for oil-prohibited use (option codes K1 and K2).

*12: The unit on the certificate is always kPa/MPa regardless of selection of option code D1, D3 and D4.

*13: Applicable for wetted parts material code S.

*14: 316 or 316L SST. The specification is included in amplifier code 2.

*15: Applicable for measurement span code D. If compliance with category III is needed, specify this option code.

*16: Not applicable for output signal code Q.

*17: The 1 to 5 V voltage output corresponding to 4 to 20 mA current output is applied to output signal code Q which is non-compliant to NAMUR NE43.

*18: Applicable for capsule code D.

*19: Applicable for capsule code D with /HG specified.

■ OPTIONAL SPECIFICATIONS (for Diaphragm Seal System)

Following table shows the option codes dedicated for EJXC50A Diaphragm Seal System. These codes cannot be specified without a diaphragm seal system. Please also refer to the GS 01C25W01-01EN for EJXC50A.

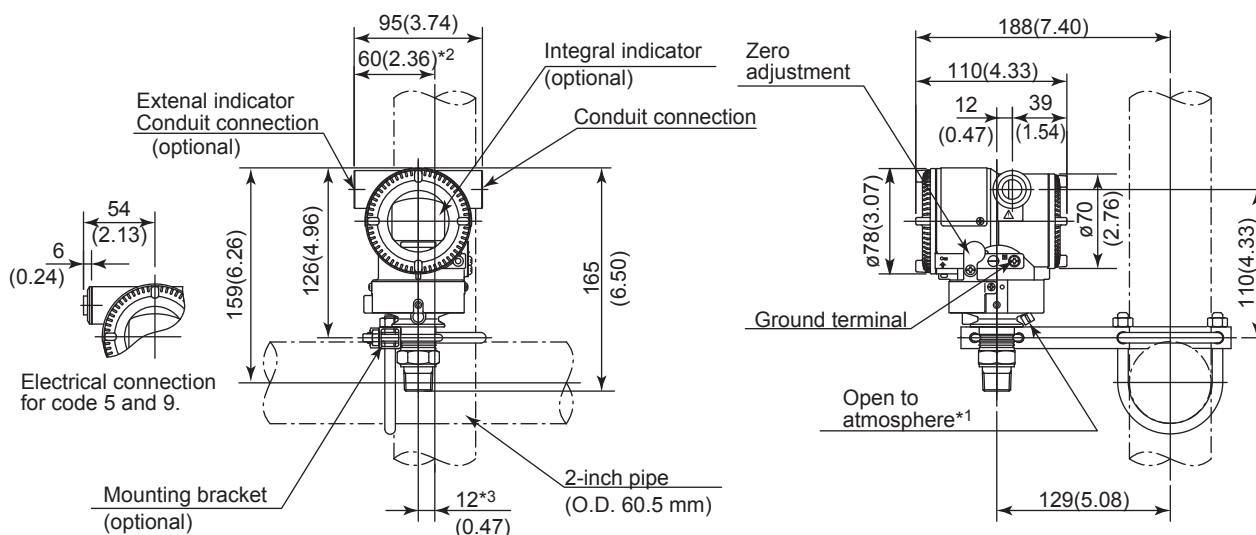
Item	Description	Code
Oil-prohibited use	Degrease cleansing treatment	K11
	Degrease cleansing treatment and fluorinated oilfilled capsule. Operating temperature -20 to 80°C (-4 to 176°F)	K12
Oil-prohibited use with dehydrating treatment	Degrease cleansing and dehydrating treatment	K15
	Degrease cleansing and dehydrating treatment with fluorinated oilfilled capsule. Operating temperature -20 to 80°C (-4 to 176°F)	K16
Capsule fill fluid	Fluorinated oil filled in capsule Operating temperature -20 to 80°C (-4 to 176°F)	K13

■ DIMENSIONS

Unit: mm (approx.inch)

Model EJA510E and EJA530E

● With process connections code 7



*1: Only for EJA530E whose measurement span code is A, B, or C.

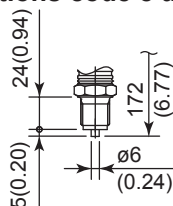
*2: 58 mm (2.28 inch) for measurement span code D.

*3: 11 mm (0.43 inch) for measurement span code D.

● With Process connections code 4

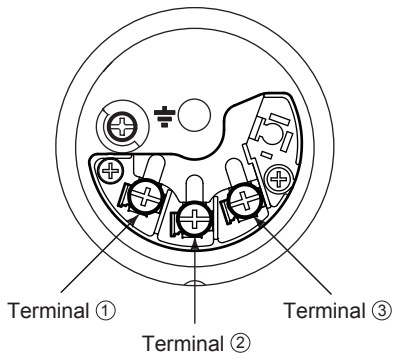


● With Process connections code 8 and 9



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• Terminal Configuration



• Terminal Wiring for 4 to 20 mA output, FOUNDATION Fieldbus and PROFIBUS PA communication types

SUPPLY	+	①	Power supply and output terminals
	-	②	
CHECK	+	③	External indicator (ammeter) terminals**2
	-	②	
			Ground terminal

*1: When using an external indicator or check meter, the internal resistance must be 10 Ω or less.
*2: Not available for FOUNDATION Fieldbus and PROFIBUS PA communication types.

• Terminal Wiring for 1 to 5 V output

SUPPLY	+	①	Power supply terminals
	-	②	
VOUT	+	③	1 to 5 V DC with HART communication terminals
	-	②	
			Ground terminal

Three or four wire connection. For four wire connection, both supply and signal lines use SUPPLY - terminal.

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< Ordering Information > “◇”

Specify the following when ordering

1. Model, suffix codes, and option codes
2. Calibration range and units
 - 1) Calibration range can be specified with range value specifications up to 5 digits (excluding any decimal point) for low or high range limits within the range of -32000 to 32000. When reverse range is designated, specify Lower Range Value (LRV) as greater than Upper Range Value (URV).
 - 2) Specify only one unit from the table, 'Factory Settings' when shipped.
3. Display scale and units (for transmitters equipped with integral indicator only)
Specify either 0 to 100 % or engineering unit scale and 'Range and Unit' for engineering units scale:
Scale range can be specified with range limit specifications up to 5 digits (excluding any decimal point) for low or high range limits within the range of -32000 to 32000. The unit display consists of 6-digit, therefore, if the specified unit is longer than 7 characters excluding '/', the first 6 characters will be displayed on the unit display.
4. HART PROTOCOL
When output signal code is "J", specify the HART protocol revision "5" or "7".
5. TAG NO (if required)
Specified characters (up to 16 characters for BRAIN, 22 characters for HART) are engraved on the stainless steel tag plate fixed on the housing.
6. SOFTWARE TAG (for HART only, if required)
Specified characters (up to 32 characters) are set as "Tag" (the first 8 characters) and "Long tag"*1 (32 characters) in the amplifier memory. Use alphanumeric capital letters.
When the "SOFTWARE TAG" is not specified, specified "TAG NO" is set as "Tag" (the first 8 characters) and "Long tag"*1 (22 characters) in the amplifier memory.
*1: applicable only when HART 7 is selected.
7. Other factory configurations (if required)
Specifying option code **CA** or **CB** will allow further configuration at factory. Following are configurable items and setting range.
[CA : For HART communication type]
 - 1) Descriptor (up to 16 characters)
 - 2) Message (up to 30 characters)
 - 3) Software damping in second (0.00 to 100.00)
 [CB : For BRAIN communication type]
 - 1) Software damping in second (0.00 to 100.00)

< Factory Setting > “◇”

Tag number	As specified in order
Software damping *1	'2.00 s' or as specified in order
Calibration range lower range value	As specified in order
Calibration range upper range value	As specified in order
Calibration range units	[EJA530E] Selected from mmH ₂ O, mmH ₂ O(68°F), mmAq* ² , mmWG* ² , mmHg, Pa, hPa* ² , kPa, MPa, mbar, bar, gf/cm ² , kgf/cm ² , inH ₂ O, inH ₂ O(68°F), inHg, ftH ₂ O, ftH ₂ O(68°F) or psi. (Only one unit can be specified) [EJA510E] Torr, Pa abs, hPa abs* ² , kPa abs, MPa abs, mbar abs, bar abs, kgf/cm ² abs, mmH ₂ O abs, mmH ₂ O abs(68°F), mmHg abs, inH ₂ O abs, inH ₂ O abs(68°F), inHg abs, ftH ₂ O abs, ftH ₂ O abs(68°F), psia, atm.
Display setting	Designated value specified in order. (% , or user scaled value.)

*1: To specify these items at factory, /**CA** or /**CB** option is required.

*2: Not available for HART protocol type.

< Material Cross Reference >

ASTM	JIS
grade 316	SUS316
grade 316L	SUS316L
grade 304	SUS304

Features

- All NPT connections are in the valve body to allow in-line piping
- No Minimum Operating Pressure Differential required
- Broadest range of applications
- Mountable in any position

Construction

Valve Parts in Contact with Fluids		
Body	Brass	303 Stainless Steel
Seals and Disc	NBR or Cast UR, as Listed	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Core Springs	302 Stainless Steel	
Shading Coil	Copper	Silver
Disc-Holder	CA	
Core Guide	CA (10.1 and 17.1 Watt only)	

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
	DC Watts	AC			General Purpose		Explosionproof	
		Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	10.6	6.1	16	30	238210	238310	238214	238314
F	-	9.1	25	40	238210	-	238214	-
F	11.6	10.1	25	50	238610	238710	238614	238714
F	22.6	17.1	40	70	238610	238710	238614	238714

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages are available when required.

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X.

Optional: Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9. (To order, add prefix "EF" to the catalog number.)

See *Optional Features Section* for other available options.

Nominal Ambient Temp. Ranges

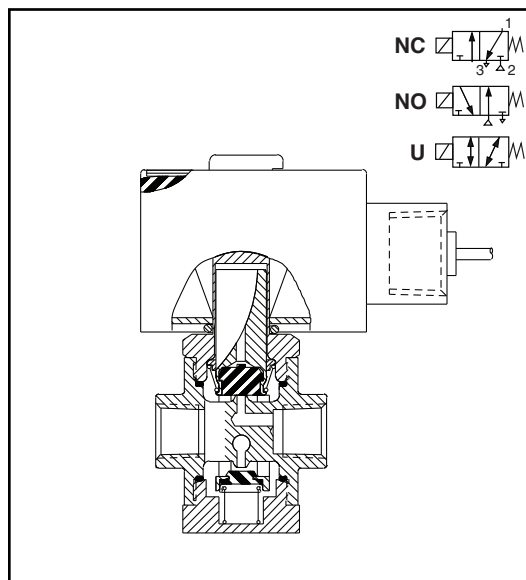
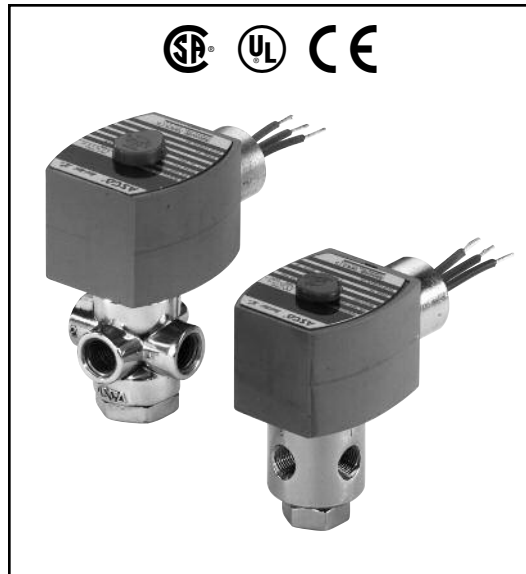
AC: 32°F to 125°F (0°C to 52°C)

DC: 32°F to 104°F (0°C to 40°C)

Note: Some stainless steel constructions are rated -40°F (-40°C).

See note ④ in specifications table.

Refer to *Engineering Section* for details.



Approvals

CSA certified. UL listed General Purpose Valves.

Meets applicable CE directives.

SIL 3 capable per IEC 61508 on normally closed const.

Third party certification provided by EXIDA.

Refer to *Engineering Section* for details.

ATEX/IECEx certified with prefix "EV" as listed.

Refer to *Optional Features Electrical Section* for details.

Specifications (English units)

Pipe Size (in)	Orifice Size (in)	Cv Flow Factor	Operating Pressure Differential (psi)						Max. Fluid Temp. °F		Brass Body		Stainless Steel Body		Watt Rating/ Class of Coil Insulation ②	
			Max. AC			Max. DC					Catalog Number	Const. Ref.	Catalog Number	Const. Ref.		
			Air-Inert Gas	Water ⑤	Lt. Oil @ 300 SSU	Air-Inert Gas	Water ⑤	Lt. Oil @ 300 SSU	AC	DC						
UNIVERSAL OPERATION (Pressure at any port)																
1/8	3/64	0.06	175	175	175	125	125	125	140	120	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1/16	0.09	100	100	100	65	65	65	180	120	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1/16	0.09	175	175	175	125	125	125	200	150	8320G212	4	8320G221 ④⑥	4	17.1/F	22.6/F
1/8	3/32	0.12	50	50	50	50	50	50	180	120	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	3/32	0.12	100	100	100	60	60	60	200	150	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	1/8	0.21	30	30	30	20	20	20	180	120	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	1/8	0.21	50	50	50	25	25	25	200	150	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1/16	0.09	125	130	130	75	75	75	200	150	8320G172	2	-	-	10.1/F	11.6/F
1/4	1/16	0.09	175	175	175	125	125	125	200	150	-	-	8320G230 ④⑥	3	17.1/F	22.6/F
1/4	3/32	0.12	100	100	100	60	60	60	200	150	8320G174	2	8320G200 ③④⑥	3	17.1/F	11.6/F
1/4	1/8	0.25	50	50	50	25	25	25	200	150	8320G176 ⑥	2	8320G201 ③④⑥	3	17.1/F	11.6/F
1/4	11/64	0.35	20	20	20	12	12	12	200	150	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD _{AVG} = 6.81 x 10 ⁻⁴																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8320G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1/16	0.09	210	225	225	160	160	160	200	150	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	150	150	115	115	115	200	150	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	1/8	0.21	85	85	85	60	60	60	200	150	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	210	225	225	160	160	160	200	150	8320G182 ⑥	2	8320G231 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	150	150	115	115	115	200	150	8320G184	2	8320G202 ③④⑥	3	10.1/F	11.6/F
1/4	1/8	0.25	85	85	85	60	60	60	200	150	8320G186	2	8320G203 ③④⑥	3	10.1/F	11.6/F
1/4	11/64	0.35	45	45	45	25	25	25	200	150	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1/16	0.09	235	250	250	160	160	160	200	150	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	140	140	100	100	100	200	150	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	1/8	0.21	70	70	70	55	55	55	200	150	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	235	250	250	160	160	160	200	150	8320G192 ⑥	2	8320G232 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	140	140	100	100	100	200	150	8320G194	2	8320G204 ③④⑥	3	10.1/F	11.6/F
1/4	1/8	0.25	70	70	70	55	55	55	200	150	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	40	40	40	30	30	30	200	150	8320G198	2	-	-	10.1/F	11.6/F

① Supplied with cast UR disc.

② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.

③ Can be used for **dry** natural gas service with the EF prefix.

④ Constructions standard rated -40°F (-40°C) ambient temperature. EFX prefix and TPL # not required.

⑤ Water rating, CSA certified up to 232 psi.

⑥ ATEX/IECEx certified with prefix "EV".

Specifications (Metric units)

Pipe Size (in)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar)						Max. Fluid Temp. °C		Brass Body		Stainless Steel Body		Watt Rating/ Class of Coil Insulation ^②	
			Max. AC			Max. DC			AC	DC	Catalog Number	Const. Ref.	Catalog Number	Const. Ref.	AC	DC
			Air-Inert Gas	Water ^⑤	Lt. Oil @ 300 SSU	Air-Inert Gas	Water ^⑤	Lt. Oil @ 300 SSU								
UNIVERSAL OPERATION (Pressure at any port)																
1/8	1.2	0.05	12	12	12	9	9	9	60	49	8320G130 ^①	1	8320G140 ^①	1	9.1F	10.6F
1/8	1.6	0.08	7	7	7	4	4	4	82	49	8320G001	1	8320G041 ^③	1	9.1F	10.6F
1/8	1.6	0.08	12	12	12	9	9	9	93	66	8320G212	4	8320G221 ^{④⑥}	4	17.1/F	22.6/F
1/8	2.4	0.10	3	3	3	3	3	3	82	49	8320G083	1	8320G087 ^③	1	6.1/F	10.6/F
1/8	2.4	0.10	7	7	7	4	4	4	93	66	8320G213	4	8320G222 ^④	4	17.1/F	11.6/F
1/8	3.2	0.18	2	2	2	1	1	1	82	49	8320G003	1	8320G043 ^③	1	9.1/F	10.6/F
1/8	3.2	0.18	3	3	3	2	2	2	93	66	8320G214	4	8320G223 ^④	4	17.1/F	11.6/F
1/4	1.6	0.08	9	9	9	5	5	5	93	66	8320G172	2	-	-	10.1/F	11.6/F
1/4	1.6	0.08	12	12	12	9	9	9	93	66	-	-	8320G230 ^{④⑥}	3	17.1/F	22.6/F
1/4	2.4	0.10	7	7	7	4	4	4	93	66	8320G174	2	8320G200 ^{③④⑥}	3	17.1/F	11.6/F
1/4	3.2	0.21	3	3	3	2	2	2	93	66	8320G176 ^⑥	2	8320G201 ^{③④⑥}	3	17.1/F	11.6/F
1/4	4.4	0.30	1	1	1	1	1	1	93	66	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD _{AVG} = 6.81 x 10 ⁻⁴																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G132	1	8320G142 ^③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8320G013	1	8320G045 ^③	1	6.1F	10.6/F
1/8	1.6	0.08	14	15	15	11	11	11	93	66	8320G215	4	8320G224 ^④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G015	1	8320G047 ^③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	8	8	8	93	66	8320G216	4	8320G225 ^④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G017	1	8320G049 ^③	1	6.1F	10.6/F
1/8	3.2	0.18	6	6	6	4	4	4	93	66	8320G217	4	8320G226 ^④	4	10.1/F	11.6/F
1/4	1.6	0.08	14	15	15	11	11	11	93	66	8320G182 ^⑥	2	8320G231 ^④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	8	8	8	93	66	8320G184	2	8320G202 ^{③④⑥}	3	10.1/F	11.6/F
1/4	3.2	0.21	6	6	6	4	4	4	93	66	8320G186	2	8320G203 ^{③④⑥}	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G136	1	8320G146 ^③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8320G027	1	8320G051 ^③	1	6.1F	10.6/F
1/8	1.6	0.08	16	17	17	11	11	11	93	66	8320G218	4	8320G227 ^④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G029	1	8320G053 ^③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	7	7	7	93	66	8320G219	4	8320G228 ^④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G031	1	8320G055 ^③	1	6.1F	10.6/F
1/8	3.2	0.18	5	5	5	4	4	4	93	66	8320G220	4	8320G229 ^④	4	10.1/F	11.6/F
1/4	1.6	0.08	16	17	17	11	11	11	93	66	8320G192 ^⑥	2	8320G232 ^④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	7	7	7	93	66	8320G194	2	8320G204 ^{③④⑥}	3	10.1/F	11.6/F
1/4	3.2	0.21	5	5	5	4	4	4	93	66	8320G196	2	8320G205 ^{③④}	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G198	2	-	-	10.1/F	11.6/F

^① Supplied with cast UR disc.

^② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.

^③ Can be used for **dry** natural gas service with the EF prefix.

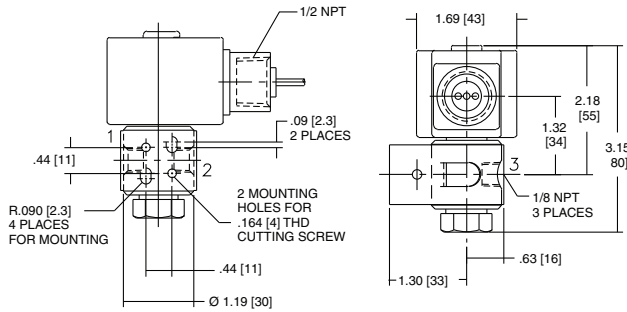
^④ Constructions standard rated -40°F (-40°C) ambient temperature. EFX prefix and TPL # not required.

^⑤ Water rating, CSA certified up to 16 bar.

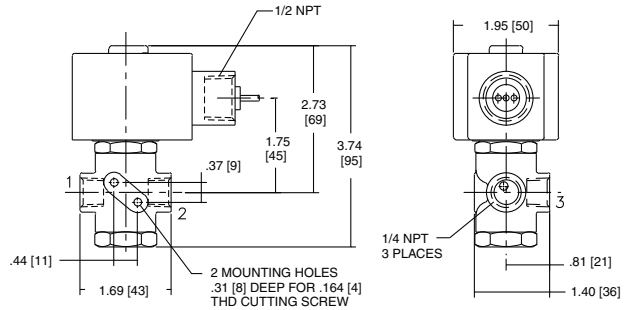
^⑥ ATEX/IECEx certified with prefix “EV”.

Dimensions: inches (mm)

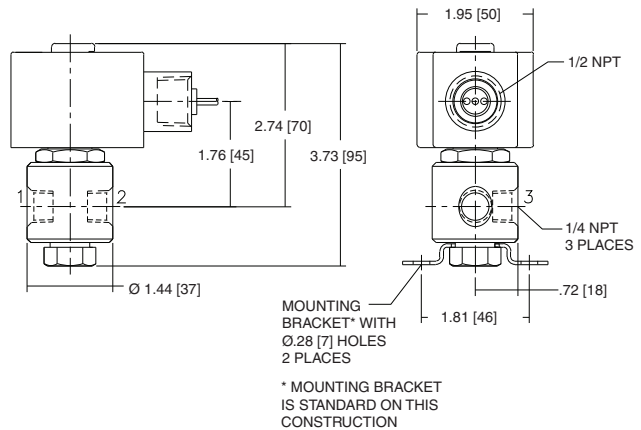
Const. Ref. 1



Const. Ref. 2



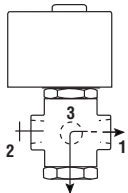
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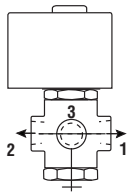
FLOW DIAGRAMS

Universal

De-Energized

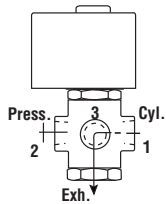


Energized

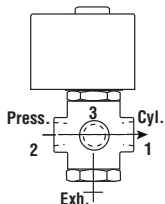


Normally Closed

De-Energized

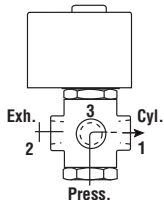


Energized

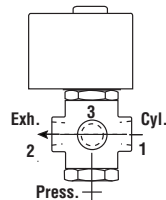


Normally Open

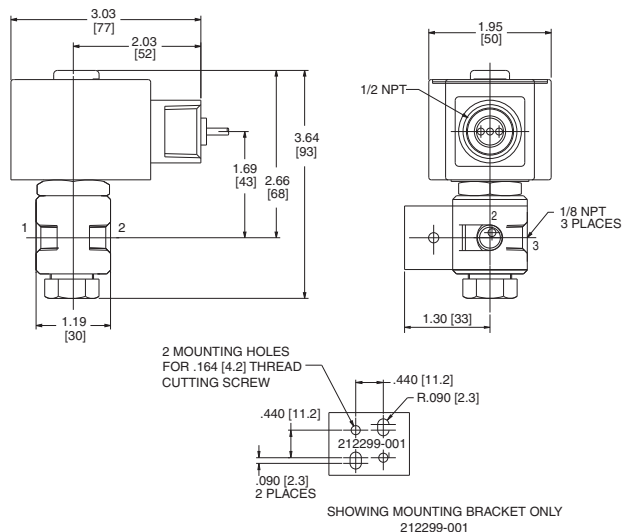
De-Energized



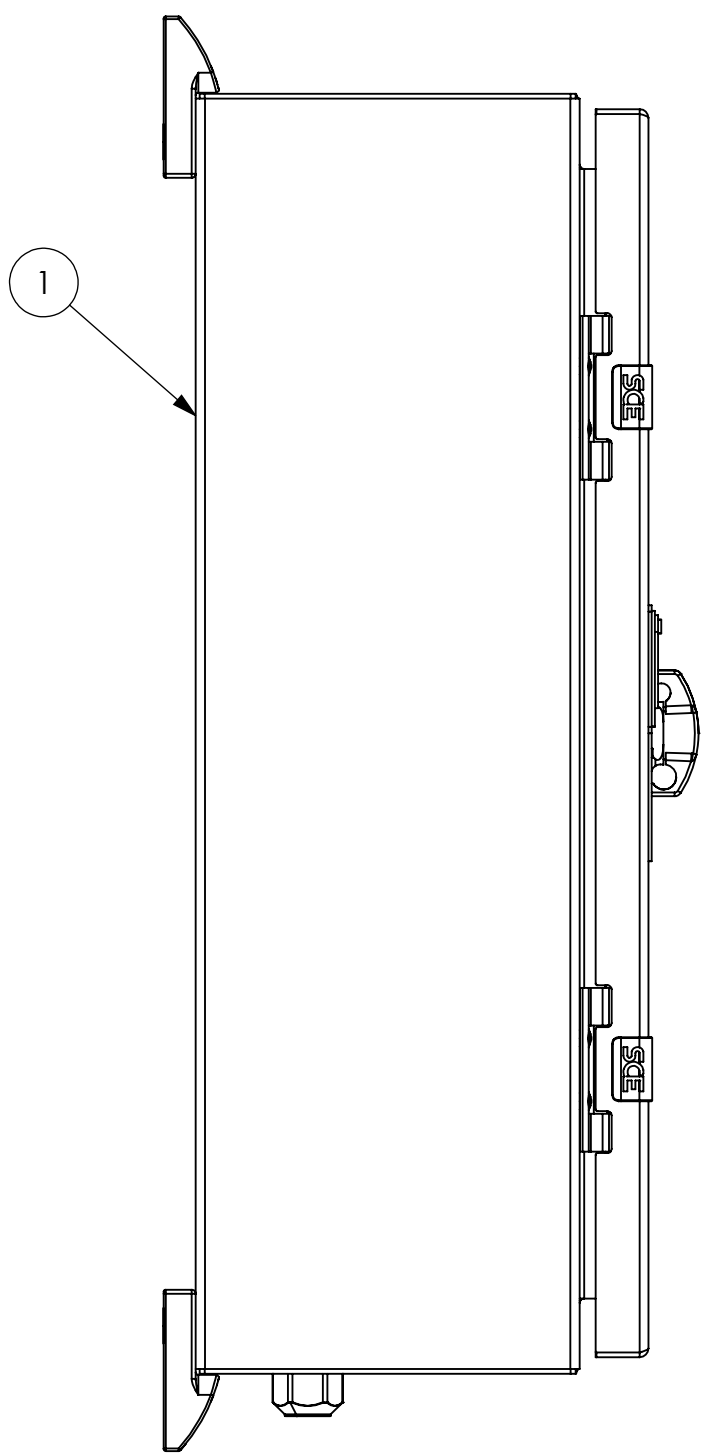
Energized



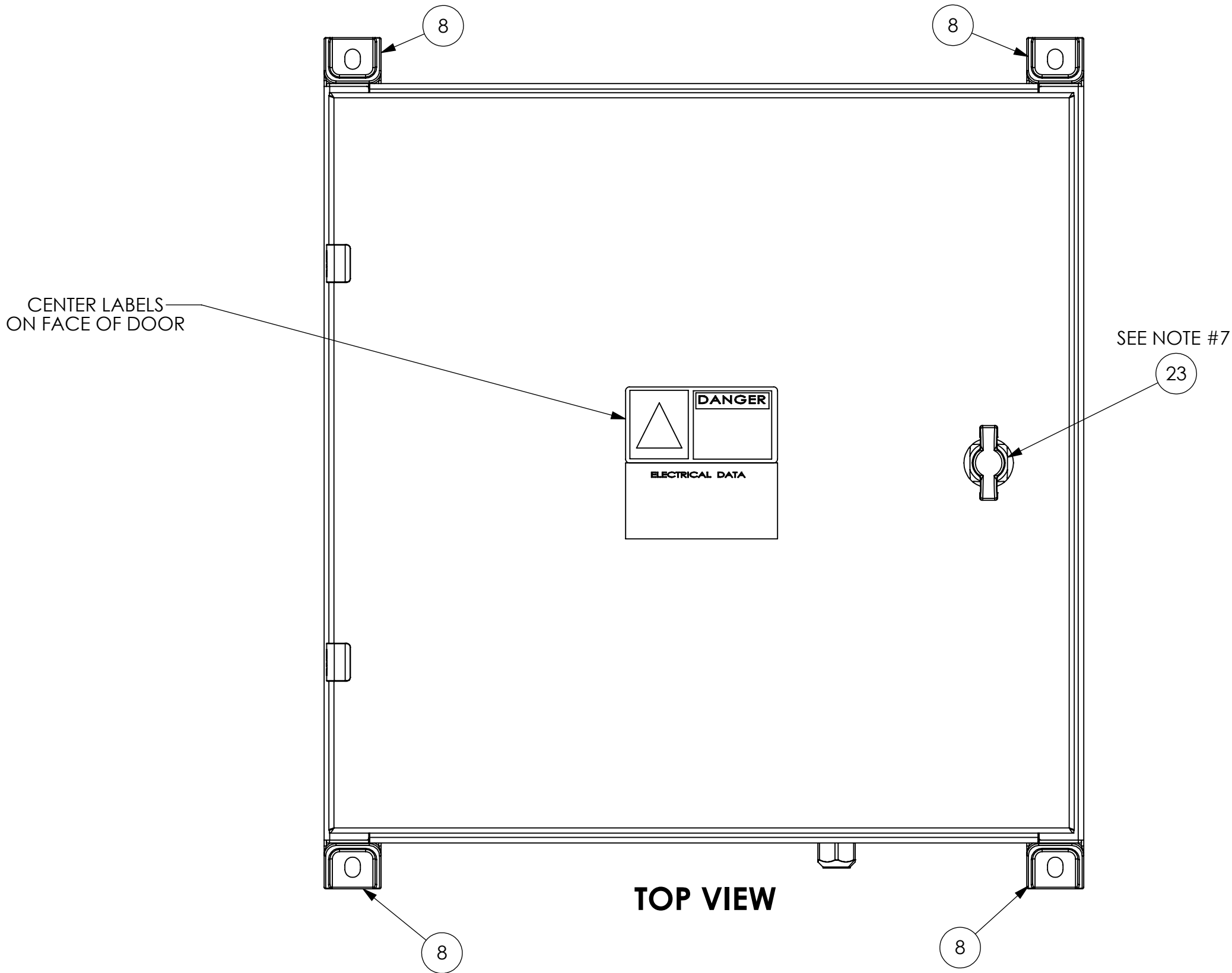
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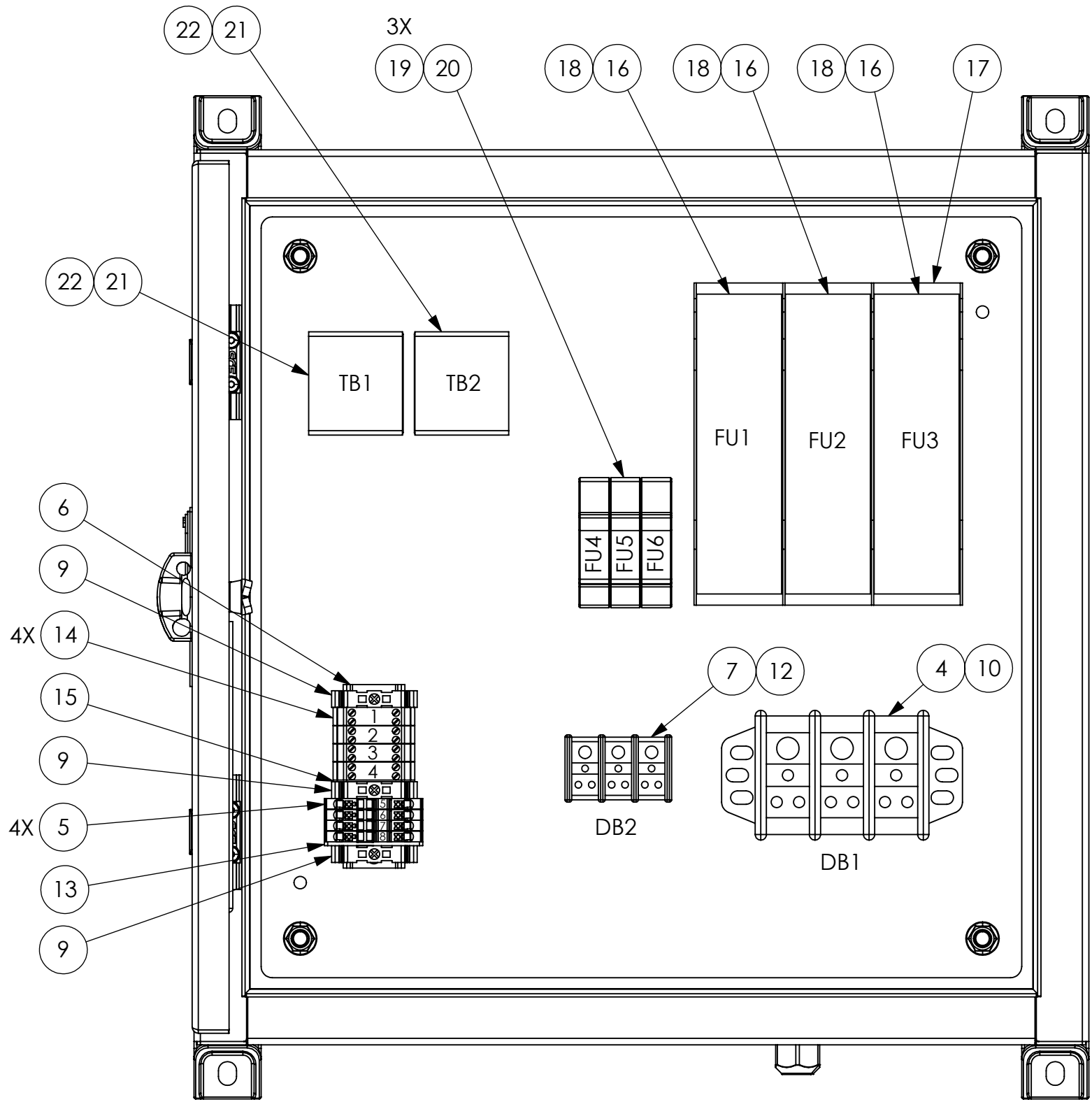
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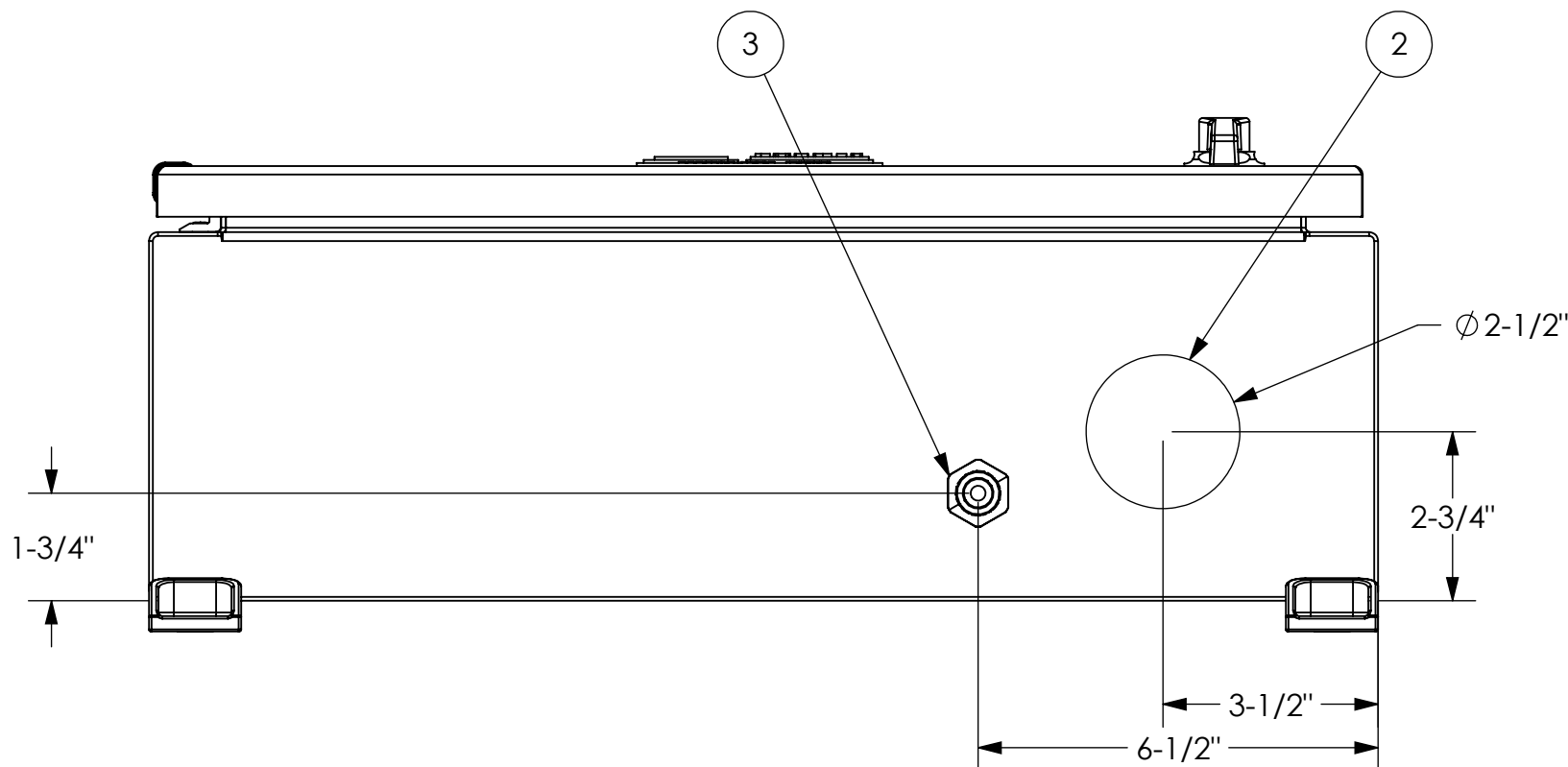
LEFT VIEW



TOP VIEW

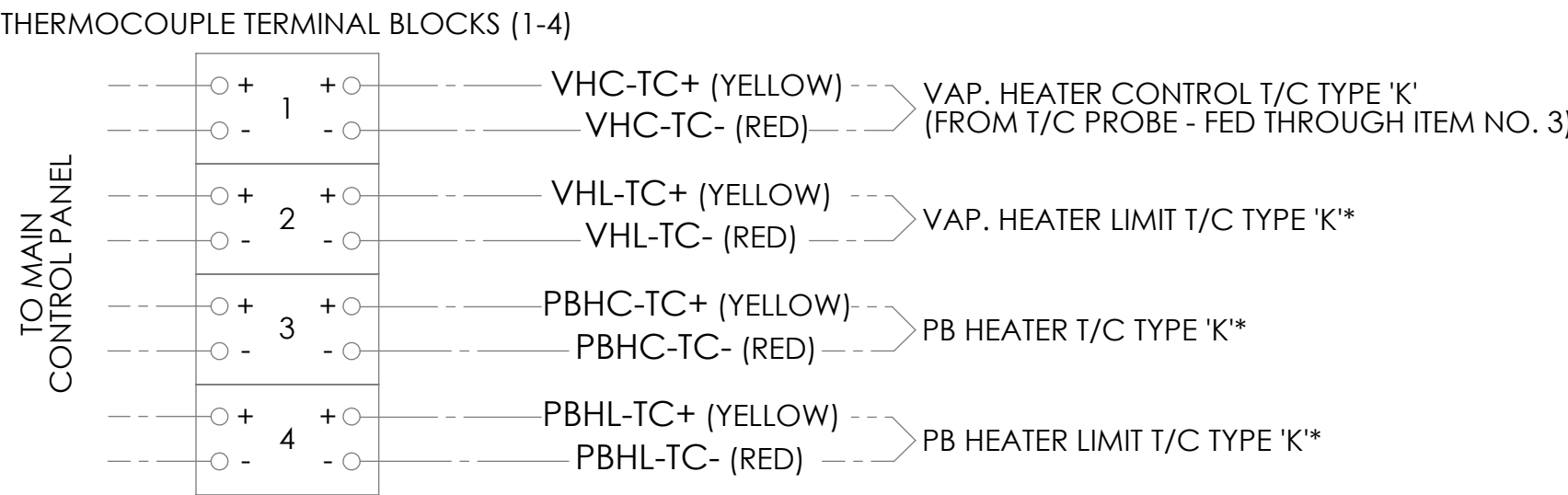
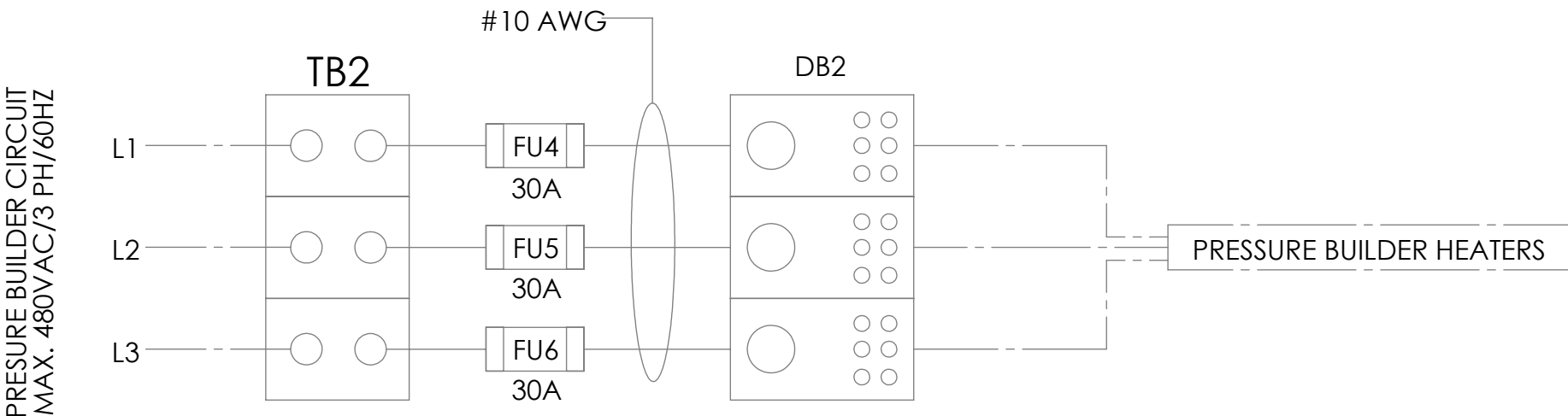
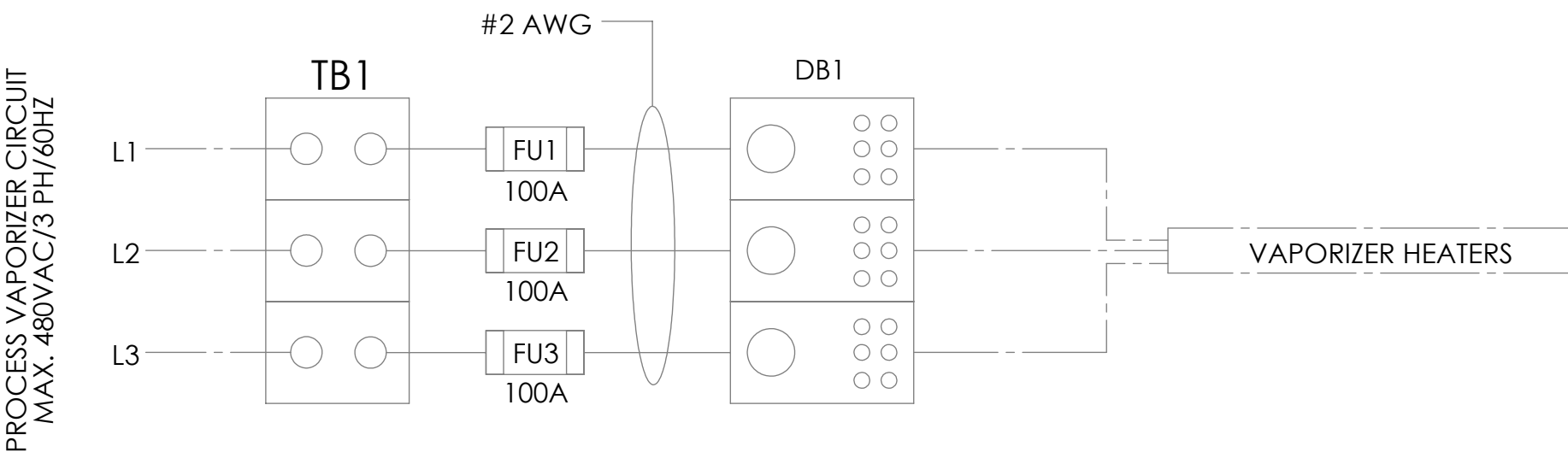


INTERIOR PANEL LAYOUT VIEW



BOTTOM VIEW

ITEM NO.	MFG	MFG PART NO.	DESCRIPTION	DWG LABEL	QTY
1	SAGINAW	SCE-20EL2006SS6LP	ENCLOSURE, 20"X20"X6", NEMA 4X		1
2	ICOTEK	KEL-DPZ-63-14 GY	CABLE PASS THROUGH		1
3	HEYCO	M4518	CORD GRIP		1
4	MARATHON SPECIAL PRODUCTS	1403401	175A, 3P POWER DISTRIBUTION BLOCK	DB1	1
5	PHOENIX CONTACT	3211757	FEED-THROUGH TERMINAL BLOCK		4
6	ALLEN-BRADLEY	1492-DR5	DIN RAIL		AR
7	MARATHON SPECIAL PRODUCTS	CC1413	60A, 3P DISTRIBUTION BLOCK COVER		1
8	SAGINAW	SCE-ELMFK4	ENCLOSURE MOUNTING FEET		4
9	PHOENIX CONTACT	800886	DIN RAIL END ANCHOR		3
10	MARATHON SPECIAL PRODUCTS	CC1403	175A, 3P DISTRIBUTION BLOCK COVER		1
11	SAGINAW	SCE-20P20	ENCLOSURE SUBPANEL		1
12	MARATHON SPECIAL PRODUCTS	1413403	60A, 3P POWER DISTRIBUTION BLOCK	DB2	1
13	PHOENIX CONTACT	3030420	END PLATE, TERMINAL BLOCK		1
14	PHOENIX CONTACT	310062	THERMOCOUPLE TERMINAL BLOCK, TYPE K		4
15	PHOENIX CONTACT	3101029	END PLATE, THERMOBLOCK TERMINAL BLOCK		1
16	EATON (BUSSMAN)	JKS-100	FUSE, 100A	FU1, FU2, FU3	3
17	EATON (BUSSMAN)	JM60100-3CR	FUSE HOLDER, 3-POLE, 100A		1
18	EATON (BUSSMAN)	CVRI-J-60100	FUSE COVER W/ STATUS INDICATION		3
19	EATON (BUSSMAN)	LP-CC-30	FUSE, 30A	FU4, FU5, FU6	3
20	EATON (BUSSMAN)	CHCC3DUI	FUSE HOLDER, 3-POLE, 30A		1
21	MARATHON SPECIAL PRODUCTS	1413300	115A, 3P TERMINAL BLOCK	TB1, TB2	2
22	MARATHON SPECIAL PRODUCTS	CC1413	115A, 3P TERMINAL BLOCK COVER		2
23	SAGINAW	SCE-PLWKSS	DOOR LATCH WITH PADLOCKING WING KNOB		1



*NOTE: THERMOCOUPLE LEADS BUNDLED WITHIN HEATER WIRE LEADS. SEE DRAWING 21840424 FOR ADDITIONAL DETAIL.

WIRING DIAGRAM

- NOTES:
- ENCLOSURE SHALL BE NEMA 4X AND PAINTED SEMI-GLOSS WHITE.
 - HOLES SHALL BE FREE OF BURRS.
 - DENOTES FIELD WIRING.
 - PROVIDE GROUND TERMINAL BAR SIZED FOR A MINIMUM OF (3) #4 AWG WIRE MOUNTED TO ENCLOSURE SUBPANEL. GROUND BAR SHALL BE ELECTRICALLY CONTINUOUS WITH THE ENCLOSURE, ENCLOSURE DOOR AND SUBPANEL THROUGH METAL-TO-METAL CONTACT OR THROUGH #8 AWG BONDING JUMPERS.
 - PROVIDE 3 FEET OF GREEN INSULATED, #8 AWG TINNED COPPER WIRE AND (1) UNCRIMPED COMPRESSION LUG CONNECTOR, MCMaster-CARR #6926K36 OR EQUIVALENT, SHIPPED LOOSE INSIDE PANEL.
 - TYPE K THERMOCOUPLE WIRE SHALL BE USED FOR ALL THERMOCOUPLE CONNECTIONS.
 - REPLACE EXISTING STANDARD LATCH WITH LATCH WITH PAD LOCK ACCESSORY, ITEM #23.

								APPROVED BY RFA	DATE 3/29/2021				
A	JTC	211162	INITIAL RELEASE	RFA	7/22/2021			CHK'D BY					
REV	APPV	ECR	DESCRIPTION	BY	DATE			PROJ. ENG. THIRD ANGLE PROJECTION					
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SEE BOM UNLESS OTHERWISE STATED										CHART JUNCTION BOX 480V, NEMA 4X THERMOBLOCK COMBO VAPORIZER			
										Chart Inc. Distribution & Storage			
										DRAWING NUMBER D-21787646			
										REV A			
										SCALE 1:3			
										SIZE D			
										SHEET 1 OF 1			



TELEDYNE HASTINGS INSTRUMENTS

MODELS

*DV-4, DV-5, DV-6
DV-23, DV-24*

FEATURES

- Rugged Construction
- Non-Contaminating
- Color Coded

APPLICATIONS

- Refrigerator
- Cryogenics / Vacuum Insulator
- Air Conditioning
- Freeze Drying
- Transformer Oil Refill
- Pharmaceutical

BENEFITS

- Reliable
- Repeatable
- Stable Calibration

DESCRIPTION

Teledyne Hastings Thermocouple Gauge Tubes/Sensors are precision sensing devices designed to provide accurate measurement and control of vacuum. Fully compensated for both temperature and rate of temperature change, the tubes are renowned worldwide for their dependability, and boast a history of success that has endured for over 60 years.

THI Thermocouple Gauge Tubes/Sensors use the rugged but sensitive, time-tested THI thermopile sensor. Short, firmly connected thermocouples have no suspended weld to an external heater.

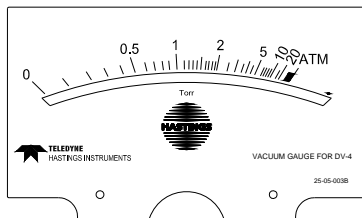
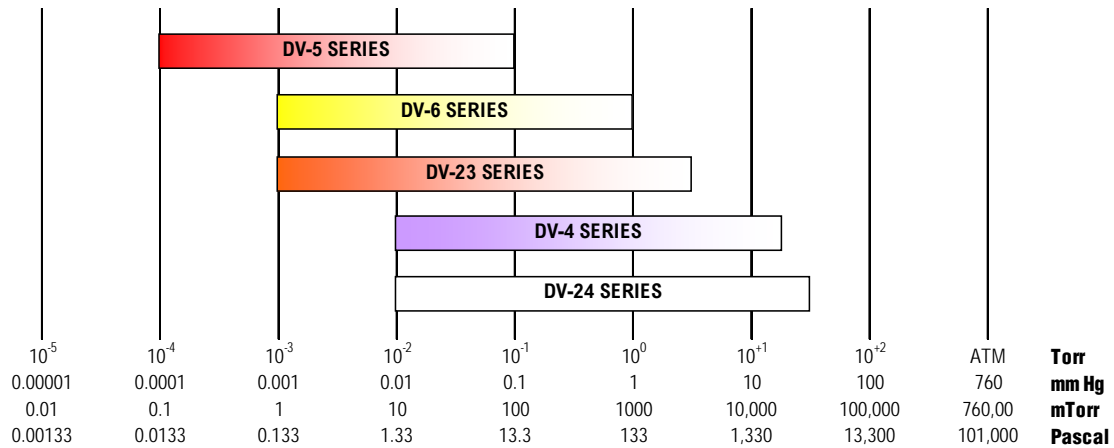
Proprietary tooling and process control improvements offer extended service life for these gauge tubes/sensors.

Thermocouple Vacuum Gauge Tubes/Sensors

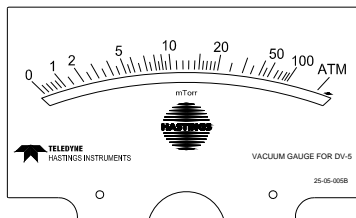


Selection Chart

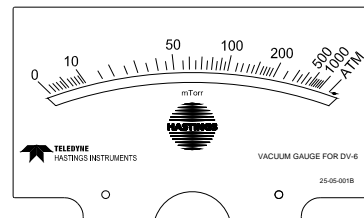
Thermocouple Gauge Pressure Ranges



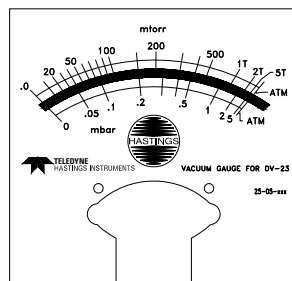
VT-4A
VT-4AB
CVT-24A



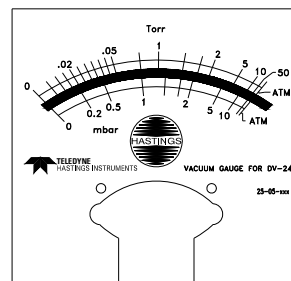
VT-5A
VT-5AB
CVT-25A



VT-6A
VT-6AB
CVT-26A



VH-3
CVH-3 (obsolete)



VH-4 (obsolete)
CVH-4 (obsolete)

Hastings Instruments reserves the right to change or modify the design of its equipment without any obligation to provide notification of change or intent to change.

Selection Chart

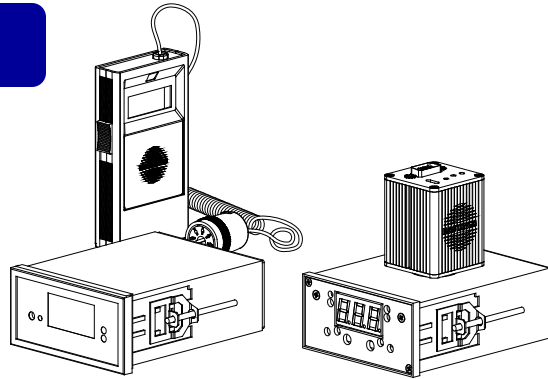
Gauge tube available with fittings not listed, contact factory.

Instrument Series	VT-4A VT-4AB CVT-24A	VT-5A VT-5AB CVT-25A	VT-6A VT-6AB CVT-26A
Vacuum Range	0-20 Torr	0-100 mTorr	0-1000 mTorr
Color Band	Purple	Red	Yellow
1/8" NPT - Standard	DV-4D	DV-5M	DV-6M
1/8" NPT - Ruggedized	DV-4R	---	DV-6R
VCR	DV-4D-VCR	DV-5M-VCR	DV-6-VCR
KF-16	DV-4D-KF-16	---	DV-6-KF-16
KF-25	DV-4D-KF-25	---	DV-6-KF-25
Mini-CF	---	---	DV-6R-CF
Stainless (high temp/pressure)	DV-34	---	DV-36
Glass 3/8" OD	---	---	DV-20

Note: Color band is not used on all tubes.

For proper accuracy and performance THI Vacuum Gauges should always be used with the proper range of THI Vacuum Gauge Tubes.

Selection Chart

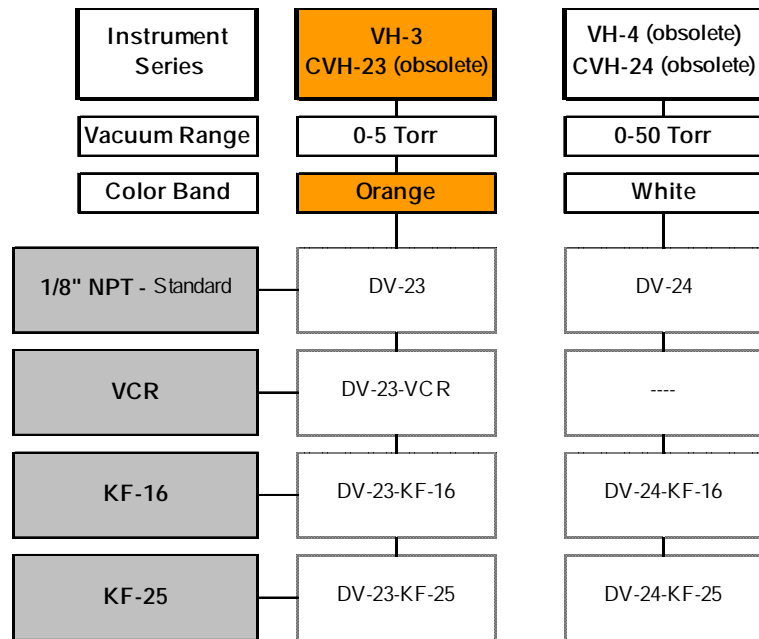


Instrument Series	Digital VT-4 Digital CVT-4 Digital AVC-4 HPM 4/6	Digital VT-6 Digital CVT-6 Digital AVC-6 HPM 4/6
Vacuum Range	0-20 Torr	0-1000 mTorr
Color Band	Purple	Yellow
1/8" NPT - Standard	DV-4D	DV-6M
1/8" NPT - Ruggedized	DV-4R	DV-6R
VCR	DV-4D-VCR	DV-6-VCR
KF-16	DV-4D-KF-16	DV-6-KF-16
KF-25	DV-4D-KF-25	DV-6-KF-25
Mini-CF	----	DV-6R-CF
Stainless (high temp/pressure)	DV-34 (Adapter-Cable Req'd)	DV-36 (Adapter-Cable Req'd)
Robust W/Protective Cup	----	DV-6S

Note: Color band is not used on all tubes.

For proper accuracy and performance THI Vacuum Gauges should always be used with the proper range of THI Vacuum Gauge Tubes.

Selection Chart

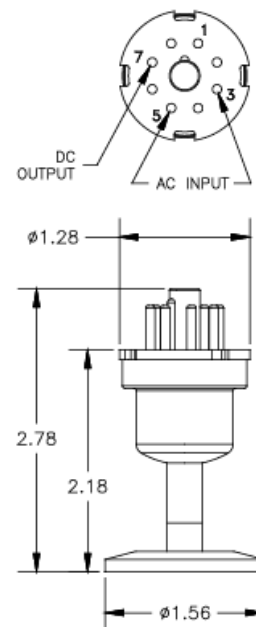
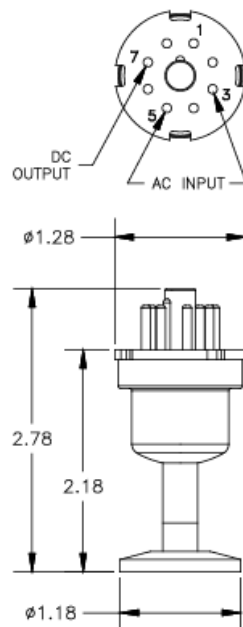
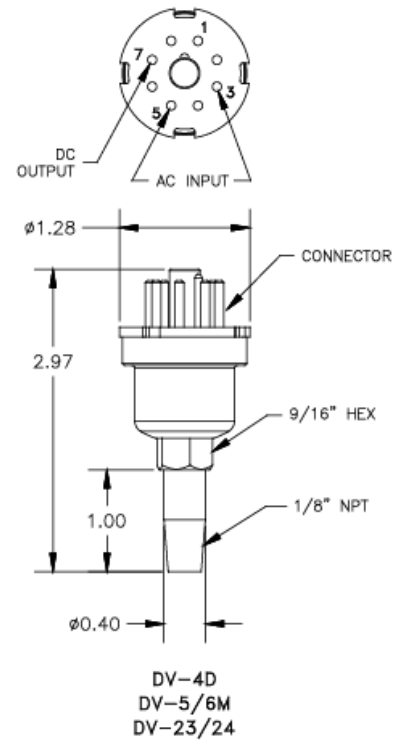
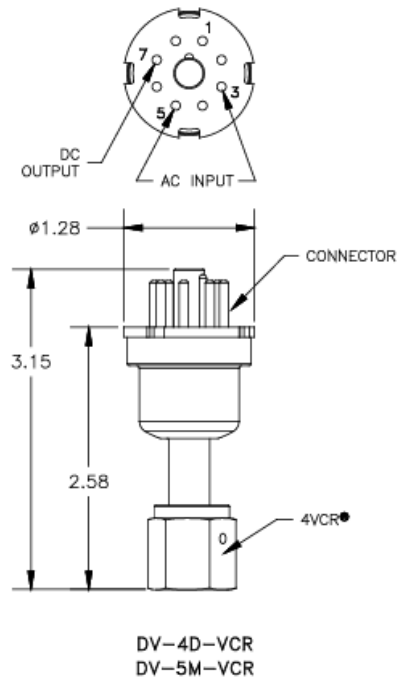


Note: Color band is not used on all tubes.

For proper accuracy and performance
THI Vacuum Gauges should always be used
with the proper range of THI Vacuum Gauge Tubes.

Standard Gauge Tube

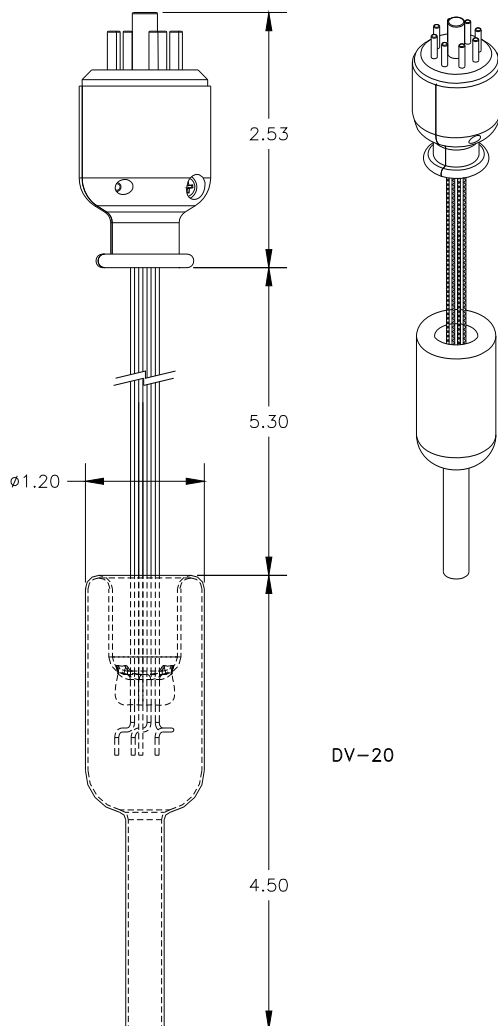
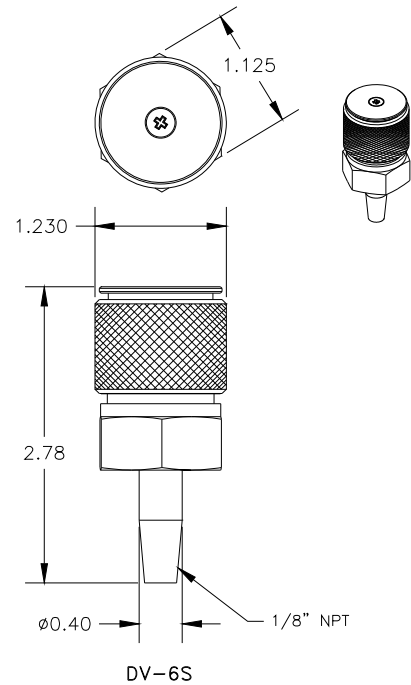
- Hermetically Sealed base with glass.
- Stainless Steel and Nickel Plated components.
- Color coded label
- Max Temp: 100°C
- Max Press: 150psig



LINEAR DIMENSIONS
(TYP)

DV-6S, Weather Proof Outdoor

- DV-6 Thermocouple
- 0-1000mTorr
- Rugged Construction
- Includes Protective Cap



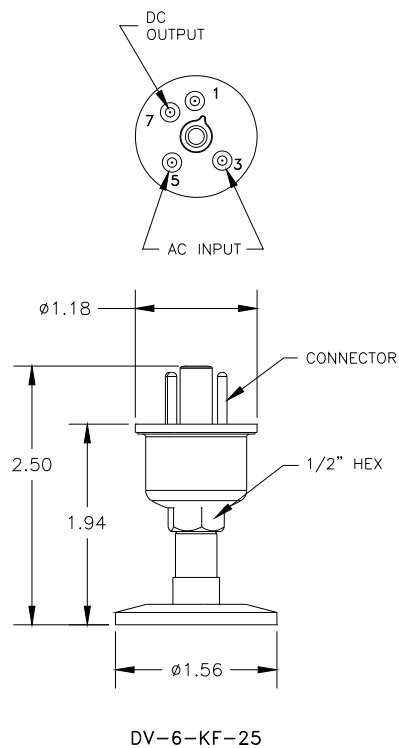
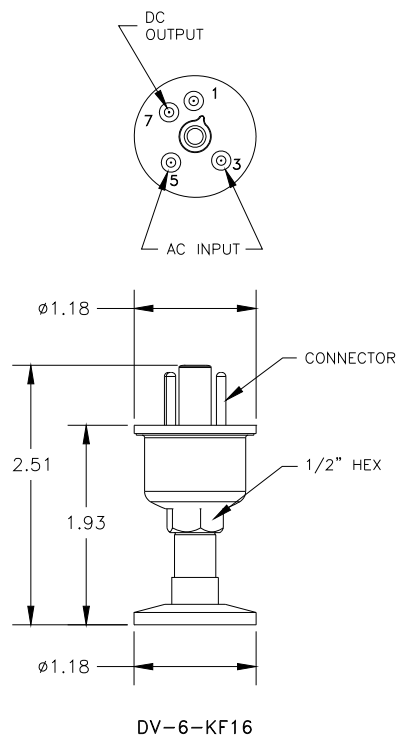
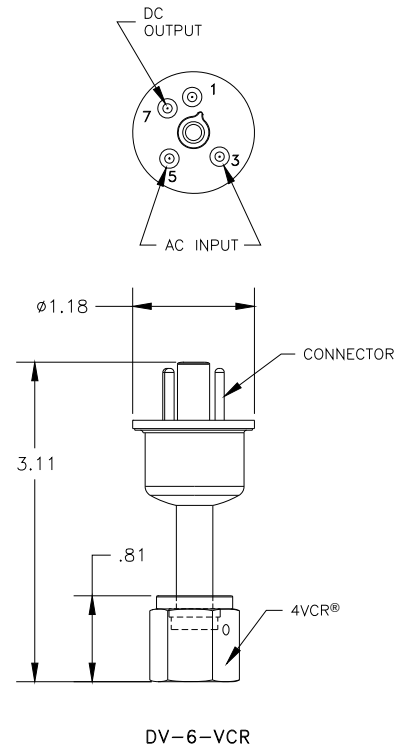
Glass Gauge Tube

- Constructed of Corning #7052 type glass or equivalent

LINEAR DIMENSIONS
(TYP)

RoHS Gauge Tube

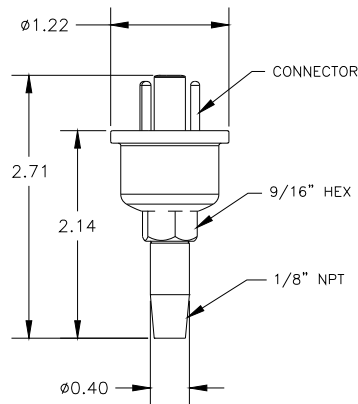
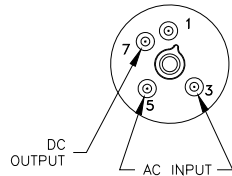
- Stainless Steel
- All welded
- No Plastic
- No Braze
- Color coded label
- Max Press: 400psig



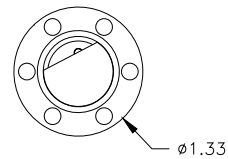
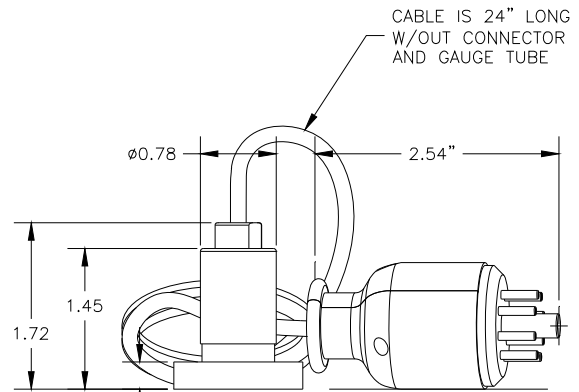
LINEAR DIMENSIONS
(TYP)

Ruggedized Gauge Tube

- Hermetically Sealed base with glass.
- Stainless Steel and Nickel Plated components.
- Color coded label
- Max Temp: 150°C
- Max Press: 400psig



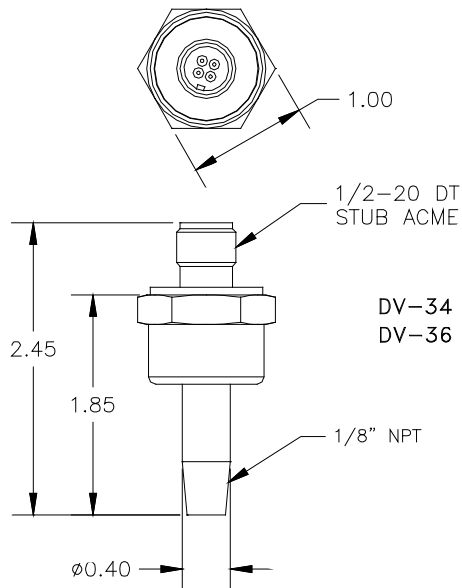
DV-4R
DV-6R



DV-6R-CF

Stainless Steel Gauge Tube

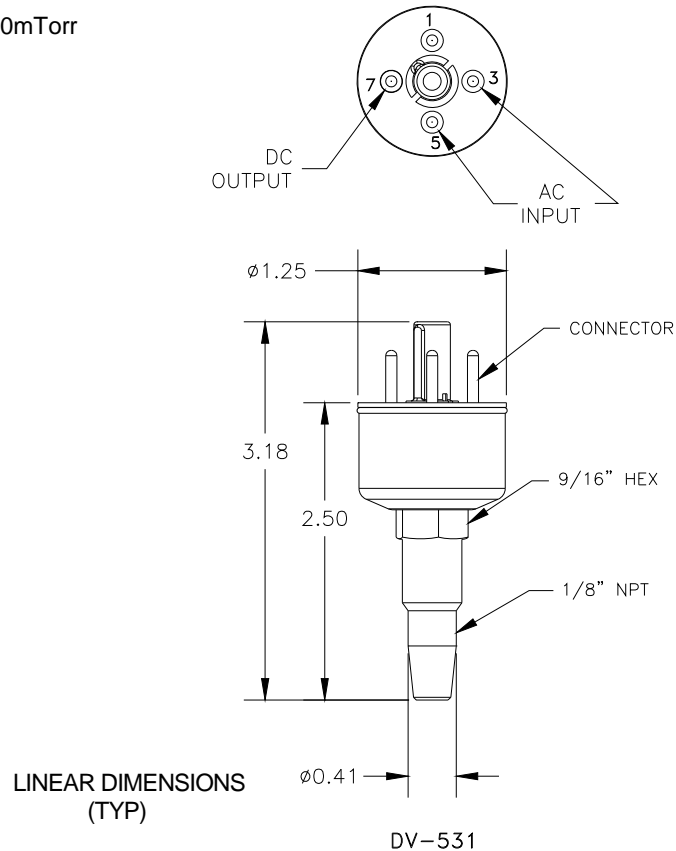
- Stainless Steel
- Corrosion Resistant which can withstand high temperatures and high pressures
- Max Temp: 150°C
- Max Press: 400psig



DV-34
DV-36

Varian DV-531

- Range: 0-2000mTorr



Teledyne Hastings; Specialties in custom sensor solutions,
our design services, machine shop and welding facilities
can quickly generate specialized solutions for all vacuum gauging.

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World Wide Web: <http://www.teledyne-hi.com>
E-mail: hastings_instruments@teledyne.com
P.O. Box 1436
Hampton, VA 23661



4100 Series

316 Stainless Steel or Brass Bellows Sealed Valves
(.060"/1.5 mm or .170"/4.3 mm orifices)

Introduction

With its compact size suitable for confined spaces, the 4100 Series design includes an internal volume of only 0.08 cubic inches. Brass and 316 stainless steel bodies are available. Operating pressures range from 0 - 600 psig (brass) and 0-1000 psig (stainless steel). 316 stainless steel operating temperature ratings range from -40° to +600° F (-40° to +316° C), while the brass operating temperature range is -40° to +300° F (-40° to +149° C) depending on whether a hard or soft seat is selected.



Brass



316 Stainless Steel

Typical Applications

Stainless steel valves

- Critical gas analysis
- High temperature liquid metals
- Handling reactive and toxic fluids
- Vacuum system bake-out

Brass valves

- Sampling systems
- Gas analysis equipment
- Laboratory service
- Instrumentation

Features & Benefits

- Low internal volume for gas analysis
- Panel mounting is available (specify kit 4100K1)

Stainless steel valves

- Choice of blunt or regulating stem points
- Seal welded bellows to body

Brass valves

- Phosphor bronze bellows silver-soldered to body and stem isolates fluid from atmosphere
- Choice of vee stem with small orifice for metering, blunt point, or PCTFE stem
- Special High Tolerance NPT Thread

Technical Data

	316 STAINLESS STEEL	BRASS
MAXIMUM OPERATING PRESSURE	Vacuum to 1000 psig (70 kg/cm ²)	Vacuum to 600 psig @ 70° F (45 kg/cm ² @ 21° C)
TEMPERATURE RANGE	-40° F to +600° F (-40° C to +316° C)	Hard seat: -40° F to +300° F (-40° C to +149° C) Soft seat: -40° F to +250° F (-40° C to +121° C)
ORIFICE SIZE	Vee stem: 0.059 (1.5 mm) Blunt stem: 0.170 (4.3 mm)	Vee stem: 0.060 (1.5 mm) Blunt stem: 0.170 (4.3 mm) PCTFE stem: 0.170 (4.3 mm)
Cv FACTOR	0.35 (maximum)	0.35 (maximum)
INTERNAL VOLUME	0.08 cubic inches	0.08 cubic inches

HOKE®

PO Box 4866 • Spartanburg, SC 29305-4866
Phone (864) 574-7966 Fax (864) 587-5608
www.hoke.com • Sales-hoke@circor.com

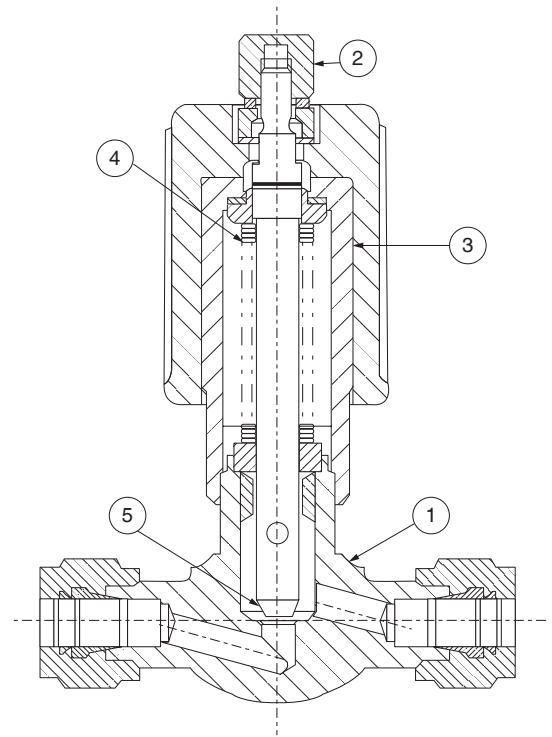
packless valves

4100 Series

Materials of Construction

316 Stainless Steel

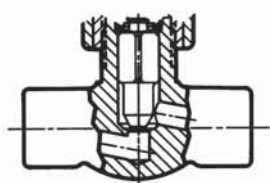
	DESCRIPTION	MATERIAL
1	Body	316 stainless steel
2	Cap nut	Brass, nickel-plated
3	Handle	Brass, nickel-plated
4	Bellows	316 stainless steel
5	Stem point	316 stainless steel
6	Panel mounting kit	Brass, nickel-plated



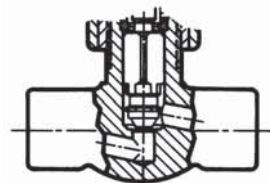
Materials of Construction

Brass

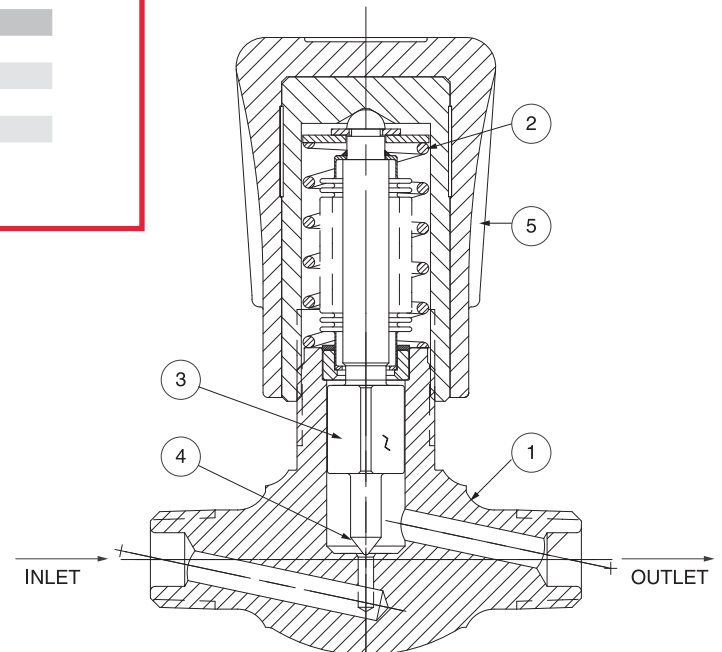
	DESCRIPTION	MATERIAL
1	Body	Forged brass
2	Bellows	Phosphor bronze silver-soldered to body
3	Stem	316 stainless steel
4	Stem tip	PCTFE
5	Handle	Nylon with brass insert



Blunt Stem
4111M4B



PCTFE Stem
4151M4B



Vee Stem
4171M4B

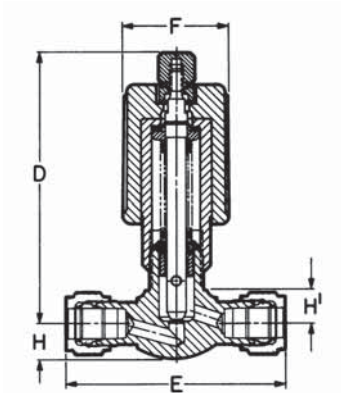
4100 Series

Dimensions

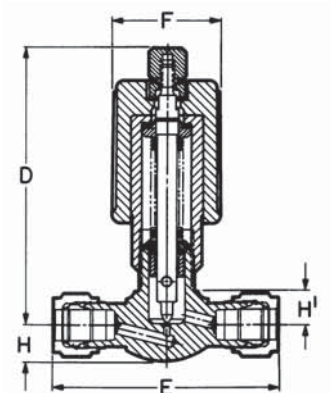
Stainless Steel

CONNECTIONS		D	E	F	H	H1	PANEL MOUNTING	
							HOLE SIZE	MAX. THICKNESS
¼" NPT Male	inch	3	1 ¾	1	2 5/8	1 1/2	1 1/4	¼
	mm	76	44	25	10	9	26	6
¼" O.D. Tube GYROLOK®	inch	3	2 ¾	1	2 5/8	1 1/2	1 1/4	¼
	mm	76	60	25	10	9	26	6
6 mm GYROLOK®	inch	3	2 ¾	1	2 5/8	1 1/2	1 1/4	¼
	mm	76	60	25	10	9	26	6

Dimensions for reference only, subject to change.



Blunt Stem
4112G4Y



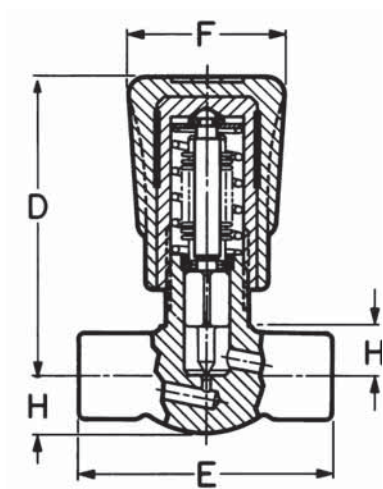
Vee Stem
4172G4Y

Dimensions

Brass

CONNECTIONS		D	E	F	H	H1	PANEL MOUNTING	
							HOLE SIZE	MAX. THICKNESS
⅜" NPT Male	inch	2 5/8	1 ¾	1 1/6	2 3/8	3/8	1 1/4	¼
	mm	67	44	27	9	10	26	6
¼" NPT Male	inch	2 5/8	1 ¾	1 1/6	2 3/8	3/8	1 1/4	¼
	mm	67	44	27	9	10	26	6
¼" O.D. Tube GYROLOK®	inch	2 5/8	1 ¾	1 1/6	2 3/8	3/8	1 1/4	¼
	mm	67	60	27	9	10	26	6

Dimensions for reference only, subject to change.



Vee Stem
4171M4B

4100 Series

How to Order

Stainless Steel: Order valve by part number shown in chart.

CONNECTIONS	ORDER BY PART NUMBER		CV FACTOR	ORIFICE
	BLUNT STEM	VEE STEM		
¼" NPT Male	4112M4Y	—	0.35	0.17
¼" O.D. Tube GYROLOK®	—	4172G4Y	0.059	0.06
¼" O.D. Tube GYROLOK®	4112G4Y	—	0.35	0.17
6 mm GYROLOK®	4112G6Y/MM	—	0.35	0.17
6 mm GYROLOK®	—	4172G6Y/MM	0.059	0.06
Panel Mounting Kit	4100K1	4100K1	—	—

Brass: Order valve by part number shown in chart.

CONNECTIONS	ORDER BY PART NUMBER			CV FACTOR	ORIFICE
	BLUNT STEM	VEE STEM	PCTFE STEM		
½" NPT Male	4111M2B	—	4151M2B	0.35	0.17
½" NPT Male	—	4171M2B	—	0.059	0.06
½" NPT Male x ½" NPT Female	4111L2B	—	—	0.35	0.17
¼" NPT Male	4111M4B	—	4151M4B	0.35	0.17
¼" NPT Male	—	4171M4B	—	0.059	0.06
¼" O.D. Tube GYROLOK®	—	—	4151G4B	0.35	0.17

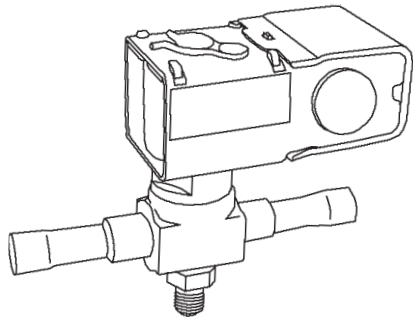
Panel Mounting

To order Panel Mounting Kit, specify part number 4100K1.

FOR YOUR SAFETY

IT IS SOLELY THE RESPONSIBILITY OF THE SYSTEM DESIGNER AND USER TO SELECT PRODUCTS SUITABLE FOR THEIR SPECIFIC APPLICATION REQUIREMENTS AND TO ENSURE PROPER INSTALLATION, OPERATION AND MAINTENANCE OF THESE PRODUCTS. MATERIAL COMPATIBILITY, PRODUCT RATINGS AND APPLICATION DETAILS SHOULD BE CONSIDERED IN THE SELECTION. IMPROPER SELECTION OR USE OF PRODUCTS DESCRIBED HEREIN CAN CAUSE PERSONAL INJURY OR PROPERTY DAMAGE.

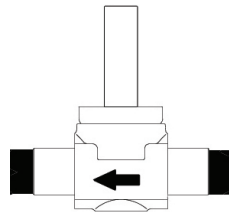
Solenoid Valves 200RB/500RB Model



①

R-11
R-12
R-22
R-113
R-114
R-115

R-123
R-124
R-125
R-134a
R-401A



R-401B
R-402A
R-402B
R-404A
R-407A

R-407B
R-407C
R-500
R-502
R-507

Refrigerant Compatibility

Compatibilidad con Refrigerantes

Compatibilidade do Refrigerante

Compatibilité du réfrigérant

冷媒適合性

냉매 호환성

冷媒兼容性

②

Model	Coil				
	AM	AH	DM	MM	ASC2
100RB	✓	✓	✓	✓	✓
200RB	✓	✓	✓	✓	✓
240RA	✓	✓	✓	✓	✓
500RB			✓	✓	✓
540RA	✓	✓	✓	✓	✓

Verify Coil

Verifique la Bobina

Verifique a bobina

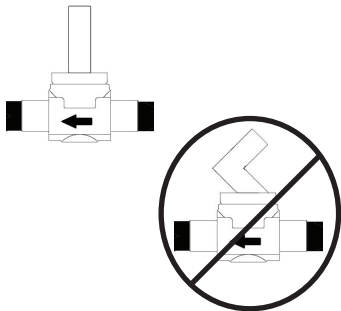
Vérifier la bobine

コイルの確認

코일 대조 확인 하시오

确认线圈型号

③



Do Not Bend Enclosing Tube

No doble el casquillo del Embolo de la Aguja

Não danifique o tubo de apoio da bobina

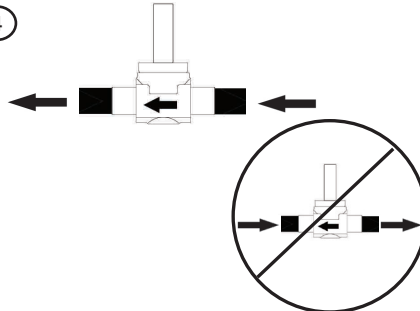
Ne pas plier le tube

エンクロージングチューブを曲げることは禁止

연결관을 구부리지 마시오

不要压弯阀杆

④



Flow Follows Arrow

El Flujo sigue la Flecha

Barra Indica Posição do Fluido

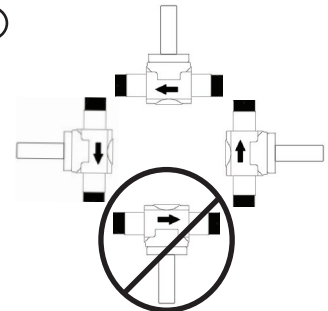
L'écoulement doit suivre la flèche

矢印方向に冷媒流

화살표방향으로 흐름

流向箭头

⑤



Valve Orientation

Orientación de Válvulas

Orientação da Válvula

Orientation de la valve

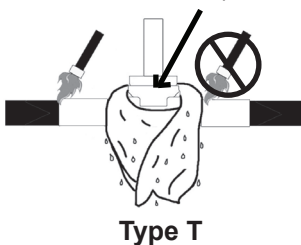
バルブの向き

올바른 밸브 설치방향

阀的安装角度

⑥

T < 250°F (121°C)



Type T

Submerge Rag In Cold Water After Each Installation

Sumerja el trapo en agua fría despues de cada instalacion

Mergulhe o pano em água fria após cada instalação

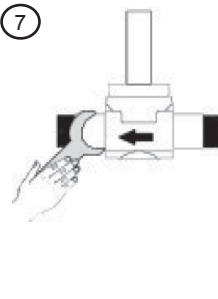
Submerger le chiffon dans l'eau froide après chaque installation

ろう付時は、1 回毎に雑巾を冷水に浸すこと

매번 설치 후 찬물에 헹궂을 담근다

在每个产品焊接时，必须包裹完全浸湿的湿布

⑦



Type F = SAE
Type P = FTP

Use Wrench On Valve Body Only

Utilice la llave sólo en el cuerpo de la Válvula

No corpo use sómente uma chave de boca

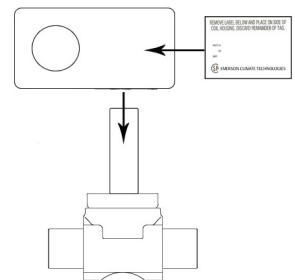
Utiliser la clé a molette sur le corps seulement

レンチ使用は、バルブ本体のみ

밸브 본체에만 렌치를 사용하시오

扳手只能用在阀体上

⑧



Coil Installation

Instalación de la Bobina

Instalação da bobina

l'installation de la bobine

コイルの取付

코일 설치

安装线圈

9

AM Coil Electrical Data			
VAC/Hz	Maximum Amps		VA Holding
	Inrush	Holding	
24/50	2.0	0.96	23
24/60	1.6	0.74	18
120/50	0.45	0.21	25
120/60	0.36	0.16	19
208/50	0.19	0.08	17
208/60	0.15	0.06	12
220/50	0.24	0.10	24
240/60	0.19	0.08	19
480/50	0.11	0.05	24
480/60	0.09	0.04	19

Transformer Selection

Selección del Transformador

Selecione transformador capacidade suficiente

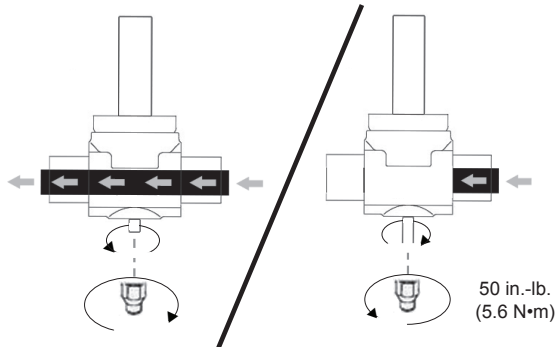
Sélection du transformateur

トランスフォーマーの選択

변압기 선정

选择变压器

10



Manual Override

Vástago de Operación Manual

Acionamento manual

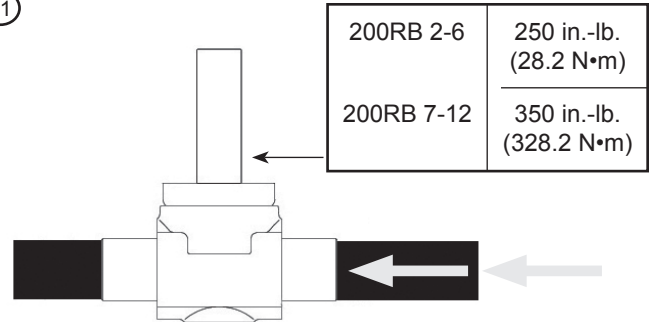
Ouverture manuel de la tige

マニュアルオーバーライド

수동으로 변경

手动开阀

11



Disassembly - must use new o-ring when reassembling.
Replace with same type o-ring. Retorque per table above.

Desmontaje - cuando este remontando usar nuevo o-ring.
Substituya por el mismo tipo de o-ring. Reajuste utilizando la table encima.

Desmontagem - quando for remontar é necessário usar um novo anel o-ring.
Substitua pelo mesmo tipo de anel o-ring. Reaperte utilizando a tabela acima.

Désassemblé - un rouveau joint doit être utilisé lorsque rassemblée.
Utilisé le même type de joint. Reserrer selon le tableau ci-joint.

分解後、再組立時には新しいオーリングを使用のこと。同種のオーリングを使用し、上記のトルク値で締め付けます。

분해할 경우 - 재 조립할 때 반드시 새 오링을 사용.
교체할 경우 같은 종류의 오링 사용. 위 테이블 표에 의해 조임.

拆解后-在重新组装时必须使用新的O形圈。
更换相同型号的O形圈。扭矩按照上表内的参数要求。

12

When using replacement kits, use entire kit. Do not replace individual components.

Cuando utilice partes de reemplazo use el kit completo. No substituya los componentes individuales.

Quando necessária a utilização do Kit de Reparo, utilize todas as peças. Não substitua componentes individuais.

Quand vous utilisez le kit de remplacement, utilisez le au complet, ne remplacer pas les composantes individuellement.

交換用キットをご使用の際は、その全てを交換して下さい。一部だけの交換は、不可です。

대체 키트를 사용할때, 키트내 개별부품을 사용마시고 전체 키트를 사용하시오.

在使用维修组件时，必须更换全套组件，不能只更换其中某个零件



Rosemount™ 2051 Pressure Transmitter



- Rosemount™ Coplanar™ platform enables integration of primary elements, manifolds, and remote seal solutions
- Best-in-class performance with up to 0.05 percent high accuracy option
- IEC 62591 (*WirelessHART*®) enables cost effective installations
- Local Operator Interface (LOI) offers easy to use configuration capabilities at the transmitter
- Protocols available include 4–20 mA HART®, FOUNDATION™ Fieldbus, PROFIBUS® PA, and HART 1–5 Vdc Low Power
- Selectable HART Revision prepares your plant for the latest HART capabilities while ensuring seamless integration with today's systems
- SIL2/3 safety certification to IEC 61508 is available with the full 4–20 mA HART offering to simplify compliance

Contents

Rosemount 2051 Pressure Transmitter product offering..... 2

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Rosemount™ 2051CF Flow Meters..... 30

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Specifications..... 71

Product certifications..... 88

Dimensional drawings..... 109

Options..... 123

Rosemount 2051 Pressure Transmitter product offering



Foundation of reliable measurement

- Differential, gage, and absolute pressure measurement
- Select from an extensive offering of DP flow meters, liquid level, manifolds, and flanges
- Available with variety of protocols and materials

Best-in-class capabilities extended to IEC 62591 (WirelessHART Protocol)

- Cost effectively implement wireless on the industry's most proven platform
- Optimize safety with the industry's only intrinsically safe power module
- Eliminate wiring design and construction complexities to lower costs by 40–60 percent
- Quickly deploy new pressure, level, and flow measurements in 70 percent less time

Innovative, integrated DP flow meters

- Fully assembled and leak tested for out-of-the-box installation
- Reduce straight pipe requirements, lower permanent pressure loss, and achieve accurate measurement in small line sizes
- Up to two percent volumetric flow accuracy at 5:1 turndown

Proven, reliable, and innovative DP level technologies

- Connect to virtually any process with a comprehensive offering of process connections, fill fluids, direct mount or capillary connections, and materials.
- Quantify and optimize total system performance with QZ option.
- Optimize level measurement with cost efficient Tuned-System™ Assemblies

Instrument manifolds — quality, convenient, and easy

- Designed and engineered for optimal performance with Rosemount transmitters
- Save installation time and money with factory assembly
- Offers a variety of styles, materials, and configurations

Rosemount 2051C Coplanar Pressure Transmitter ordering information



- Performance up to 0.05% of span accuracy
- Patented coplanar technology allows direct mounting to pressure, flow or level solutions for installation flexibility
- Delivered fully assembled to manifolds, diaphragm seals or primary flow elements for straightforward installation
- Local Operator Interface offers easy-to-use menus and built-in configuration buttons for streamline commissioning
- SIL 2/3 certified to IEC 61508 (via 3rd party) and prior-use certificate of FMEDA data for safety installations

[CONFIGURE >](#)

[VIEW PRODUCT >](#)

Online Product Configurator

Many products are configurable online using our Product Configurator. Select the **Configure** button or visit our [website](#) to start. With this tool's built-in logic and continuous validation, you can configure your products more quickly and accurately.

Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 1](#).

Figure 1: Model Code Example

3051C D 2 X 2 2 1 A	WA3 WP5	M5 B4
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051C	Coplanar Pressure Transmitter	★

Measurement type

Code	Description	
D	Differential	★
G	Gage	★

Pressure range

Code	Differential (Rosemount 3051CD)	Gage (Rosemount 3051CG)	
1	–25 to 25 inH ₂ O (–62.2 to 62.2 mbar)	–25 to 25 inH ₂ O (–62.2 to 62.2 mbar)	★
2	–250 to 250 inH ₂ O (–623 to 623 mbar)	–250 to 250 inH ₂ O (–623 to 623 mbar)	★
3	–1000 to 1000 inH ₂ O (–2.5 to 2.5 bar)	–393 to 1000 inH ₂ O (–0.98 to 2.5 bar)	★
4	–300 to 300 psi (–20.7 to 20.7 bar)	–14.2 to 300 psi (–0.98 to 20.7 bar)	★
5	–2000 to 2000 psi (–137.9 to 137.9 bar)	–14.2 to 2000 psi (–0.98 to 137.9 bar)	★

Transmitter output

Code	Description	
A ⁽¹⁾	4–20 mA with digital signal based on HART® Protocol	★
F	FOUNDATION™ Fieldbus Protocol	★
W	PROFIBUS® PA Protocol	★
X	Wireless	★
M	Low-power, 1–5 Vdc with digital signal based on HART Protocol	

(1) HART Revision 5 is the default HART output. The Rosemount 2051 with Selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Process flange type, material, drain/vent

Code	Process flange type	Flange material	Drain/vent	
2		SST	SST	★
3 ⁽¹⁾	Coplanar	Cast C-276	Alloy C-276	★
5		Plated CS	SST	★

Code	Process flange type	Flange material	Drain/vent	
7 ⁽¹⁾		SST	Alloy C-276	★
8 ⁽¹⁾		Plated CS	Alloy C-276	★
0	Alternate process connection			★

- (1) Materials of construction comply with recommendations per NACE® MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments. Order with Q15 or Q25 to receive a NACE certificate.

Isolating diaphragm

Code	Description	
2 ⁽¹⁾	316L SST	★
3 ⁽¹⁾	Alloy C-276	★
5 ⁽¹⁾⁽²⁾	Tantalum	

- (1) Available in ranges 2–5 only.
 (2) Not available with output code X.

O-ring

Code	Description	
A	Glass-filled PTFE	★
B	Graphite-filled PTFE	★

Sensor fill fluid

Code	Description	
1	Silicone	★
2 ⁽¹⁾	Inert (differential and gage only)	★

- (1) Not available with wireless output (code X).

Housing material

Code	Description	Conduit entry size	
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 x 1.5	★
J	Aluminum, ultra low copper	½–14 NPT	★
K ⁽¹⁾	Aluminum, ultra low copper	M20 x 1.5	★
P ⁽²⁾	SST	½–14 NPT	★
D	SST	M20 x 1.5	★
M ⁽²⁾	Engineered polymer	No conduit entries	★

- (1) Not available with low power (output code M).
 (2) Only available with output code X.

Wireless options

Requires wireless output code X and engineered polymer housing code P.

Wireless transmit rate, operating frequency, and protocol

Code	Description	
WA3	User configurable transmit rate, 2.4 GHz WirelessHART ®	★

Antenna and SmartPower™

Code	Description	
WP5	Internal antenna, compatible with Green Power Module (I.S. Power Module sold separately)	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

HART revision configuration

Only available with 4–20 mA HART (output code A).

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Plantweb™ control functionality

Code	Description	
A01	FOUNDATION™ Fieldbus control function block suite	★

Alternate flange

The alternate flange option code requires the 0 code in materials of construction for alternate process connection.

Code	Description	
H2	Traditional flange, 316 SST, SST drain/vent	★
H3 ⁽¹⁾	Traditional flange, alloy C, alloy C-276 drain/vent	★
H7 ⁽¹⁾	Traditional flange, 316 SST, alloy C-276 drain/vent	★
HJ	DIN-compliant traditional flange, SST, 7/16-in. (10 mm) adapter/manifold bolting	★
FA	Level flange, SST, 2-in. (51 mm), ANSI Class 150, vertical mount	★
FB	Level flange, SST, 2-in. (51 mm), ANSI Class 300, vertical mount	★
FC	Level flange, SST, 3-in. (76 mm), ANSI Class 150, vertical mount	★

FD	Level flange, SST, 3-in. (76 mm), ANSI Class 300, vertical mount	★
FP	DIN level flange, SST, DN 50, PN 40, vertical mount	★
FQ	DIN level flange, SST, DN 80, PN 40, vertical mount	★
HK ⁽²⁾	DIN compliant traditional flange, SST, 10 mm adapter/manifold bolting	
HL ⁽²⁾⁽³⁾	DIN compliant traditional flange, SST, 12 mm adapter/manifold bolting	

(1) Materials of construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments. Order with Q15 or Q25 to receive a NACE certificate.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

(3) Not valid with optional code P9 for 4500 psi static pressure.

Manifold assembly

“Assemble-to” items are specified separately and require a completed model number.

These options are not valid with option code P9 for 4500 psi static pressure.

Code	Description	
S5	Assemble to Rosemount 305 Integral Manifold	★
S6	Assemble to Rosemount 304 Manifold or Connection System	★

Integral mount primary element

Not valid with option code P9 for 4500 static pressure. “Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S3	Assemble to Rosemount 405 Compact Orifice Plate	★
S4 ⁽¹⁾	Assemble to Rosemount Annubar™ or Rosemount 1195 Integral Orifice	★

(1) Process flange limited to coplanar (option codes 2, 3, 5, 7, or 8) or traditional (option codes H2, H3, or H7).

Seal assemblies

“Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S1 ⁽¹⁾	Assemble to one Rosemount 1199 seal	★
S2 ⁽²⁾	Assemble to two Rosemount 1199 seals	★

(1) Not valid with option code D9 for RC1/2 adapters.

(2) Not valid for option codes DF and D9 for adapters.

Mounting brackets

Code	Description	
B1	Traditional flange bracket for 2-in. pipe mounting, CS bolts	★
B2	Traditional flange bracket for panel mounting, CS bolts	★
B3	Traditional flange flat bracket for 2-in. pipe mounting, CS bolts	★
B4	Coplanar flange bracket for 2-in. pipe or panel mounting, all SST	★
B7	B1 bracket with Series 300 SST bolts	★
B8	B2 bracket with Series 300 SST bolts	★

Code	Description	
B9	B3 bracket with Series 300 SST bolts	★
BA	SST B1 bracket with Series 300 SST bolts	★
BC	SST B3 bracket with Series 300 SST bolts	★

Product certifications

Code	Description	
E1 ⁽¹⁾	ATEX Flameproof	★
E2 ⁽¹⁾	INMETRO Flameproof	★
E3 ⁽¹⁾	China Flameproof	★
E4 ⁽¹⁾	TIIS Flameproof	★
E5	USA Explosion-proof, Dust Ignition-proof	★
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽¹⁾	IECEx Flameproof	★
EW	India (CCOE) Flameproof Approval	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2 ⁽¹⁾	INMETRO Intrinsically Safe	★
I3 ⁽¹⁾	China Intrinsic Safety	★
I4 ⁽¹⁾⁽²⁾	TIIS Intrinsic Safety	★
I5	USA Intrinsically Safe, Division 2	★
I6	Canada intrinsically Safe	★
I7 ⁽¹⁾	IECEx Intrinsic Safety	★
IA ⁽³⁾	ATEX FISCO Intrinsic Safety	★
IE ⁽⁴⁾	USA FISCO Intrinsically Safe	★
IF ⁽⁴⁾	Canada FISCO Intrinsically Safe	★
IG ⁽⁴⁾	IECEx FISCO Intrinsically Safe	★
IW	India (CCOE) Intrinsically Safe	★
K1 ⁽¹⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K2	INMETRO Flameproof and Intrinsic Safety	★
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K7 ⁽¹⁾	IECEx Flameproof, Intrinsic Safety, Type n and Dust	★
KA ⁽¹⁾	ATEX and Canada Flameproof, Intrinsically Safe, Division 2	★
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
KC ⁽¹⁾	USA and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽¹⁾	USA, Canada, and ATEX Explosion-proof, Intrinsically Safe	★
N1 ⁽¹⁾	ATEX Type n	★

Code	Description	
N7 ⁽¹⁾	IECEX Type n	★
ND ⁽¹⁾	ATEX Dust	★
EM	Technical Regulations Customs Union (EAC) Flameproof	★
IM	Technical Regulations Customs Union (EAC) Intrinsic Safety	★
KM	Technical Regulations Customs Union (EAC) Flameproof and Intrinsic Safety	★
KL	USA, Canada, IECEX, ATEX Intrinsic Safety Combination	★
KS	USA, Canada, IECEX, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	★

(1) Not available with low power (output code M).

(2) Only available with output code X.

(3) Only valid with FOUNDATION Fieldbus (output code F).

(4) Not valid with optional codes DF or D9 for adapters.

Drinking water approval

This approval is not available with Alloy C-276 isolator (code 3), tantalum isolator (code 5), all cast C-276 flanges, all plated carbon steel (CS) flanges, all DIN flanges, all level flanges, assemble-to manifolds (codes S5 and S6), assemble-to seals (codes S1 and S2), assemble-to primary elements (codes S3 and S4), surface finish certification (code Q16), and remote seal system report (code QZ).

Code	Description	
DW	NSF drinking water approval	★

Shipboard approvals

Shipyards approvals are not available with wireless output (code X).

Code	Description	
SBS	American Bureau of Shipping	★
SBV	Bureau Veritas (BV)	★
SDN	Det Norske Veritas	★
SLL	Lloyds Register (LR)	★

Bolting material

Code	Description	
L4	Austenitic 316 SST bolts	★
L5	ASTM A 193, grade B7M bolts	★
L6	Alloy K-500 bolts	★
L8	ASTM A 193 Class 2, Grade B8M bolts	★

Display and interface options

Code	Description	
M4 ⁽¹⁾	LCD display with LOI	★
M5	LCD display	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Hardware adjustments

Code	Description	
D4 ⁽¹⁾	Zero and span configuration buttons	★
DZ ⁽²⁾	Digital zero trim	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

(2) Only available with 4–20 mA HART (output codes A) and wireless (output code X).

Flange adapters

This option is not valid with alternate process connection options S3, S4, S5, or S6.

Code	Description	
DF	½–14 NPT flange adapters	★

Conduit plug

Not available with output code X. Transmitter is shipped with 316 SST conduit plug (uninstalled) in place of standard CS conduit plug.

Code	Description	
DO	316 SST conduit plug	★

RC¼ RC½ process connection

This option is not available with alternate process connection, DIN flanges, and level flanges.

Code	Description	
D9	RC¼ flange with RC½ flange adapter - SST	

Ground screw

The ground screw option is not available with wireless output (code X). The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

Performance

Available with 4–20 mA HART (output code A), wireless (output code X), FOUNDATION Fieldbus (output code F), Rosemount 2051C Ranges 2–5 or Rosemount 2051T Ranges 1–4, SST and, alloy C-276 diaphragms and silicone fill fluid. High performance option includes 0.05 percent reference accuracy, and five year stability. See Performance specifications for details.

Code	Description	
P8	High performance option	★

Transient protection

The transient protection option is not available with wireless output (code X). The T1 option is not needed with FISCO Product Certifications; transient protection is included in the FISCO product certification codes IA, IB, and IE.

Code	Description	
T1	Transient protection terminal block	★

Software configuration

The software configuration option is only available with HART 4–20 mA output (output code A) and wireless output (output code X).

Code	Description	
C1	Custom software configuration (For wired, see the Rosemount 3051 Configuration Data Sheet . For wireless, see the Rosemount 3051 Wireless Configuration Data Sheet .)	★

Alarm limit

The option is not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
CN	NAMUR alarm and saturation levels, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

Pressure testing

Code	Description	
P1	Hydrostatic testing with certificate	★

Cleaning process area

This option is not valid with alternate process connection S5.

Code	Description	
P2	Cleaning for special service	
P3	Cleaning for < 1 ppm chlorine/fluorine	

Maximum static line pressure

Code	Description	
P9	4500 psig (310 bar) static pressure limit (Rosemount 2051CD Ranges 2–5 only)	★

Calibration certificate

Code	Description	
Q4	Calibration Certificate	★
QG ⁽¹⁾	Calibration Certificate and GOST Verification Certificate	★

QP	Calibration certification and tamper evident seal	★
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(1) Contact an Emerson representative for availability.

Material traceability certification

Code	Description	
Q8	Material Traceability Certification per EN 10204 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Quality certification for safety

The quality certification for safety is only available with HART 4–20 mA output (code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QT	Safety certified to IEC 61508 with certificate of FMEDA	★

Surface finish

Code	Description	
Q16	Surface finish certification for sanitary remote seals	★

Toolkit total system performance reports

Code	Description	
QZ	Remote seal system performance calculation report	★

Conduit electrical connector

The conduit electrical connector option is not available with wireless output (code X).

Code	Description	
GE	M12, 4-pin, male connector (eurofast®)	★
GM	A size mini, 4-pin, male connector (minifast®)	★

NACE® Certificate

Note that NACE-compliant wetted materials are required. Materials of construction must comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult the latest standard for details. All selected materials must also conform to NACE MR0103 for sour refining environments.

Code	Description	
Q15	Certificate of Compliance to NACE MR0175/ISO 15156 for wetted materials	★
Q25	Certificate of Compliance to NACE MR0103 for wetted materials	★

Rosemount 2051T In-line Pressure Transmitter ordering information



- Intuitive Local Operator Interface streamlines commissioning for simple and cost-effective installation
- SIL 2/3 certified to IEC 61508 (via 3rd party) and prior-use certificate of FMEDA data for safety installations

CONFIGURE >

VIEW PRODUCT >

Online Product Configurator

Many products are configurable online using our Product Configurator. Select the **Configure** button or visit our [website](#) to start. With this tool's built-in logic and continuous validation, you can configure your products more quickly and accurately.

Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 2](#).

Figure 2: Model Code Example

3051C D 2 X 2 2 1 A	WA3 WP5	M5 B4
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051T	In-Line Pressure Transmitter	★

Pressure type

Code	Description	
G	Gage	★
A ⁽¹⁾	Absolute	★

(1) Wireless (output code X) only available in absolute measurement type in range 1–5 with ½–14 NPT process connection (code 2B), and housing (code P).

Pressure range

Code	(Rosemount 2051TG)	Rosemount 2051TA)	
1	–14.7 to 30 psi (–1.0 to 2.1 bar)	0 to 30 psia (0 to 2.1 bar)	★
2	–14.7 to 150 psi (–1.0 to 10.3 bar)	0 to 150 psi (0 to 10.3 bar)	★
3	–14.7 to 800 psi (–1.0 to 55 bar)	0 to 800 psi (0 to 55 bar)	★
4	–14.7 to 4000 psi (0 to 276 bar)	0 to 4000 psi (0 to 276 bar)	★
5	–14.7 to 10000 psi (–1.0 to 689 bar)	0 to 10000 psi (0 to 689 bar)	★

Transmitter output

Code	Description	
A ⁽¹⁾	4–20 mA with digital signal based on HART® Protocol	★
F	FOUNDATION™ Fieldbus Protocol	★
W	PROFIBUS® PA Protocol	★
X	Wireless	★
M	Low-power, 1–5 Vdc with digital signal based on HART Protocol	

(1) HART Revision 5 is the default HART output. The Rosemount 2051 with Selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Process connection style

Code	Description	
2B	½–14 NPT female	★
2C ⁽¹⁾	G½ A DIN 16288 male	★

Code	Description	
2F ⁽²⁾	Coned and threaded, compatible with autoclave type F-250-C (range 5 only)	

(1) *Wireless (output code X) only available in G½ A DIN 16288 Male process connection (code 2C) with range 1–4, 316 SST isolating diaphragm (code 2), silicone fill fluid (code 1), and housing (code P).*

(2) *Not available with output code X.*

Isolating diaphragm

Code	Isolating diaphragm	Process connection wetted parts material	
2	316L SST	316L SST	★
3	Alloy C-276	Alloy C-276	★

Sensor fill fluid

Code	Description	
1	Silicone	★
2 ⁽¹⁾	Inert	★

(1) *Not available with output code X.*

Housing material

Code	Description	Conduit entry size	
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 x 1.5	★
J	SST	½–14 NPT	★
K ⁽¹⁾	SST	M20 x 1.5	★
P ⁽²⁾	Engineered polymer	No conduit entries	★
D	Aluminum	G½	★
M ⁽²⁾	SST	G½	

(1) *Not available with low power (output code M).*

(2) *Only available with output code X.*

Wireless options

Requires wireless output code X and engineered polymer housing code P.

Wireless transmit rate, operating frequency, and protocol

Code	Description	
WA3	User configurable transmit rate, 2.4 GHz WirelessHART ®	★

Antenna and SmartPower™

Code	Description	
WP5	Internal antenna, compatible with Green Power Module (I.S. Power Module sold separately)	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

HART revision configuration

Available with 4–20 mA HART (output code A), wireless (output code X), FOUNDATION™ Fieldbus (output code F), Rosemount 2051C Ranges 2–5 or Rosemount 2051T Ranges 1–4, SST and Alloy C 276 diaphragms and silicone fill fluid. High performance option includes 0.05 percent reference accuracy, and five year stability.

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Plantweb™ control functionality

Code	Description	
A01	FOUNDATION Fieldbus advanced control function block suite	★

Manifold assemblies

“Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S5	Assemble to Rosemount 306 Integral Manifold	★

Seal assemblies

“Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S5	Assemble to one Rosemount 1199 diaphragm seal	★

Mounting bracket

Code	Description	
B4	Bracket for 2-in. pipe or panel mounting, all SST	★

Product certifications

Code	Description	
E1 ⁽¹⁾	ATEX Flameproof	★
E2 ⁽¹⁾	INMETRO Flameproof	★

Code	Description	
E3 ⁽¹⁾	China Flameproof	★
E4 ⁽¹⁾	TIIS Flameproof	★
E5	USA Explosion-proof, Dust Ignition-proof	★
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽¹⁾	IECEX Flameproof	★
EW ⁽¹⁾	India (CCOE) Flameproof Approval	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2 ⁽¹⁾	INMETRO Intrinsically Safe	★
I3 ⁽¹⁾⁽²⁾	China Intrinsic Safety	★
I4 ⁽¹⁾⁽²⁾	TIIS Intrinsic Safety	★
I5	USA Intrinsically Safe, Division 2	★
I6	Canada intrinsically Safe	★
I7 ⁽¹⁾	IECEX Intrinsic Safety	★
IA ⁽³⁾	ATEX FISCO Intrinsic Safety	★
IE ⁽⁴⁾	USA FISCO Intrinsically Safe	★
IF ⁽⁴⁾	Canada FISCO Intrinsically Safe	★
IG ⁽⁴⁾	IECEX FISCO Intrinsically Safe	★
IW ⁽¹⁾	India (CCOE) Intrinsically Safe	★
K1 ⁽¹⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K7 ⁽¹⁾	IECEX Flameproof, Intrinsic Safety, Type n and Dust	★
KA ⁽¹⁾	ATEX and Canada Flameproof, Intrinsically Safe, Division 2	★
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
KC ⁽¹⁾	USA and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽¹⁾	USA, Canada, and ATEX Explosion-proof, Intrinsically Safe	★
N1 ⁽¹⁾	ATEX Type n	★
N7 ⁽¹⁾	IECEX Type n	★
ND ⁽¹⁾	ATEX Dust	★
EM	Technical Regulations Customs Union (EAC) Flameproof	★
IM	Technical Regulations Customs Union (EAC) Intrinsic Safety	★
KM	Technical Regulations Customs Union (EAC) Flameproof and Intrinsic Safety	★
KL	USA, Canada, IECEX, ATEX Intrinsic Safety Combination	★
KS	USA, Canada, IECEX, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	★

(1) Not available with low power (output code M).

(2) Only available with output code X.

(3) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

(4) Only valid with FOUNDATION Fieldbus (output code F).

Drinking water approval

This option is not available with coned and threaded connection (2F code), assemble-to manifold (S5 code), assemble-to seal (S1 code), surface finish certification (Q16 code), remote seal system report (QZ code).

Code	Description	
DW	NSF drinking water approval	★

Shipboard approvals

Shipyard approvals are not available with wireless output (code X).

Code	Description	
SBS	American Bureau of Shipping	★
SBV	Bureau Veritas (BV)	★
SDN	Det Norske Veritas	★
SLL	Lloyds Register (LR)	★

Display and interface options

Code	Description	
M4 ⁽¹⁾	LCD display with LOI	★
M5	LCD display	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Hardware adjustments

Code	Description	
D4 ⁽¹⁾	Zero and span configuration buttons	★
DZ ⁽²⁾	Digital zero trim	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

(2) Only available with 4–20 mA HART (output codes A) and wireless (output code X).

Wireless SST sensor module

This option is only available with output code X.

Code	Description	
WSM	Wireless SST sensor module	★

Conduit plug

Not available with output code X. Transmitter is shipped with 316 SST conduit plug (uninstalled) in place of standard CS conduit plug.

Code	Description	
DO	316 SST conduit plug	★

Ground screw

This option is not available with output code x. The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

Performance

Available with 4–20 mA HART (output code A), wireless (output code X), FOUNDATION Fieldbus (output code F), Rosemount 2051C Ranges 2–5 or Rosemount 2051T Ranges 1–4, SST and, alloy C-276 diaphragms and silicone fill fluid. High performance option includes 0.05 percent reference accuracy, and five year stability. See Performance specifications for details.

Code	Description	
P8	High performance option	★

Terminal blocks

This option is not available with output code x. The T1 option is not needed with FISCO Product Certifications; transient protection is included in the FISCO product certification codes IA and IE.

Code	Description	
T1	Transient protection terminal block	★

Software configuration

The software configuration option is only available with HART 4–20 mA output (output code A) and wireless output (output code X).

Code	Description	
C1	Custom software configuration (completed Rosemount 2051 Configuration Data Sheet or Rosemount 3051 Wireless Configuration Data Sheet .)	★

Alarm limit

The option is not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
CN ⁽¹⁾	NAMUR alarm and saturation levels, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

(1) Only available with 4–20 mA HART (output code A).

Pressure testing

Code	Description	
P1	Hydrostatic testing with certificate	★

Cleaning process area

This option is not valid with alternate process connection S5.

Code	Description	
P2	Cleaning for special service	
P3	Cleaning for < 1 ppm chlorine/fluorine	

Calibration certification

Code	Description	
Q4	Calibration certificate	★
QG	Calibration certificate and GOST verification certificate	★
QP	Calibration certificate and tamper evident seal	★

Material traceability certification

Code	Description	
Q8	Material traceability certification per EN 10204 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Quality certification for safety

This option is only available with 4–20 mA HART (output code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QT	Safety certified to IEC 61508 with certificate of FMEDA	★

Surface finish

Code	Description	
Q16	Surface finish certification for sanitary remote seals	★

Toolkit total system performance reports

Code	Description	
QZ	Remote seal system performance calculation report	★

Conduit electrical connector

This option is not available with output code X.

Code	Description	
GE	M12, 4-pin, male connector (eurofast®)	★
GM	A size mini, 4-pin, male connector (minifast®)	★

NACE® certificate

NACE Compliant wetted materials are identified by materials of construction that comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining).

Code	Description	
Q15	Certificate of compliance to NACE MR0175/ISO 15156 for wetted materials	★
Q25	Certificate of compliance to NACE MR0103 for wetted materials	★

Rosemount 2051G In-line Pressure Transmitter ordering information



- Patented coplanar technology allows direct mounting to pressure, flow or level solutions for installation flexibility
- Delivered fully assembled to manifolds, diaphragm seals or primary flow elements for straightforward installation
- Local Operator Interface offers easy-to-use menus and built-in configuration buttons for streamline commissioning

Online Product Configurator

Many products are configurable online using our Product Configurator. Select the **Configure** button or visit our [website](#) to start. With this tool's built-in logic and continuous validation, you can configure your products more quickly and accurately.

Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 3](#).

Figure 3: Model Code Example

<u>3051C D 2 X 2 2 1 A</u>	<u>WA3 WP5</u>	<u>M5 B4</u>
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051G	In-line pressure transmitter	★

Pressure type

Code	Description	
P	Gage	★
A	Absolute	★
	Rosemount 2051GP	Rosemount 2051GA
1	–14.7 to 30 psi (–1.0 to 2.1 bar)	0 to 30 psi (0 to 2.1 bar)
2	–14.7 to 150 psi (–1.0 to 10.3 bar)	0 to 150 psi (0 to 10.3 bar)
3	–14.7 to 800 psi (–1.0 to 55 bar)	0 to 800 psi (0 to 55 bar)
4	–14.7 to 4000 psi (–1.0 to 276 bar)	0 to 4000 psi (0 to 276 bar)

Transmitter output

Code	Description	
A	4–20 mA with digital signal based on HART® Protocol	★

Process connection style

Code	Description	
2B	½–14 NPT female	★
2C	G½ A DIN 16288 male	★

Isolating diaphragm and process connection wetted parts material

Materials of construction comply with recommendations per NACE® MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

Code	Description	
2	316L SST	★
3	Alloy C-276	★

Sensor fill fluid

Code	Description	
1	Silicone	★

Code	Description	
2	Inert	★

Housing material

Code	Material	Conduit entry size	
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 x 1.5	★
D	Aluminum	G½	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Integral manifold assembly

“Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S5	Assemble to Rosemount 306 Integral Manifold	★

Seal assemblies

“Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S1	Assemble to one Rosemount 1199 Diaphragm Seal	★

Mounting bracket

Panel mounting bolts are not supplied.

Code	Description	
B4	Bracket for 2-in. pipe or panel mounting, all SST	★
BE	316 SST B4 bracket with 316 SST bolts	★

Product certifications

Consult an Emerson representative for availability of product certifications.

Code	Description	
E1	ATEX Flameproof	

Code	Description	
E2	INMETRO Flameproof	
E3	China Flameproof	
E5	USA Explosion-proof, Dust Ignition-proof	
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	
E7	IECEx Flameproof	
EM	Technical Regulations Customs Union (EAC) Flameproof	
EP	Republic of Korea Flameproof	
EW	India (CCOE) Flameproof Approval	
I1	ATEX Intrinsic Safety	
I2	INMETRO Intrinsically Safe	
I3	China Intrinsic Safety	
I5	USA Intrinsically Safe, Division 2	
I6	Canada intrinsically Safe	
I7	IECEx Intrinsic Safety	
IM	Technical Regulations Customs Union (EAC) Intrinsic Safety	
IP	Republic of Korea Intrinsic Safety	
IW	India (CCOE) Intrinsic Safety	
K1	ATEX Flameproof, Intrinsic Safety, Type n, Dust	
K2	INMETRO Flameproof, Intrinsic Safety	
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsic Safety, Division 2	
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsic Safety, Division 2	
K7	IECEx Flameproof, Intrinsic Safety, Type n and Dust	
KA	Canada and ATEX Explosion proof, Dust Ignition-proof, Intrinsic Safety, division (combo of E1, I1, and K6)	
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsic Safety, and Division 2 (combo of K5 and K6)	
KD	USA, Canada and ATEX Explosion proof, Intrinsically Safety (combination of K5, K6 I1, and E1)	
KM	Technical Regulations Customs Union (EAC) Flame-proof, Intrinsic Safety	
KP	Republic of Korea Flame-proof, Intrinsic Safety	
N1	ATEX Type n	
N3	China Type n	
N7	IECEx Type n	
ND	ATEX Dust	
NK	IECEx Dust	
KL	USA, Canada, IECEx, ATEX Intrinsic Safety Combination	
KS	USA, Canada, IECEx, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	

Drinking water approval

This option is not available with coned and threaded connection (2F code), assemble-to manifold (S5 code), assemble-to seal (S1 code), surface finish certification (Q16 code), remote seal system report (QZ code).

Code	Description	
DW	NSF drinking water approval	★

Pressure testing

Code	Description	
P1	Hydrostatic testing with certificate	★

Cleaning process area

This option is not valid with alternate process connection S5.

Code	Description	
P2	Cleaning for special service	★
P3	Cleaning for < 1 ppm chlorine/fluorine	★

Calibration certification

Code	Description	
Q4	Calibration certificate	★
QG	Calibration certificate and GOST verification certificate	★
QP	Calibration certificate and tamper evident seal	★

Material traceability certification

Code	Description	
Q8	Material traceability certification per EN 10204 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Quality certification for safety

This option is only available with 4–20 mA HART (output code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QT	Safety certified to IEC 61508 with certificate of FMEDA	★

Configuration buttons

Code	Description	
D4	Analog zero and span	★
DZ	Digital zero trim	★

Conduit plug

Transmitter is shipped with 316 SST conduit plug (uninstalled) in place of standard CS conduit plug.

Code	Description	
DO	316 SST conduit plug	★

Ground screw

The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

Performance

High performance option includes 0.05 percent reference accuracy, and five year stability. See Performance specifications for details.

Code	Description	
P8	High performance option	★

Display and interface options

Select configuration buttons (option code D4 or DZ) if local configuration buttons are required.

Code	Description	
M4	LCD display with LOI	★
M5	LCD display	★

Transient terminal block

Code	Description	
T1	Transient protection terminal block	★

Software configuration

Code	Description	
C1	Custom software configuration (requires Rosemount 2051 Configuration Data Sheet)	★

Alarm levels

Code	Description	
C4	Analog output levels compliant with NAMUR recommendation NE 43, high alarm	★
CN	Analog output levels compliant with NAMUR recommendation NE 43, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

HART revision configuration

Only available with 4–20 mA HART (output code A).

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Surface finish

Code	Description	
Q16	Surface finish certification for sanitary remote seals	★

Toolkit total system performance reports

Code	Description	
QZ	Remote seal system performance calculation report	★

Conduit electrical connection

Code	Description	
GE	M12, 4-pin, male connector (eurofast®)	★
GM	A size mini, 4-pin, male connector (minifast®)	★

NACE® certificate

NACE Compliant wetted materials are identified by materials of construction that comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining).

Code	Description	
Q15	Certificate of compliance to NACE MR0175/ISO 15156 for wetted materials	★
Q25	Certificate of compliance to NACE MR0103 for wetted materials	★

SST tagging

Code	Description	
Y2	316 SST nameplates, labels, tags, and fasteners	

Rosemount™ 2051CF Flow Meters

Rosemount 2051CF Flow Meters combine the proven Rosemount 2051 Pressure Transmitter and the latest primary element technologies. All flow meters are fully assembled, calibrated, configured, and leak tested for out-of-the-box installation and are available with wired or wireless capabilities to meet all of your application needs.

Rosemount 2051CFA Annubar Flow Meter



Rosemount Annubar technology minimizes permanent pressure loss while delivering best in class accuracy.

- Lowest material costs for large line sizes.
- Flo-tap enables installation without process shutdown.
- Realize up to 96 percent less permanent pressure loss compared to traditional orifice plate installations.

Rosemount 2051CFC Compact Conditioning Flow Meter



Rosemount Compact Conditioning technologies provide unprecedented performance with minimal straight-run requirements. Solutions include conditioning orifice plate or Rosemount Annubar primary elements.

- Conditioning orifice requires only two pipe diameters upstream and downstream.
- Eliminate swirl and regular profiles resulting in more stable and accurate flow measurement.
- Savings up to 55 percent when compared to a traditional orifice plate installation can be realized.

Rosemount 2051CFP Integral Orifice Flow Meter



Rosemount Integral Orifice Flow Meters deliver highly accurate small-bore flow measurement capability with minimal installation and maintenance requirements.

- Best performance for small line sizes ½- to 1½-in. (15 to 40 mm).
- Precision honed pipe section and tight machining tolerances deliver higher installed performance.
- Reduces uncertainty by up to five percent compared to traditional orifice plate installation.

Rosemount CFA Annubar ordering information



- Patented T-shape Annubar creates a fixed separation point for DP signal improvement over a wider flow rate
- Complete flow assemblies are leak-tested and calibrated to reduce leak points up to 70% and simplify installation
- T-shape design of averaging pitot tube ensures very low permanent pressure loss
- Local operator interface offers easy-to-use menus and built-in configuration buttons for streamlined commissioning
- Sensor stagnation zone positioned to reduce noise, measurement inaccuracies and keeps particulates from clogging
- SIL 2/3 certified to IEC 61508 (via 3rd party) and prior-use certificate of FMEDA data for safety installations

[VIEW PRODUCT >](#)

Online Product Configurator

Many products are configurable online using our Product Configurator. Select the **Configure** button or visit our [website](#) to start. With this tool's built-in logic and continuous validation, you can configure your products more quickly and accurately.

Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 4](#).

Figure 4: Model Code Example

3051C D 2 X 2 2 1 A	WA3 WP5	M5 B4
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051CFA	Rosemount Annubar Flow Meter	★

Measurement type

Code	Description	
D	Differential	★

Fluid type

Code	Description	
L	Liquid	★
G	Gas	★
S	Steam	★

Line size

Code	Description	
020	2-in. (50 mm)	★
025	2½-in. (63.5 mm)	★
030	3-in. (80 mm)	★
035	3½-in. (89 mm)	★

040	4-in. (100 mm)	★
050	5-in. (125 mm)	★
060	6-in. (150 mm)	★
070	7-in. (175 mm)	★
080	8-in. (200 mm)	★
100	10-in. (250 mm)	★
120	12-in. (300 mm)	★

Pipe I.D. range

See the Rosemount DP Flow Meters and Primary Elements [Product Data Sheet](#) for pipe I.D. table.

Code	Description	
C	Range C from the pipe I.D. table	★
D	Range D from the pipe I.D. table	★
A	Range A from the pipe I.D. table	
B	Range B from the pipe I.D. table	
E	Range E from the pipe I.D. table	
Z	Non-standard pipe I.D. range or line sizes greater than 12-in.	

Pipe and mounting assembly material

Code	Description	
C	CS (A105)	★
S	316 SST	★
0 ⁽¹⁾	No mounting (customer supplied)	
G	Chrome-moly grade F-11	
N	Chrome-moly grade F-22	
J	Chrome-moly grade F-91	

(1) Provide the "A" dimension for flanged and pak-lok shown in "Dimensional drawings" section.

Pipe orientation

Code	Description	
H	Horizontal piping	★
D	Vertical piping with downward flow	★
U	Vertical piping with upward flow	★

Rosemount Annubar type

Code	Description	
P	Pak-lok	★

F	Flanged with opposite side support	★
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Sensor material

Code	Description	
S	316 SST	★

Sensor size

Code	Description	
1	Sensor size 1 — line sizes 2- to 8-in. (50 to 200 mm)	★
2	Sensor size 2 — line sizes 6- to 96-in. (150 to 2400 mm)	★
3	Sensor size 3 — line sizes greater than 12-in. (300 mm)	★

Mounting type

Code	Description	
T1	Compression or threaded connection	★
A1	ANSI Class 150 RF	★
A3	ANSI Class 300 RF	★
A6	ANSI Class 600 RF	★
D1	DN PN 16 flange	★
D3	DN PN 40 flange	★
D6	DN PN 100 flange	★
R1	Class 150 RTJ flange	
R3	Class 300 RTJ flange	
R6	Class 600 RTJ flange	

Opposite side support or packing gland

Code	Description	
0	No opposite side support or packing gland (required for pak-lok and flange-lok models)	★

Opposite side support (required for flanged models)

Code	Description	
C	NPT threaded opposite support assembly — extended tip	★
D	Welded opposite support assembly — extended tip	★

Isolation valve for flo-tap models

Provide the “A” dimension for flanged and pak-lok shown in "Dimensional drawings" section.

Code	Description	
0	Not applicable or customer supplied	★

Temperature measurement

Code	Description	
T	Integral RTD – not available with flanged model greater than Class 600	★
0	No temperature sensor	★
R	Remote thermowell and RTD	

Transmitter connection platform

Code	Description	
3	Direct mount, Integral 3-valve manifold – not available with flanged model greater than Class 600	★
5	Direct mount, 5-valve manifold – not available with flanged model greater than Class 600	★
7	Remote mount NPT connections (½-in. FNPT)	★
8	Remote mount SW connections (½-in.)	

Differential pressure range

Code	Description	
1	0 to 25 inH ₂ O (0 to 62.3 mbar)	★
2	0 to 250 inH ₂ O (0 to 623 mbar)	★
3	0 to 1000 inH ₂ O (0 to 2.5 bar)	★

Transmitter output

Code	Description	
A ⁽¹⁾	4–20 mA with digital signal based on HART® Protocol	★
F	FOUNDATION™ Fieldbus Protocol	★
W	PROFIBUS® PA Protocol	★
X	Wireless	★
M	Low-power, 1–5 Vdc with digital signal based on HART Protocol	

(1) HART Revision 5 is the default HART output. The Rosemount 2051 with Selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Transmitter housing material

Code	Description	Conduit entry size	
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 x 1.5	★
J	SST	½–14 NPT	★

Code	Description	Conduit entry size	
K ⁽¹⁾	SST	M20 x 1.5	★
P ⁽²⁾	Engineered polymer	No conduit entries	★
D	Aluminum	G½	
M ⁽¹⁾	SST	G½	

(1) Not available with low power (output code M).

(2) Only available with output code X.

Transmitter performance class

Code	Description	
1	2.0 percent flow rate accuracy, 5:1 flow turndown, 2-year stability	★

Wireless options

Requires wireless output code X and engineered polymer housing code P.

Wireless transmit rate, operating frequency, and protocol

Code	Description	
WA3	User configurable transmit rate, 2.4 GHz WirelessHART ®	★

Antenna and SmartPower™

Code	Description	
WP5	Internal antenna, compatible with Green Power Module (I.S. Power Module sold separately)	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Special cleaning

This option is not available with low power (output code M).

Code	Description	
P2	Cleaning for special services	
PA	Cleaning per ASTM G93 Level D (section 11.4)	

Material testing

Not available with low power (output code M).

Code	Description	
V1	Dye penetrant exam	

Material examination

Not available with low power (output code M).

Code	Description	
V2	Radiographic examination	

Special inspection

Not available with low power (output code M).

Code	Description	
QC1	Visual and dimensional inspection with certificate	★
QC7	Inspection and performance certificate	★

Surface finish

Not available with low power (output code M).

Code	Description	
RL	Surface finish for low pipe Reynolds number in gas and steam	★
RH	Surface finish for high pipe Reynolds number in liquid	★

Material traceability certification

This option is not available with low power (output code M).

This option is only valid with FOUNDATION Fieldbus (output code F).

Code	Description	
Q8	Material traceability certification per EN 10474:2004 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Code conformance

This option is not available with low power (output code M).

Code	Description	
J2	ANSI/ASME B31.1	
J3	ANSI/ASME B31.3	

Materials conformance

This option is not available with low power (output code M).

This option is only valid with FOUNDATION Fieldbus (output code F).

Code	Description	
J5	NACE MR-0175/ISO 15156	

Country certification

This option is not available with low power (output code M).

Code	Description	
J6	European Pressure Directive (PED)	★
J1	Canadian registration	

Instrument connections for remote mount options

This option is not available with low power (output code M).

Code	Description	
G2	Needle valves, SST	★
G6	OS&Y gate valve, SST	★
G1	Needle valves, CS	
G3	Needle valves, alloy C-276	
G5	OS&Y gate valve, CS	
G7	OS&Y gate valve, alloy C-276	

Special shipment

This option is not available with low power (output code M).

Code	Description	
Y1	Mounting hardware shipped separately	★

Product certifications

Code	Description	
E1 ⁽¹⁾	ATEX Flameproof	★
E2 ⁽¹⁾	INMETRO Flameproof	★
E3 ⁽¹⁾	China Flameproof	★
E5	USA Explosion-proof, Dust Ignition-proof	★
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽¹⁾	IECEx Flameproof	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2 ⁽¹⁾	INMETRO Intrinsically Safe	★

I3 ⁽¹⁾	China Intrinsic Safety	★
I5	USA Intrinsically Safe, Division 2	★
I6	Canada Intrinsically Safe	★
I7 ⁽¹⁾	IECEx Intrinsic Safety	★
IA ⁽¹⁾⁽²⁾	ATEX FISCO Intrinsic Safety; for FOUNDATION Fieldbus protocol only	★
IE ⁽¹⁾⁽²⁾	USA FISCO Intrinsically Safe	★
IF ⁽¹⁾⁽²⁾	Canada FISCO Intrinsically Safe	★
IG ⁽¹⁾⁽²⁾	IECEx FISCO Intrinsically Safe	★
K1 ⁽¹⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E5 and I5)	★
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E6 and I6)	★
K7 ⁽¹⁾	IECEx Flameproof, Dust Ignition-proof, Intrinsic Safety, Type n (combination of E7, I7, and N7)	★
KA ⁽¹⁾	ATEX and Canada Flameproof, Intrinsically Safe, Division 2	★
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E5, E6, I5, and I6)	★
KC ⁽¹⁾	USA and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽¹⁾	USA, Canada, and ATEX Explosion-proof, Intrinsically Safe (combination of E5, I5, E6, I6, E1, and I1)	★
N1 ⁽¹⁾	ATEX Type n	★
N7 ⁽¹⁾	IECEx Type n	★
ND ⁽¹⁾	ATEX Dust	★
KL	USA, Canada, IECEx, ATEX Intrinsic Safety Combination	★
KS	USA, Canada, IECEx, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	★

(1) Not available with low power (output code M).

(2) Only valid with FOUNDATION Fieldbus (output code F).

Sensor fill fluid and O-ring options

This option is not available with low power (output code M).

Code	Description	
L1 ⁽¹⁾	Inert sensor fill fluid	★
L2	Graphite-filled (PTFE) O-ring	★
LA ⁽¹⁾	Inert sensor fill fluid and graphite-filled (PTFE) O-ring	★

(1) Not available with output code X.

Display and interface options

This option is not available with low power (output code M).

Code	Description	
M4 ⁽¹⁾	LCD display with LOI	★

M5	LCD display	★
----	-------------	---

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Transmitter calibration certification

This option is not available with low power (output code M).

Code	Description	
Q4	Calibration certificate for transmitter	★

Quality certification for safety

The quality certification for safety is only available with HART 4–20 mA output (code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QT	Safety certified to IEC 61508 with certificate of FMEDA	★

Transient protection

This option is not available with low power (output code M).

This option is not available with output code X.

This option is not available with housing code 00, 5A, or 7J. The T1 option is not needed with FISCO Product Certifications, transient protection is included with the FISCO Product Certification code IA.

Code	Description	
T1	Transient terminal block	★

Manifold for remote mount option

This option is not available with low power (output code M).

Code	Description	
F2	3-valve manifold, SST	★
F6	5-valve manifold, SST	★
F1	3-valve manifold, CS	
F5	5-valve manifold, CS	

Plantweb control functionality

This option is not available with low power (output code M).

This option is only valid with FOUNDATION Fieldbus (output code F).

Code	Description	
A01	FOUNDATION Fieldbus advanced control function block suite	★

Hardware adjustments

This option is not available with low power (output code M).

Code	Description	
D4 ⁽¹⁾	Zero and span hardware adjustments	★
DZ ⁽²⁾	Digital zero trim	★

(1) Only available with 4–20 mA HART (output codes A and M).

(2) Only available with 4–20 mA HART (output codes A and M) and wireless output (code X).

Alarm limit

This option is not available with low power (output code M).

This option is only available with 4–20 mA HART (output codes A and M).

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
CN	NAMUR alarm and saturation levels, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

Ground screw

This option is not available with low power (output code M).

This option is not available with output code X.

The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

HART Revision Configuration

This option is not available with low power (output code M).

This option is only available with 4–20 mA HART (output codes A and M).

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Rosemount 2051CFC Compact Flow Meter ordering information



- Complete flow assemblies are leak-tested and calibrated to reduce leak points up to 70% and simplify installation
- Primary element design delivers reliable and accurate flow measurement for gas, liquid and steam service
- Orifice plate available in 0.5 - 12 in. (15 - 300 mm) line sizes for application flexibility
- Local operator interface offers easy-to-use menus and built-in configuration buttons for streamlined commissioning
- SIL 2/3 certified to IEC 61508 (via 3rd party) and prior-use certificate of FMEDA data for safety installations

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Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 5](#).

Figure 5: Model Code Example

3051C D 2 X 2 2 1 A	WA3 WP5	M5 B4
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051CFC	Compact flow meter	★

Measurement type

Code	Description	
D	Differential	★

Primary element technology

Code	Description	
A	Rosemount Annubar™ averaging pitot tube	
C	Conditioning orifice plate	★
P	Orifice plate	★

Material type

Code	Description	
S	316 SST	★

Line size

Code	Description	
005 ⁽¹⁾	½-in. (15 mm)	★
010 ⁽¹⁾	1-in. (25 mm)	★
015 ⁽¹⁾	1½-in. (40 mm)	★
020	2-in. (50 mm)	★
030	3-in. (80 mm)	★
040	4-in. (100 mm)	★
060	6-in. (150 mm)	★
080	8-in. (200 mm)	★
100 ⁽²⁾⁽³⁾	10-in. (250 mm)	★
120 ⁽¹⁾⁽³⁾	12-in. (300 mm)	★

(1) Not available for primary element technology C.

(2) For the 10- and 12-in. (250 and 300 mm) line size, the alignment ring must be ordered (installation accessories).

(3) 10- and 12-in. (250 and 300 mm) line sizes not available with primary element technology A.

Primary element type

Code	Description	
N000	Rosemount Annubar sensor size 1	★
N040	0.40 beta ratio	★
N050	0.50 beta ratio	★
N065 ⁽¹⁾	0.65 beta ratio	★

(1) For 2-in. (50 mm) line sizes the primary element type is 0.6 for primary element technology code C.

Temperature measurement

Code	Description	
0	No temperature sensor	★
T ⁽¹⁾	Integral RTD	
R	Remote thermowell and RTD	

(1) Available with primary element technology A only.

Transmitter connection platform

Code	Description	
3	Direct mount	★
7	Remote mount, NPT connections	★

Differential pressure range

Code	Description	
1	0 to 25 inH ₂ O (0 to 62.3 mbar)	★
2	0 to 250 inH ₂ O (0 to 623 mbar)	★
3	0 to 1000 inH ₂ O (0 to 2.5 bar)	★

Transmitter output

Code	Description	
A ⁽¹⁾	4–20 mA with digital signal based on HART® Protocol	★
F	FOUNDATION™ Fieldbus Protocol	★
W	PROFIBUS® PA Protocol	★
X	Wireless	★
M	Low-power, 1–5 Vdc with digital signal based on HART Protocol	

(1) HART Revision 5 is the default HART output. The Rosemount 2051 with Selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Transmitter housing material

Code	Description	Conduit entry size	
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 x 1.5	★
J	SST	½–14 NPT	★
K ⁽¹⁾	SST	M20 x 1.5	★
P ⁽²⁾	Engineered polymer	No conduit entries	★
D	Aluminum	G½	
M ⁽¹⁾	SST	G½	

(1) Not available with low power (output code M).

(2) Only available with output code X.

Transmitter performance class

Code	Description	
1	Up to ±2.25 percent flow rate accuracy, 5:1 flow turndown, 2-year stability	★

Wireless options

Requires wireless output code X and engineered polymer housing code P.

Wireless transmit rate, operating frequency, and protocol

Code	Description	
WA3	User configurable transmit rate, 2.4 GHz WirelessHART ®	★

Antenna and SmartPower™

Code	Description	
WP5	Internal antenna, compatible with Green Power Module (I.S. Power Module sold separately)	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Installation accessories

This option is not available with low power (output code M).

Code	Description	
AB	ANSI alignment ring (Class 150) [only required for 10- and 12-in. (250 and 300 mm) line sizes]	★
AC	ANSI alignment ring (Class 300) [only required for 10- and 12-in. (250 and 300 mm) line sizes]	★
AD	ANSI alignment ring (Class 600) [only required for 10- and 12-in. (250 and 300 mm) line sizes]	★
DG	DIN alignment ring (PN 16)	★
DH	DIN alignment ring (PN 40)	★
DJ	DIN alignment ring (PN 100)	★
JB	JIS alignment ring (10K)	
JR	JIS alignment ring (20K)	
JS	JIS alignment ring (40K)	

Remote adapters

This option is not available with low power (output code M).

Code	Description	
FE	Flange adapters 316 SST (½-in. NPT)	★

High temperature application

This option is not available with low power (output code M).

Code	Description	
HT	Graphite valve packing ($T_{\max} = 850^{\circ}\text{F}$)	

Flow calibration

This option is not available with low power (output code M).

This option is not available with primary element technology P.

Code	Description	
WC	Flow calibration, 3 Pt, conditioning orifice option C (all pipe schedules)	
WD	Flow calibration, 10 Pt, conditioning option C (all schedules), Rosemount Annubar option A (schedule 40)	

Pressure testing

This option is not available with low power (output code M).

Code	Description	
P1	Hydrostatic testing with certificate	

Special cleaning

This option is not available with low power (output code M).

Code	Description	
P2	Cleaning for special services	
PA	Cleaning per ASTM G93 Level D (section 11.4)	

Special inspection

Not available with low power (output code M).

Code	Description	
QC1	Visual and dimensional inspection with certificate	★
QC7	Inspection and performance certificate	★

Transmitter calibration certification

This option is not available with low power (output code M).

Code	Description	
Q4	Calibration certificate for transmitter	★

Quality certification for safety

The quality certification for safety is only available with HART 4–20 mA output (code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QT	Safety certified to IEC 61508 with certificate of FMEDA	★

Material traceability certification

This option is not available with low power (output code M).

Code	Description	
Q8	Material traceability certification per EN 10204:2004 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Code conformance

This option is not available with low power (output code M).

Code	Description	
J2	ANSI/ASME B31.1	

J3	ANSI/ASME B31.3	
J4	ANSI/ASME B31.8	

Materials conformance

This option is not available with low power (output code M).

Materials of Construction comply with metallurgical requirements within NACE MR0175/ISO for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

Code	Description	
J5	NACE MR-0175/ISO 15156	

Country certification

This option is not available with low power (output code M).

Code	Description	
J1	Canadian registration	

Product certifications

Code	Description	
E1 ⁽¹⁾	ATEX Flameproof	★
E2 ⁽¹⁾	INMETRO Flameproof	★
E3 ⁽¹⁾	China Flameproof	★
E5	USA Explosion-proof, Dust Ignition-proof	★
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽¹⁾	IECEX Flameproof	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2 ⁽¹⁾	INMETRO Intrinsically Safe	★
I3 ⁽¹⁾	China Intrinsic Safety	★
I5	USA Intrinsically Safe, Division 2	★
I6	Canada Intrinsically Safe	★
I7 ⁽¹⁾	IECEX Intrinsic Safety	★
IA ⁽¹⁾⁽²⁾	ATEX FISCO Intrinsic Safety; for FOUNDATION Fieldbus protocol only	★
IE ⁽¹⁾⁽²⁾	USA FISCO Intrinsically Safe	★
IF ⁽¹⁾⁽²⁾	Canada FISCO Intrinsically Safe	★
IG ⁽¹⁾⁽²⁾	IECEX FISCO Intrinsically Safe	★
K1 ⁽¹⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E5 and I5)	★
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E6 and I6)	★

K7 ⁽¹⁾	IECEX Flameproof, Dust Ignition-proof, Intrinsic Safety, Type n (combination of E7, I7, and N7)	★
KA ⁽¹⁾	ATEX and Canada Flameproof, Intrinsically Safe, Division 2	★
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E5, E6, I5, and I6)	★
KC ⁽¹⁾	USA and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽¹⁾	USA, Canada, and ATEX Explosion-proof, Intrinsically Safe (combination of E5, I5, E6, I6, E1, and I1)	★
N1 ⁽¹⁾	ATEX Type n	★
N7 ⁽¹⁾	IECEX Type n	★
ND ⁽¹⁾	ATEX Dust	★
KL	USA, Canada, IECEX, ATEX Intrinsic Safety Combination	★
KS	USA, Canada, IECEX, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	★

(1) Not available with low power (output code M).

(2) Only valid with FOUNDATION Fieldbus (output code F).

Sensor fill fluid and O-ring options

This option is not available with low power (output code M).

Code	Description	
L1 ⁽¹⁾	Inert sensor fill fluid	★
L2	Graphite-filled (PTFE) O-ring	★
LA ⁽¹⁾	Inert sensor fill fluid and graphite-filled (PTFE) O-ring	★

(1) Not available with output code X.

Display and interface options

This option is not available with low power (output code M).

Code	Description	
M4 ⁽¹⁾	LCD display with LOI	★
M5	LCD display	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Transient protection

This option is not available with low power (output code M).

This option is not available with output code X.

This option is not available with housing code 00, 5A, or 7J. The T1 option is not needed with FISCO Product Certifications, transient protection is included with the FISCO Product Certification code IA.

Code	Description	
T1	Transient terminal block	★

Manifold for remote mount option

This option is not available with low power (output code M).

Code	Description	
F2	3-valve manifold, SST	★
F6	5-valve manifold, SST	★

Alarm limit

This option is not available with low power (output code M).

This option is only available with 4–20 mA HART (output codes A and M).

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
CN	NAMUR alarm and saturation levels, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

Plantweb control functionality

This option is not available with low power (output code M).

This option is only valid with FOUNDATION Fieldbus (output code F).

Code	Description	
A01	FOUNDATION Fieldbus advanced control function block suite	★

Hardware adjustments

This option is not available with low power (output code M).

Code	Description	
D4 ⁽¹⁾	Zero and span hardware adjustments	★
DZ ⁽²⁾	Digital zero trim	★

(1) Only available with 4–20 mA HART (output codes A and M).

(2) Only available with 4–20 mA HART (output codes A and M) and wireless output (code X).

Ground screw

This option is not available with low power (output code M).

This option is not available with output code X.

The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

HART Revision Configuration

This option is not available with low power (output code M).

This option is only available with 4–20 mA HART (output codes A and M).

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Rosemount 2051CFP Integral Orifice Flow Meter ordering information



- Complete flow assemblies are leak-tested and calibrated to reduce leak points up to 70% and simplify installation
- Primary element integrated in a meter run for ease of installation
- Orifice plate suitable for small line sizes 0.5- 1.5 in. (15 - 40 mm) for flow measurement accuracy and repeatability
- Local operator interface offers easy-to-use menus and built-in configuration buttons for streamlined commissioning
- SIL 2/3 certified to IEC 61508 (via 3rd party) and prior-use certificate of FMEDA data for safety installations

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Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 6](#).

Figure 6: Model Code Example

3051C D 2 X 2 2 1 A	WA3 WP5	M5 B4
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051CFP	Integral orifice flow meter	★

Measurement type

Code	Description	
D	Differential	★

Material type

Code	Description	
S	316 SST	★

Line size

Code	Description	
005	½-in. (15 mm)	★
010	1-in. (25 mm)	★
015	1½-in. (40 mm)	★

Process connections

Code	Description	
T1	NPT female body (not available with thermowell and RTD)	★
S1 ⁽¹⁾	Socket weld body (not available with thermowell and RTD)	★
P1	Pipe ends: NPT threaded	★
P2	Pipe ends: beveled	★
D1	Pipe ends: flanged, DIN PN 16, slip-on	★
D2	Pipe ends: flanged, DIN PN 40, slip-on	★

Code	Description	
D3	Pipe ends: flanged, DIN PN 100, slip-on	★
W1	Pipe ends: flanged, RF, ANSI Class 150, weld-neck	★
W3	Pipe ends: flanged, RF, ANSI Class 300, weld-neck	★
W6	Pipe ends: flanged, RF, ANSI Class 600, weld-neck	★
A1	Pipe ends: flanged, RF, ANSI Class 150, slip-on	
A3	Pipe ends: flanged, RF, ANSI Class 300, slip-on	
A6	Pipe ends: flanged, RF, ANSI Class 600, slip-on	
R1	Pipe ends: flanged, RTJ, ANSI Class 150, slip-on	
R3	Pipe ends: flanged, RTJ, ANSI Class 300, slip-on	
R6	Pipe ends: flanged, RTJ, ANSI Class 600, slip-on	

(1) To improve pipe perpendicularity for gasket sealing, socket diameter is smaller than standard pipe O.D.

Orifice plate material

Code	Description	
S	316 SST	★

Bore size

Code	Description	
0066	0.066-in. (1,68 mm) for ½-in. pipe	★
0109	0.109-in. (2,77 mm) for ½-in. pipe	★
0160	0.160-in. (4,06 mm) for ½-in. pipe	★
0196	0.196-in. (4,98 mm) for ½-in. pipe	★
0260	0.260-in. (6,60 mm) for ½-in. pipe	★
0340	0.340-in. (8,64 mm) for ½-in. pipe	★
0150	0.150-in. (3,81 mm) for 1-in. pipe	★
0250	0.250-in. (6,35 mm) for 1-in. pipe	★
0345	0.345-in. (8,76 mm) for 1-in. pipe	★
0500	0.500-in. (12,70 mm) for 1-in. pipe	★
0630	0.630-in. (16,00 mm) for 1-in. pipe	★
0800	0.800-in. (20,32 mm) for 1-in. pipe	★
0295	0.295-in. (7,49 mm) for 1½-in. pipe	★
0376	0.376-in. (9,55 mm) for 1½-in. pipe	★
0512	0.512-in. (13,00 mm) for 1½-in. pipe	★
0748	0.748-in. (19,00 mm) for 1½-in. pipe	★
1022	1.022-in. (25,96 mm) for 1½-in. pipe	★

Code	Description	
1184	1.184-in. (30,07 mm) for 1½-in. pipe	★
0010	0.010-in. (0,25 mm) for ½-in. pipe	
0014	0.014-in. (0,36 mm) for ½-in. pipe	
0020	0.020-in. (0,51 mm) for ½-in. pipe	
0034	0.034-in. (0,86 mm) for ½-in. pipe	

Transmitter connection platform

Code	Description	
D3	Direct mount, 3-valve manifold, SST	★
D5	Direct mount, 5-valve manifold, SST	★
R3	Remote mount, 3-valve manifold, SST	★
R5	Remote mount, 5-valve manifold, SST	★

Differential pressure range

Code	Description	
1	0 to 25 inH ₂ O (0 to 62.3 mbar)	★
2	0 to 250 inH ₂ O (0 to 623 mbar)	★
3	0 to 1000 inH ₂ O (0 to 2.5 bar)	★

Transmitter output

Code	Description	
A ⁽¹⁾	4–20 mA with digital signal based on HART® Protocol	★
F	FOUNDATION™ Fieldbus Protocol	★
W	PROFIBUS® PA Protocol	★
X	Wireless	★
M	Low-power, 1–5 Vdc with digital signal based on HART Protocol	

(1) HART Revision 5 is the default HART output. The Rosemount 2051 with Selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Transmitter housing material

Code	Description	Conduit entry size	
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 x 1.5	★
J	SST	½–14 NPT	★
K ⁽¹⁾	SST	M20 x 1.5	★
P ⁽²⁾	Engineered polymer	No conduit entries	★

Code	Description	Conduit entry size	
D	Aluminum	G½	
M ⁽¹⁾	SST	G½	

(1) Not available with low power (output code M).

(2) Only available with output code X.

Transmitter performance class

Code	Description	
1	Up to ±2.25 percent flow rate accuracy, 5:1 flow turndown, 2-year stability	★

Wireless options

Requires wireless output code X and engineered polymer housing code P.

Wireless transmit rate, operating frequency, and protocol

Code	Description	
WA3	User configurable transmit rate, 2.4 GHz WirelessHART ®	★

Antenna and SmartPower™

Code	Description	
WP5	Internal antenna, compatible with Green Power Module (I.S. Power Module sold separately)	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Temperature sensor

This option is not available with low power (output code M). Thermowell material is the same as the body material.

Code	Description	
RT	Thermowell and RTD	

Optional connection

This option is not available with low power (output code M).

Code	Description	
G1	DIN 19213 transmitter connection	★

Pressure testing

This option is not available with low power (output code M).

This option does not apply to process connection codes T1 and S1.

Code	Description	
P1	Hydrostatic testing with certificate	

Special cleaning

This option is not available with low power (output code M).

Code	Description	
P2	Cleaning for special services	
PA	Cleaning per ASTM G93 Level D (section 11.4)	

Material testing

Not available with low power (output code M).

Code	Description	
V1	Dye penetrant exam	

Material examination

Not available with low power (output code M).

Code	Description	
V2	Radiographic examination	

Flow calibration

This option is not available with low power (output code M).

This option is not available for bore sizes 0010, 0014, 0020, or 0034.

Code	Description	
WD	Discharge coefficient verification	

Special inspection

Not available with low power (output code M).

Code	Description	
QC1	Visual and dimensional inspection with certificate	★

QC7	Inspection and performance certificate	★
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Material traceability certification

This option is not available with low power (output code M).

Code	Description	
Q8	Material traceability certification per EN 10204:2004 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Code conformance

This option is not available with low power (output code M).

This option is not available with DIN process connection codes D1, D2, or D3.

Code	Description	
J2	ANSI/ASME B31.1	
J3	ANSI/ASME B31.3	
J4	ANSI/ASME B31.8	

Materials conformance

This option is not available with low power (output code M).

Materials of Construction comply with metallurgical requirements within NACE MR0175/ISO for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

Code	Description	
J5	NACE MR-0175/ISO 15156	

Country certification

This option is not available with low power (output code M).

Code	Description	
J6	European Pressure Directive (PED)	★
J1	Canadian registration	

Transmitter calibration certification

This option is not available with low power (output code M).

Code	Description	
Q4	Calibration certificate for transmitter	★

Quality certification for safety

The quality certification for safety is only available with HART 4–20 mA output (code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QT	Safety certified to IEC 61508 with certificate of FMEDA	★

Product certifications

Code	Description	
E1 ⁽¹⁾	ATEX Flameproof	★
E2 ⁽¹⁾	INMETRO Flameproof	★
E3 ⁽¹⁾	China Flameproof	★
E5	USA Explosion-proof, Dust Ignition-proof	★
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽¹⁾	IECEX Flameproof	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2 ⁽¹⁾	INMETRO Intrinsically Safe	★
I3 ⁽¹⁾	China Intrinsic Safety	★
I5	USA Intrinsically Safe, Division 2	★
I6	Canada Intrinsically Safe	★
I7 ⁽¹⁾	IECEX Intrinsic Safety	★
IA ⁽¹⁾⁽²⁾	ATEX FISCO Intrinsic Safety; for FOUNDATION Fieldbus protocol only	★
IE ⁽¹⁾⁽²⁾	USA FISCO Intrinsically Safe	★
IF ⁽¹⁾⁽²⁾	Canada FISCO Intrinsically Safe	★
IG ⁽¹⁾⁽²⁾	IECEX FISCO Intrinsically Safe	★
K1 ⁽¹⁾⁽²⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E5 and I5)	★
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E6 and I6)	★
K7 ⁽¹⁾	IECEX Flameproof, Dust Ignition-proof, Intrinsic Safety, Type n (combination of E7, I7, and N7)	★
KA ⁽¹⁾	ATEX and Canada Flameproof, Intrinsically Safe, Division 2	★
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2 (combination of E5, E6, I5, and I6)	★
KC ⁽¹⁾	USA and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽¹⁾	USA, Canada, and ATEX Explosion-proof, Intrinsically Safe (combination of E5, I5, E6, I6, E1, and I1)	★
N1 ⁽¹⁾	ATEX Type n	★
N7 ⁽¹⁾	IECEX Type n	★
ND ⁽¹⁾	ATEX Dust	★
KL	USA, Canada, IECEX, ATEX Intrinsic Safety Combination	★

KS	USA, Canada, IECEx, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	★
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(1) Not available with low power (output code M).

(2) Only valid with FOUNDATION Fieldbus (output code F).

Sensor fill fluid and O-ring options

This option is not available with low power (output code M).

Code	Description	
L1 ⁽¹⁾	Inert sensor fill fluid	★
L2	Graphite-filled (PTFE) O-ring	★
LA ⁽¹⁾	Inert sensor fill fluid and graphite-filled (PTFE) O-ring	★

(1) Not available with output code X.

Display and interface options

This option is not available with low power (output code M).

Code	Description	
M4 ⁽¹⁾	LCD display with LOI	★
M5	LCD display	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Transient protection

This option is not available with low power (output code M).

This option is not available with output code X.

This option is not available with housing code 00, 5A, or 7J. The T1 option is not needed with FISCO Product Certifications, transient protection is included with the FISCO Product Certification code IA.

Code	Description	
T1	Transient terminal block	★

Alarm limit

This option is not available with low power (output code M).

This option is only available with 4–20 mA HART (output codes A and M).

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
CN	NAMUR alarm and saturation levels, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

Plantweb control functionality

This option is not available with low power (output code M).

This option is only valid with FOUNDATION Fieldbus (output code F).

Code	Description	
A01	FOUNDATION Fieldbus advanced control function block suite	★

Hardware adjustments

This option is not available with low power (output code M).

Code	Description	
D4 ⁽¹⁾	Zero and span hardware adjustments	★
DZ ⁽²⁾	Digital zero trim	★

(1) Only available with 4–20 mA HART (output codes A and M).

(2) Only available with 4–20 mA HART (output codes A and M) and wireless output (code X).

Ground screw

This option is not available with low power (output code M).

This option is not available with output code X.

The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

HART Revision Configuration

This option is not available with low power (output code M).

This option is only available with 4–20 mA HART (output codes A and M).

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Rosemount 2051L Liquid Level Transmitter



- Designed with a variety of process connections, materials and output protocols to meet diverse application requirements
- Tuned-System Level assembly and direct mounting produce optimal performance for level applications
- SIL 2/3 certified to IEC 61508 (via 3rd party) and prior-use certificate of FMEDA data for safety installations
- Local Operator Interface (LOI) for simple, local commissioning on-site without the use of extra tools or training
- Optimized seal system construction ensures a quality measurement in harsh process conditions

CONFIGURE >

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Online Product Configurator

Many products are configurable online using our Product Configurator. Select the **Configure** button or visit our [website](#) to start. With this tool's built-in logic and continuous validation, you can configure your products more quickly and accurately.

Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 7](#).

Figure 7: Model Code Example

<u>3051C D 2 X 2 2 1 A</u>	<u>WA3 WP5</u>	<u>M5 B4</u>
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description	
2051L	Liquid level transmitter	★

Pressure range

Code	Description	
2	–250 to 250 inH ₂ O (–623 to 623 mbar)	★
3	–1000 to 1000 inH ₂ O (–2.5 to 2.5 bar)	★
4	–300 to 300 psi (–20.7 to 20.7 bar)	★

Transmitter output

Code	Description	
A ⁽¹⁾	4–20 mA with digital signal based on HART® Protocol	★
F	FOUNDATION™ Fieldbus Protocol	★
W	PROFIBUS® PA Protocol	★
X	Wireless	★
M	Low-power, 1–5 Vdc with digital signal based on HART Protocol	

(1) HART Revision 5 is the default HART output. The Rosemount 2051 with Selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Process connection size

Code	Description	Diaphragm	
G ⁽¹⁾	2-in./DN 50	316L SST	★
H ⁽¹⁾	2-in./DN 50	Alloy C-276	★
J	2-in./DN 50	Tantalum	★
A ⁽¹⁾	3-in./DN 80	316L SST	★
B ⁽¹⁾	4-in./DN 100	316L SST	★
C ⁽¹⁾	3-in./DN 80	Alloy C-276	★
D ⁽¹⁾	4-in./DN 100	Alloy C-276	★
E	3-in./DN 80	Tantalum	★

Code	Description	Diaphragm	
F	4-in./DN 100	Tantalum	★

- (1) Materials of construction comply with metallurgical requirements highlighted within NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE®MR0103 for sour refining environments. Order with Q15 or Q25 to receive a NACE certificate.

Extentsion length

Code	Description	
0	None, flush mount	★
2	2-in./50 mm	★
4	4-in./100 mm	★
6	6-in./150 mm	★

Mounting flange size rating, material (high size)

Code	Description	Rating	Material	
M	2-in.	ANSI/ASME B16.5 Class 150	CS	★
A	3-in.	ANSI/ASME B16.5 Class 150	CS	★
B	4-in.	ANSI/ASME B16.5 Class 150	CS	★
N	2-in.	ANSI/ASME B16.5 Class 300	CS	★
C	3-in.	ANSI/ASME B16.5 Class 300	CS	★
D	4-in.	ANSI/ASME B16.5 Class 300	CS	★
X ⁽¹⁾	2-in.	ANSI/ASME B16.5 Class 150	SST	★
F ⁽¹⁾	3-in.	ANSI/ASME B16.5 Class 150	SST	★
G ⁽¹⁾	4-in.	ANSI/ASME B16.5 Class 150	SST	★
Y ⁽¹⁾	Displayed	ANSI/ASME B16.5 Class 300	SST	★
H ⁽¹⁾	3-in.	ANSI/ASME B16.5 Class 300	SST	★
J ⁽¹⁾	4-in.	ANSI/ASME B16.5 Class 300	SST	★
Q	DN 50	PN 10-40 per EN 1092-1	CS	★
R	DN 80	PN 40 per EN 1092-1	CS	★
K	DN 50	PN 10-40 per EN 1092-1	SST	★
T	DN 80	PN 40 per EN 1092-1	SST	★

Seal fill fluid (high side)

Code	Seal fill fluid (high side)	Specific gravity at 77 °F (25 °C)	Temperature limits (ambient temperature of 70 °F [21 °C])	
A	SYLTHERM™ XLT	0.085	–157 to 293 °F (–105 to 145 °C)	★
C	Silicone 704	1.07	32 to 401 °F (0 to 205 °C)	★

Code	Seal fill fluid (high side)	Specific gravity at 77 °F (25 °C)	Temperature limits (ambient temperature of 70 °F [21 °C])	
D	Silicone 200	0.93	–49 to 401 °F (–45 to 205 °C)	★
F	Silicone 200 for vacuum applications limits: For use in vacuum applications below 14.7 psia (1 bar-a), refer to vapor pressure curves in Rosemount DP Level Fill Fluid Specification Technical Note .			
H	Inert (halocarbon)	1.85	5 to 401 °F (–15 to 205 °C)	★
G	Glycerin and water	1.13	–49 to 320 °F (–45 to 160 °C)	★
L	Silicone 200 for vacuum applications limits: For use in vacuum applications below 14.7 psia (1 bar-a), refer to vapor pressure curves in Rosemount DP Level Fill Fluid Specification Technical Note .			
N	Neobee® M-20	0.92	5 to 401 °F (–15 to 205 °C)	★
P	Propylene glycol and water	1.02	5 to 203 °F (–15 to 95 °C)	★

Sensor module configuration, flange adapter (low side)

Code	Configuration	Flange adapter	
1	Gage	SST	★
2	Differential	SST	★
3 ⁽¹⁾	Tuned-System™ with remote seal	None	★

(1) Requires option code S1.

Sensor module diaphragm, sensor fill fluid (low side)

Code	Diaphragm material	Sensor fill fluid	
1	316L SST	Silicone	★
2	Alloy C-276 (SST valve seat)		★
7	Alloy C-276 (alloy C-276 valve seat)		★
A ⁽¹⁾	316L SST	Inert (halocarbon)	★
B ⁽¹⁾⁽²⁾	Alloy C-276 (SST valve seat)		★
G ⁽¹⁾	Alloy C-276 (alloy C-276 valve seat)		★

(1) Not available with output code X.

(2) Materials of construction comply with metallurgical requirements highlighted within NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments. Order with Q15 or Q25 to receive a NACE certificate.

O-ring

Code	Description	
A	Glass-filled PTFE	★

Housing material

Code	Description	Conduit entry size	
A	Aluminum	½–14 NPT	★

B	Aluminum	M20 x 1.5	★
E	Aluminum, ultra low copper	½–14 NPT	★
F	Aluminum, ultra low copper	M20 x 1.5	★
J	SST	½–14 NPT	★
K	SST	M20 x 1.5	★
p ⁽¹⁾	Engineered polymer	No conduit entries	★
D ⁽²⁾	Aluminum	G½	
M ⁽²⁾	SST	G½	

(1) Only available with wireless output (code X).

(2) Transmitter conduit entry will be ½ NPT and a ½ NPT to G½ thread adapter will be provided. Not available with product certifications options E8, K8, E5, K5, C6, K6, E7, K7, E2, K2, E3, KB, or KD.

Wireless options

Requires wireless output code X and engineered polymer housing code P.

Wireless transmit rate, operating frequency and protocol

Code	Description	
WA3	User configurable transmit rate, 2.4 GHz WirelessHART® Protocol	★

Antenna and SmartPower™

Code	Description	
WP5	Internal antenna, compatible with Green Power Module (I.S. Power Module sold separately)	★

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Plantweb™ control functionality

This option is only valid with FOUNDATION™ Fieldbus output code F.

Code	Description	
A01	FOUNDATION Fieldbus advanced control function block suite	★

Seal assemblies

“Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S5	Assemble to one Rosemount 1199 diaphragm seal	★

Product certifications

Code	Description	
E1 ⁽¹⁾	ATEX Flameproof	★
E2 ⁽¹⁾	INMETRO Flameproof	★
E3 ⁽¹⁾	China Flameproof	★
E4 ⁽¹⁾	TIIS Flameproof	★
E5	USA Explosion-proof, Dust Ignition-proof	★
E6	Canada Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽¹⁾	IECEX Flameproof	★
EW ⁽¹⁾	India (CCOE) Flameproof Approval	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2 ⁽¹⁾	INMETRO Intrinsically Safe	★
I3 ⁽¹⁾⁽²⁾	China Intrinsic Safety	★
I4 ⁽¹⁾⁽²⁾	TIIS Intrinsic Safety	★
I5	USA Intrinsically Safe, Division 2	★
I6	Canada intrinsically Safe	★
I7 ⁽¹⁾	IECEX Intrinsic Safety	★
IA ⁽³⁾	ATEX FISCO Intrinsic Safety	★
IE ⁽⁴⁾	USA FISCO Intrinsically Safe	★
IF ⁽⁴⁾	Canada FISCO Intrinsically Safe	★
IG ⁽⁴⁾	IECEX FISCO Intrinsically Safe	★
IW ⁽¹⁾	India (CCOE) Intrinsically Safe	★
K1 ⁽¹⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K5	USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K6	Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K7 ⁽¹⁾	IECEX Flameproof, Intrinsic Safety, Type n and Dust	★
KA ⁽¹⁾	ATEX and Canada Flameproof, Intrinsically Safe, Division 2	★
KB	USA and Canada Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
KC ⁽¹⁾	USA and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽¹⁾	USA, Canada, and ATEX Explosion-proof, Intrinsically Safe	★
N1 ⁽¹⁾	ATEX Type n	★
N7 ⁽¹⁾	IECEX Type n	★

Code	Description	
ND ⁽¹⁾	ATEX Dust	★
EM	Technical Regulations Customs Union (EAC) Flameproof	★
IM	Technical Regulations Customs Union (EAC) Intrinsic Safety	★
KM	Technical Regulations Customs Union (EAC) Flameproof and Intrinsic Safety	★
KL	USA, Canada, IECEx, ATEX Intrinsic Safety Combination	★
KS	USA, Canada, IECEx, ATEX Explosion Proof, Intrinsically Safe, Dust, Non-Incendive, Type-N, Div. 2	★

(1) Not available with low power (output code M).

(2) Only available with output code X.

(3) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

(4) Only valid with FOUNDATION Fieldbus (output code F).

Shipboard approvals

Shipyard approvals are not available with wireless output (code X).

Code	Description	
SBS	American Bureau of Shipping	★
SBV	Bureau Veritas (BV)	★
SDN	Det Norske Veritas	★
SLL	Lloyds Register (LR)	★

Display and interface options

Code	Description	
M4 ⁽¹⁾	LCD display with LOI	★
M5	LCD display	★

(1) Not available with FOUNDATION Fieldbus (output code F) or wireless (output code X).

Flange adapters

This option is not valid with alternate process connection options S3, S4, S5, or S6.

Code	Description	
DF	½–14 NPT flange adapters	★

Conduit plug

Not available with output code X. Transmitter is shipped with 316 SST conduit plug (uninstalled) in place of standard CS conduit plug.

Code	Description	
DO	316 SST conduit plug	★

Ground screw

The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Code	Description	
V5	External ground screw assembly	★

Transient protection

Not available with output code X. Not valid with FOUNDATION Fieldbus output code F and wireless output code X. The T1 option is not needed with FISCO Product Certifications; transient protection is included in the FISCO product certification codes IA, E, IF, and IG.

Code	Description	
T1	Transient terminal block	★

Software configuration

Only available with 4–20 mA HART output (codes A) and wireless output (code X).

Code	Description	
C1	Custom software configuration (requires completed Configuration Data Sheet)	★

Alarm limit

Only available with 4–20 mA HART (output codes A and M).

Code	Description	
C4 ⁽¹⁾	NAMUR alarm and saturation levels, high alarm	★
CN ⁽¹⁾	NAMUR alarm and saturation levels, low alarm	★
CR	Custom alarm and saturation signal levels, high alarm (requires C1 and Configuration Data Sheet)	★
CS	Custom alarm and saturation signal levels, low alarm (requires C1 and Configuration Data Sheet)	★
CT	Low alarm (standard Rosemount alarm and saturation levels)	★

(1) NAMUR-Compliant operation is pre-set at the factory.

Calibration certification

Code	Description	
Q4	Calibration certificate	★
QG	Calibration certificate and GOST verification certificate	★
QP	Calibration certificate and tamper evident seal	★

Material traceability certification

Code	Description	
Q8	Material traceability certification per EN 10204 3.1	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Quality certification for safety

The option is only available with 4–20 mA HART output (code A).

Code	Description	
QS	Prior-use certificate of FMEDA data	★
QZ	Safety certified to IEC 61508 with certificate of FMEDA	★

Toolkit total system performance reports

Code	Description	
QZ	Remote seal system performance calculation report	★

Conduit electrical connector

This option is not available with output code X.

Code	Description	
GE	M12, 4-pin, male connector (eurofast®)	★
GM	A size mini, 4-pin, male connector (minifast®)	★

NACE® certificate

NACE Compliant wetted materials are identified by materials of construction that comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining).

Code	Description	
Q15	Certificate of compliance to NACE MR0175/ISO 15156 for wetted materials	★
Q25	Certificate of compliance to NACE MR0103 for wetted materials	★

Lower housing alignment clamp

Code	Description	
SA	Lower housing alignment clamp	★

Lower housing flushing connection

Code	Ring material	Number	Size (NPT)	
F1	316 SST	1	¼–18 NPT	★
F2	316 SST	2	¼–18 NPT	★

Code	Ring material	Number	Size (NPT)	
F3 ⁽¹⁾	Alloy C-276	1	¼-18 NPT	★
F4 ⁽¹⁾	Alloy C-276	2	¼-18 NPT	★
F7	316 SST	1	½-14 NPT	★
F8	316 SST	2	½-14 NPT	★
F9	Alloy C-276	1	½-14 NPT	★
F10	Alloy C-276	2	½-14 NPT	★

(1) Not available with option codes A0, B0, and G0.

Specifications

Performance specifications

This product data sheet covers HART, Wireless, FOUNDATION Fieldbus, and PROFIBUS PA Protocols unless specified.

Conformance to specification ($\pm 3\sigma$ [sigma])

Technology leadership, advanced manufacturing techniques, and statistical process control ensure specification conformance to at least $\pm 3\sigma$.

Reference accuracy

Stated reference accuracy equations include terminal based linearity, hysteresis, and repeatability. For Wireless, FOUNDATION Fieldbus, and PROFIBUS PA devices, use calibrated range in place of span.

Models	Standard	High performance option, P8	
Rosemount 2051C3			
Range 1	±0.10 percent of span For spans less than 15:1, accuracy = $\pm\left(0.025 + 0.005\left[\frac{URL}{Span}\right]\right)\%$ of span	N/A	N/A
Ranges 2–4	±0.065 percent of span For spans less than 10:1, accuracy = $\pm\left(0.025 + 0.005\left[\frac{URL}{Span}\right]\right)\%$ of span	Ranges 2–4	High accuracy option, P8 ±0.05 percent of span For spans less than 10:1 ⁽¹⁾ , accuracy = $\pm\left(0.015 + 0.005\left[\frac{URL}{Span}\right]\right)\%$ of span
Range 5	±0.075 percent of span For spans less than 10:1, accuracy= $\pm\left(0.025 + 0.005\left[\frac{URL}{Span}\right]\right)\%$ of span	Range 5	High performance option, P8 ±0.065 percent of span For spans less than 10:1, accuracy= $\pm\left(0.015 + 0.005\left[\frac{URL}{Span}\right]\right)\%$ of span
Rosemount 2051T, 2051G ⁽²⁾			
Ranges 1–4	±0.065 percent of span For spans less than 10:1, accuracy = $\pm\left(0.0075\left[\frac{URL}{Span}\right]\right)\%$ of span	Ranges 1–4	High accuracy option, P8 ±0.05 percent of span For spans less than 10:1 ⁽¹⁾ , accuracy = $\pm\left(0.0075\left[\frac{URL}{Span}\right]\right)\%$ of span
Range 5 ⁽³⁾	±0.075 percent of span For spans less than 10:1, accuracy = $\pm\left(0.0075\left[\frac{URL}{Span}\right]\right)\%$ of span	N/A	N/A

Models	Standard	High performance option, P8	
Rosemount 2051L			
Ranges 2–4	±0.075 percent of span For spans less than 10:1, accuracy = $\pm\left(0.025 + 0.005\left[\frac{URL}{Span}\right]\right)\% \text{ of span}$	N/A	N/A

- (1) For protocol code F, accuracy specification is for spans less than 7:1. Not available with output code W.
 (2) For Rosemount 2051C, 2051T, and 2051G with 1199 assembly to code S1, use 3051L specification.
 (3) Rosemount 2051G is not available with range 5.

Flow performance

Flow reference accuracy

Rosemount 2051CFA Annubar Flow Meter		
Ranges 2–3		±2.00 percent of flow rate at 5:1 flow turndown
Rosemount 2051CFC_A Compact Annubar Flow Meter — Annubar option A		
Ranges 2–3	Standard	±2.60 percent of flow rate at 5:1 flow turndown
	Calibrated	±2.30 percent of flow rate at 5:1 flow turndown
Rosemount 2051CFC Compact Orifice Flow Meter — conditioning option C		
Ranges 2–3	β = 0.4	±2.25 percent of flow rate at 5:1 flow turndown
	β = 0.65	±2.45 percent of flow rate at 5:1 flow turndown
Rosemount 2051CFC Compact Orifice Flow Meter — Orifice Type Option P⁽¹⁾		
Ranges 2–3	β = 0.4	±2.50 percent of flow rate at 5:1 flow turndown
	β = 0.65	±2.50 percent of flow rate at 5:1 flow turndown
Rosemount 2051CFP Integral Orifice Flow Meter		
Ranges 2–3	Bore < 0.1	±3.10 percent of flow rate at 5:1 flow turndown
	0.1 < bore < 0.2	±2.75 percent of flow rate at 5:1 flow turndown
	0.2 < bore < 0.6	±2.25 percent of flow rate at 5:1 flow turndown
	0.6 < bore < 0.8	±3.00 percent of flow rate at 5:1 flow turndown

- (1) For smaller line sizes, see Rosemount Compact Orifice.

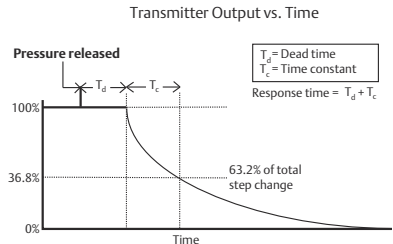
Long-term stability

±50 °F (28 °C) temperature changes and up to 1000 psi. (6,9 MPa) line pressure.

Models	Standard	High performance option, P8
Rosemount 2051C		
Range 1 (CD)	±0.2 percent of URL for 1 year	±0.175 percent of URL for 7 years
Ranges 2–5	±0.125 percent of URL for 5 years	
Rosemount 2051T, 2051G		
Ranges 1–5 ⁽¹⁾	±0.125 percent of URL for 5 years	±0.15 percent of URL for 7 years

- (1) Rosemount 2051G is not available with range 5.

Dynamic performance

	4–20 mA HART ⁽¹⁾ 1–5 Vdc HART Low Power	FOUNDATION Fieldbus and PROFIBUS PA Protocols ⁽²⁾	Typical HART Transmitter Response Time
Total response time ($T_d + T_c$):			 <p>Transmitter Output vs. Time</p> <p>Pressure released</p> <p>100%</p> <p>36.8%</p> <p>0%</p> <p>Time</p> <p>T_d = Dead time T_c = Time constant Response time = $T_d + T_c$</p> <p>63.2% of total step change</p>
Rosemount 2051C Range 3–5:	115 ms	152 ms	
Range 1: Range 2: 2051T and 2051G: 2051L:	270 ms 130 ms 100 ms See Instrument Toolkit™	307 ms 152 ms 152 ms See Instrument Toolkit	
Dead time (T_d)	60 ms (nominal ⁽³⁾)	97 ms	
Update rate ⁽⁴⁾	22 times per second		

(1) Dead time and update rate apply to all models and ranges; analog output only.

(2) Transducer block response time, analog input block execution time not included.

(3) Nominal total response time at 75 °F (24 °C) reference conditions.

(4) Does not apply to wireless (output code X). See [Wireless \(output code X\)](#) for wireless update rate.

Line pressure effect per 1000 psi (6,9 MPa)

For line pressures above 2000 psi (13,7 MPa) and ranges 4–5, see Rosemount 2051 Reference Manual for HART, Rosemount 2051 [Reference Manual](#) for WirelessHART, Rosemount 2051 [Reference Manual](#) for FOUNDATION Fieldbus, and Rosemount 2051 [Reference Manual](#) PROFIBUS PA.

Models	Line pressure effect	
Rosemount 2051CD, 2051CF	Zero Error ⁽¹⁾	Span error
Range 1	±0.25 percent of URL/1000 psi (68,9 bar)	±0.4 percent of reading/1,000 psi (68,9 bar)
Ranges 2–3	±0.05 percent of URL/1000 psi (68,9 bar) for line pressures from 0 to 2000 psi (0 to 13,7 MPa)	±0.1 percent of reading/1,000 psi (68,9 bar)

(1) Can be calibrated out at line pressure.

Ambient temperature effect per 50 °F (28 °C)

Models	Ambient temperature effect
Rosemount 2051C, 2051CF	
Ranges 2–5	±(0.025% URL + 0.125% span) from 1:1 to 5:1 ±(0.05% URL + 0.25% span) from 5:1 to 100:1
Range 1	±(0.1% URL + 0.25% span) from 1:1 to 30:1
Rosemount 2051T, 2051G	
Range 2–4	±(0.05% URL + 0.25% span) from 1:1 to 10:1 ±(0.07% URL + 0.125% span) from 10:1 to 100:1
Range 1	±(0.05% URL + 0.25% span) from 1:1 to 5:1 ±(0.10% URL + 0.125% span) from 5:1 to 100:1
Range 5 ⁽¹⁾	±(0.1% URL + 0.15% span)
Rosemount 2051L	See Instrument Toolkit™

(1) Rosemount 2051G is not available with range 5.

Mounting position effects

Models	Mounting position effects
Rosemount 2051C	Zero shifts up to ± 1.25 inH ₂ O (3,1 mbar), which can be calibrated out. No span effect.
Rosemount 2051T and 2051G	Zero shifts up to ± 2.5 inH ₂ O (6,2 mbar), which can be calibrated out. No span effect.
Rosemount 2051L	With liquid level diaphragm in vertical plane, zero shift of up to 1 inH ₂ O (2,49 mbar). With diaphragm in horizontal plane, zero shift of up to 5 inH ₂ O (12,43 mbar) plus extension length on extended units. Zero shifts can be calibrated out. No span effect.

Vibration effect

Less than ± 0.1 percent of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10–60 Hz 0.21 mm displacement peak amplitude/60–2000 Hz 3g).

Power supply effect

Less than ± 0.005 percent of calibrated span per volt.

Electromagnetic compatibility (EMC)

Meets all industrial environment requirements of EN61326 and NAMUR NE-21. Maximum deviation $<1\%$ Span during EMC disturbance.

Note

NAMUR NE-21 does not apply to Low-Power (Transmitter output option code M) or Wireless (Transmitter output code X).

Note

During surge event, device with 4-20mA (Transmitter output option code A) may exceed maximum EMC deviation limit or reset; however, device will self-recover and return to normal operation within specified start-up time.

Transient protection (option code T1)

Meets IEEE C62.41, category location B

- 6 kV crest (0.5 μ s–100 kHz)
- 3 kA crest (8 x 20 microseconds)
- 6 kV crest (1.2 x 50 microseconds)

Functional specifications**Range and sensor limits**

Table 1: Rosemount 2051CD, 2051CF, 2051CG, and 2051L

Range	Minimum span	Upper (URL)	Lower (LRL)			
			Rosemount 2051C Differential, 2051CF Flow Meters	Rosemount 2051C Gage ⁽¹⁾	Rosemount 2051L Differential	Rosemount 2051L Gage ⁽¹⁾
1	0.5 inH ₂ O (1,2 mbar)	25 inH ₂ O (62,3 mbar)	–25 inH ₂ O (–62,1 mbar)	–25 inH ₂ O (–62,1 mbar)	N/A	N/A
2	2.5 inH ₂ O (6,2 mbar)	250 inH ₂ O (0,62 bar)	–250 inH ₂ O (–0,62 bar)	–250 inH ₂ O (–0,62 bar)	–250 inH ₂ O (–0,62 bar)	–250 inH ₂ O (–0,62 bar)

Table 1: Rosemount 2051CD, 2051CF, 2051CG, and 2051L (continued)

Range	Minimum span	Upper (URL)	Lower (LRL)			
			Rosemount 2051C Differential, 2051CF Flow Meters	Rosemount 2051C Gage ⁽¹⁾	Rosemount 2051L Differential	Rosemount 2051L Gage ⁽¹⁾
3	10 inH ₂ O (24,9 mbar)	1000 inH ₂ O (2,49 bar)	–1000 inH ₂ O (–2,49 bar)	–393 inH ₂ O (–979 mbar)	–1000 inH ₂ O (–2,49 bar)	–393 inH ₂ O (–979 mbar)
4	3 psi (0,207 bar)	300 psi (20,7 bar)	–300 psi (–20,7 bar)	–14.2 psig (–979 mbar)	–300 psi (–20,7 bar)	–14.2 psig (–979 mbar)
5	20 psi (1,38 bar)	2000 psi (137,9 bar)	–2000 psi (–137,9 bar)		N/A	N/A

(1) Assumes atmospheric pressure of 14.7 psig.

Table 2: Rosemount 2051T and 2051G

Range	Minimum span	Upper (URL)	Lower (LRL) - Absolute	Lower ⁽¹⁾ (LRL) - Gage
1	0.3 psi (20,7 mbar)	30 psi (2,07 bar)	0 psia (0 bar)	–14.7 psig (–1,01 bar)
2	1.5 psi (0,103 bar)	150 psi (10,3 bar)		
3	8 psi (0,55 bar)	800 psi (55,2 bar)		
4	40 psi (2,76 bar)	4000 psi (275,8 bar)		
5 ⁽²⁾	2,000 psi (137,9 bar)	10,000 psi (689,5 bar)		

(1) Assumes atmospheric pressure of 14.7 psig.

(2) Rosemount 2051G is not available with range 5.

Service

Liquid, gas, and vapor applications

Protocols

4–20 mA HART(output code A)

Power supply

External power supply required. Standard transmitter operates on 10.5–42.4 Vdc with no load.

Load limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

Indication

Optional two line LOI/LCD display

Zero and span adjustment requirements

Zero and span values can be set anywhere within the range limits stated in [Table 1](#) and [Table 2](#).

Span must be greater than or equal to the minimum span stated in [Table 1](#) and [Table 2](#).

Output

Two-wire 4–20 mA, user selectable for linear or square root output. Digital process variable superimposed on 4–20 mA signal, available to any host that conforms to HART Protocol.

Rosemount 2051

Digital communications based on HART Revision 5 Protocol.

Rosemount 2051 with Selectable HART

The Rosemount 2051 with Selectable HART comes with Selectable HART Revisions. Digital communications based on HART Revision 5 (default) or Revision 7 (option code HR7) Protocol can be selected. The HART revision can be switched in the field using any HART based configuration tool or the optional LOI.

LOI

The LOI utilizes a two-button menu with internal and external configuration buttons. Internal buttons are always configured for LOI. External buttons can be configured for either LOI, (option code M4), analog zero and span (option code D4) or digital zero trim (option code DZ). See [Rosemount 2051 with Selectable HART Reference Manual](#) for LOI configuration menu.

FOUNDATION Fieldbus (output code F)

Power supply

External power supply required; transmitters operate on 9.0–32.0 Vdc transmitter terminal voltage for non-I.S. applications, 9.0–30 Vdc for entity model intrinsically safe applications and 9.0–17.5 Vdc for FISCO intrinsically safe applications.

Current draw

17.5 mA for all configurations (including LCD display option)

Indication

Optional two-line LCD display

FOUNDATION Fieldbus Function block Execution times

Block	Execution time
Resource	N/A
Transducer	N/A
LCD display block	N/A
Analog input 1, 2	20 milliseconds
PID	25 milliseconds
Arithmetic	20 milliseconds
Input selection	20 milliseconds
Signal characterizer	20 milliseconds
Integrator	20 milliseconds
Output splitter	20 milliseconds
Control selector	20 milliseconds

FOUNDATION Fieldbus parameters

Schedule entries	Links	Virtual communications relationships (VCR)
7 (max.)	25 (max.)	20 (max.)

Standard function blocks**Resource block**

The resource block contains diagnostic, hardware and electronics information. There are no linkable inputs or outputs to the resource block.

Sensor transducer block

The sensor transducer block contains sensor information including the sensor diagnostics and the ability to trim the pressure sensor or recall factory calibration.

LCD display transducer block

The LCD display transducer block is used to configure the LCD display meter.

Analog input (AI) block

The AI function block processes the measurements from the sensor and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The AI block is widely used for scaling functionality.

Note

The channel, Set XD_Scale, Set L_Type, and sometimes Set Out_Scale are typically configured by instrument personnel. Other AI block parameters, block links, and schedule are typically configured by the control systems configuration engineer.

Input selector (ISEL) block

The ISEL function block can be used to select the first good, Hot Backup, maximum, minimum, or average of as many as eight input values and place it at the output. The block supports signal status propagation.

Integrator (INT) block

The INT function block integrates one or two variables over time. The block compares the integrated or accumulated value to pre-trip and trip limits and generates discrete output signals when the limits are reached.

The Integrator block is used as a totalizer. This block will accept up to two inputs, has six options how to totalize the inputs, and two trip outputs.

Arithmetic (ARTH) block

The ARTH function block provides the ability to configure a range extension function for a primary input. It can also be used to compute nine different arithmetic functions including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control and others.

Signal characterizer (SGCR) block

The SGCR function block characterizes or approximates any function that defines an input/output relationship. The function is defined by configuring as many as twenty X,Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. Two separate analog input signals can be processed simultaneously to give two corresponding separate output values using the same defined curve.

Proportional/integral/derivative (PID) block

The PID function block combines all of the necessary logic to perform PID control. The block supports mode control, signal scaling and limiting, feed forward control, override tracking, alarm limit detection, and signal status propagation.

Control selector block

The control selector function block selects one of two or three inputs to be the output. The inputs are normally connected to the outputs of PID or other function blocks. One of the inputs would be considered Normal and the other two overrides.

Output splitter block

The output splitter function block provides the capability to drive two control outputs from a single input. It takes the output of one PID or other control block to control two valves or other actuators.

Backup link active scheduler (LAS)

The transmitter can function as a LAS if the current link master device fails or is removed from the segment.

PROFIBUS PA (output code W)**Profile version**

3.02

Power supply

External power supply required; transmitters operate on 9.0–32.0 Vdc transmitter terminal voltage for non-I.S. applications, 9.0–30 Vdc for entity model intrinsically safe applications and 9.0–17.5 Vdc for FISCO intrinsically safe applications.

Current draw

17.5 mA for all configurations (including LCD display option)

Output update rate

Four times per second

Standard function blocks**Resource block**

The resource block contains diagnostic, hardware and electronics information. There are no linkable inputs or outputs to the resource block.

Sensor transducer block

The sensor transducer block contains sensor information including the sensor diagnostics and the ability to trim the pressure sensor or recall factory calibration.

LCD display transducer block

The LCD display transducer block is used to configure the LCD display meter.

Analog input (AI) block

The AI function block processes the measurements from the sensor and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The AI block is widely used for scaling functionality.

Note

The channel, Set XD_Scale, Set L_Type, and sometimes Set Out_Scale are typically configured by instrument personnel. Other AI block parameters, block links, and schedule are typically configured by the control systems configuration engineer.

Input selector (ISEL) block

The ISEL function block can be used to select the first good, Hot Backup, maximum, minimum, or average of as many as eight input values and place it at the output. The block supports signal status propagation.

Integrator (INT) block

The INT function block integrates one or two variables over time. The block compares the integrated or accumulated value to pre-trip and trip limits and generates discrete output signals when the limits are reached.

The Integrator block is used as a totalizer. This block will accept up to two inputs, has six options how to totalize the inputs, and two trip outputs.

Arithmetic (ARTH) block

The ARTH function block provides the ability to configure a range extension function for a primary input. It can also be used to compute nine different arithmetic functions including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control and others.

Signal characterizer (SGCR) block

The SGCR function block characterizes or approximates any function that defines an input/output relationship. The function is defined by configuring as many as twenty X,Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates. Two separate analog input signals can be processed simultaneously to give two corresponding separate output values using the same defined curve.

Proportional/integral/derivative (PID) block

The PID function block combines all of the necessary logic to perform PID control. The block supports mode control, signal scaling and limiting, feed forward control, override tracking, alarm limit detection, and signal status propagation.

Control selector block

The control selector function block selects one of two or three inputs to be the output. The inputs are normally connected to the outputs of PID or other function blocks. One of the inputs would be considered Normal and the other two overrides.

Output splitter block

The output splitter function block provides the capability to drive two control outputs from a single input. It takes the output of one PID or other control block to control two valves or other actuators.

Indication

Optional two-line LCD display

LOI

Optional external configuration buttons

Wireless (output code X)**Output**

IEC 62591 (*Wireless*HART), 2.4 GHz DSSS

Wireless radio (internal antenna, WP5 option)

- Frequency: 2.400–2.485 GHz
- Channels: 15
- Modulation: IEEE 802.15.4 compliant DSSS
- Transmission: Maximum of 10 dBm EIRP

Local display

The optional three-line, seven-digit LCD display can display user-selectable information such as primary variable in engineering units, scaled variable, percent of range, sensor module temperature, and electronics temperature. The display updates based on the wireless update rate.

Digital zero trim

Digital zero trim (option DZ) is an offset adjustment to compensate for mounting position effects, up to 5 percent of URL.

Update rate

User selectable 1 second to 60 minutes

Wireless sensor module for in-line transmitters

The Rosemount 2051 Wireless Transmitter requires the engineered polymer housing to be selected. The standard sensor module will come with aluminum material. If SST is required, the option WSM must be selected.

Power module

Field replaceable, keyed connection eliminates the risk of incorrect installation, Intrinsically Safe Lithium-thionyl chloride Power Module with PBT/PC enclosure. 10-year life at one minute update rate.

Note

Reference conditions are 70 °F (21 °C), and routing data for three additional network devices. Continuous exposure to ambient temperature limits of –40 to 185 °F (–40 to 85 °C) may reduce specified life by less than 20 percent.

HART 1–5 Vdc low power (output code M)

Output

Three-wire 1–5 Vdc output, user-selectable for linear or square root output. Digital process variable superimposed on voltage signal, available to any host conforming to the HART Protocol.

Rosemount 2051

Digital communications based on HART Revision 5 Protocol.

Rosemount 2051 with Selectable HART

The Rosemount 2051 with Selectable HART comes with Selectable HART Revisions. Digital communications based on HART Revision 5 (default) or Revision 7 (option code HR7) Protocol can be selected. The HART revision can be switched in the field using any HART based configuration tool or the optional LOI.

LOI

The LOI utilizes a two-button menu with internal and external configuration buttons. Internal buttons are always configured for LOI. External buttons can be configured for either LOI, (option code M4), analog zero and span (option code D4) or digital zero trim (option code DZ). See Rosemount 2051 with Selectable HART [Reference Manual](#) for LOI configuration menu.

Power supply

External power supply required. Standard transmitter operates on 90–28 Vdc with no load.

Power consumption

3.0 mA, 27–84 mW

Output load

100 kΩ or greater (meter input impedance)

Turn-on time

Performance within specifications less than two seconds after power is applied to the transmitter.

Output

IEC 62591 (WirelessHART), 2.4 GHz DSSS

LOI

Optional external configuration buttons

Power supply

External power supply required; transmitters operate on 9.0–32.0 Vdc transmitter terminal voltage for non-I.S. applications, 9.0–30 Vdc for entity model intrinsically safe applications and 9.0–17.5 Vdc for FISCO intrinsically safe applications.

Overpressure limits

Transmitters withstand the following limits without damage:

Rosemount 2051C, 2051CF

- Ranges 2–5: 3,626 psig (250 bar) 4,500 psig (310,3 bar) for option code P9
- Range 1: 2,000 psig (137,9 bar)

Rosemount 2051T, 2051G

- Range 1: 750 psi (51,7 bar)
- Range 2: 1,500 psi (103,4 bar)
- Range 3: 1,600 psi (110,3 bar)
- Range 4: 6,000 psi (413,7 bar)
- Range 5: 15,000 psi (1034,2 bar)⁽¹⁾

Rosemount 2051L

Limit is flange rating or sensor rating, whichever is lower (See [Table 3](#)).

Table 3: Rosemount 2051L Flange Rating

Standard	Type	CS rating	SST rating
ANSI/ASME	Class 150	285 psig	275 psig
ANSI/ASME	Class 300	740 psig	720 psig
At 100 °F (38 °C), the rating decreases with increasing temperature, per ANSI/ASME B16.5.			
DIN	PN 10–40	40 bar	40 bar
DIN	PN 10/16	16 bar	16 bar
At 248 °F (120 °C), the rating decreases with increasing temperature, per DIN 2401.			

Static pressure limit

Rosemount 2051CD, 2051CF

- Operates within specifications between static line pressures of –14.2 and 3626 psig (0,034 and 250 bar)
- For option code P9, 4500 psig (310,3 bar)
- Range 1: 0.5 psia to 2000 psig (34 mbar and 137,9 bar)

(1) The Rosemount 2051G is not available with range 5.

Burst pressure limits

Rosemount 2051C, 2051CF coplanar or traditional process flange

10,000 psig (689.5 bar)

Rosemount 2051T in-line

- Ranges 1–4: 11000 psi (758,4 bar)
- Range 5: 26000 psi (1792,6 bar)

Temperature limits

Ambient

–40 to 185 °F (–40 to 85 °C)

with LCD display: –40 to 175 °F (–40 to 80 °C)

Note

Rosemount 2051 LCD display may not be readable and LCD display updates may be slower at temperatures below –22 °F (–30 °C).

Note

Wireless LCD display may not be readable and LCD display updates will be slower at temperatures below –4 °F (–20 °C).

Storage

–50 to 230 °F (–46 to 110 °C)

Note

Rosemount 2051 LCD display may not be readable and LCD display updates may be slower at temperatures below –22 °F (–30 °C).

with LCD display: –40 to 185 °F (–40 to 85 °C)

with Wireless output: –40 to 185 °F (–40 to 85 °C)

Process

At atmospheric pressures and above. See [Table 4](#).

Table 4: Process Temperature Limits

Rosemount 2051C, 2051CF	
Silicone fill sensor ⁽¹⁾	
with Coplanar flange	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
with Traditional flange	–40 to 300 °F (–40 to 149 °C) ⁽²⁾⁽³⁾
with Level flange	–40 to 300 °F (–40 to 149 °C) ⁽²⁾
with Rosemount 305 Integral Manifold	–40 to 300 °F (–40 to 149 °C) ⁽²⁾
Inert fill sensor ⁽¹⁾	–40 to 185 °F (–40 to 85 °C) ⁽³⁾
Rosemount 2051T (process fill fluid)	
Silicone fill sensor ⁽¹⁾	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
Inert fill sensor ⁽¹⁾	–22 to 250 °F (–30 to 121 °C) ⁽²⁾
Rosemount 2051L low side temperature limits	
Silicone fill sensor ⁽¹⁾	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
Inert fill sensor ⁽¹⁾	–40 to 185 °F (–40 to 85 °C) ⁽²⁾

Table 4: Process Temperature Limits (continued)

Rosemount 2051L high side temperature limits (process fill fluid)	
SYLTHERM™ XLT	–102 to 293 °F (–75 to 145 °C)
Silicone 704	32 to 401 °F (0 to 205 °C)
Silicone 200	–49 to 401 °F (–45 to 205 °C)
Inert	–49 to 320 °F (–45 to 160 °C)
Glycerin and water	5 to 203 °F (–15 to 95 °C)
Neobee® M-20	5 to 401 °F (–15 to 205 °C)
Propylene glycol and water	5 to 203 °F (–15 to 95 °C)

- (1) Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio.
 (2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.
 (3) 160 °F (71 °C) limit in vacuum service.

Humidity limits

0–100 percent relative humidity

Volumetric displacement

Less than 0.005 in³ (0,08 cm³)

Damping

4–20 mA HART Protocol

Rosemount 2051 with selectable HART

Analog output response to a step input change is user-enterable from 0–60 seconds for one time constant. This software damping is in addition to sensor module response time.

Rosemount 2051

Analog output response to a step input change is user-selectable from 0.4–60 seconds for one time constant. This software damping is in addition to sensor module response time.

FOUNDATION Fieldbus Protocol

Transducer block: User configurable

AI block: User configurable

PROFIBUS PA Protocol

AI block only: User configurable

Failure mode alarm

4–20 mA HART Protocol (output code A)

If self-diagnostics detect a sensor or microprocessor failure, the analog signal is driven either high or low to alert the user. High or low failure mode is user-selectable with a jumper on the transmitter. The values to which the transmitter drives its output in failure mode depend on whether it is factory-configured to standard or NAMUR-compliant operation. The values for each are as follows:

Table 5: Standard Operation

Output code	Linear output	Fail high	Fail low
A	$3.9 \leq I \leq 20.8$	$I \geq 21.75 \text{ mA}$	$I \leq 3.75 \text{ mA}$
M	$0.97 \leq V \leq 5.2$	$V \geq 5.4 \text{ V}$	$V \leq 0.95 \text{ V}$

Table 6: NAMUR-Compliant Operation

Output code	Linear output	Fail high	Fail low
A	$3.8 \leq I \leq 20.5$	$I \geq 22.5 \text{ mA}$	$I \leq 3.6 \text{ mA}$

Output code F and X

If self-diagnostics detect a gross transmitter failure, that information gets passed as a status along with the process variable.

Physical specifications

Material selection

Emerson provides a variety of Rosemount product with various product options and configurations including materials of construction that can be expected to perform well in a wide range of applications. The Rosemount product information presented is intended as a guide for the purchaser to make an appropriate selection for the application. It is the purchaser's sole responsibility to make a careful analysis of all process parameters (such as all chemical components, temperature, pressure, flow rate, abrasives, contaminants, etc.), when specifying product, materials, options, and components for the particular application. Emerson is not in a position to evaluate or guarantee the compatibility of the process fluid or other process parameters with the product, options, configuration or materials of construction selected.

Electrical connections

½–14 NPT, G½, and M20 x 1.5 conduit

Process connections

Rosemount 2051C

- ¼–18 NPT on 2½-in. centers
- ½–14 NPT and RC½ on 2-in. (50,8 mm), 2½-in. (54,0 mm), or 2¼-in. (57,2 mm) centers (process adapters)

Rosemount 2051T, 2051G

- ½–14 NPT female
- G½ A DIN 16288 male (available in SST for range 1–4 transmitters only)
- Autoclave type F-250-C (pressure relieved 9/16–18 gland thread; ¼ O.D. high pressure tube 60° cone; available in SST for range 5 transmitters only)

Rosemount 2051L

- High pressure side: 2-in. (50,8 mm), 3-in. (72 mm), or 4-in. (102 mm), ASME B 16.5 (ANSI) Class 150 or 300 flange; 50, 80, or 100 mm, DIN 2501 PN 40 or 10/16 flange
- Low pressure side: ¼–18 NPT on flange, ½–14 NPT on process adapter

Rosemount 2051CF

- For Rosemount 2051CFA wetted parts, see Rosemount DP Flow Meters and Primary Elements [Product Data Sheet](#) in the 485 section
- For Rosemount 2051CFC wetted parts, see Rosemount DP Flow Meters and Primary Elements [Product Data Sheet](#) in the 405 section
- For Rosemount 2051CFP wetted parts, see Rosemount DP Flow Meters and Primary Elements [Product Data Sheet](#) in the 1195 section

Rosemount 2051C process wetted parts**Drain/vent valves**

316 SST or alloy C-276

Process flanges and adapters

Plated CS, SST CF-8M (cast version of 316 SST, material per ASTM-A743), or CW2M (cast version of alloy C)

Wetted O-rings

Glass-filled PTFE or graphite-filled PTFE

Process isolating diaphragms

316L SST, alloy C-276, or tantalum

Rosemount 2051T process wetted parts**Process connections**

316L SST or alloy C-276

Process Isolating diaphragms

316L SST or alloy C-276

Rosemount 2051L process wetted parts**Flanged process connection (transmitter high side)**

Process diaphragms, including process gasket surface	316L SST, alloy C-276, or Tantalum
Extension	CF-3M (cast version of 316L SST, material per ASTM-A743), or cast C-276. Fits schedule 40 and 80 pipe.
Mounting flange	Zinc-cobalt plated CS or SST

Reference process connection (transmitter low side)

Isolating diaphragms	316L SST or alloy C-276
Reference flange and adapter	CF-8M (cast version of 316 SST, material per ASTM-A743)

Non-wetted parts for Rosemount 2051C, 2051T, 2051L, 2051G**Electronics housing**

Low-copper aluminum or CF-8M (cast version of 316 SST) Enclosures meet NEMA Type 4X, IP66, and IP68 when properly installed.
Housing material code P: PBT/PC with NEMA 4X and IP66/67/68

Paint for aluminum housing

Polyurethane

Coplanar sensor module housing

CF-3M (cast version of 316L SST)

Bolts

ASTM A449, Type 1 (zinc-cobalt plated CS) ASTM F593G, Condition CW1 (austenitic 316 SST) ASTM A193, Grade B7M (zinc plated alloy steel) Alloy K-500

Sensor module fill fluid

Silicone or inert halocarbon

In-line series uses Fluorinert® FC-43

Process fill fluid (Rosemount 2051L only)

Syltherm XLT, Silicone 704, Silicone 200, inert, glycerin and water, Neobee® M-20, or propylene glycol and water

Cover O-rings

Buna-N

Silicone (for wireless option code X)

Power module

Field replaceable, keyed connection eliminates the risk of incorrect installation, Intrinsically Safe Lithium-thionyl chloride power module with PBT enclosure.

Shipping weights**Table 7: Transmitter Weights without Options**

Transmitter weights include the sensor module and housing only (aluminum for standard Rosemount 2051 and polymer for wireless).

Transmitter	Standard in lb (kg)	Wireless in lb (kg)
Rosemount 2051C	4.9 (2.2)	3.9 (1,8)
Rosemount 2051L	See Table 8	See Table 8
Rosemount 2051T	3.1 (1.4)	1.9 (0,86)
Rosemount 2051G	2.4 (1,1)	N/A

Table 8: Rosemount 2051L Weights without Options

Flange	Flush in lb (kg)	2-in. ext. in lb (kg)	4-in. ext. in lb (kg)	6-in. ext. in lb (kg)
2-in., Class 150	12.5 (5,7)	N/A	N/A	N/A
3-in., Class 150	17.5 (7,9)	19.5 (8,8)	20.5 (9,3)	21.5 (9,7)
4-in., Class 150	23.5 (10,7)	26.5 (12,0)	28.5 (12,9)	30.5 (13,8)
2-in., Class 300	17.5 (7,9)	N/A	N/A	N/A
3-in., Class 300	22.5 (10,2)	24.5 (11,1)	25.5 (11,6)	26.5 (12,0)
4-in., Class 300	32.5 (14,7)	35.5 (16,1)	37.5 (17,0)	39.5 (17,9)
DN 50/PN 40	13.8 (6,2)	N/A	N/A	N/A

Table 8: Rosemount 2051L Weights without Options (continued)

Flange	Flush in lb (kg)	2-in. ext. in lb (kg)	4-in. ext. in lb (kg)	6-in. ext. in lb (kg)
DN 80/PN 40	19.5 (8,8)	21.5 (9,7)	22.5 (10,2)	23.5 (10,6)
DN 100/PN 10/16	17.8 (8,1)	19.8 (9,0)	20.8 (9,5)	21.8 (9,9)
DN 100/PN 40	23.2 (10,5)	25.2 (11,5)	26.2 (11,9)	27.2 (12,3)

Table 9: Transmitter Option Weights

Code	Option	Add lb (kg)
J, K, L, M	SST housing	3.9 (1,8)
M5	LCD display for aluminum housing	0.5 (0,2)
M5	LCD display for wireless output	0.1 (0,04)
B4	SST mounting bracket for coplanar flange	1.0 (0,5)
B1, B2, B3	Mounting bracket for traditional flange	2.3 (1,0)
B7, B8, B9	Mounting bracket for traditional flange	2.3 (1,0)
BA, BC	SST bracket for traditional flange	2.3 (1,0)
H2	Traditional flange	2.6 (1,2)
H3	Traditional flange	3.0 (1,4)
H4	Traditional flange	3.0 (1,4)
H7	Traditional flange	2.7 (1,2)
FC	Level flange—3-in., Class 150	12.7 (5,8)
FD	Level flange—3-in., Class 300	15.9 (7,2)
FA	Level flange—2-in., Class 150	8.0 (3,6)
FB	Level flange—2-in., Class 300	8.4 (3,3)
FP	DIN level flange, SST, DN 50, PN 40	7.8 (3,5)
FQ	DIN level flange, SST, DN 80, PN 40	12.7 (5,8)
WSM	SST sensor module	1.0 (0,45)
N/A	Power Module (701PGNKF)	0.4 (0,18)

Product certifications

Rosemount 2051C/T/L

Rev 1.15

European directive information

A copy of the EC Declaration of Conformity can be found at the end of the Quick Start Guide. The most recent revision of the EC Declaration of Conformity can be found at www.Emerson.com.

Ordinary Location Certification

As standard, the transmitter has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

Hazardous location certifications

Note

Device ambient temperature ratings and electrical parameters may be limited to the levels dictated by the hazardous location certificate parameters.

North America

E5 USA Explosionproof (XP) and Dust-Ignitionproof (DIP)

Certificate: FM16US0232

Standards: FM Class 3600 – 2011, FM Class 3615 – 2006, FM Class 3616 – 2011, FM Class 3810 – 2005, ANSI/NEMA 250 – 2008, ANSI/IEC 60529 2004

Markings: XP CL I, DIV 1, GP B, C, D; DIP CL II, DIV 1, GP E, F, G; CL III; T5($-50^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$); Factory Sealed; Type 4X

I5 USA Intrinsic Safety (IS) and Nonincendive (NI)

Certificate: FM16US0231X (HART)

Standards: FM Class 3600 – 2011, FM Class 3610 – 2010, FM Class 3611 – 2004, FM Class 3810 – 2005, ANSI/NEMA 250 – 2008

Markings: IS CL I, DIV 1, GP A, B, C, D; CL II, DIV 1, GP E, F, G; Class III; DIV 1 when connected per Rosemount drawing 02051-1009; Class I, Zone 0; AEx ia IIC T4; NI CL 1, DIV 2, GP A, B, C, D; T4($-50^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$); Type 4X

Specific Condition of Use (X):

1. The Model 2051 transmitter housing contains aluminum and is considered a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact and friction.

Certificate: 2041384 (HART/Fieldbus/Profibus)

Standards: ANSI/ISA 12.27.01-2003, CSA Std. C22.2 No.142-M1987, CSA Std. C22.2. No.157-92

Markings: IS CL I, DIV 1, GP A, B, C, D; CL II, DIV 1, GP E, F, G; Class III; DIV 1 when connected per Rosemount drawing 02051-1009; Class I, Zone 0; AEx ia IIC T4; NI CL 1, DIV 2, GP A, B, C, D; T4($-50^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$); Type 4x

IE USA FISCO

Certificate: FM16US0231X (HART)

Standards: FM Class 3600 – 2011, FM Class 3610 – 2010, FM Class 3611 – 2004, FM Class 3810 – 2005

Markings: IS CL I, DIV 1, GP A, B, C, D when connected per Rosemount drawing 02051-1009 ($-50^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}$); Type 4X

Specific Condition of Use (X):

1. The Model 2051 transmitter housing contains aluminum and is considered a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact and friction.

Certificate: 2041384 (HART/Fieldbus/Profibus)

Standards: ANSI/ISA 12.27.01-2003, CSA Std. C22.2 No. 30 -M1986, CSA Std. C22.2 No.142-M1987, CSA Std. C22.2 No. 213 - M1987

Markings: IS CL I, DIV 1, GP A, B, C, D when connected per Rosemount drawing 02051-1009 (-50°C ≤ Ta ≤ +60°C); Type 4x

E6 Canada Explosion-Proof, Dust Ignition Proof

Certificate: 2041384

Standards: CAN/CSA C22.2 No. 0-10, CSA Std C22.2 No. 25-1966, CSA Std C22.2 No. 30-M1986, CAN/CSA-C22.2 No. 94-M91, CSA Std C22.2 No.142-M1987, CAN/CSA-C22.2 No.157-92, CSA Std C22.2 No. 213-M1987, CAN/CSA-E60079-0:07, CAN/CSA-E60079-1:07, CAN/CSA-E60079-11-02, CAN/CSA-C22.2 No. 60529:05, ANSI/ISA-12.27.01-2003

Markings: Explosion-Proof for Class I, Divisions 1, Groups B, C, and D. Dust-Ignition Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2; Groups A, B, C, and D for indoor and outdoor hazardous locations. Class I Zone 1 Ex d IIC T5. Enclosure type 4X, factory sealed. Single Seal.

I6 Canada Intrinsic Safety

Certificate: 2041384

Standards: CSA Std. C22.2 No. 142 - M1987, CSA Std. C22.2 No. 213 - M1987, CSA Std. C22.2 No. 157 - 92, CSA Std. C22.2 No. 213 - M1987, ANSI/ISA 12.27.01 – 2003, CAN/CSA-E60079-0:07, CAN/CSA-E60079-11:02

Markings: Intrinsically safe for Class I, Division 1, Groups A,B, C, and D when connected in accordance with Rosemount drawing 02051-1008. Ex ia IIC T3C. Single Seal. Enclosure Type 4X.

Europe**E1 ATEX Flameproof**

Certificate: KEMA 08ATEX0090X

Standards: EN 60079-0:2012 + A11:2013, EN 60079-1:2014, EN 60079-26:2015

Markings: ⚡ II 1/2 G Ex db IIC T6 (-60 °C ≤ Ta ≤ +70°C); T4/T5 (-60 °C ≤ Ta ≤ +80 °C)

Table 10: Process Connection Temperature

Temperature class	Process connection temperature	Ambient temperature
T6	-60 °C to +70 °C	-60 °C to +70 °C
T5	-60 °C to +80 °C	-60 °C to +80 °C
T4	-60 °C to +120 °C	-60 °C to +80 °C

Special Conditions for Safe Use (X):

1. Appropriate cable, glands and plugs need to be suitable for a temperature of 5 °C greater than maximum specified temperature for location where installed.
2. Non- standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

3. The device contains a thin wall diaphragm less than 1 mm thickness that forms a boundary between zone 0 (process connection) and zone 1 (all other parts of the equipment). The model code and datasheet are to be consulted for details of the diaphragm material. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm shall be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
4. Flameproof joints are not intended for repair.

I1 ATEX Intrinsic Safety

Certificate: Baseefa08ATEX0129X
Standards: EN60079-0:2012+A11:2013, EN60079-11:2012
Markings: ⚡ II 1 G Ex ia IIC T4 Ga ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 11: Input Parameters

	HART	Fieldbus/PROFIBUS
Voltage U_i	30 V	30 V
Current I_i	200 mA	300 mA
Power P_i	1 W	1.3 W
Capacitance C_i	0.012 μF	0 μF
Inductance L_i	0 mH	0 mH

Special Condition for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V isolation from earth test and this must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact and abrasion when located in Zone 0.

IA ATEX FISCO

Certificate: Baseefa08ATEX0129X
Standards: EN60079-0:2012+A11:2013, EN60079-11:2012
Markings: ⚡ II 1 G Ex ia IIC T4 Ga
 $(-60^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C})$

Table 12: Input Parameters

	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	0 μF
Inductance L_i	0 mH

Special Conditions for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V isolation from earth test and this must be taken into account during installation.

- The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact and abrasion when located in Zone 0.

N1 ATEX Type n

Certificate: Baseefa08ATEX0130X
Standards: EN60079-0:2012, EN60079-15:2010
Markings: Ⓔ II 3G Ex nA IIC T4 Gc ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

- If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V electrical strength test as defined in clause 6.5.1 of by EN 60079-15:2010. This must be taken into account during installation.

ND ATEX Dust

Certificate: Baseefa08ATEX0182X
Standards: EN60079-0:2012+A11:2013, EN60079-31:2009
Markings: Ⓔ II 1 D Ex ta IIIC T95 °C T₅₀₀ 105 °C Da ($-20^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$)

Special Condition for Safe Use (X):

- If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V isolation from earth test and this must be taken into account during installation.

International

E7 IECEx Flameproof

Certificate: IECExKEM08.0024X
Standards: IEC 60079-0:2011, IEC 60079-1:2014-06, IEC 60079-26:2014-10
Markings: Ex db IIC T6... T4 Ga/Gb T6 ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$), T4/T5 ($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$)

Table 13: Process Connection Temperature

Temperature class	Process connection temperature	Ambient temperature
T6	-60°C to $+70^{\circ}\text{C}$	-60°C to $+70^{\circ}\text{C}$
T5	-60°C to $+80^{\circ}\text{C}$	-60°C to $+80^{\circ}\text{C}$
T4	-60°C to $+120^{\circ}\text{C}$	-60°C to $+80^{\circ}\text{C}$

Special Conditions for Safe Use (X):

- The device contains a thin wall diaphragm less than 1 mm thickness that forms a boundary between zone 0 (process connection) and zone 1 (all other parts of the equipment). The model code and datasheet are to be consulted for details of the diaphragm material. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm shall be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
- Appropriate cable, glands and plugs need to be suitable for a temperature of 5°C greater than maximum specified temperature for location where installed.
- Flameproof joints are not intended for repair.
- Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

I7 IECEx Intrinsic Safety

Certificate: IECExBAS 08.0045X
Standards: IEC60079-0:2011, IEC60079-11:2011
Markings: Ex ia IIC T4 Ga ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 14: Input Parameters

	HART	Fieldbus/PROFIBUS
Voltage U_i	30 V	30 V
Current I_i	200 mA	300 mA
Power P_i	1 W	1.3 W
Capacitance C_i	12 nF	0 μF
Inductance L_i	0 mH	0 mH

Special Condition for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V isolation from earth test and this must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact and abrasion when located in Zone 0.
3. The equipment contains thin wall diaphragms. The installation, maintenance and use shall take into account the environmental conditions to which the diaphragms will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

IG IECEx FISCO

Certificate: IECExBAS 08.0045X
Standards: IEC60079-0:2011, IEC60079-11:2011
Markings: Ex ia IIC T4 Ga ($-60^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}$)

Table 15: Input Parameters

	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	0 nF
Inductance L_i	0 μH

Special Condition for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V isolation from earth test and this must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact and abrasion when located in Zone 0.
3. The equipment contains thin wall diaphragms. The installation, maintenance and use shall take into account the environmental conditions to which the diaphragms will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

N7 IECEx Type n

Certificate: IECExBAS 08.0046X
Standards: IEC60079-0:2011, IEC60079-15:2010
Markings: Ex nA IIC T4 Gc ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. If fitted with a 90 V transient suppressor, the equipment is not capable of withstanding the 500 V electrical strength test as defined in clause 6.5.1 of IEC60079-15:2010. This must be taken into account during installation.

Brazil**E2 INMETRO Flameproof**

Certificate: UL-BR 14.0375X
Standards: ABNT NBR IEC60079-0:2008 + Errata 1:2011, ABNT NBR IEC 60079-1:2009 + Errata 1:2011, ABNT NBR IEC 60079-26:2008 + Errata 1:2009
Markings: Ex db IIC T6...T4 Ga/Gb IP66, T6($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$), T4/T5($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$)

Special Conditions for Safe Use (X):

1. The device contains a thin wall diaphragm. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

I2 INMETRO Intrinsic Safety

Certificate: UL-BR 14.0759X
Standards: ABNT NBR IEC 60079-0:2013; ABNT NBR IEC 60079-11:2013
Markings: Ex ia IIC T4 Ga ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 16: Input Parameters

	HART	Fieldbus/PROFIBUS
Voltage U_i	30 V	30 V
Current I_i	200 mA	300 mA
Power P_i	1 W	1.3 W
Capacitance C_i	12 nF	0
Inductance L_i	0	0

Special Conditions for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V insulation from earth test and this must be taken into account during installation.
2. The enclosure may be made of aluminium alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact and abrasion when located in atmospheres that require ELP Ga.

IB INMETRO FISCO**Certificate:** UL-BR 14.0759X**Standards:** ABNT NBR IEC 60079-0:2008 + Errata 1:2011; ABNT NBR IEC 60079-11:2009**Markings:** Ex ia IIC T4 Ga ($-60^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}$)**Table 17: Input Parameters**

	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	0 nF
Inductance L_i	0 μH

Special Conditions for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding the 500 V insulation from earth test and this must be taken into account during installation.
2. The enclosure may be made of aluminium alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact and abrasion when located in atmospheres that require ELP Ga.

China**E3 China Flameproof****Certificate:** GYJ18.1432X; GYJ15.1366X [Flow meters]**Standards:** GB3836.1-2010, GB3836.2-2010, GB3836.20-2010-2010**Markings:** Pressure Transmitter: Ex d IIC Gb, T6~T4 Ga/Gb
Flow meter: Ex d IIC T5/T6 Ga/Gb**I3 China Intrinsic Safety****Certificate:** GYJ17.1225X; GYJ15.1365X [Flow meters]**Standards:** GB3836.1-2010, GB3836.4-2010, GB3836.20-2010**Markings:** Ex ia IIC T4 Ga**Korea****EP Korea Flameproof****Certificate:** 12-KB4BO-0342X, 12-KB4BO-0344X, 19-KB4BO-0978X**Markings:** Ex d IIC T6...T4 Ga/Gb, T4/T5 ($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6 ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)**Special Condition for Safe Use (X)**

1. See certificate for special conditions.

IP Korea Intrinsic Safety**Certificate:** 12-KB4BO-0343X, 12-KB4BO-0345X, 13-KB4BO-0205X, 13-KB4BO-0207X, 18-KA4BO-0309X

Markings: Ex ia IIC T4 Ga ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

Japan

E4 Japan Flameproof

Certificate: TC20598, TC20599, TC20602, TC20603 [HART]; TC20600, TC20601, TC20604, TC20605 [Fieldbus]

Markings: Ex d IIC T5

Technical Regulations Customs Union (EAC)

EM EAC Flameproof

Certificate: TC RU C-US.AA87.B.00588

Markings: Ga/Gb Ex d IIC X, T5 ($-50^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6 ($-50^{\circ}\text{C} \leq T_a \leq +65^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

IM EAC Intrinsically Safe

Certificate: TC RU C-US.AA87.B.00588

Markings: 0Ex ia IIC T4 Ga X ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

Combinations

K1 combination of E1, I1, N1, and ND

K2 combination of E2 and I2

K5 combination of E5 and I5

K6 combination of E6 and I6

K7 combination of E7, I7, N7 and IECEx Dust

IECEx Dust

Certificate: IECExBAS 08.0058X

Standards: IEC60079-0:2011, IEC60079-31:2008

Markings: Ex tA IIIC T95 °C T500 105 °C Da ($-20^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. If the equipment is fitted with an optional 90 V transient suppressor, it is incapable of withstanding a 500 V isolation from earth test and this must be taken into account during installation.

KA combination of E1, I1, and K6

KB combination of K5 and K6

KC combination of E1, I1, and K5

KD combination of K1, K5, and K6

KP combination of EP and IP

KM Combination of EM and IM

Additional Certifications

SBS American Bureau of Shipping (ABS) Type Approval

Certificate: 18-HS1753847-PDA

Intended Use: Marine and Offshore Applications Measurement of either Gauge or Absolute Pressure for Liquid, Gas, and Vapor

ABS Rules: 2018 Steel Vessels Rules 1-1-4/7.7, 1-1-Appendix 3, 1-1-Appendix 4

SBV Bureau Veritas (BV) Type Approval

Certificate: 23157 BV

BV Rules: Bureau Veritas Rules for the Classification of Steel Ships

Application: Class notations: AUT-UMS, AUT-CCS, AUT-PORT and AUT-IMS; Pressure transmitter type 2051 cannot be installed on diesel engines.

SDN Det Norske Veritas (DNV) Type Approval

Certificate: TAA00004F

Intended Use: DNV GL Rules for Classification — Ships and offshore units

Application:

Location classes	
Type	2051
Temperature	D
Humidity	B
Vibration	A
EMC	B
Enclosure	D

SLL Lloyds Register (LR) Type Approval

Certificate: 11/60002

Application: Environmental categories ENV1, ENV2, ENV3, and ENV5

Rosemount 2051G

Rev 1.6

European Directive Information

A copy of the EU Declaration of Conformity can be found at the end of the Quick Start Guide. The most recent revision of the EU Declaration of Conformity can be found at Emerson.com/Rosemount.

North America

E5 USA Explosionproof (XP) and Dust-Ignitionproof (DIP)

Certificate 1015441

Standards FM Class 3600 – 2011, FM Class 3615 – 2006, FM Class 3616 – 2011, FM Class 3810 – 2005

Markings XP CL I, DIV 1, GP B, C, D; DIP CL II, DIV 1, GP E, F, G; CL III; T5(-50°C ≤ Ta ≤ +85°C); Factory Sealed; Type 4X

I5 USA Intrinsic Safety (IS) and Nonincendive (NI)

Certificate 1015441

Standards FM Class 3600 – 2011, FM Class 3610 – 2010, FM Class 3611 – 2004, FM Class 3810 – 2005

Markings IS CL I, DIV 1, GP A, B, C, D; CL II, DIV 1, GP E, F, G; Class III; DIV 1 when connected per Rosemount drawing 02088-1024; NI CL 1, DIV 2, GP A, B, C, D; T4(-50°C ≤ Ta ≤ +70°C); Type 4x

E6 Canada Explosionproof, Division 2, Dust-Ignitionproof

Certificate 1015441

Standards CAN/CSA C22.2 No. 0-M91 (R2001), CSA Std C22.2 No. 25-1966, CSA Std C22.2 No. 30-M1986, CAN/CSA-C22.2 No. 94-M91, CSA Std C22.2 No. 142-M1987, CAN/CSA-C22.2 No. 157-92, CSA Std C22.2 No. 213-M1987, ANSI-ISA-12.27.01-2003

Markings Class I, Division 1, Groups B, C and D; Class II, Groups E, F, and G; Class III; Class I Division 2 Groups A, B, C and D; Type 4X; Factory Sealed; Single Seal

I6 Canada Intrinsic Safety

Certificate 1015441

Standards CAN/CSA C22.2 No. 0-M91 (R2001), CSA Std C22.2 No. 25-1966, CSA Std C22.2 No. 30-M1986, CAN/CSA-C22.2 No. 94-M91, CSA Std C22.2 No. 142-M1987, CAN/CSA-C22.2 No. 157-92, CSA Std C22.2 No. 213-M1987, ANSI-ISA-12.27.01-2003

Markings Intrinsically Safe Class I, Division 1 when connected in accordance with Rosemount drawing 02088-1024, Temperature Code T4; Ex ia; Type 4X; Factory Sealed; Single Seal

Europe

E1 ATEX Flameproof

Certificate KEMA97ATEX2378X

Standards EN 60079-0:2012 + A11:2013, EN60079-1:2014, EN60079-26:2015

Markings ⓈII 1/2 G Ex db IIC T6..T4 Ga/Gb, T6(-60 °C ≤ Ta ≤ +70 °C), T5/T4 (-60 °C ≤ Ta ≤ +80 °C)

Table 18: Process Connection Temperature

Temperature class	Process connection temperature	Ambient temperature
T6	–60 to +70 °C	–60 to +70 °C
T5	–60 to +80 °C	–60 to +80 °C
T4	–60 to +120 °C	–60 to +80 °C

Special Conditions for Safe Use (X):

1. This device contains a thin wall diaphragm less than 1 mm thickness that forms a boundary between zone 0 (process connection) and zone 1 (all other parts of the equipment). The model code and data sheet are to be consulted for details of the diaphragm material. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.
4. Appropriate cable, glands and plugs need to be suitable for a temperature of 5 °C greater than maximum specified temperature for location where installed.

I1 ATEX Flameproof

Certificate	BAS00ATEX1166X
Standards	EN60079-0:2012 + A11:2013, EN60079-11:2012
Markings	Ⓔ II 1 G Ex ia IIC T4 Ga (–55 °C ≤ Ta ≤ +70 °C)

Table 19: Input Parameters

Parameter	HART
Voltage U_i	30 V
Current I_i	200 mA
Power P_i	0.9 W
Capacitance C_i	0.012 μ F

Special Conditions for Safe Use (X):

1. The apparatus is not capable of withstanding the 500 V insulation test required by EN60079-11. This must be taken into account when installing the apparatus.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a Zone 0 environment.

N1 ATEX Type n

Certificate	BAS00ATEX3167X
Standards	EN60079-0:2012 + A11:2013, EN60079-15:2010
Markings	Ⓔ II 3 G Ex nA IIC T5 Gc (–55 °C ≤ Ta ≤ +70 °C)

Special Condition for Safe Use (X):

1. This apparatus is not capable of withstanding the 500V insulation test required by EN60079-15. This must be taken into account when installing the apparatus.

ND ATEX Dust

Certificate: BAS01ATEX1427X
Standards: EN60079-0:2012 + A11:2013, EN60079-31:2009
Markings: Ⓔ II 1 D Ex t IIIC T50 °C T₅₀₀ 60 °C Da

Special Conditions for Safe Use (X):

1. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66.
2. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66.
3. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7J impact test.

International**E7 IECEx Flameproof**

Certificate: IECEx KEM 06.0021X
Standards: IEC 60079-0:2011, IEC 60079-1:2014, IEC 60079-26:2014
Markings: Ex db IIC T6...T4 Ga/Gb
 T6(−60 °C ≤ T_a ≤ +70 °C),
 T5/T4(−60 °C ≤ T_a ≤ +80 °C)

Table 20: Process Connection Temperature

Temperature class	Process connection temperature	Ambient temperature
T6	−60 to +70 °C	
T5	−60 to +80 °C	
T4	−60 to +120 °C	−60 to +80 °C

Special Conditions for Safe Use (X):

1. This device contains a thin wall diaphragm less than 1 mm thickness that forms a boundary between zone 0 (process connection) and zone 1 (all other parts of the equipment). The model code and data sheet are to be consulted for details of the diaphragm material. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.
4. Appropriate cable, glands and plugs need to be suitable for a temperature of 5°C greater than maximum specified temperature for location where installed.

I7 IECEx Intrinsic Safety

Certificate: IECEx BAS 12.0071X
Standards: IEC60079-0:2011, IEC60079-11:2011
Markings: Ex ia IIC T4 Ga ($-55^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 21: Input Parameters

Voltage U_i	30 V
Current I_i	200 mA
Power P_i	0.9 W
Capacitance C_i	0.012 μF

Special Conditions for Safe Use (X):

1. When fitted with a transient suppression terminal block, the Rosemount™ 2088 is incapable of passing the 500 V isolation test. This must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a Zone 0 environment.

N7 IECEx Type n

Certificate: IECEx BAS 12.0072X
Standards: IEC60079-0:2011, IEC60079-15:2010
Markings: Ex nA IIC T5 Gc ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. When fitted with a transient suppression terminal block, the Rosemount 2088 is incapable of passing the 500 sV isolation test. This must be taken into account during installation.

NK IECEx Dust

Certificate: IECEx BAS12.0073X
Standards: IEC60079-0:2011, IEC60079-31:2008
Markings: Ex t IIIC T55 $^{\circ}\text{C} \leq T_{500} \leq 60^{\circ}\text{C}$ Da

Table 22: Input Parameters

	HART®
Voltage U_i	36 V
Current I_i	24 mA

Special Conditions for Safe Use (X):

1. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66.
2. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66.
3. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7J impact test.

Brazil

E2 INMETRO Flameproof

Certificate: UL-BR 15.0728X

Standards: ABNT NBR IEC 60079-0:2013, ABNT NBR IEC 60079-1:2016, ABNT NBR IEC 60079-26:2016

Markings: Ex db IIC T6...T4 Ga/Gb T4/T5($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$),
T6($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Conditions for Safe Use (X):

1. This device contains a thin wall diaphragm less than 1 mm thickness that forms a boundary between zone 0 (process connection) and zone 1 (all other parts of the equipment). The model code and data sheet are to be consulted for details of the diaphragm material. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

I2 INMETRO Intrinsic Safety

Certificate: UL-BR 13.0246X

Standards: ABNT NBR IEC60079-0:2008 + Errata 1:2011, ABNT NBR IEC60079-11:2009

Markings: Ex ia IIC T4 Ga ($-55^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$),
T6($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 23: Input Parameters

Voltage U_i	30 V
Current I_i	200 mA
Power P_i	0.9 W
Capacitance C_i	0.012 μF
Inductance L_i	0 mH

Special Conditions for Safe Use (X):

1. When fitted with a transient suppression terminal block, the Rosemount™ 2088 is incapable of passing the 500 V isolation test. This must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a zone 0 environment (areas that require EPL Ga).

China

E3 China Flameproof

Certificate: GYJ17.1158X

Standards: GB3836.1-2010, GB3836.2-2010, GB3836.20-2010

Markings: : Ex d IIC T6~T4 Ga/Gb, T5/T4($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. Contact the original manufacturer when repair work relates to the flamepath.

I3 China Intrinsic Safety

Certificate:	GYJ17.1157X
Standards:	GB3836.1-2010, GB3836.4-2010, GB3836.20-2010
Markings:	Ex ia IIC T4 Ga ($-55^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Conditions for Safe Use (X):

1. The enclosure may contain light metal, attention should be taken to avoid ignition hazard due to impact or friction when used in Zone 0.
2. When transient protection board is chosen (option code T1), this apparatus is not capable of withstanding the 500 V r.m.s insulation test required by clause 6.3.12 of GB3836.4-2010.

N3 China Type n

Certificate:	GYJ17.1159X
Standards:	GB3836.1-2010, GB3836.8-2014
Markings:	Ex nA IIC T5 Gc ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. When transient protection board is chosen (option code T1), this apparatus is not capable of withstanding the 500 V r.m.s insulation test required by Clause 6.3.12 of GB3836.4-2010.

Technical Regulations Customs Union (EAC)**EM EAC Flameproof**

Certificate	EAEC RU C-US.EX01.B.00176
Standards	GB3836.1-2010, GB3836.2-2010, GB3836.20-2010
Markings	:Ga/Gb Ex db IIC T5/T6 X, T5($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

IM EAC Intrinsic Safety

Certificate	EAEC RU C-US.EX01.B.00176
Standards	GB3836.1-2010, GB3836.4-2010, GB3836.20-2010
Markings	0Ex ia IIC T4 Ga X, T4($-55^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Conditions for Safe Use (X):

1. See certificate for special conditions.

Combinations

K1	Combination of E1, I1, N1, and ND
K2	Combination of E2 and I2

K3	Combination of E3 and I3
K5	Combination of E5 and I5
K6	Combination of E6 and I6
K7	Combination of E7, I7, N7, and NK
KB	Combination of K5 and K6
KD	Combination of E1, I1, K5 and K6
KM	Combination of EM and IM

Conduit plugs and adapters

IECEx Flameproof and Increased Safety

Certificate:	IECEx FMG 13.0032X
Standards:	IEC60079-0:2011, IEC60079-1:2007, IEC60079-7:2006-2007
Markings:	Ex d e IIC Gb

ATEX Flameproof and Increased Safety

Certificate:	FM13ATEX0076X
Standards:	EN60079-0:2012, EN60079-1:2007, IEC60079-7:2007
Markings:	Ⓔ II 2 G Ex d e IIC Gb

Table 24: Conduit Plug Thread Sizes

Thread	Identification mark
M20 x 1.5	M20
½ – 14 NPT	½ NPT
G½	G½

Table 25: Thread Adapter Thread Sizes

Male thread	Identification mark
M20 x 1.5 – 6H	M20
½ – 14 NPT	½ – 14 NPT
¾ – 14 NPT	¾ – 14 NPT
Female thread	Identification mark
M20 x 1.5 – 6H	M20
½ – 14 NPT	½ – 14 NPT
G½	G½

Special Conditions for Safe Use (X):

1. When the thread adapter or blanking plug is used with an enclosure in type of protection increased safety “e” the entry thread shall be suitably sealed in order to maintain the ingress protection rating (IP) of the enclosure.
2. The blanking plug shall not be used with an adapter.

3. Blanking plug and threaded adapter shall be either NPT or metric thread forms. G½ thread forms are only acceptable for existing (legacy) equipment installations.

Rosemount 2051 Wireless

Rev 1.6

European Directive Information

A copy of the EU Declaration of Conformity can be found at the end of the Quick Start Guide. The most recent revision of the EU Declaration of Conformity can be found at [Emerson.com/Rosemount](https://emerson.com/Rosemount).

Telecommunication compliance

All wireless devices require certification to ensure that they adhere to regulations regarding the use of the RF spectrum. Nearly every country requires this type of product certification. Emerson™ is working with governmental agencies around the world to supply fully compliant products and remove the risk of violating country directives or laws governing wireless device usage.

FCC and IC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: This device may not cause harmful interference. This device must accept any interference received, including interference that may cause undesired operation. This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

Ordinary Location Certification

As standard, the transmitter has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

Installing in North America

The US National Electrical Code® (NEC) and the Canadian Electrical Code (CEC) permit the use of Division marked equipment in Zones and Zone marked equipment in Divisions. The markings must be suitable for the area classification, gas, and temperature class. This information is clearly defined in the respective codes.

USA

I5 U.S.A. Intrinsically Safe (IS)

Certificate: FM19US0050X

Standards: FM Class 3600 – 2018, FM Class 3610 – 2018, FM Class 3810 – 2018, ANSI/ISA 60079-0:2013, ANSI/UL 60079-11:2014, NEMA 250: 2003, ANSI/IEC 60529:2014, ANSI/UL 61010:2016

Markings: IS CL I, DIV 1, GP A, B, C, D T4; CL 1, Zone 0 AEx ia IIC T4; T4 (–40 °C ≤ T_a ≤ +70 °C) when installed per Rosemount drawing 03031-1062; Type 4X/IP66/IP68

Special Conditions for Safe Use (X):

1. The Rosemount 2051 Wireless Pressure Transmitter shall only be used with the 701PGNKF Rosemount SmartPower™ Battery Pack.
2. The inline pressure sensor may contain more than 10 percent aluminum and is considered a potential risk of ignition by impact or friction. Care must be taken into account during installation and used to prevent impact and friction.
3. The surface resistivity of the transmitter housing is greater than one gigaohm. To avoid electrostatic charge build-up, it must not be rubbed or cleaned with solvents or a dry cloth.

Canada

I6 Canada Intrinsically Safe

Certificate: CSA 2526009

Standards: CAN/CSA C22.2 No. 0-M91, CAN/CSA C22.2 No. 94-M91, CSA Std C22.2 No. 142-M1987, CSA Std C22.2 No. 157-92, CSA Std C22.2 No. 60529:05

Markings: Intrinsically Safe for Class I, Division 1, Groups A, B, C, D, T4 when installed per Rosemount drawing 03031-1063; Type 4X/IP66/IP68

Europe

I1 ATEX Intrinsic Safety

Certificate: Baseefa12ATEX0228X

Standards: EN 60079-0:2012, EN 60079-11:2012

Markings:  II 1 G Ex ia IIC T4 Ga, T4 ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$) IP66/IP68

Special Conditions for Safe Use (X):

1. The plastic enclosure may constitute a potential electrostatic ignition risk and must not be rubbed or cleaned with a dry cloth.
2. The Rosemount 701PGNKF Power Module may be replaced in a hazardous area. The power module has a surface resistivity greater than $1\text{ G}\Omega$ and must be properly installed in the wireless device enclosure. Care must be taken during transportation to and from the point of installation to prevent electrostatic charge build-up.

International

I7 IECEx Intrinsic Safety

Certificate: IECEx BAS 12.0124X

Standards: IEC 60079-0:2011, IEC 60079-11:2011

Markings: Ex ia IIC T4 Ga, T4 ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$) IP66/IP68

Special Conditions for Safe Use (X):

1. The plastic enclosure may constitute a potential electrostatic ignition risk and must not be rubbed or cleaned with a dry cloth.
2. The Rosemount 701PGNKF Power Module may be replaced in a hazardous area. The power module has a surface resistivity greater than $1\text{ G}\Omega$ and must be properly installed in the wireless device enclosure. Care must be taken during transportation to and from the point of installation to prevent electrostatic charge build-up.

Brazil

I2 INMETRO Intrinsic Safety

Certificate: UL-BR 13.0534X

Standards: ABNT NBR IEC 60079-0:2008 + Errata 1:2011, ABNT NBR IEC 60079-11:2009

Markings: Ex ia IIC T4 IP66 Ga, T4 ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

China

I3 China Intrinsic Safety

Certificate: GYJ17.1225X GYJ15.1365X [Flow meters]
Standards: GB3836.1-2010, GB3836.4-2010, GB3836.20-2010
Markings: Ex ia IIC Ga T4, -40 ~ +70°C

Special Condition for Safe Use (X):

1. See certificate for special conditions.

Japan

I4 TIIS Intrinsic Safety

Certificate: TC22022X (Rosemount™ 2051C/L) TC22023X (Rosemount 2051T) TC22024X (Rosemount 2051CFx)
Markings: Ex ia IIC T4 Ga, T4 (-20 ~ +60 °C)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

EAC - Belarus, Kazakhstan, Russia

IM Technical Regulation Customs Union (EAC) Intrinsic Safety

Certificate: TC RU C-US.AA87.B.00588
Markings: 0Ex ia IIC T4 Ga X; (-40°C ≤ T_a ≤ +70°C)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

Korea

IP Korea Intrinsic Safety

Certificate: 13-KB4BO-0220X
Markings: Ex ia IIC T4 (-40 °C ≤ T_a ≤ +70 °C)

Special Condition for Safe Use (X):

1. See certificate for special conditions.

Additional certifications

SBS American Bureau of Shipping (ABS) Type Approval

Certificate: 15-HS1405241-PDA
Intended use: Marine & Offshore Applications – Measurement of either gauge or absolute pressure for liquid, gas and vapor.
ABS rules: 2015 Steel Vessels Rules 1-1-4/7.7, 1-1-Appendix 3, 1-1-Appendix 4

SBV Bureau Veritas (BV) Type Approval

Certificate: 23157 BV

BV rules: Bureau Veritas Rules for the Classification of Steel Ships

Application: Class notations: AUT-UMS, AUT-CCS, AUT-PORT and AUT-IMS; Pressure transmitter type 2051 cannot be installed on diesel engines.

SDN Det Norske Veritas (DNV) Type Approval

Certificate: TAA000004F

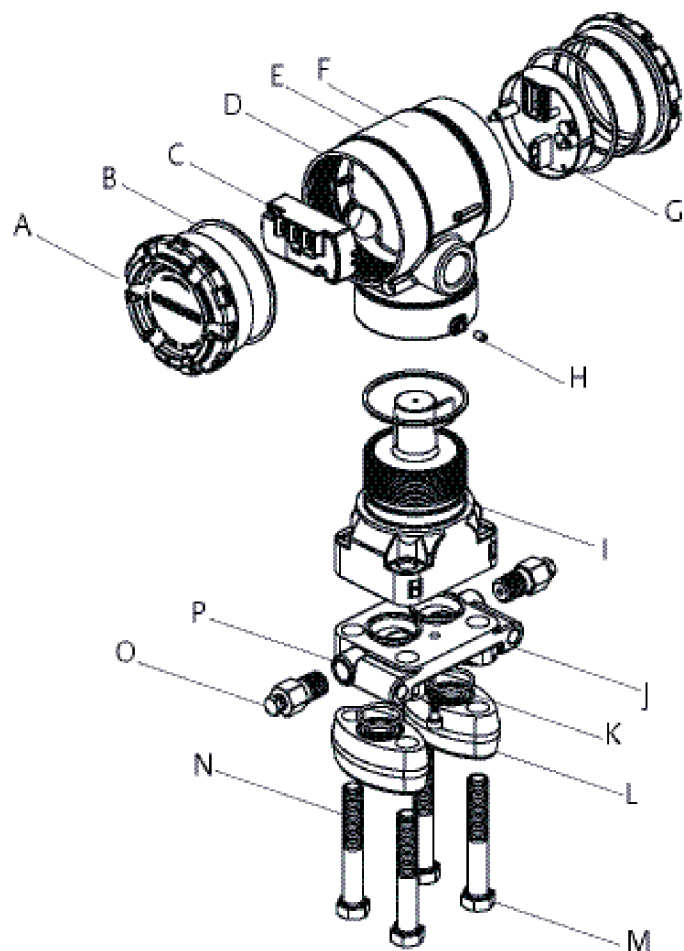
Intended use: DNV GL Rules for Classification - Ships and offshore units

Application:

Location classes	
Type	2051
Temperature	B
Humidity	B
Vibration	A
EMC	B
Enclosure	D

Dimensional drawings

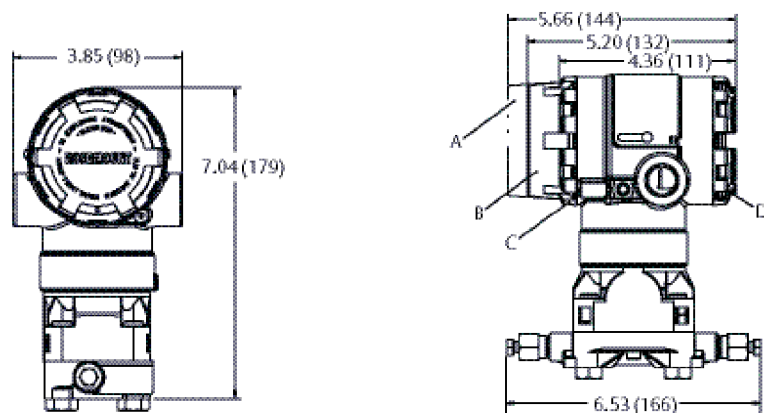
Figure 8: Rosemount 2051C Exploded View



- A. Cover
- B. Cover O-ring
- C. Terminal block
- D. Electronics housing
- E. Local configuration buttons
- F. Nameplate
- G. Electronics board
- H. Housing rotation set screw (180° maximum housing rotation without further disassembly)
- I. Sensor module
- J. Process O-ring
- K. Flange adapter O-ring
- L. Flange alignment screw (not pressure retaining)
- M. Flange bolts
- N. Flange adapters
- O. Drain/vent valve
- P. Coplanar flange

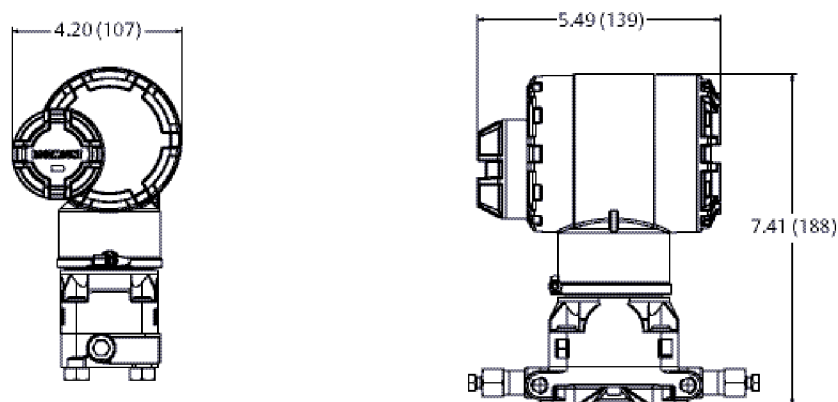
Note

Local configuration buttons: Span and zero adjustment buttons are optional with 4–20 mA and 1–5 Vdc HART® Protocol. LOI buttons are optional for PROFIBUS® PA Protocol. Local configuration buttons are not available with FOUNDATION™ Fieldbus Protocol.

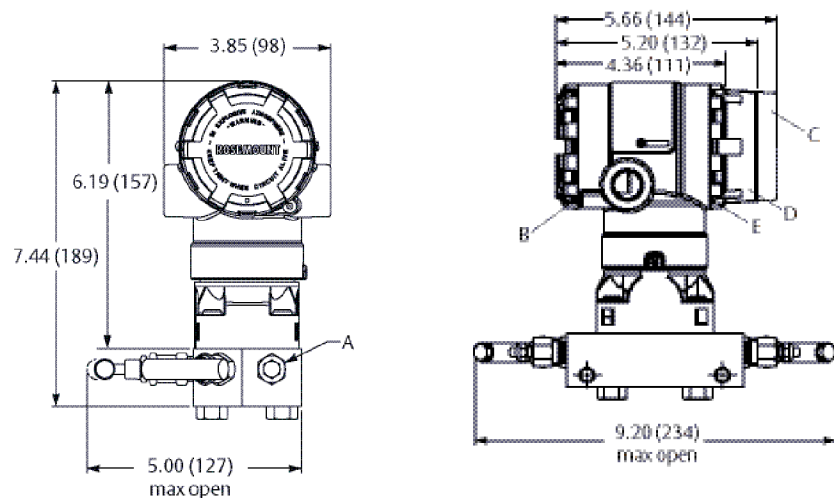
Figure 9: Rosemount 2051C Coplanar Flange

- A. FOUNDATION Fieldbus display cover
- B. HART display cover
- C. Transmitter circuitry
- D. Terminal connections

Dimensions are in inches (millimeters).

Figure 10: Rosemount 2051 Wireless Housing with Coplanar Platform

Dimensions are in inches (millimeters).

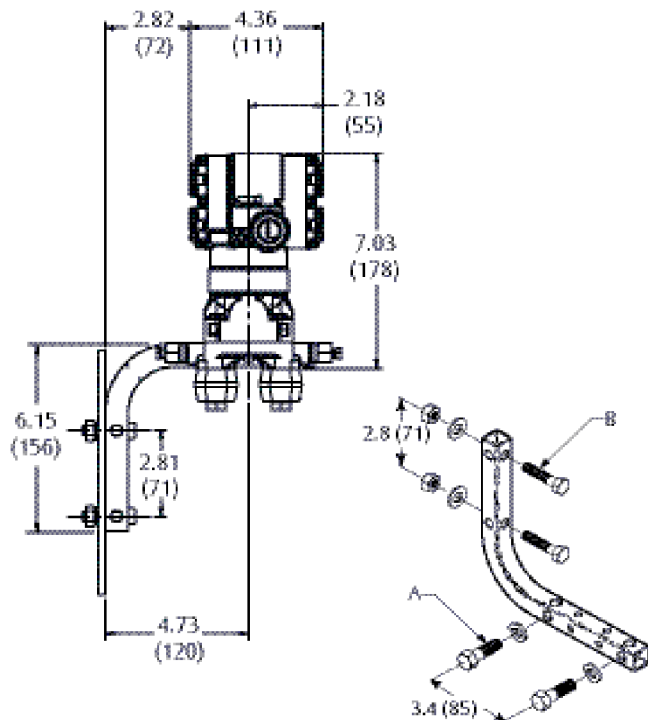
Figure 11: Rosemount 2051C Coplanar with Rosemount 305 Three-Valve Coplanar Integral Manifold

- A. Drain/vent valve
- B. Terminal connections
- C. FOUNDATION Fieldbus display cover

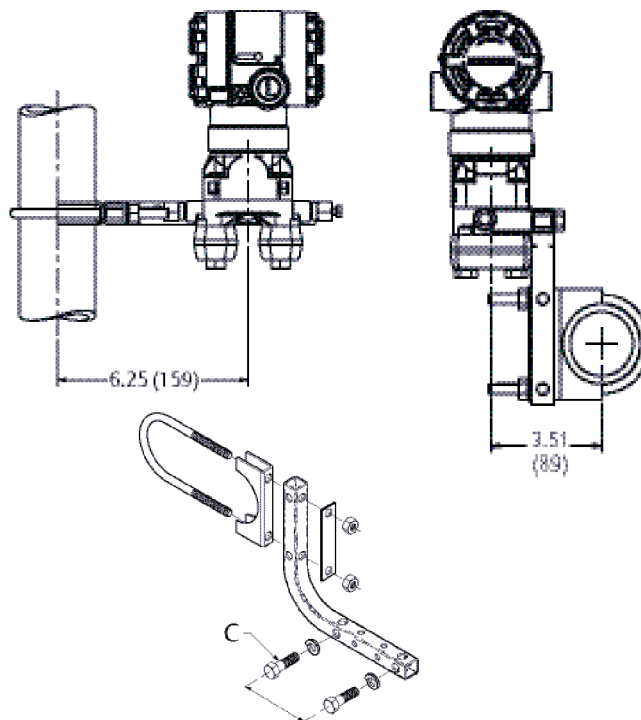
Dimensions are in inches (millimeters).

Figure 12: Coplanar Flange Mounting Configurations with Optional Bracket (B4) for 2-in. Pipe or Panel Mounting

Panel mounting



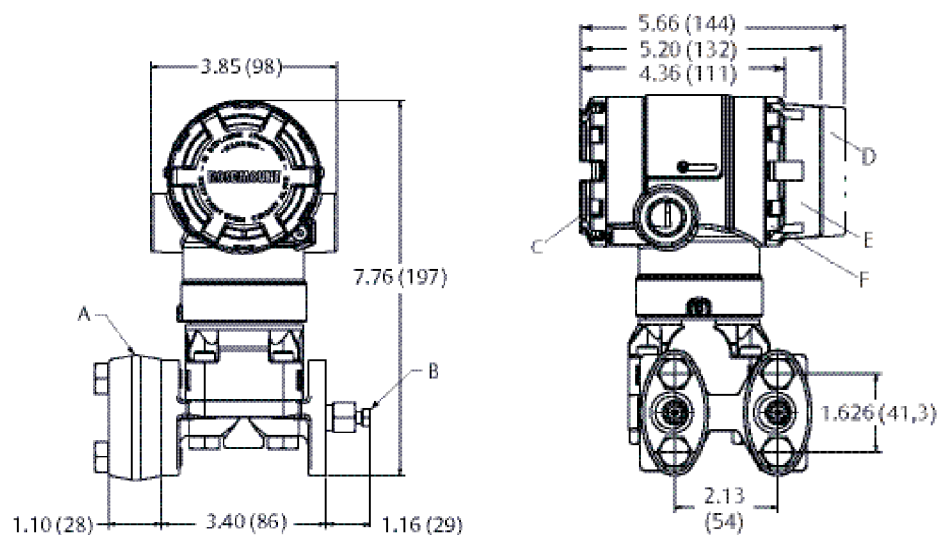
Pipe mounting



- A. 3/8-16 x 11/4 bolts for mounting to transmitter
- B. 5/16 x 11/2 bolts for panel mounting (not supplied)
- C. 2-in. U-bolt for pipe mounting

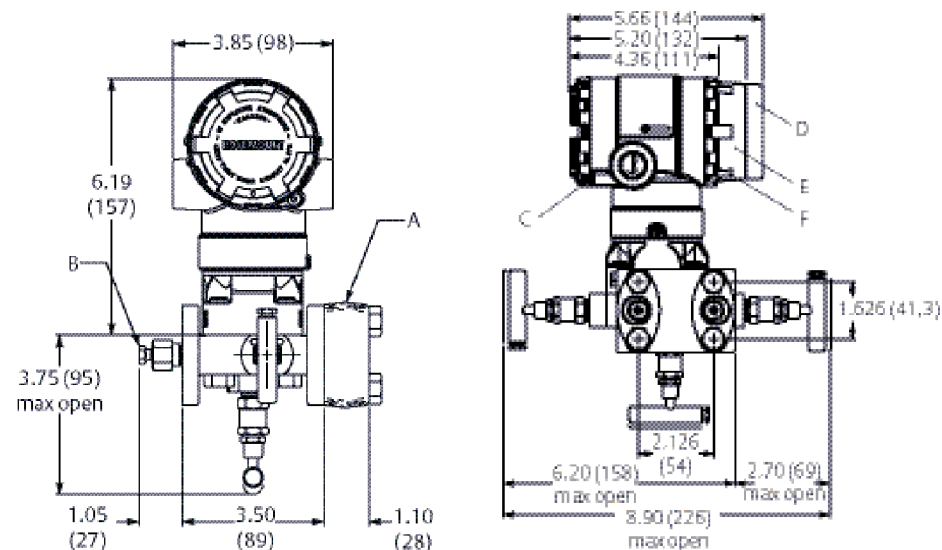
Dimensions are in inches (millimeters).

Figure 13: Rosemount 2051C Coplanar with Traditional Flange



- A. 1/2-14 NPT flange adapter (optional)
- B. Drain/vent valve
- C. Terminal connections
- D. FOUNDATION Fieldbus display cover
- E. HART display cover
- F. Transmitter circuitry

Dimensions are in inches (millimeters).

Figure 14: Rosemount 2051C Coplanar with Rosemount 305 Three-Valve Traditional Integral Manifold

- A. 1/2-14 NPT flange adapter (optional)
- B. Drain/vent valve
- C. Terminal connections
- D. FOUNDATION Fieldbus display cover
- E. HART display cover
- F. Transmitter circuitry

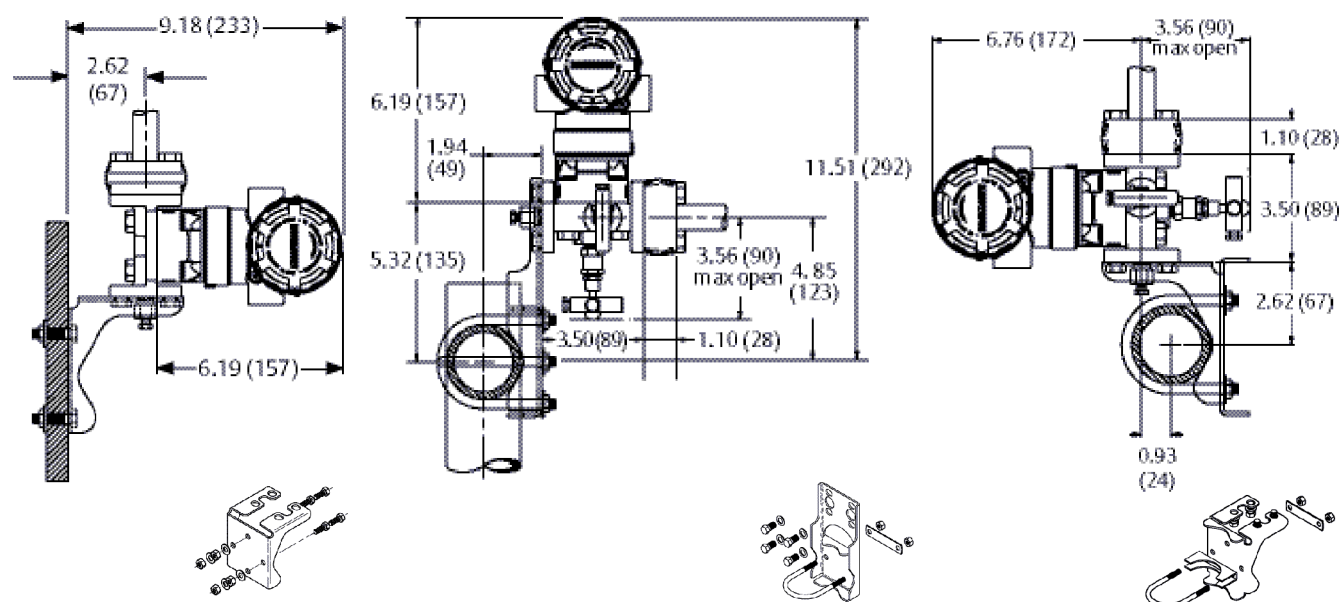
Dimensions are in inches (millimeters).

Figure 15: Traditional Flange Mounting Configurations with Optional Brackets for 2-in. Pipe or Panel Mounting

Panel mount (bracket option B2/B8)

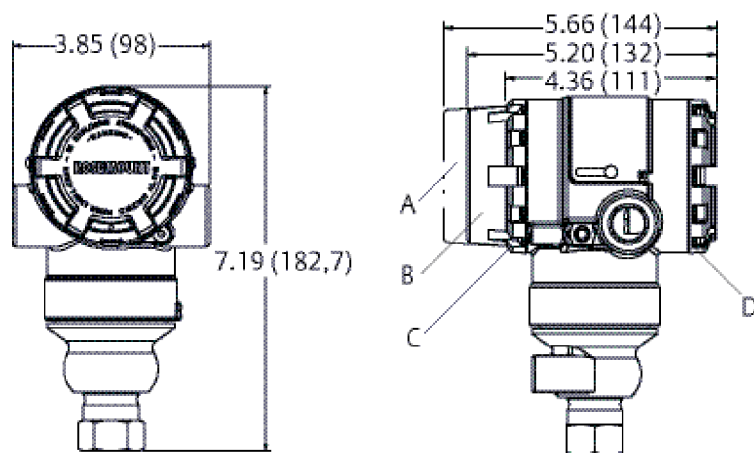
Pipe mount (bracket option B3/B9/BC)

Pipe mount (bracket option B1/B7/BA)



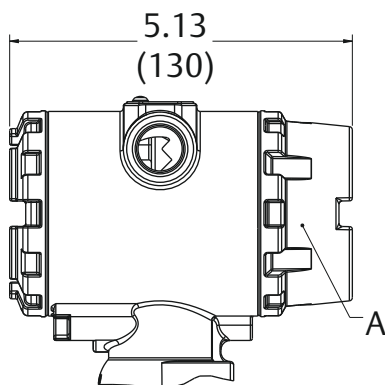
Dimensions are in inches (millimeters).

Figure 16: Rosemount 2051T

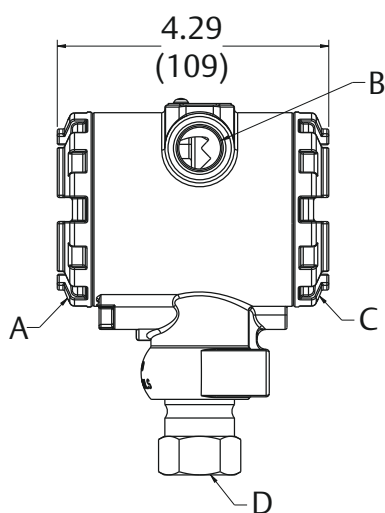


- A. FOUNDATION Fieldbus display cover
- B. HART display cover
- C. Transmitter circuitry
- D. Terminal connections

Dimensions are in inches (millimeters).

Figure 17: Rosemount 2051G with Optional Display

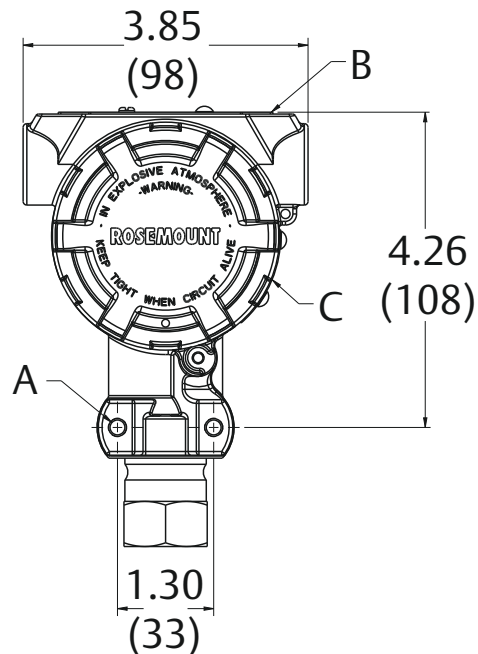
A. Digital display cover

Figure 18: Rosemount 2051G Process Connection

- A. Field terminals
- B. Conduit connection
- C. Transmitter electronics
- D. 1/2-14 NPT female connection⁽²⁾

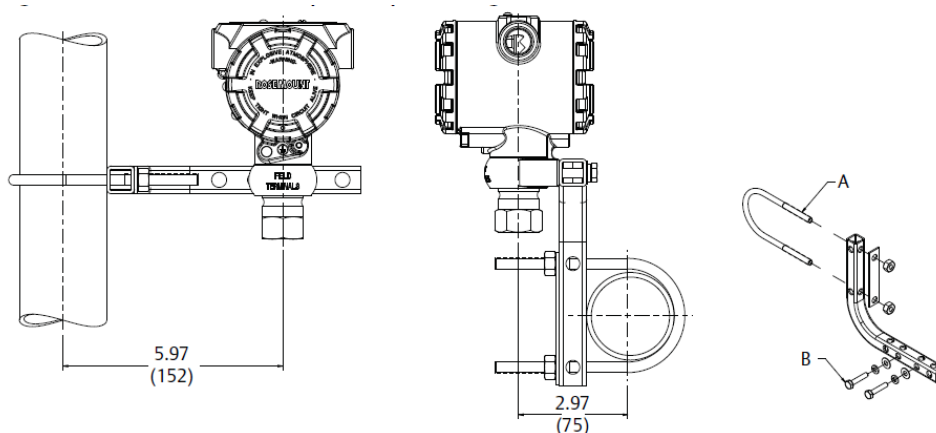
(2) RC1/2 female (PT1/2 female), and M20 female also available as options.

Figure 19: Rosemount 2051G Nameplate and Labels



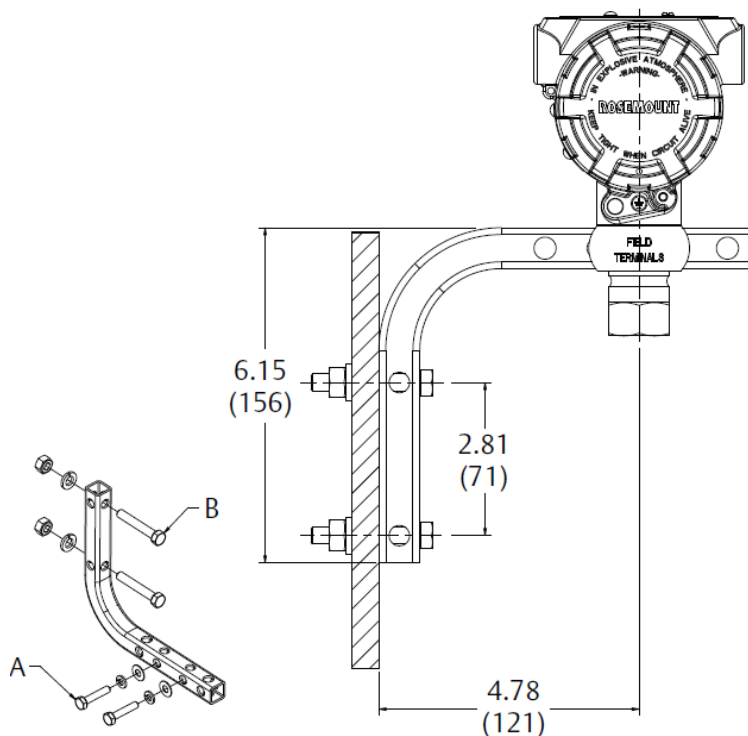
- A. Bracket mounting holes ($\frac{1}{4}$ -20 UNC)
- B. Nameplate
- C. Certification label (located on side)

Figure 20: Rosemount 2051G with Optional Pipe Mounting Bracket



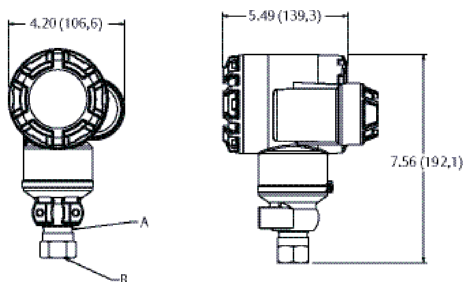
- A. 2-in. U-bolt for pipe mounting (clamp shown)
- B. $\frac{1}{4}$ x $1\frac{1}{4}$ bolts for transmitter mounting

Dimensions are in inches (millimeters).

Figure 21: Rosemount 2051G with Optional Mounting Bracket

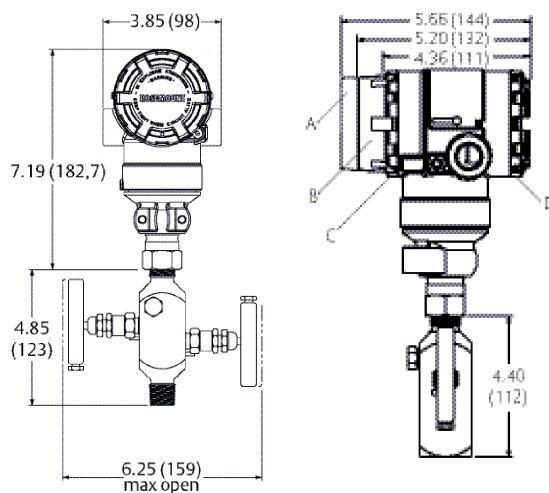
- A. $\frac{1}{4} \times 1\frac{1}{4}$ bolts for transmitter mounting
- B. $\frac{5}{16} \times \frac{1}{2}$ bolts for panel mounting (not supplied)

Dimensions are in inches (millimeters)

Figure 22: Rosemount 2051 Wireless Housing with In-line Platform

- A. U-bolt bracket
- B. $\frac{1}{2}$ -14 NPT female or $G\frac{1}{2}$ A DIN 16288 make process connection

Dimensions are in inches (millimeters).

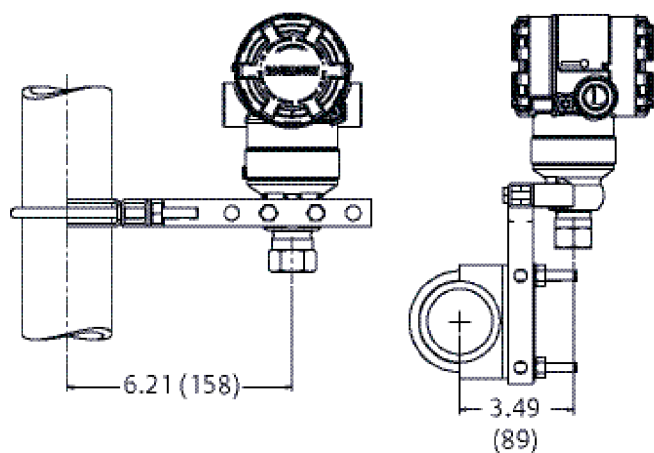
Figure 23: Rosemount 2051T with Rosemount 306 Two-Valve Integral Manifold

- A. FOUNDATION Fieldbus display cover
- B. HART display cover
- C. Transmitter circuitry
- D. Terminal connections

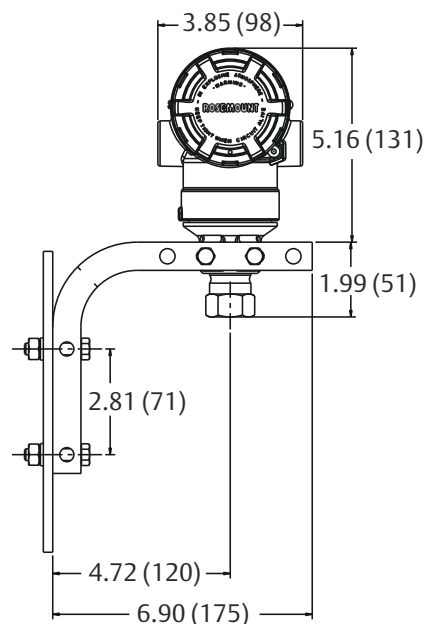
Dimensions are in inches (millimeters).

Figure 24: Rosemount 2051T Typical Mounting Configurations with Optional Mounting Bracket

Pipe mounting



Panel mounting



Dimensions are in inches (millimeters).

Figure 25: Rosemount 2051CFA Annubar Pak-Lok Flow Meter

The Rosemount Annubar Pak-Lok model is available up to Class 600 ANSI (1,440 psig at 100 °F [99 bar at 38°C]).

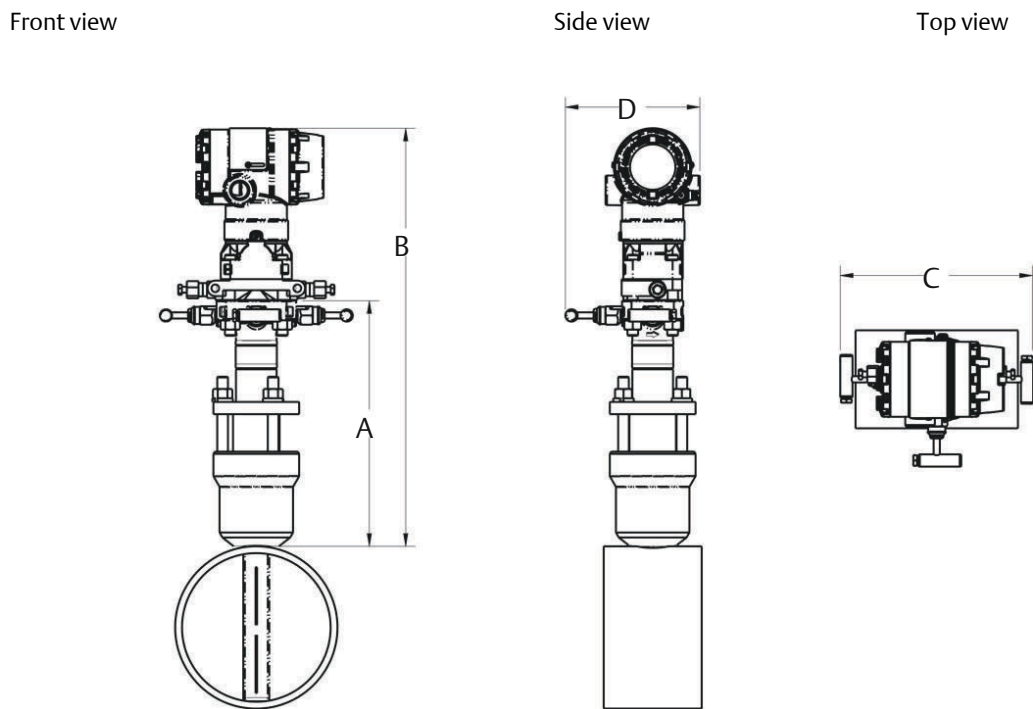


Table 26: Rosemount 2051CFA Annubar Pak-Lok Flow Meter Dimensional Data

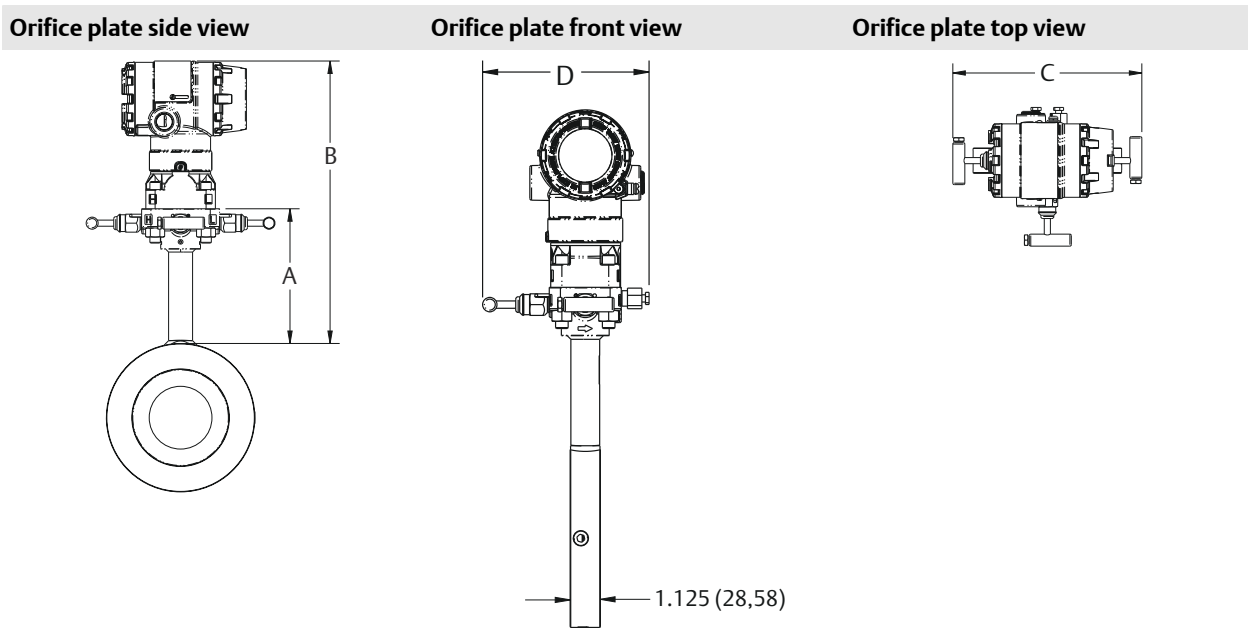
Sensor size	A (max)	B (max)	C (max)	D (max)
1	8.50 (215.9)	14.55 (369.6)	9.00 (228.6)	6.00 (152.4)
2	11.00 (279.4)	16.30 (414.0)	9.00 (228.6)	6.00 (152.4)
3	12.00 (304.8)	19.05 (483.9)	9.00 (228.6)	6.00 (152.4)

Dimensions are in inches (millimeters).

Figure 26: Rosemount 2051CFC Compact Orifice Flow Meter

Orifice plate side view	Orifice plate front view	Orifice plate top view
-------------------------	--------------------------	------------------------

Compact orifice plate (primary element type code P)



Compact orifice plate (primary element type code P)

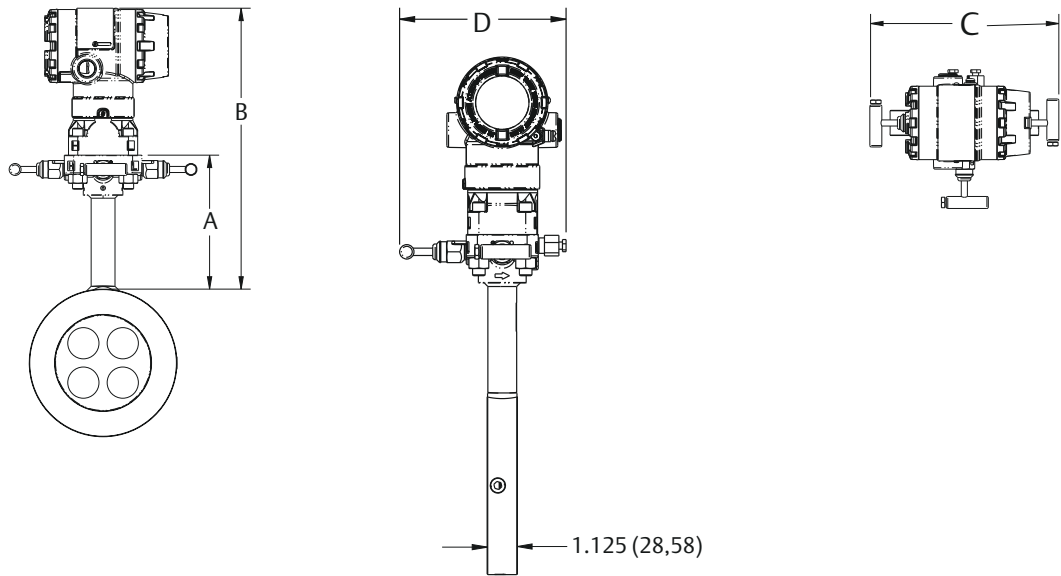
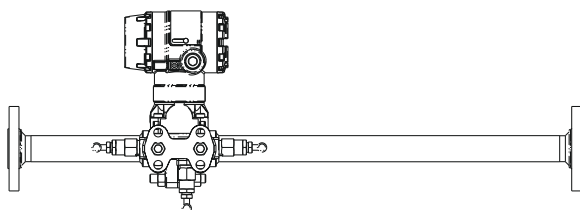


Table 27: Rosemount 2051CFC Dimensional Data

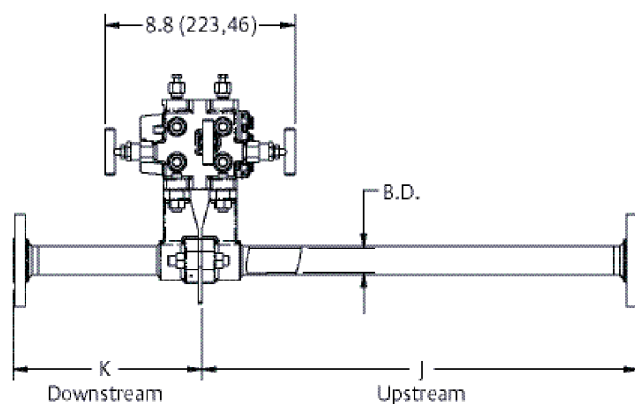
Primary element type	A	B	Transmitter height	C	D
Type P and C	5.62 (143)	Transmitter Height + A	6.27 (159)	7.75 (197) - closed 8.25 (210) - open	6.00 (152) - closed 6.25 (159) - open
Dimensions are in inches (millimeters).					

Figure 27: Rosemount 2051CFP Integral Orifice Flow Meter

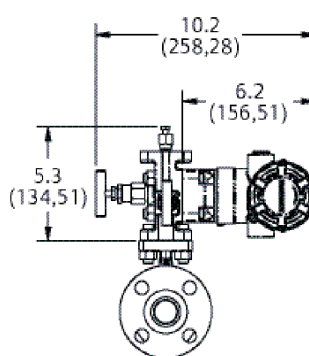
Side view



Bottom view



Front view



Dimensions are in inches (millimeters).

Table 28: Rosemount 2051CFP Dimensional Data

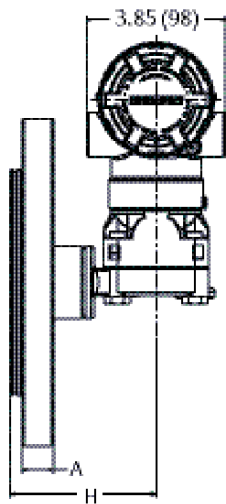
Dimension	Line size		
	½-in. (15 mm)	1-in. (25 mm)	1½-in. (40 mm)
J (beveled/threaded pipe ends)	12.54 (318,4)	20.24 (514,0)	28.44 (722,4)
J (RF slip-on, RTJ slip-on, RF-DIN slip on)	12.62 (320,4)	20.32 (516,0)	28.52 (724,4)
J (RF Class 150, weld neck)	14.37 (364,9)	22.37 (568,1)	30.82 (782,9)
J (RF Class 300, weld neck)	14.56 (369,8)	22.63 (574,7)	31.06 (789,0)
J (RF Class 600, weld neck)	14.81 (376,0)	22.88 (581,0)	31.38 (797,1)
K (beveled/threaded pipe ends)	5.74 (145,7)	8.75 (222,2)	11.91 (302,6)
K (RF slip-on, RTJ slip-on, RF-DIN slip on) ⁽¹⁾	5.82 (147,8)	8.83 (224,2)	11.99 (304,6)
K (RF Class 150, weld neck)	7.57 (192,3)	10.88 (276,3)	14.29 (363,1)
K (RF Class 300, weld neck)	7.76 (197,1)	11.14 (282,9)	14.53 (369,2)
K (RF Class 600, weld neck)	8.01 (203,4)	11.39 (289,2)	14.85 (377,2)
B.D. (bore diameter)	0.664 (16,87)	1.097 (27,86)	1.567 (39,80)

⁽¹⁾ Downstream length shown here includes plate thickness of 0.162-in. (4.11 mm).

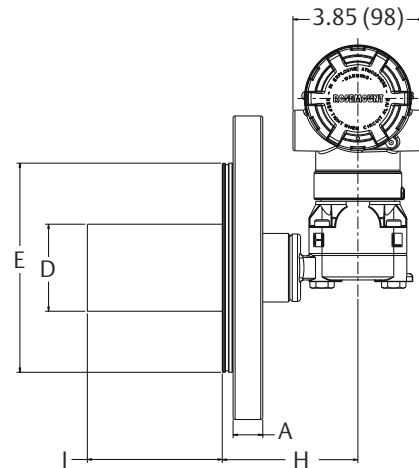
Dimensions are in inches (millimeters).

Figure 28: Rosemount 2051L Liquid Level

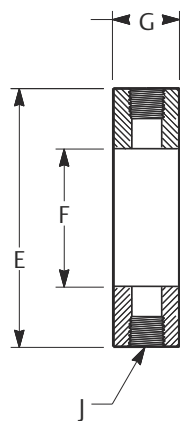
2-in. flange configuration (flush mount only)



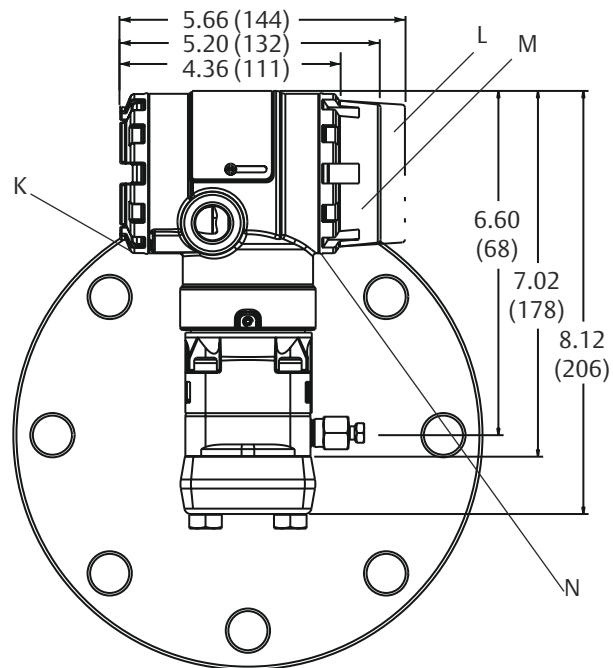
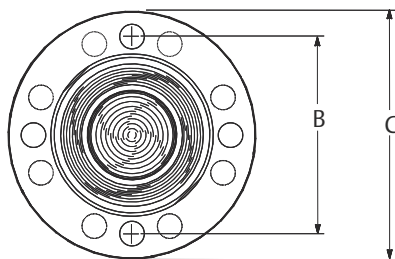
3- and 4-in. flange configuration



Optional flushing connection ring (lower housing)



Diaphragm assembly and mounting flange



A–H. Refer to [Table 29](#)

I. 2-, 4-, or 6-in. extension (50.8, 101.6, 152.4)

J. Flushing connection

K. Terminal connections

L. FOUNDATION Fieldbus display cover

M. HART display cover

N. Transmitter circuitry

Dimensions are in inches (millimeters).

Table 29: 2051L Dimensional Specifications

Class ⁽¹⁾	Pipe size	Flange thickness A	Bolt circle diameter B	Outside diameter C	No. of bolts	Bolt hole diameter	Extension diameter ⁽¹⁾ D	O.D. gasket surface E
ASME B16.5 (ANSI) 150	2 (51)	0.69 (18)	4.75 (121)	6.0 (152)	4	0.75 (19)	N/A	3.6 (92)
	3 (76)	0.88 (22)	6.0 (152)	7.5 (191)	4	0.75 (19)	2.58 (66)	5.0 (127)
	4 (102)	0.88 (22)	7.5 (191)	9.0 (229)	8	0.75 (19)	3.5 (89)	6.2 (158)
ASME B16.5 (ANSI) 300	2 (51)	0.82 (21)	5.0 (127)	6.5 (165)	8	0.75 (19)	N/A	3.6 (92)
	3 (76)	1.06 (27)	6.62 (168)	8.25 (210)	8	0.88 (22)	2.58 (66)	5.0 (127)
	4 (102)	1.19 (30)	7.88 (200)	10.0 (254)	8	0.88 (22)	3.5 (89)	6.2 (158)
DIN 2501 PN 10–40	DN 50	20 mm	125 mm	165 mm	4	18 mm	N/A	4.0 (102)
DIN 2501 PN 25/40	DN 80	24 mm	160 mm	200 mm	8	18 mm	66 mm	5.4 (138)
	DN 100	24 mm	190 mm	235 mm	8	22 mm	89 mm	6.2 (158)

Dimensions are in inches (millimeters).

(1) Tolerances are -0.020 and $+0.040$ ($-0,51$ and $+1,02$).

Class ⁽¹⁾	Pipe size	Process side F	Lower housing G		H
			¼ NPT	½ NPT	
ASME B16.5 (ANSI) 150	2 (51)	2.12 (54)	0.97 (25)	1.31 (33)	5.65 (143)
	3 (76)	3.6 (91)	0.97 (25)	1.31 (33)	5.65 (143)
	4 (102)	3.6 (91)	0.97 (25)	1.31 (33)	5.65 (143)
ASME B16.5 (ANSI) 300	2 (51)	2.12 (54)	0.97 (25)	1.31 (33)	5.65 (143)
	3 (76)	3.6 (91)	0.97 (25)	1.31 (33)	5.65 (143)
	4 (102)	3.6 (91)	0.97 (25)	1.31 (33)	5.65 (143)
DIN 2501 PN 10–40	DN 50	2.4 (61)	0.97 (25)	1.31 (33)	5.65 (143)
DIN 2501 PN 25/40	DN 80	3.6 (91)	0.97 (25)	1.31 (33)	5.65 (143)
	DN 100	3.6 (91)	0.97 (25)	1.31 (33)	5.65 (143)

(1) Tolerances are -0.020 and $+0.040$ ($-0,51$ and $+1,02$).

Dimensions are in inches (millimeters).

Options

Standard configuration

Unless otherwise specified, transmitter is shipped as follows:

Engineering units	inH ₂ O (ranges 1, 2, and 3)
Differential/gage	psi (ranges 4–5)
Rosemount 2051TA	psi (all ranges)

4 mA (1 Vdc) ⁽¹⁾	0 (engineering units)
20 mA (5 Vdc) ⁽¹⁾ :	Upper range limit
Output:	Linear
Flange type	Specified model code option
Flange material	Specified model code option
O-ring material	Specified model code option
Drain/vent:	Specified model code option
LCD display	Installed or none
Alarm ⁽¹⁾	High
Software tag	(Blank)

(1) Not applicable to FOUNDATION Fieldbus, PROFIBUS PA, or wireless.

Custom configuration

If option code C1 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

Note

Custom configurations are not applicable to FOUNDATION Fieldbus or PROFIBUS PA Protocols.

- Output information
- Transmitter information
- LCD display configuration
- Hardware selectable information
- Signal selection
- Wireless information
- Scaled variable

Refer to the Rosemount 2051 [Configuration Data Sheet](#) and the Rosemount 2051 Wireless [Configuration Data Sheet](#).

Tagging (3 options available)

Standard SST hardware tag is permanently affixed on transmitter. Tag character height is 0.125-in. (3,18 mm), 84 characters maximum.

Tag may be wired to the transmitter nameplate upon request, 85 characters maximum.

Tag may be stored in transmitter memory. Character limit is dependent on protocol.

- HART® Revision 5: 8 characters
- HART Revision 7 and wireless: 32 characters
- FOUNDATION Fieldbus: 32 characters
- PROFIBUS PA: 32 characters

Commissioning tags are temporarily attached to all transmitters. The tag indicates the device ID and allows an area for writing the location.

Note

The commissioning tag applies only to FOUNDATION Fieldbus Protocol.

Optional Rosemount 304, 305, or 306 Integral Manifolds

Factory assembled to Rosemount 2051C, 2051T, and 2051G Transmitters. Refer to the Rosemount Manifolds [Product Data Sheet](#) for additional information.

Other seals

Refer to the Rosemount DP Level Transmitters and 1199 Seal Systems [Product Data Sheet](#) for additional information.

Output information

Output range points must be the same unit of measure. Available units of measure include:

Pressure		
atm	mmH ₂ O at 4 °C ⁽¹⁾	ftH ₂ O at 4 °C ⁽¹⁾
mbar	ftH ₂ O	psi
bar	inH ₂ O at 60 °F ⁽¹⁾	torr
inH ₂ O	Psf ⁽¹⁾	cmH ₂ O at 4 °C ⁽¹⁾
inHg	g/cm ²	cmHg at 0 °C ⁽¹⁾
hPa ⁽¹⁾	kg/cm ²	ftH ₂ O at 60 °F ⁽¹⁾
mHg at 0 °C ⁽¹⁾	Pa	mH ₂ O at 4 °C ⁽¹⁾
inH ₂ O at 4 °C ⁽¹⁾	kPa	mHg at 0 °C ⁽¹⁾
mmH ₂ O	MPa ⁽¹⁾⁽²⁾	hPa ⁽¹⁾
mmHg	kg/m ² ⁽¹⁾	
Flow ⁽²⁾⁽³⁾		
bbl	kg	cm ³
ft ³	lb	m ³
gal	L	ton
Level ⁽³⁾		
%	ft	cm
in	mm	

(1) Available with enhanced Rosemount 2051 and wireless.

(2) Available on PROFIBUS PA Protocol.

(3) All flow units are available per second, minute, hour or day.

Display and interface options

M4 Digital display with LOI

- Available for 4–20 mA HART®, 4–20 mA HART Low Power, and PROFIBUS® PA Protocols.

M5 Digital display

- 2-line, 5-digit LCD display for 4–20 mA HART Protocol
- 2-line, 5-digit LCD display for HART 1–5 Vdc Low Power Protocol
- 2-line, 8-digit LCD display for FOUNDATION™ Fieldbus and PROFIBUS PA Protocols
- 3-line, 7-digit LCD display for wireless
- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90° rotation capability for easy viewing

Configuration buttons

Rosemount 2051 requires option D4 (analog zero and span), DZ (digital trim), M4 (LOI) for local configuration buttons.

Transient protection

T1 Integral transient protection terminal block

Meets IEEE C62.41, category location B

- 6 kV crest (0.5 μ s–100 kHz)
- 3 kA crest (8 x 20 microseconds)
- 6 kV crest (1.2 x 50 microseconds)

Bolts for flanges and adapters

Standard material is plated carbon steel per ASTM A449, type 1

L4 Austenitic 316 SST bolts

L5 ASTM A 193, Grade B7M bolts

L6 Alloy K-500 bolts

L8 ASTM A 193 Class 2, Grade B8M bolts

Conduit plug

DO 316 SST conduit plug

Single 316 SST conduit plug replaces CS plug

Rosemount 2051C coplanar flange and 2051T bracket option

B4 Bracket for 2-in. pipe or panel mounting

- For use with the standard coplanar flange configuration

- Bracket for mounting of transmitter on 2-in. pipe or panel
- SST construction with SST bolts

Rosemount 2051C traditional flange bracket options

B1 Bracket for 2-in. pipe mounting

- For use with the traditional flange option
- Bracket for mounting on 2-in. pipe
- CS construction with CS bolts
- Coated with polyurethane paint

B2 Bracket for panel mounting

- For use with the traditional flange option
- Bracket for mounting transmitter on wall or panel
- CS construction with CS bolts
- Coated with polyurethane paint

B3 Flat bracket for 2-in. pipe mounting

- For use with the traditional flange option
- Bracket for vertical mounting of transmitter on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B7 B1 bracket with SST bolts

- Same bracket as the B1 option with Series 300 SST bolts

B8 B2 bracket with SST bolts

- Same bracket as the B2 option with Series 300 SST bolts

B9 B3 bracket with SST bolts

- Same bracket as the B3 option with Series 300 SST bolts

BA SST B1 bracket with SST bolts

- B1 bracket in SST with Series 300 SST bolts

BC SST B3 bracket with SST bolts

- B3 bracket in stainless steel with Series 300 SST bolts

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Rosemount™ 2088 Absolute and Gauge Pressure Transmitter



- Performance of 0.065 percent with high accuracy option
- Lightweight, compact design for cost-effective installation
- Protocols available include 4–20 mA HART® and 1–5 Vdc HART Low Power
- Absolute and gauge pressure ranges up to 4,000 psi (276 bar)
- Rangeability of 50:1

Product offering

Proven reliability for gauge and absolute applications



- Available protocols include 4–20 mA HART and 1–5 Vdc HART Low Power
- Fully configurable LCD display to display process variable, percent of range, and diagnostic messages
- Lightweight, compact design enables easy installation
- Choice of stainless steel (SST) or Alloy C-276 wetted materials

Unlock the value of devices with the Emerson Wireless THUM™ Adapter



- Gain access to field intelligence and improve quality, safety, availability, operations, and maintenance costs
- Remotely manage devices and monitor health
- Enable new wireless measurement points
- Utilize existing loop power

Proven, reliable, and innovative DP Level Technologies



- Connect to virtually any process with a comprehensive offering of process connections, fill fluids, direct mount or capillary connections and materials.
- Quantify and optimize total system performance with QZ option

Contents

Product offering.....	2
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Product certifications.....	17
Dimensional drawings	26
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Instrument manifolds – quality, convenient, and easy



- Designed and engineered for optimal performance with Rosemount transmitters.
- Save installation time and money with factory assembly.
- Offers a variety of styles, materials, and configurations

Ordering information



The Rosemount 2088 Gage and Absolute Pressure Transmitter offers proven reliability for gage and absolute pressure measurement. The in-line, compact design allows the transmitter to be connected directly to the process for quick, easy, and cost effective installation. Capabilities include:

- Local Operator Interface (LOI) that has easy-to-use menus and built-in configuration buttons, so you can commission the device on the spot without complicated tools.
- Available with manifolds and remote seals.
- 4-20 mA HART and 1-5 Vdc HART Low Power.

CONFIGURE >

VIEW PRODUCT >

Online Product Configurator

Many products are configurable online using our Product Configurator. Select the **Configure** button or visit our [website](#) to start. With this tool's built-in logic and continuous validation, you can configure your products more quickly and accurately.

Specifications and options

See the Specifications and options section for more details on each configuration. Specification and selection of product materials, options, or components must be made by the purchaser of the equipment. See the Material selection section for more information on material selection.

Model codes

Model codes contain the details related to each product. Exact model codes will vary; an example of a typical model code is shown in [Figure 1](#).

Figure 1: Model Code Example

3051C D 2 X 2 2 1 A	WA3 WP5	M5 B4
1	2	3

1. Required model components (choices available on most)
2. Wireless options (optional for many products, required for wireless products)
3. Additional options (variety of features and functions that may be added to products)

The starred offerings (★) represent the most common options and should be selected for best delivery. The non-starred offerings are subject to additional delivery lead time.

Required model components

Model

Code	Description
2088	Pressure transmitter

Measurement type

Code	Description	
A	Absolute	★
G	Gauge	★

Pressure ranges

Code	Rosemount 2088G	Rosemount 2088A	
1	–14.7 to 30 psi (–1.01 to 2.1 bar)	0 to 30 psi (0 to 2.1 bar)	★
2	–14.7 to 150 psi (–1.01 to 10.3 bar)	0 to 150 psi (0 to 10.3 bar)	★
3	–14.7 to 800 psi (–1.01 to 55.2 bar)	0 to 800 psi (0 to 55.2 bar)	★
4	–14.7 to 4,000 psi (–1.01 to 275.8 bar)	0 to 4,000 psi (0 to 275.8 bar)	★

Transmitter output

HART Revision 5 is the default HART output. The Rosemount 2088 with selectable HART can be factory or field configured to HART Revision 7. To order HART Revision 7 factory configured, add option code HR7.

Code	Description	
S	4–20 mA dc/Digital HART Protocol	★
N	1–5 Vdc Low Power/Digital HART Protocol	★

Materials of construction

Materials of construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

Code	Description			
	Process connection	Isolating diaphragm	Fill fluid	
22	316L SST	316L SST	Silicone	★
33	Alloy C-276	Alloy C-276	Silicone	★
2B	316L SST	316L SST	Inert	

Process connection

Code	Description	
A	½–14 NPT female	★
B ⁽¹⁾	DIN 16288 G ½ male	★
D ⁽¹⁾⁽²⁾	M20 x 1.5 male	★
C ⁽²⁾⁽³⁾	RC ½ female	

(1) Not available with Low Power transmitter output code N.

(2) Not available with Alloy C-276, materials of construction code 33.

(3) Consists of a ½–14 NPT housing with a G½ adapter.

Conduit entry

Code	Description	
1	½–14 NPT	★
2 ⁽¹⁾	M20 x 1.5	★
4 ⁽¹⁾⁽²⁾	G–½	

(1) Not available with Low Power transmitter output code N.

(2) Consists of a ½–14 NPT housing with a G½ adapter.

Additional options

Extended product warranty

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Diaphragm seal assemblies

Use ½–14 NPT female process connection code A. “Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S1	Assemble to one Rosemount 1199 Diaphragm Seal	★

Display and interface

Code	Description	
M4	LCD display with local operator interface	★
M5	LCD display, configured for engineering units	★

Configuration buttons

Code	Description	
D4	Analog zero and span	★
DZ	Digital zero trim	★

Mounting brackets

Code	Description	
B4	SST mounting bracket with SST bolts	★

Product certifications

Code	Description	
C6	Canada Explosionproof, Intrinsic Safety, Division 2, and Dust-Ignitionproof	★
E2	INMETRO Flameproof	★
E4 ⁽¹⁾⁽²⁾	Japan Flameproof	★
E5	USA Explosionproof (XP) and Dust-Ignitionproof (DIP)	★
E7	IECEx Flameproof	★
ED	ATEX Flameproof	★
EM	Technical Regulations Customs Union (EAC) Flameproof	★
I1 ⁽¹⁾	ATEX Intrinsic Safety	★
I2	INMETRO Intrinsic Safety	★
I3	China Intrinsic Safety	
I5	USA Intrinsic Safety (IS) and Nonincendive (NI)	★
I7	IECEx Intrinsic Safety	★
IM	Technical Regulation Customs Union (EAC) Intrinsic Safety	★
K1	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K2	INMETRO Flameproof, Intrinsic Safety	★
K5	USA Explosionproof, Dust-Ignitionproof, Intrinsic Safety, and Nonincendive	★
K6 ⁽¹⁾	Canada Explosion-Proof, Intrinsic Safety, Division 2, Dust-ignitionproof, and ATEX Flameproof, Intrinsic Safety	★
K7	IECEx Flameproof, Intrinsic Safety, Type n, Dust	★
KB	USA Explosionproof, Dust-Ignitionproof, Intrinsic Safety, Nonincendive, and Canada Explosionproof, Dust-Ignitionproof, Intrinsic Safety, Division 2	★
KM	Technical Regulation Customs Union (EAC) Flameproof and Intrinsic Safety	★
KH ⁽¹⁾	ATEX Flameproof, Intrinsic Safety, and USA Explosion-Proof, Dust Ignitionproof, Intrinsic Safety, and Nonincendive	★
N1 ⁽¹⁾	ATEX Type n	★
N3	China Type n	★
N7	IECEx Type n	★

Code	Description	
ND ⁽¹⁾	ATEX Dust	★
NK	IECEX Dust	★

(1) Not available with Low Power transmitter output code N.

(2) Only available with conduit thread code 4.

Shipboard approvals

Code	Description	
SBS	American Bureau of Shipping (ABS) Type Approval	★
SBV	Bureau Veritas (BV) Type Approval	★
SDN	Det Norske Veritas (DNV) Type Approval	★
SLL	Lloyd's Register (LR) Type Approval	★

Pressure testing

Code	Description	
P1	Hydrostatic testing	

Terminal blocks

Code	Description	
T1	Transient protection	★

Special cleaning

Code	Description	
P2	Cleaning for special service	

Calibration certificate

Code	Description	
Q4	Calibration certificate	★

Quality calibration certificate traceability certification

Code	Description	
Q8	Material traceability certification per EN 10204 3.1	★
Q15	Certificate of compliance to NACE® MR0175/ISO 15156 for wetted materials	★
Q25	Certificate of compliance to NACE MR0103 for wetted materials	★

Positive material identification (PMI)

Code	Description	
Q76	PMI verification and certificate	★

Digital signal

Code	Description	
C4 ⁽¹⁾	NAMUR alarm and saturation levels, high alarm	★
CN ⁽¹⁾	NAMUR alarm and saturation levels, low alarm	★
C5 ⁽¹⁾⁽²⁾	Custom alarm and saturation levels, high alarm (requires C9 and Configuration Data Sheet)	★
C7 ⁽¹⁾⁽²⁾	Custom alarm and saturation levels, low alarm (requires C9 and Configuration Data Sheet)	★
C8 ⁽²⁾	Low alarm (Standard Rosemount alarm and saturation levels)	★

(1) Only available with 4–20 mA HART output (output code A).

(2) Select configuration buttons (option code D4 or DZ) or local operator interface (option code M4) if local configuration buttons are required.

Conduit plug

Transmitter shipped with 316SST conduit plug (uninstalled) in place of standard carbon steel conduit plug.

Code	Description	
DO	316 SST conduit plug	★

Configuration

Code	Description	
C9	Software configuration	★

Manifold assemblies

Use ½–14 NPT female process connection code A. “Assemble-to” items are specified separately and require a completed model number.

Code	Description	
S5	Assemble to Rosemount 306 Integral Manifold	★

Calibration accuracy

Requires transmitter output code S with either materials of construction code 22 or 23.

Code	Description	
P8	0.065% accuracy to 10:1 turndown	★

Water approval

Requires materials of construction code 22 with process connection code A.

Code	Description	
DW	NSF drinking water approval	★

Surface finish

Code	Description	
Q16	Surface finish certification for sanitary remote seals	★

Toolkit total system performance reports

Code	Description	
QZ	Remote seal system performance calculation report	★

HART revision configuration

Select configuration buttons (option code D4 or DZ) or local operator interface (option code M4) if local configuration buttons are required.

Code	Description	
HR5 ⁽¹⁾	Configured for HART Revision 5	★
HR7 ⁽²⁾	Configured for HART Revision 7	★

(1) Configures the HART output to HART Revision 5. The device can be field configured to HART Revision 7 if needed.

(2) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.

Specifications

Performance specifications

For zero-based spans, reference conditions, silicone oil fill, and 316L SST isolating diaphragm

Reference accuracy

±0.075 percent of calibrated span. Includes combined effects of linearity, hysteresis, and repeatability

±0.065 percent of calibrated span (high accuracy option – P8)

For spans less than 10:1, accuracy = $\pm \left[0.009 \left(\frac{URL}{Span} \right) \right]$ percent of span

Ambient temperature effect

Expressed as a total effect per 50 °F (28 °C)

Total effect includes zero and span effects

± (0.15 percent URL + 0.15 percent of span)

Stability

Ranges 2–4: ±0.10 percent of URL for three years

Range 1: ±0.10 percent of URL for one year

Warranty

Warranty details can be found in [Emerson Terms & Conditions of Sale](#), document 63445, Rev G (10/6).

For all Rosemount 2088 models:

- One-year limited warranty is standard.
- Extended three-year and five-year limited warranties available if ordered (select option WR3 or WR5 in model string respectively).

Note

Goods are warranted for 12 months from the date of initial installation or 18 months from the date of shipment by seller, whichever period expires first.

Note

Three-year and five-year warranty period begins on date of shipment by seller.

Vibration effect

Less than ±0.1 percent of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10–60 Hz 0.21 mm displacement peak amplitude/60–2000 Hz 3g)

Power supply effect

Less than ±0.005 percent of calibrated span per volt change in voltage at the transmitter terminals.

Electromagnetic compatibility (EMC)

Note

NAMUR NE-21 does not apply to Low-Power (Transmitter output option code N).

Note

During surge event, device may exceed maximum EMC deviation limit or reset; however, device will self-recover and return to normal operation within specified start-up time.

Mounting position effect

Zero shifts to ± 2.5 inH₂O (6.22 mbar), which can be zeroed

Span: no effect

Transient protection

Tested in accordance with IEEE C62.41.2-2002, Location Category B

6 kV crest (0.5 μ s – 100 kHz)

3 kA crest (8 \times 20 microseconds)

6 kV crest (1.2 \times 50 microseconds)

General specifications

Tested to IEC 801-3

Functional specifications

Table 1: Rosemount 2088 Range Values

Range	Minimum span	Upper (URL)	Lower (LRL)	Lower ⁽¹⁾ (LRL) (gauge)
1	0.60 psi (41.37 mbar)	30.00 psi (2.07 bar)	0 psia (0 bar)	–14.70 psig (–1.01 bar)
2	3.00 psi (206.85 mbar)	150.00 psi (10.34 bar)	0 psia (0 bar)	–14.70 psig (–1.01 bar)
3	16.00 psi (1.11 bar)	800.00 psi (55.16 bar)	0 psia (0 bar)	–14.70 psig (–1.01 bar)
4	80.00 psi (5.52 bar)	4000.00 psi (275.79 bar)	0 psia (0 bar)	–14.70 psig (–1.01 bar)

(1) Assumes atmospheric pressure of 14.70 psia (1.01 bar-a).

Output

Code S: 4–20 mA Code N: 1–5 Vdc, Low Power

Outputs are directly proportional to the input pressure

Selectable HART

Digital communications based on HART Revision 5 (default) or Revision 7 (option code HR7) protocol can be selected. The HART revision can be switched in the field using any HART based configuration tool or the optional local operator interface (LOI).

Service

Liquid, gas, and vapor applications

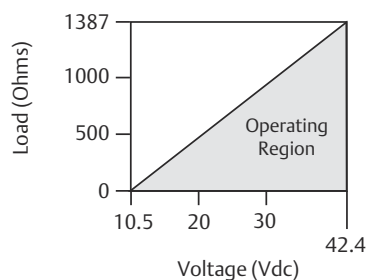
Power supply

External power supply required. Transmitter operates on 10.5–42.4 Vdc with no load (5.8–28 V for Low Power). Reverse polarity protection is standard.

Load limitations

Reverse polarity protection is standard. Maximum loop resistance is determined by the power supply voltage as described by the following equations:

Figure 2: Maximum Loop Resistance



Maximum loop resistance = $43.5 (\text{Power supply voltage} - 10.5)$

The Field Communicator requires a minimum loop resistance of 250 Ω for communication.

Indication

Optional two-line LOI/LCD display

Zero and span adjustment requirements

Zero and span values can be set anywhere within the range limits stated in [Table 1](#). Span must be greater than or equal to the minimum span stated in [Table 1](#).

LOI

The LOI utilizes a two-button menu with internal and external configuration buttons. Internal buttons are always configured for LOI. External buttons can be configured for either LOI, (option code M4), analog zero and span (option code D4) or digital zero trim (option code DZ) for LOI configuration menu.

Current draw

Output code N: ≤ 3 mA

Overpressure limits

Range 1: 120 psig max

All other ranges: two times the URL

Burst pressure

11,000 psi for all ranges

Zero elevation and suppression

Zero can be suppressed between atmosphere for gage transmitters or zero psia for absolute transmitters and upper range limit, provided the calibrated span is equal to or greater than the minimum span, and the upper range value does not exceed the upper range limit.

Dynamic performance

Total response time: 145 milliseconds Update rate: 22 times per second minimum

Temperature limits

Ambient

–40 to 185 °F (–40 to 85 °C)

With LCD display: –40 to 176 °F (–40 to 80 °C)

Note

For the output code N, LCD display may not be readable and LCD display updates will be slower at temperatures below –22 °F (–30 °C).

Storage

–50 to 230 °F (–46 to 110 °C)

With LCD display: –40 to 185 °F (–40 to 85 °C)

Note

If storage temperature is above 185 °F (85 °C), perform a sensor trim prior to installation.

Process

Silicone fill sensor: –40 to 250 °F (–40 to 121 °C)

Inert fill sensor: –22 to 250 °F (–30 to 121 °C)

Note

220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.

Note

Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio. For example, for process temperature of 195 °F (91 °C), new ambient temperature limit is equal to 170 °F (77 °C). This can be determined as follows: $(195\text{ °F} - 185\text{ °F}) \times 1.5 = 15\text{ °F}$, $185\text{ °F} - 15\text{ °F} = 170\text{ °F}$

Humidity limits

0–100 percent relative humidity

Volumetric displacement

Less than 0.0005 in³ (0.008 cm³)

Damping

Analog output response time to a step change is user-selectable from 0 to 60 seconds for one time constant. Software damping is in addition to sensor module response time.

Turn-on time

2.0 seconds, no warm-up required

Transmitter security

Activating the transmitter security function prevents changes to the transmitter configuration, including local zero and span adjustments. Security is activated by an internal switch.

Failure mode alarm

If self-diagnostics detect a sensor or microprocessor failure, the analog signal will be driven either high or low to alert the user. High or low failure mode is user-selectable with a jumper on the transmitter. The values to which the transmitter drives its output in failure mode depend on whether it is factory-configured to standard or NAMUR-compliant operation. The values for each are as follows:

Table 2: Standard Operation

Output code	Linear output	Fail high	Fail low
S	$3.9 \leq I \leq 20.8$	$I \geq 21.75 \text{ mA}$	$I \leq 3.75 \text{ mA}$
N	$0.97 \leq V \leq 5.2$	$V \geq 5.4 \text{ V}$	$V \leq 0.95 \text{ V}$

Table 3: NAMUR-Compliant Operation

Output code	Linear output	Fail high	Fail low
S	$3.8 \leq I \leq 20.5$	$I \geq 22.5 \text{ mA}$	$I \leq 3.6 \text{ mA}$

Physical specifications

Material selection

Emerson provides a variety of Rosemount product with various product options and configurations including materials of construction that can be expected to perform well in a wide range of applications. The Rosemount product information presented is intended as a guide for the purchaser to make an appropriate selection for the application. It is the purchaser's sole responsibility to make a careful analysis of all process parameters (such as all chemical components, temperature, pressure, flow rate, abrasives, contaminants, etc.), when specifying product, materials, options, and components for the particular application. Emerson is not in a position to evaluate or guarantee the compatibility of the process fluid or other process parameters with the product, options, configuration or materials of construction selected.

Electrical connections

½–14 NPT, M20 x 1.5 (CM20), or G–½ female (PF ½ female) conduit entry

Note

Consists of a ½-14NPT housing with a G–½ adapter.

Process connections

½–14 NPT female, DIN 16288 G–½ male, RC ½ female (PT ½ female), M20 x 1.5 (CM20) male

Process-wetted parts

Isolating diaphragm

316L SST (UNS S31603), Alloy C-276 (UNS N10276)

Process connector

316L stainless steel CF-3M (Cast version of 316L SST, material per ASTM_A743) or Alloy C-276

Non-wetted parts

Electronics housing

Low-copper aluminum

Enclosures meet NEMA® Type 4X, IP66, and IP68 when properly installed

Paint for aluminum housing

Polyurethane

Cover O-rings

Buna-N

Fill fluid

Silicone or inert fill

Weight

Output code S and N: approximately 2.44 lb (1.11 kg)

Product certifications

Rev 1.18

European Directive Information

A copy of the EU Declaration of Conformity can be found at the end of the Quick Start Guide. The most recent revision of the EU Declaration of Conformity can be found at Emerson.com/Rosemount.

Ordinary Location Certification

As standard, the transmitter has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

North America

E5 USA Explosionproof (XP) and Dust-Ignitionproof (DIP)

Certificate 1V2A8.AE

Standards FM Class 3600 – 2011, FM, Class 3615 – 2006, FM Class 3616 – 2011, FM Class 3810 – 2005, ANSI/NEMA 250 – 1991

Markings XP CL I, DIV 1, GP B, C, D; DIP CL II, DIV 1, GP E, F, G; CL III; T5(–40 °C ≤ T_a ≤ +85 °C); Factory Sealed; Type 4X

I5 USA Safety (IS) and Nonincendive (NI)

Certificate 1015441

Standards FM Class 3600 – 2011, FM Class 3610 – 2010, FM Class 3611 – 2004, FM Class 3810 – 2005

Markings IS CL I, DIV 1, GP A, B, C, D; CL II, DIV 1, GP E, F, G; Class III; DIV 1 when connected per Rosemount drawing 02088–1024; NI CL 1, DIV 2, GP A, B, C, D; T4(–50 °C ≤ T_a ≤ +70 °C); Type 4x

C6 Canada Explosionproof, Intrinsic Safety and Division 2, Dust-Ignitionproof

Certificate 1015441

Standards CAN/CSA C22.2 No. 0–M91 (R2001), CSA Std C22.2 No. 25–1966, CSA Std C22.2 No. 30–M1986, CAN/CSA–C22.2 No. 94–M91, CSA Std C22.2 No. 142–M1987, CAN/CSA–C22.2 No. 157–92, CSA Std C22.2 No. 213–M1987, ANSI–ISA–12.27.01–2003

Markings Explosionproof for Class I, Division 1, Groups B, C and D; Class II, Groups E, F, and G; Class III; Intrinsically Safe Class I, Division 1 when connected in accordance with Rosemount drawing 02088–1024, Temperature Code T3C; Ex ia; Class I Division 2 Groups A, B, C and D; Type 4X; Factory Sealed; Single Seal

Europe

ED ATEX Flameproof

Certificate KEMA97ATEX2378X

Standards EN60079-0:2012 + A11:2013, EN60079-1:2014, EN60079-26:2015

Markings Ⓔ II ½ G Ex db IIC T6....T4, Ga/Gb, T6(−60 °C ≤ T_a ≤ +70 °C), T4/T5(−60 °C ≤ T_a ≤ +80 °C)

Table 4: Process Connection Temperature

Temperature class	Process connection temperature	Ambient temperature
T6	−60 to +70 °C	−60 to +70 °C
T5	−60 to +80 °C	−60 to +80 °C
T4	−60 to +120 °C	−60 to +80 °C

Special Conditions for Safe Use (X):

1. This device contains a thin wall diaphragm. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

I1 ATEX Intrinsic Safety

Certificate BAS00ATEX1166X

Standards EN60079-0:2012 + A11:2013, EN60079-11:2012

Markings Ⓔ II 1 G Ex ia IIC T4 Ga (−55 °C ≤ T_a ≤ +70 °C)

Table 5: Input Parameters

Parameter	HART
Voltage U _i	30 V
Current I _i	200 mA
Power P _i	0.9 W
Capacitance C _i	0.012 μF

Special Conditions for Safe Use (X):

1. The apparatus is not capable of withstanding the 500 V insulation test required by EN60079-11. This must be taken into account when installing the apparatus.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a Zone 0 environment.

N1 ATEX Type n

Certificate BAS00ATEX3167X

Standards EN60079-0:2012 + A11:2013, EN60079-15:2010

Markings  II 3 G Ex nA IIC T5 Gc ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)


Special Condition for Safe Use (X):

1. When fitted with a transient suppression terminal block, the equipment is not capable of withstanding the 500V insulation test that is required by EN60079–15. This must be taken into account when installing the apparatus.

ND ATEX Dust

Certificate BAS01ATEX1427X

Standards EN60079–0:2012 + A11:2013, EN60079–31:2009

Markings  II 1 D Ex t IIIC T50 °C T₅₀₀ 60 °C Da

Special Conditions for Safe Use (X):

1. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66
2. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66
3. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7J impact test.

International

E7 IECEx Flameproof

Certificate IECEx KEM 06.0021X

Standards IEC 60079–0:2011, IEC60079–1:2014, IEC60079–26:2014

Markings Ex d IIC T6...T4 Ga/Gb, T6 ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$), T4/T5 ($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$)

Special Conditions for Safe Use (x):

1. This device contains a thin wall diaphragm. Installation, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

I7 IECEx Intrinsic Safety

Certificate IECEx BAS 12.0071X

Standards IEC60079–0:2011, IEC60079–11:2011

Markings Ex ia IIC T4 Ga ($-55^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 6: Input Parameters

Parameter	HART
Voltage U_i	30 V
Current I_i	200 mA
Power P_i	0.9 W

Table 6: Input Parameters
(continued)

Parameter	HART
Capacitance C_i	0.012 μ F

Special Conditions for Safe Use (X):

1. When fitted with a transient suppression terminal block, the Rosemount 2088 is incapable of passing the 500 V isolation test. This must be taken into account during installation.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a Zone 0 environment.

N7 IECEx Type n

Certificate	IECEx BAS 12.0072X
Standards	IEC60079-0:2011, IEC60079-15:2010
Markings	Ex nA IIC T5 Gc ($-40^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. When fitted with a transient suppression terminal block, the Rosemount 2088 is incapable of passing the 500 V isolation test. This must be taking into account during installation.

NK IECEx Dust

Certificate	IECEx BAS12.0073X
Standards	IEC60079-0:2011, IEC60079-31:2008
Markings	Ex t IIIC T50 $^{\circ}\text{C}$ T ₅₀₀ 60 $^{\circ}\text{C}$ Da

Table 7: Input Parameter

Parameter	HART
Voltage U_i	36 V

Special Conditions For Safe Use (x):

1. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP66.
2. Unused cable entries must be filled with suitable blanking plugs which maintain the ingress protection of the enclosure to at least IP66.
3. Cable entries and blanking plugs must be suitable for the ambient range of the apparatus and capable of withstanding a 7 J impact.

Brazil

E2 INMETRO Flameproof

Certificate	UL-BR 15.0728X
Standards	ABNT NBR IEC60079-0:2013, ABNT NBR IEC 60079-1:2016, ABNT NBR IEC 60079-26:2016
Markings	Ex db IIC T6...T4 Ga/Gb, T4/T5 ($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6 ($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Table 8: Process Connection Temperature

Temperature class	Process connection temperature	Ambient temperature
T6	–60 to +70 °C	–60 to +70 °C
T5	–60 to +80 °C	–60 to +80 °C
T4	–60 to +120 °C	–60 to +80 °C

Special Conditions For Safe Use (x):

1. This device contains a thin wall diaphragm less than 1mm thickness that forms a boundary between zone 0 (process connection) and zone 1 (all other parts of the equipment). The model code and data sheet are to be consulted for details of the diaphragm material. Installations, maintenance and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.
2. Flameproof joints are not intended for repair.
3. Non-standard paint options may cause risk from electrostatic discharge. Avoid installations that could cause electrostatic build-up on painted surfaces, and only clean the painted surfaces with a damp cloth. If paint is ordered through a special option code, contact the manufacturer for more information.

I2 INMETRO Intrinsic Safety

Certificate: UL-BR 13.0246X

Standards: ABNT NBR IEC60079-0:2008 + Errata 1:2011, ABNT NBR IEC60079-11:2009

Markings: Ex ia IIC T4 Ga (–55 °C ≤ T_a ≤ +70 °C)

Table 9: Input Parameters

Parameter	HART
Voltage U _i	30 V
Current I _i	200 mA
Power P _i	0.9 W
Capacitance C _i	0.012 μF

Special Conditions for Safe Use (X):

1. When fitted with a transient suppression terminal block, the Rosemount 2088 is incapable of passing the 500 V isolation test. This must be taken into account when installing the equipment.
2. The enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in Zone 0.

China**E3 China Flameproof**

Certificate GYJ15.1505

Standards GB3836.1-2010, GB3836.2-2010

Markings Ex d IIC T4/T6 Gb, T6(–20 °C ≤ T_a ≤ +40 °C), T4(–20 °C ≤ T_a ≤ +80 °C)

Special Conditions For Safe Use (X):

1. The ambient temperature is as follows:

T_a	Temperature class
$-20\text{ }^{\circ}\text{C} \leq T_a \leq 80\text{ }^{\circ}\text{C}$	T4
$-20\text{ }^{\circ}\text{C} \leq T_a \leq 40\text{ }^{\circ}\text{C}$	T6

2. The earth connection facility in the enclosure should be connected reliably.
3. During installation in hazardous location, cable glands, conduits, and blanking plugs, certified by state-appointed inspection bodies with Ex d IIC type of protection, should be used.
4. During installation, use and maintenance in explosive gas atmospheres, observe the warning “Do not open when energized”.
5. During installation, there should be no mixture harm to flameproof housing.
6. End user is not permitted to change any components insides, but to settle the problem in conjunction with manufacturer to avoid damage to the product.
7. Maintenance should be done in non-hazardous location.
8. During installation, use and maintenance of this product, observe the following standards: GB3836.13-2013, GB3836.15-2000, GB3836.16-2006, GB50257-2014.

I3 China Intrinsic Safety

Certificate	GYJ15.1507
Standards	GB3836.1-2010, GB3836.4-2010, GB3836.20-2010
Markings	Ex ia IIC T4 Ga

Special Conditions for Safe Use (X):

1. The enclosure may contain light metal, attention should be taken to avoid ignition hazard due to impact or friction when used in Zone 0.
2. When transient protection board is chosen (Option Code T1), this apparatus is not capable of withstanding the 500V r.m.s insulation test required by Clause 6.3.12 of GB3836.4-2010.

N3 China Type n

Certificate	GYJ15.1108X
Standards	GB3836.1-2010, GB3836.8-2003
Markings	Ex nA IIC T5 Gc ($-40\text{ }^{\circ}\text{C} \leq T_a \leq +70\text{ }^{\circ}\text{C}$)

Special Condition For Safe Use (X):

1. When transient protection board is chosen (Option Code T1), this apparatus is not capable of withstanding the 500V r.m.s insulation test required by Clause 6.3.12 of GB3836.4-2010.

Korea**EP Korea Flameproof**

Certificate	13-KB4BO-0020X, 10-KB4BO-0137X, 19-KA4BO-0989X
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Markings Ex d IIC T6...T4 Ga/Gb, T4/T5($-60^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6($-60^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition For Safe Use (X):

1. See certificate.

Japan

E4 Japan Flameproof

Certificate TC20869, TC20870

Markings Ex d IIC T5

Technical Regulations Customs Union (EAC)

EM EAC Flameproof

Certificate EAEC RU C-US.EX01.B.00176

Markings Ga/Gb Ex d IIC T4/T6 X, T4($-40^{\circ}\text{C} \leq T_a \leq +80^{\circ}\text{C}$), T6($-40^{\circ}\text{C} \leq T_a \leq +40^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate.

IM EAC Intrinsically Safe

Certificate: EAEC RU C-US.EX01.B.00176

Markings: 0Ex ia IIC T4 Ga X ($-55^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$)

Special Condition for Safe Use (X):

1. See certificate.

Combinations

K1	Combination of ED, I1, ND, and N1
K2	Combination of E2 and I2
K5	Combination of E5 and I5
K6	Combination of C6, ED, and I1
K7	Combination of E7, I7, NK, and N7
KB	Combination of K5 and C6
KM	Combination of EM and IM
KH	Combination of ED, I1, and K5

Conduit plugs and adapters

IECEx Flameproof and Increased Safety

Certificate	IECEx FMG 13.0032X
Standards	IEC60079-0:2011, IEC60079-1:2007-04, IEC60079-7:2006-07
Markings	Ex de IIC Gb

ATEX Flameproof and Increased Safety

Certificate	FM13ATEX0076X
Standards	EN60079-0:2012, EN60079-1:2007, IEC60079-7:2007
Markings	Ⓔ II 2 G Ex de IIC Gb

Table 10: Conduit Plug Thread Sizes

Thread	Identification mark
M20 × 1.5 – 6g	M20
½–14 NPT	½ NPT
G½A	G½

Table 11: Thread Adapter Thread Sizes

Male thread	Identification mark
M20 × 1.5 – 6H	M20
½–14 NPT	½–14 NPT
¾–14 NPT	¾–14 NPT
Female thread	Identification mark
M20 × 1.5 – 6H	M20
½–14 NPT	½–14 NPT
G½	G½

Special Conditions For Safe Use (X):

1. When the thread adapter or blanking plug is used with an enclosure in type of protection increased safety “e” the entry thread shall be suitably sealed in order to maintain the ingress protection rating (IP) of the enclosure.
2. The blanking plug shall not be used with an adapter.
3. Blanking Plug and Threaded Adapter shall be either NPT or Metric thread forms. G½ thread forms are only acceptable for existing (legacy) equipment installations.

Additional Certifications

SBS American Bureau of Shipping (ABS) Type Approval

Certificate	18-HS1814314-PDA
Intended Use	Measurement of either gauge or absolute pressure for liquid, gas, and vapor.

ABS Rules 2014 Steel Vessels Rules 1–1–4/7.7, 1–1–Appendix 3, 4–8–3/1.7, 4–8–3/13.1, 4–8–3/13.3.1 & 13.3.2, 4–8–4/27.5.1

SBV Bureau Veritas (BV) Type Approval

Certificate 23156/B0 BV

Requirements Bureau Veritas Rules for the Classification of Steel Ships

Application Class notations: AUT–UMS, AUT–CCS, AUT–PORT and AUT–IMS; Pressure transmitter type 2088 cannot be installed on diesel engines

SDN Det Norske Veritas (DNV) Type Approval

Certificate TAA000004F

Intended Use DNV GL Rules for Classification – Ships and offshore units

Application

Location classes	
Temperature	D
Humidity	B
Vibration	A
EMC	B
Enclosure	D

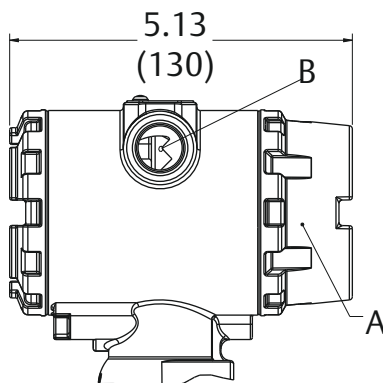
SLL Lloyds Register (LR) Type Approval

Certificate 11/60002

Application Environmental categories ENV1, ENV2, ENV3, and ENV5

Dimensional drawings

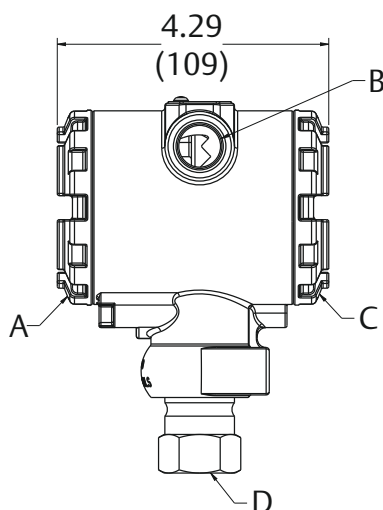
Figure 3: Optional Digital Display



- A. Digital display cover
- B. 2½–14 NPT conduit connection

Dimensions are in inches (millimeters).

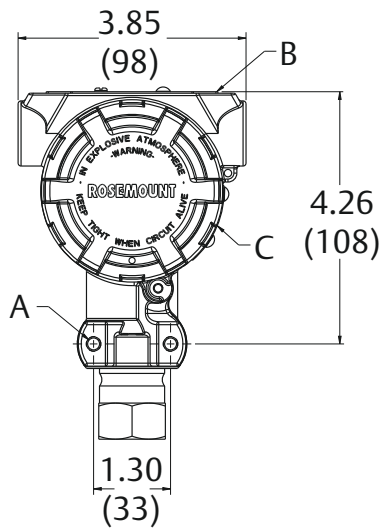
Figure 4: Process Connection



- A. Field terminals
- B. Conduit connection
- C. Transmitter electronics
- D. ½–14 NPT female connection

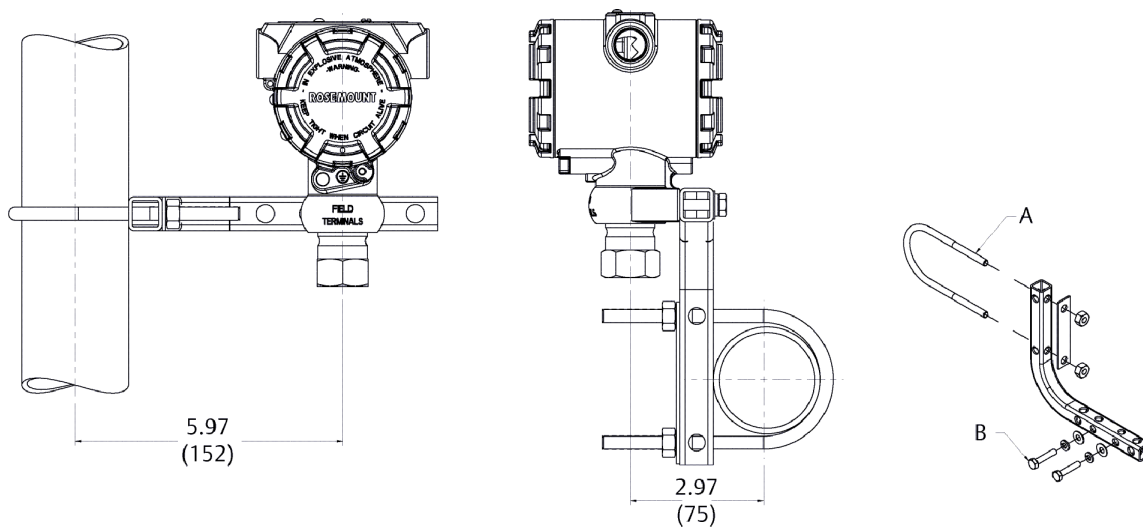
Note

RC ½ female (PT ½ female), and M20 female also available as options.

Figure 5: Nameplate and Labels

- A. Bracket mounting holes ($\frac{1}{4}$ -20 UNC)
- B. Nameplate
- C. Certification label (located on side)

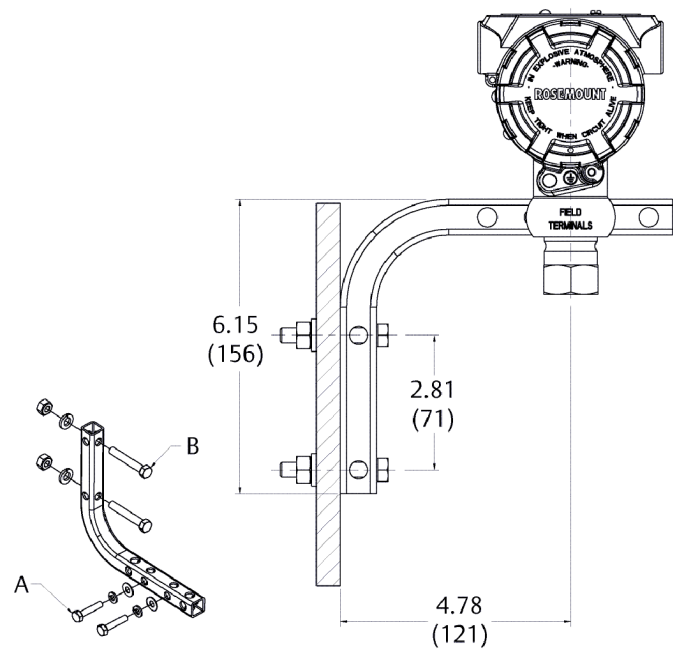
Dimensions are in inches (millimeters).

Figure 6: Optional Pipe Mounting Bracket

- A. 2-in. U-bolt for pipe mounting (clamp shown)
- B. $1\frac{1}{4}$ bolts for transmitter mounting

Dimensions are in inches (millimeters).

Figure 7: Optional Panel Mounting Bracket



- A. 1/4 X 1 1/4 bolts for transmitter mounting
- B. 5/16 X 1 1/2 bolts for panel mounting (not supplied)

Dimensions are in inches (millimeters).

Options

Standard configuration

Unless otherwise specified, transmitter is shipped as follows:

Engineering units	psi (all ranges)
4 mA (1 Vdc)	0 (engineering units)
20 mA (5 Vdc)	Upper range limit
Output	Linear
Flange type	Specified model code option
Flange material	Specified model code option
O-ring material	Specified model code option
Drain/vent	Specified model code option
LCD display	Installed or none
Alarm	High
Software tag	Blank

Custom configuration

If option code C9 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output information
- Transmitter information
- LCD display configuration
- Hardware selectable information
- Signal selection

Refer to the Rosemount 2088 [Configuration Data Sheet](#).

Tagging (three options available)

- Standard SST hardware tag is permanently affixed on transmitter.
- Tag character height is 0.125-in. (3.18 mm), 84 characters maximum.
- Tag may be wired to the transmitter nameplate upon request, 85 characters maximum.
- For HART protocols, the tag may be stored in transmitter memory (eight characters maximum).
- Software tag is left blank unless specified.
- HART Revision 5: eight characters
- HART Revision 7: 32 characters

Optional Rosemount 306 Integral Manifold

Factory-assembled to Rosemount 2088 Transmitters. Refer to Rosemount Manifolds [Product Data Sheet](#) for additional information.

Other seals

Refer to Rosemount DP Level Transmitters and 1199 Diaphragm Seal System [Product Data Sheet](#) for additional information.

Output information

Output range points must be the same unit of measure. Available units of measure include:

Table 12: Pressure Units

Field configurable only, not available for factory calibration or custom configuration (option code C9 “Software configuration”).

torr	psf	cmH ₂ O at 4 °C
atm	inH ₂ O	mH ₂ O at 4 °C
Pa	inH ₂ O at 4 °C	inHg
kPa	inH ₂ O at 60 °F	mmHg
MPa	ftH ₂ O	cmHg at 0 °C
hPa	ftH ₂ O at 4 °C	mHg at 0 °C

Table 12: Pressure Units (continued)

mbar	ftH ₂ O at 60 °F	g/cm ²
bar	mmH ₂ O	kg/m ²
psi	mmH ₂ O at 4 °C	kg/cm ²

Display and interface options

M4 Digital display with local operator interface (LOI)

- Available for 4–20 mA HART, 4–20 mA HART Low Power

M5 Digital meter

- Two-line, five-digit LCD display for 4–20 mA HART
- Two-line, five-digit LCD display for 1–5 Vdc HART Low Power
- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

Configuration buttons

Rosemount 2088 offers optional internal and external configuration buttons.

- Selecting option D4 will add external analog zero and span configuration buttons
- Selecting option DZ will add an external digital zero trim configuration button
- Selecting option M4 (LOI) adds both internal and external local configuration buttons

Certain button options can also be combined as shown below:

Table 13: Button Configuration

Option codes	Internal	External
DZ	N/A	Digital zero trim
D4	N/A	Analog zero and trim
M4	LOI	LOI
M4 + DZ	LOI	Digital zero trim
M4 + D4	LOI	Analog zero and trim

Rosemount 2088 bracket option

B4 Bracket for 2-in. pipe or panel mounting

- Bracket for mounting of transmitter on 2-in. pipe or panel
- Stainless steel construction with stainless steel bolts

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Chart Inc.
Projects D&S Americas

Condenser Cut Sheets

CARBON DIOXIDE STORAGE SYSTEM

Section 3

CCH0022LDACZ - SUBMITTAL



Project Name:		Project Location:	
Quote ID:		Item #:	1000
Submitted For:		Submitted On:	
Submitted By:		Submitted From:	
Identity #:	CCH0022LDACZ W/ OPTIONS	Tag:	CON-1

☐ For Record

☐ For Approval

By: _____

Date: _____

General Product Information

Product Family:	CCH	Compressor Brand:	Copeland
Application:	Outdoor	Compressor Type:	Scroll
Temperature Range:	Low Temp	Compressor Hp:	2
Voltage: (Volts/Ph/Hz)	460/3/60	Compressor Model:	ZF07K4E-TFD-118
Refrigerant Type:	R404A	Number of Compressor(s):	1
Piping:	Standard	Coil Type:	Microchannel

Note : This equipment meets the regulatory requirements for hydrofluorocarbons as of the manufacturing date. Only those refrigerants approved in the state for specific end uses may be used.

Technical Information

Performance Data

Ambient Temperature (°F)	Saturated Suction Temperature (°F)	Application Capacity* (BTU/H)	Altitude (ft)	AWEF Value
95	-20.0	7,550	0	3.09

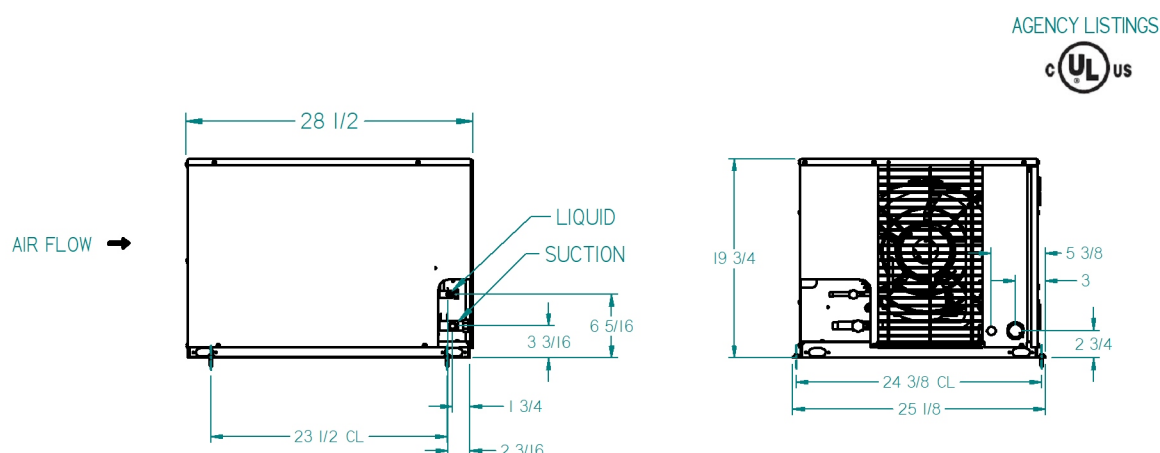
Electrical Data

Compressor(s)		Fan Motor(s)			Electric Ratings						
RLA	LRA	Quantity	Hp	FLA	Defrost Type	High or Low Amps?	Number of Contactors	MCA	MOPD	Evap.Fan Amps	Defrost Heater Amps
3.6	28	1	1/15	0.5	ELECTRIC DEFROST			20	20	5	15

Unit Specifications

Connections (in.)		Receiver 90% Full (lbs)		Fan Blade(s) Diameter (in)	Sound Data (dB)	Approx. Net Weight (lbs)
Liquid Line	Suction	Standard	Over Sized			
0.375	0.625	9		14	63	173

Dimensional Drawing(s)



UOM: inches

CCH0022LDACZ - SUBMITTAL



Project Name:		Project Location:	
Quote ID:		Item #:	1000
Submitted For:		Submitted On:	
Submitted By:		Submitted From:	
Identity #:	CCH0022LDACZ W/ OPTIONS	Tag:	CON-1

Standard Features

CABINET AND CONSTRUCTION

- MICROCHANNEL COIL TECHNOLOGY STANDARD ON ALL UNITS

QUALITY

- ALL UNITS ARE COMPLETELY LEAK TESTED IN A HELIUM ENVIRONMENT, BUMP TESTED AND ALLOWED TO CYCLE OFF ON THE HIGH AND LOW PRESSURE CONTROL. EACH UNIT HAS A COPY OF THE RUN DATA SHIPPED INSIDE THE ELECTRICAL PANEL
- ELECTRICAL CIRCUITS ARE COMPLETELY CHECKED FOR CONTINUITY
- PIPING IS LAID OUT TO MINIMIZE STRESS AND VIBRATION AND IS PRE-BENT TO ELIMINATE LEAKS
- ENCAPSULATED, AUTO-RESET, HIGH AND LOW PRESSURE CONTROLS TO ELIMINATE LEAKS (ADJUSTABLE LOW PRESSURE CONTROL STANDARD)
- PAINTED STEEL CABINETS FOR SUPERIOR STRENGTH AND CORROSION PROTECTION
- HEAVY DUTY, STEEL, 1-1/2" TALL BASE

SERVICEABILITY

- SUCTION SERVICE VALVES FOR HERMETIC AND SCROLL COMPRESSORS LOCATED OUTSIDE THE CABINET FOR QUICK INSTALLATIONS.
- RECEIVER WITH FUSIBLE PLUG, LIQUID SHUTOFF VALVE AND CHARGING PORT IS STANDARD
- LARGE ELECTRICAL PANEL FOR EASE OF ACCESS
- PREFABRICATED WIRING HARNESSES FOR TIGHT CRIMP CONNECTIONS AND CONSISTENT LABELING
- UNIT STAYS ON IF THE HOOD IS REMOVED FOR SERVICING
- SIGHT GLASS IS EASILY VIEWABLE

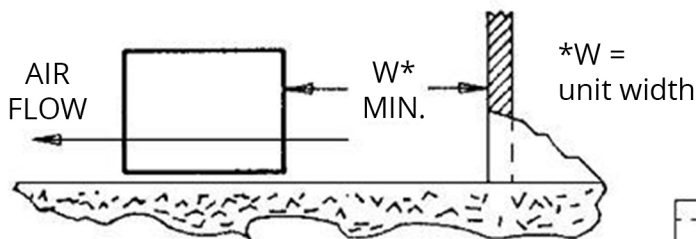
Options

Mounted Options

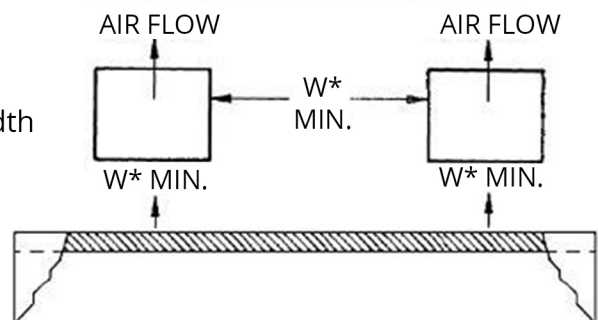
- Brand Label - CLIMATE CONTROL
- Coil Selection - MICROCHANNEL COIL
- Defrost Timer Options - ELECTRIC DEFROST TIMER
- Suction Line Options - FILTER AND ACCUMULATOR
- Cabinet Selection - Painted
- Pressure Options - ADJUSTABLE LOW - FIXED HIGH
- Phase Loss Monitor - NONE
- Snow Legs - NONE
- Non Fused disconnect - NO
- Motor - FIXED SPEED EC
- Receiver Options - STANDARD
- Liquid Line Options - FILTER DRIER AND SIGHT GLASS
- Discharge Line Options - HEAD PRESSURE VALVE 100#
- Fused Disconnect - ELECTRIC FUSED DISCONNECT
- Crankcase Heater - CRANKCASE HEATER
- Pre Charged - NONE
- Hail Guard Factory Installed - NONE
- Customer Special - N/A

Minimum Unit Clearances

Walls or Obstructions for Horizontal Air Flow



Multiple Units with Horizontal Air Flow



* Capacities shown are Application Capacities reflecting nominal operation at 10°F TD. For models within the scope of the DOE AWEF (Annual Walk-in Energy Factor) standard, the Net Capacity is determined by the AHRI 1250 test method. DOE will publish this compliance data at www.regulations.doe.gov

1/2 - 6 HP AIR-COOLED CONDENSING UNITS

Technical Guide
Now including DOE compliant models





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FEATURES & BENEFITS

CABINET AND CONSTRUCTION

- Microchannel coil technology standard on all units
- Painted steel cabinets for superior strength and corrosion protection
- Heavy duty, steel, 1-1/2" tall base

SERVICEABILITY

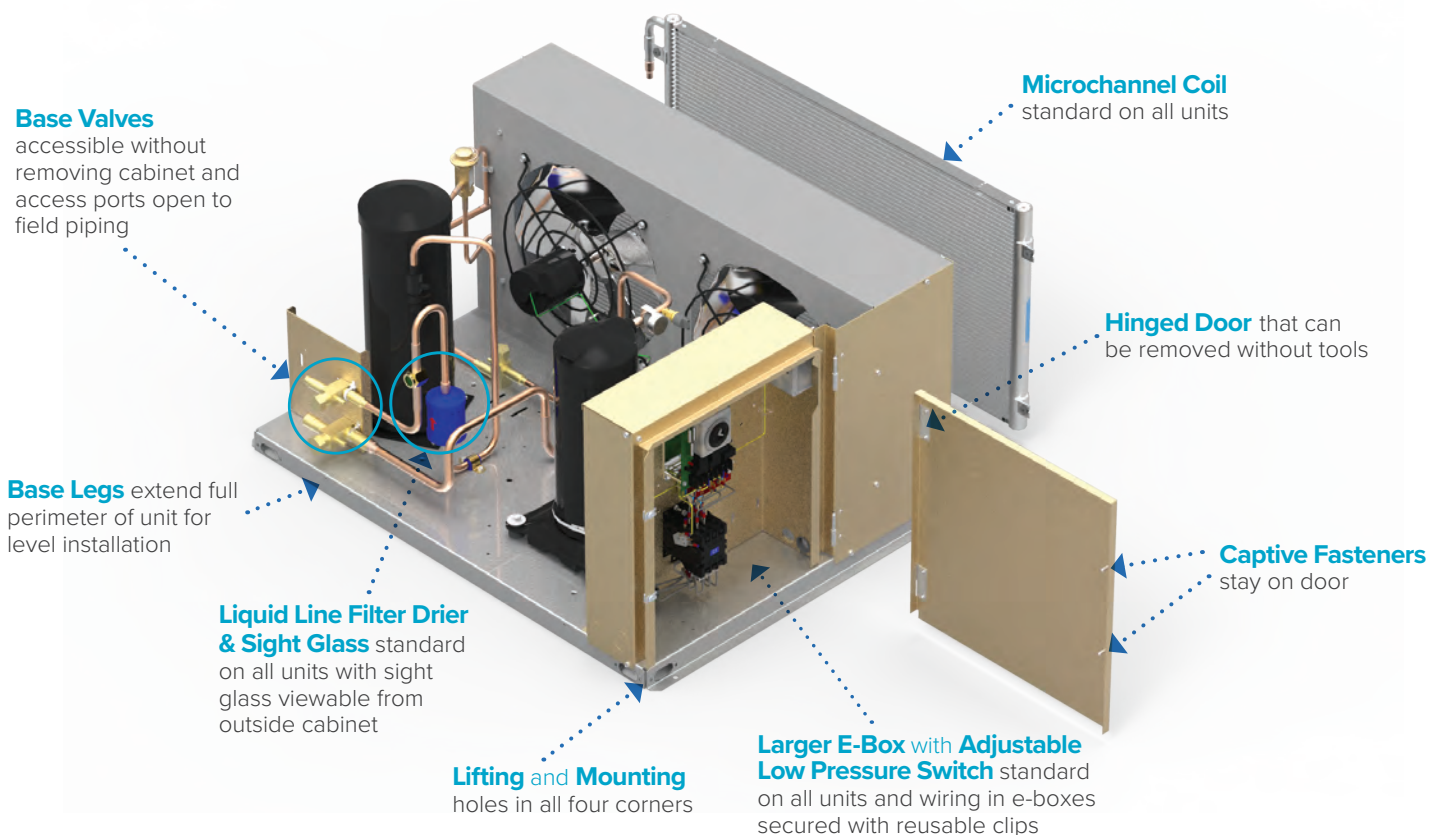
- Suction service valves for hermetic and scroll compressors located outside the cabinet for quick installations.
- Receiver with fusible plug, liquid shutoff valve and charging port is standard
- Large electrical panel for ease of access
- Prefabricated wiring harnesses for tight crimp connections and consistent labeling

- Unit stays on if the hood is removed for servicing
- Sight glass is easily viewable

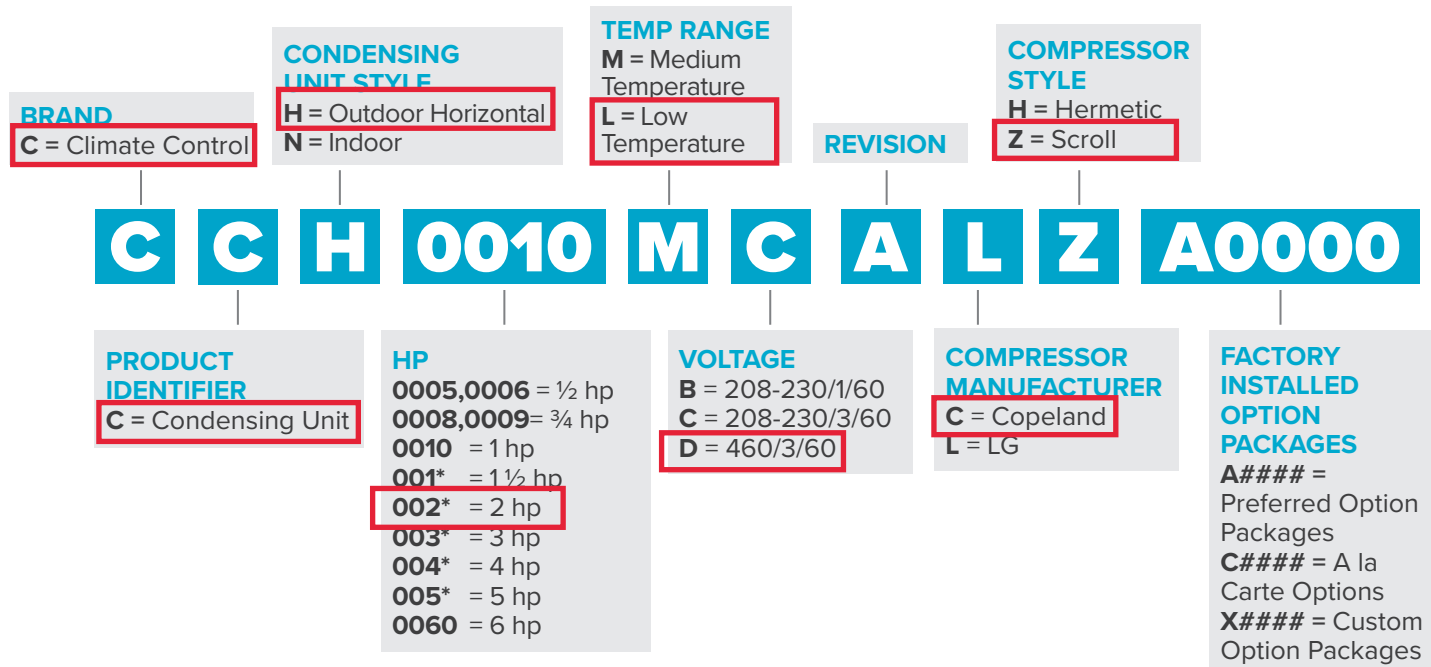
QUALITY

- All units are completely leak tested in a helium environment, bump tested and allowed to cycle off on the high and low pressure control. Each unit has a copy of the run data shipped inside the electrical panel
- Electrical circuits are completely checked for continuity
- Piping is laid out to minimize stress and vibration and is pre-bent to eliminate leaks
- Encapsulated, auto-reset, high and low pressure controls to eliminate leaks (adjustable low pressure control standard on all models)

OUTSTANDING FEATURES



NOMENCLATURE



PREFERRED OPTION PACKAGES:

Please see Price Book or The HUB for availability

Package	Description (standard base model features + indicated option below)
A0000	Standard Base
A0100	Timer-Air
A0200	Timer-Elec
A0300	Timer Contactor
A0400	intelliGen™/Beacon II™
A0800	Timer-Air-Paragon + Aluminum Fin/CopperTube Coil
A0900	intelliGen™/Beacon II™ + Suction Filter
A1000	Accumulator
A1200	R-404A Precharge
A1204	R-448A Precharge

STANDARD FEATURES

Microchannel Coil

Head Pressure Control Valve

- 150 psi standard - except Low Temperature Scroll models which are 100 psi

Crankcase Heater (optional for indoor models)

Adjustable Low Pressure Control

Fixed High Pressure Control

Sealed Liquid Line Drier (new)

Liquid Line Sight Glass (new)

Liquid Line and Suction Line Base Valves

Painted Steel Cabinet (outdoor and indoor models)

Removable & Hinged E-box Door with Captive Fasteners

ELECTRICAL OPTIONS

Option	Outdoor	Indoor
Fixed low pressure control	Option	Option
Air or Electric defrost timer only	Option	Option
intelliGen™/Beacon II™	Option	N/A
Crankcase Heater	Standard	Option
Dual pressure control (not available with intelliGen™/Beacon II™ or Low Ambient Kit)	Option	Option
Electric defrost with timer & contactors (C3 cabinet)	Option	Option
Fused disconnect	Option	Option
Phase loss / low voltage monitor (not available with intelliGen™/Beacon II™ or Low Ambient Kit)	Option	Option
Smart Defrost Kit™ (Factory-Installed)	Option	Option
Variable speed EC (VSEC) motors with Orbus controller	Option	Option

MECHANICAL OPTIONS

Option	Outdoor	Indoor
12" Extended legs	Option	Option
Head pressure control flooding valve	Standard	N/A
Liquid line drier, sight glass	Standard	Standard
Liquid line solenoid valve and pumpdown switch (not available with intelliGen™/Beacon II™)	Option	Option
Low ambient kit with heated and insulated receiver, Time Delay relay	Option	N/A
Oil separator with discharge line check valve (C3 cabinet)	Option	Option
Oversize receiver (C2 & C3 cabinets)	Option	Option
Precharged refrigerant with quick connect fittings	Option	Option
Replaceable core liquid line filter (C3 cabinet)	Option	Option
Replaceable core suction line filter (C3 cabinet)	Option	Option

PERFORMANCE DATA – R-404A/R-507A

Low Temperature Models - Scroll Compressors

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-404A/R-507A		Capacity BTUH @ 90°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	5,190	4,620	4,100	3,650	3,240	2,890	2,580	2,300	2,060
CC*0008L^ACZ	ZF04KAE	6,970	6,210	5,520	4,880	4,300	3,790	3,350	2,970	2,660
CC*0010L^ACZ	ZF05KAE	8,170	7,360	6,590	5,870	5,220	4,610	4,070	3,590	3,160
CC*0022L^ACZ	ZF07KAE	11,870	10,790	9,750	8,790	7,900	7,060	6,260	5,470	4,690
CC*0025L^ACZ	ZF08K4E	15,170	13,750	12,420	11,190	10,040	8,980	7,990	7,070	6,220
CC*0030L^ACZ	ZF09K4E	16,690	15,160	13,720	12,330	10,980	9,650	8,330	6,960	5,540
CC*0035L^ACZ	ZF11K4E	20,250	18,440	16,740	15,110	13,540	12,000	10,480	8,950	7,360
CC*0045L^ACZ	ZF13K4E	24,710	22,340	20,120	18,040	16,100	14,300	12,630	11,080	9,650
CC*0055L^ACZ	ZF15K4E	29,700	26,930	24,310	21,790	19,360	16,950	14,550	12,090	9,530
CC*0060L^ACZ	ZF18K4E	34,840	31,690	28,730	25,950	23,350	20,920	18,640	16,480	14,450

R-404A/R-507A		Capacity BTUH @ 95°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,970	4,420	3,930	3,500	3,110	2,780	2,480	2,230	2,000
CC*0008L^ACZ	ZF04KAE	6,680	5,950	5,280	4,670	4,120	3,630	3,210	2,850	2,560
CC*0010L^ACZ	ZF05KAE	7,830	7,050	6,310	5,630	5,000	4,420	3,900	3,440	3,030
CC*0022L^ACZ	ZF07KAE	11,330	10,300	9,310	8,400	7,550	6,750	5,990	5,240	4,490
CC*0025L^ACZ	ZF08K4E	14,590	13,230	11,970	10,780	9,690	8,660	7,710	6,820	6,000
CC*0030L^ACZ	ZF09K4E	16,030	14,570	13,200	11,890	10,620	9,370	8,130	6,860	5,540
CC*0035L^ACZ	ZF11K4E	19,420	17,710	16,090	14,550	13,070	11,630	10,210	8,790	7,320
CC*0045L^ACZ	ZF13K4E	23,730	21,450	19,320	17,320	15,470	13,750	12,160	10,690	9,330
CC*0055L^ACZ	ZF15K4E	28,500	25,860	23,370	21,000	18,690	16,420	14,170	11,870	9,490
CC*0060L^ACZ	ZF18K4E	33,470	30,460	27,650	25,000	22,520	20,190	18,010	15,940	13,990

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-404A/R-507A

Low Temperature Models - Scroll Compressors (Cont.)

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-404A/R-507A		Capacity BTUH @ 100°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,750	4,230	3,760	3,350	2,990	2,670	2,390	2,150	1,930
CC*0008L^ACZ	ZF04KAE	6,380	5,680	5,040	4,460	3,930	3,470	3,070	2,730	2,460
CC*0010L^ACZ	ZF05KAE	7,490	6,740	6,030	5,380	4,780	4,220	3,730	3,290	2,900
CC*0022L^ACZ	ZF07KAE	10,780	9,810	8,860	8,000	7,200	6,440	5,710	5,000	4,290
CC*0025L^ACZ	ZF08K4E	14,000	12,700	11,490	10,360	9,310	8,330	7,420	6,560	5,760
CC*0030L^ACZ	ZF09K4E	15,360	13,980	12,680	11,430	10,240	9,070	7,910	6,730	5,510
CC*0035L^ACZ	ZF11K4E	18,580	16,950	15,420	13,960	12,570	11,220	9,910	8,580	7,230
CC*0045L^ACZ	ZF13K4E	22,720	20,540	18,500	16,590	14,820	13,190	11,680	10,300	9,020
CC*0055L^ACZ	ZF15K4E	27,270	24,760	22,390	20,160	17,980	15,850	13,740	11,600	9,380
CC*0060L^ACZ	ZF18K4E	32,080	29,220	26,550	24,030	21,670	19,450	17,370	15,400	13,520

R-404A/R-507A		Capacity BTUH @ 110°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,310	3,840	3,420	3,050	2,730	2,450	2,200	1,990	1,800
CC*0008L^ACZ	ZF04KAE	5,790	5,150	4,570	4,040	3,560	3,140	2,780	2,490	2,250
CC*0010L^ACZ	ZF05KAE	6,780	6,100	5,470	4,880	4,330	3,820	3,370	2,980	2,630
CC*0022L^ACZ	ZF07KAE	9,660	8,760	7,950	7,190	6,480	5,800	5,150	4,520	3,870
CC*0025L^ACZ	ZF08K4E	12,750	11,590	10,500	9,470	8,520	7,620	6,790	6,010	5,270
CC*0030L^ACZ	ZF09K4E	14,010	12,760	11,600	10,490	9,440	8,420	7,420	6,400	5,360
CC*0035L^ACZ	ZF11K4E	16,840	15,370	14,000	12,710	11,490	10,320	9,190	8,060	6,920
CC*0045L^ACZ	ZF13K4E	20,640	18,660	16,820	15,100	13,520	12,060	10,730	9,520	8,420
CC*0055L^ACZ	ZF15K4E	24,740	22,470	20,380	18,370	16,440	14,580	12,740	10,880	8,970
CC*0060L^ACZ	ZF18K4E	29,240	26,680	24,290	22,040	19,920	17,920	16,050	14,270	12,570

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-448A/R-449A

Low Temperature Models - Scroll Compressors

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-448A/R-449A		Capacity BTUH @ 90°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,620	4,120	3,680	3,280	2,930	2,610	2,330	2,070	1,830
CC*0008L^ACZ	ZF04KAE	6,240	5,560	4,930	4,340	3,810	3,340	2,930	2,570	2,280
CC*0010L^ACZ	ZF05KAE	7,250	6,480	5,770	5,110	4,490	3,940	3,440	3,000	2,620
CC*0022L^ACZ	ZF07KAE	10,270	9,260	8,330	7,500	6,740	6,030	5,350	4,710	4,070
CC*0025L^ACZ	ZF08K4E	13,370	11,990	10,740	9,590	8,530	7,560	6,680	5,870	5,130
CC*0030L^ACZ	ZF09K4E	14,660	13,180	11,820	10,550	9,370	8,270	7,240	6,260	5,320
CC*0035L^ACZ	ZF11K4E	17,820	16,080	14,460	12,960	11,550	10,270	9,090	8,010	7,010
CC*0045L^ACZ	ZF13K4E	22,270	19,950	17,790	15,790	13,940	12,260	10,730	9,350	8,110
CC*0055L^ACZ	ZF15K4E	26,700	23,950	21,440	19,110	16,980	15,030	13,270	11,670	10,250
CC*0060L^ACZ	ZF18K4E	31,050	28,020	25,200	22,560	20,110	17,860	15,790	13,890	12,140

R-448A/R-449A		Capacity BTUH @ 95°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,460	3,980	3,560	3,180	2,840	2,540	2,260	2,010	1,780
CC*0008L^ACZ	ZF04KAE	6,030	5,370	4,760	4,200	3,690	3,240	2,840	2,500	2,220
CC*0010L^ACZ	ZF05KAE	7,000	6,260	5,580	4,940	4,350	3,810	3,330	2,910	2,550
CC*0022L^ACZ	ZF07KAE	9,880	8,920	8,040	7,240	6,510	5,830	5,190	4,570	3,950
CC*0025L^ACZ	ZF08K4E	12,990	11,660	10,440	9,320	8,290	7,350	6,500	5,710	4,980
CC*0030L^ACZ	ZF09K4E	14,250	12,810	11,500	10,270	9,120	8,060	7,060	6,110	5,210
CC*0035L^ACZ	ZF11K4E	17,290	15,610	14,040	12,580	11,240	9,990	8,850	7,800	6,840
CC*0045L^ACZ	ZF13K4E	21,470	19,220	17,140	15,210	13,440	11,840	10,390	9,100	7,950
CC*0055L^ACZ	ZF15K4E	25,730	23,090	20,680	18,450	16,400	14,540	12,870	11,360	10,010
CC*0060L^ACZ	ZF18K4E	29,930	27,030	24,330	21,800	19,470	17,320	15,360	13,560	11,920

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-448A/R-449A

Low Temperature Models - Scroll Compressors (Cont.)

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-448A/R-449A		Capacity BTUH @ 100°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,310	3,850	3,450	3,080	2,760	2,460	2,200	1,950	1,720
CC*0008L^ACZ	ZF04KAE	5,820	5,180	4,600	4,060	3,570	3,130	2,750	2,430	2,160
CC*0010L^ACZ	ZF05KAE	6,750	6,040	5,380	4,760	4,200	3,680	3,220	2,820	2,470
CC*0022L^ACZ	ZF07KAE	9,500	8,580	7,740	6,980	6,290	5,630	5,020	4,430	3,830
CC*0025L^ACZ	ZF08K4E	12,600	11,320	10,140	9,050	8,050	7,140	6,310	5,540	4,830
CC*0030L^ACZ	ZF09K4E	13,830	12,440	11,170	9,980	8,870	7,840	6,880	5,970	5,090
CC*0035L^ACZ	ZF11K4E	16,740	15,120	13,610	12,200	10,900	9,700	8,610	7,590	6,660
CC*0045L^ACZ	ZF13K4E	20,640	18,470	16,470	14,630	12,940	11,420	10,060	8,860	7,810
CC*0055L^ACZ	ZF15K4E	24,730	22,200	19,890	17,760	15,810	14,040	12,460	11,030	9,760
CC*0060L^ACZ	ZF18K4E	28,790	26,020	23,440	21,040	18,820	16,790	14,940	13,240	11,710

R-448A/R-449A		Capacity BTUH @ 110°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,010	3,600	3,230	2,890	2,590	2,320	2,070	1,830	1,610
CC*0008L^ACZ	ZF04KAE	5,380	4,800	4,270	3,770	3,320	2,920	2,580	2,280	2,040
CC*0010L^ACZ	ZF05KAE	6,240	5,590	4,980	4,410	3,890	3,420	3,000	2,630	2,310
CC*0022L^ACZ	ZF07KAE	8,710	7,890	7,130	6,450	5,820	5,230	4,680	4,130	3,590
CC*0025L^ACZ	ZF08K4E	11,800	10,600	9,500	8,480	7,550	6,690	5,910	5,190	4,520
CC*0030L^ACZ	ZF09K4E	12,980	11,700	10,500	9,400	8,370	7,420	6,530	5,690	4,880
CC*0035L^ACZ	ZF11K4E	15,600	14,100	12,700	11,400	10,190	9,090	8,070	7,140	6,280
CC*0045L^ACZ	ZF13K4E	18,930	16,940	15,120	13,450	11,950	10,610	9,440	8,430	7,590
CC*0055L^ACZ	ZF15K4E	22,650	20,340	18,260	16,330	14,590	13,020	11,610	10,360	9,270
CC*0060L^ACZ	ZF18K4E	26,440	23,950	21,630	19,480	17,510	15,710	14,080	12,620	11,300

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-407A/R-407F

Low Temperature Models - Scroll Compressors

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-407A/R-407F		Capacity BTUH @ 90°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,670	4,170	3,720	3,310	2,950	2,630	2,340	2,090	1,860
CC*0008L^ACZ	ZF04KAE	6,350	5,640	4,980	4,380	3,840	3,360	2,940	2,590	2,310
CC*0010L^ACZ	ZF05KAE	7,360	6,560	5,810	5,120	4,480	3,910	3,410	2,980	2,610
CC*0022L^ACZ	ZF07KAE	10,530	9,550	8,620	7,780	6,970	6,210	5,490	4,780	4,080
CC*0025L^ACZ	ZF08K4E	13,690	12,330	11,050	9,840	8,710	7,650	6,680	5,800	4,990
CC*0030L^ACZ	ZF09K4E	14,900	13,580	12,260	10,930	9,640	8,440	7,360	6,440	5,730
CC*0035L^ACZ	ZF11K4E	18,010	16,490	14,920	13,320	11,770	10,300	8,980	7,860	6,990
CC*0045L^ACZ	ZF13K4E	22,420	20,090	17,870	15,780	13,840	12,090	10,560	9,260	8,250
CC*0055L^ACZ	ZF15K4E	27,000	24,170	21,540	19,080	16,830	14,810	13,060	11,590	10,430
CC*0060L^ACZ	ZF18K4E	31,670	28,520	25,520	22,650	20,010	17,620	15,530	13,750	12,330

R-407A/R-407F		Capacity BTUH @ 95°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,490	4,020	3,590	3,200	2,860	2,550	2,270	2,020	1,790
CC*0008L^ACZ	ZF04KAE	6,110	5,430	4,800	4,220	3,700	3,240	2,840	2,510	2,240
CC*0010L^ACZ	ZF05KAE	7,080	6,310	5,590	4,920	4,320	3,770	3,290	2,880	2,530
CC*0022L^ACZ	ZF07KAE	10,070	9,140	8,260	7,460	6,690	5,970	5,280	4,600	3,930
CC*0025L^ACZ	ZF08K4E	13,230	11,930	10,690	9,530	8,430	7,410	6,480	5,620	4,840
CC*0030L^ACZ	ZF09K4E	14,410	13,160	11,880	10,600	9,350	8,180	7,130	6,230	5,520
CC*0035L^ACZ	ZF11K4E	17,380	15,930	14,420	12,900	11,400	9,980	8,700	7,610	6,760
CC*0045L^ACZ	ZF13K4E	21,720	19,430	17,260	15,220	13,340	11,650	10,190	8,970	8,030
CC*0055L^ACZ	ZF15K4E	26,130	23,370	20,810	18,420	16,230	14,280	12,600	11,190	10,090
CC*0060L^ACZ	ZF18K4E	30,680	27,610	24,690	21,930	19,350	17,040	15,020	13,310	11,960

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-407A/R-407F

Low Temperature Models - Scroll Compressors (Cont.)

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-407A/R-407F		Capacity BTUH @ 100°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,320	3,870	3,460	3,090	2,760	2,460	2,200	1,950	1,730
CC*0008L^ACZ	ZF04KAE	5,860	5,210	4,610	4,050	3,560	3,120	2,740	2,420	2,170
CC*0010L^ACZ	ZF05KAE	6,790	6,050	5,360	4,720	4,140	3,620	3,170	2,770	2,450
CC*0022L^ACZ	ZF07KAE	9,590	8,720	7,880	7,120	6,400	5,710	5,050	4,410	3,760
CC*0025L^ACZ	ZF08K4E	12,750	11,500	10,320	9,200	8,140	7,160	6,260	5,420	4,670
CC*0030L^ACZ	ZF09K4E	13,910	12,730	11,510	10,280	9,070	7,940	6,910	6,030	5,330
CC*0035L^ACZ	ZF11K4E	16,730	15,350	13,920	12,460	11,020	9,660	8,420	7,350	6,520
CC*0045L^ACZ	ZF13K4E	20,990	18,750	16,640	14,650	12,830	11,210	9,820	8,670	7,800
CC*0055L^ACZ	ZF15K4E	25,240	22,580	20,060	17,740	15,620	13,730	12,110	10,760	9,720
CC*0060L^ACZ	ZF18K4E	29,660	26,680	23,840	21,160	18,690	16,430	14,500	12,850	11,560

R-407A/R-407F		Capacity BTUH @ 110°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	3,990	3,580	3,220	2,880	2,580	2,310	2,060	1,830	1,620
CC*0008L^ACZ	ZF04KAE	5,360	4,760	4,210	3,710	3,260	2,870	2,530	2,250	2,030
CC*0010L^ACZ	ZF05KAE	6,200	5,530	4,900	4,320	3,790	3,320	2,910	2,570	2,280
CC*0022L^ACZ	ZF07KAE	8,590	7,820	7,080	6,410	5,770	5,150	4,560	3,970	3,390
CC*0025L^ACZ	ZF08K4E	11,740	10,600	9,530	8,500	7,530	6,620	5,790	5,010	4,310
CC*0030L^ACZ	ZF09K4E	12,920	11,850	10,740	9,610	8,500	7,440	6,470	5,630	4,950
CC*0035L^ACZ	ZF11K4E	15,400	14,170	12,880	11,570	10,260	9,000	7,860	6,860	6,060
CC*0045L^ACZ	ZF13K4E	19,450	17,320	15,320	13,460	11,770	10,280	9,020	8,020	7,290
CC*0055L^ACZ	ZF15K4E	23,340	20,830	18,480	16,300	14,310	12,560	11,040	9,810	8,870
CC*0060L^ACZ	ZF18K4E	27,550	24,750	22,080	19,570	17,250	15,170	13,350	11,840	10,660

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-407C

Low Temperature Models - Scroll Compressors

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-407C		Capacity BTUH @ 90°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,130	3,670	3,260	2,900	2,580	2,310	2,070	1,860	1,670
CC*0008L^ACZ	ZF04KAE	5,600	4,950	4,360	3,820	3,340	2,920	2,560	2,260	2,020
CC*0010L^ACZ	ZF05KAE	6,550	5,810	5,130	4,500	3,930	3,430	2,990	2,610	2,300
CC*0022L^ACZ	ZF07KAE	9,420	8,420	7,560	6,790	6,090	5,440	4,820	4,180	3,500
CC*0025L^ACZ	ZF08K4E	—	—	—	—	—	—	—	—	—
CC*0030L^ACZ	ZF09K4E	13,120	11,920	10,710	9,520	8,380	7,330	6,410	5,630	5,040
CC*0035L^ACZ	ZF11K4E	16,020	14,600	13,140	11,660	10,260	8,960	7,810	6,870	6,200
CC*0045L^ACZ	ZF13K4E	19,420	17,330	15,370	13,520	11,830	10,330	9,030	7,940	7,120
CC*0055L^ACZ	ZF15K4E	23,430	20,950	18,610	16,440	14,450	12,690	11,170	9,930	9,000
CC*0060L^ACZ	ZF18K4E	27,620	24,750	22,070	19,540	17,230	15,160	13,370	11,880	10,740

R-407C		Capacity BTUH @ 95°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	4,000	3,560	3,160	2,820	2,510	2,250	2,010	1,810	1,630
CC*0008L^ACZ	ZF04KAE	5,420	4,790	4,220	3,700	3,240	2,830	2,490	2,200	1,980
CC*0010L^ACZ	ZF05KAE	6,340	5,620	4,960	4,360	3,810	3,320	2,900	2,540	2,240
CC*0022L^ACZ	ZF07KAE	9,090	8,130	7,310	6,570	5,900	5,280	4,680	4,060	3,400
CC*0025L^ACZ	ZF08K4E	—	—	—	—	—	—	—	—	—
CC*0030L^ACZ	ZF09K4E	12,740	11,580	10,420	9,270	8,160	7,140	6,230	5,470	4,880
CC*0035L^ACZ	ZF11K4E	15,520	14,160	12,760	11,340	9,980	8,710	7,600	6,680	6,010
CC*0045L^ACZ	ZF13K4E	18,870	16,820	14,890	13,090	11,440	9,980	8,730	7,710	6,940
CC*0055L^ACZ	ZF15K4E	22,790	20,350	18,070	15,940	14,010	12,290	10,830	9,640	8,750
CC*0060L^ACZ	ZF18K4E	26,880	24,070	21,440	18,980	16,730	14,720	12,980	11,550	10,470

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

PERFORMANCE DATA – R-407C

Low Temperature Models - Scroll Compressors (Cont.)

Please consult AWEF table on page 29 to confirm DOE compliance per model

R-407C		Capacity BTUH @ 100°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	3,870	3,440	3,070	2,730	2,440	2,180	1,960	1,770	1,590
CC*0008L^ACZ	ZF04KAE	5,230	4,630	4,080	3,580	3,130	2,750	2,420	2,150	1,930
CC*0010L^ACZ	ZF05KAE	6,120	5,430	4,800	4,210	3,690	3,220	2,810	2,470	2,180
CC*0022L^ACZ	ZF07KAE	8,760	7,850	7,060	6,350	5,710	5,110	4,530	3,940	3,300
CC*0025L^ACZ	ZF08K4E	—	—	—	—	—	—	—	—	—
CC*0030L^ACZ	ZF09K4E	12,360	11,250	10,130	9,020	7,950	6,950	6,060	5,310	4,730
CC*0035L^ACZ	ZF11K4E	15,030	13,720	12,370	11,020	9,690	8,470	7,380	6,480	5,820
CC*0045L^ACZ	ZF13K4E	18,310	16,300	14,410	12,640	11,050	9,630	8,430	7,470	6,760
CC*0055L^ACZ	ZF15K4E	22,120	19,730	17,500	15,430	13,540	11,880	10,470	9,320	8,480
CC*0060L^ACZ	ZF18K4E	26,130	23,380	20,810	18,410	16,210	14,260	12,590	11,210	10,180

R-407C		Capacity BTUH @ 110°F Ambient by SST								
Model	Compressor	0°F	-5°F	-10°F	-15°F	-20°F	-25°F	-30°F	-35°F	-40°F
CC*0006L^ACZ	ZF03KAE	3,610	3,220	2,870	2,570	2,300	2,060	1,850	1,670	1,510
CC*0008L^ACZ	ZF04KAE	4,860	4,300	3,790	3,330	2,930	2,570	2,270	2,030	1,840
CC*0010L^ACZ	ZF05KAE	5,690	5,050	4,460	3,920	3,440	3,010	2,640	2,320	2,060
CC*0022L^ACZ	ZF07KAE	8,090	7,260	6,540	5,900	5,320	4,770	4,230	3,680	3,080
CC*0025L^ACZ	ZF08K4E	—	—	—	—	—	—	—	—	—
CC*0030L^ACZ	ZF09K4E	11,610	10,590	9,560	8,520	7,520	6,580	5,740	5,010	4,440
CC*0035L^ACZ	ZF11K4E	14,030	12,830	11,590	10,340	9,120	7,980	6,960	6,100	5,460
CC*0045L^ACZ	ZF13K4E	17,140	15,200	13,400	11,730	10,230	8,920	7,830	6,970	6,380
CC*0055L^ACZ	ZF15K4E	20,690	18,420	16,290	14,320	12,550	10,980	9,670	8,610	7,850
CC*0060L^ACZ	ZF18K4E	24,560	21,960	19,480	17,200	15,130	13,290	11,730	10,460	9,530

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

UNIT SPECIFICATIONS

Medium & Low Temperature Models - Scroll Compressors

Please consult AWEF table on pages 27-29 to confirm DOE compliance per model

Model	Compressor	Refrigerant Line Connections (OD)		Rec. Capacity @90% full (lbs)		Cabinet ^h	Dimensions (In.)			Net Wt.	Sound Data
		Liquid	Suction	Std	Opt		Depth	Width	Height	(lbs.)	dBa ^a
CC*0005M^ACZ	ZB06KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	167	61
CC*0008M^ACZ	ZB07KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	168	61
CC*0009M^ACZ	ZB08KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	168	61
CC*0010M^A+Z	ZS09KAE / MPA010	3/8	5/8	9	—	C1	28.25	24.625	19.75	179	61
CC*0015M^A+Z	ZS13KAE / MPA013	1/2	7/8	14	20	C2	28.25	39.125	19.75	221	63
CC*0020M^A+Z	ZS15KAE / MPA015	1/2	7/8	14	20	C2	28.25	39.125	19.75	221	63
CC*0025M^A+Z	ZS19KAE / MPA019	1/2	7/8	14	20	C2	28.25	39.125	19.75	230	63
CC*0030M^A+Z	ZS21KAE / MBA021	1/2	7/8	20	40	C3	30.25	43.875	29.25	297	63
CC*0035M^A+Z	ZS26KAE / MBA026	1/2	7/8	20	40	C3	30.25	43.875	29.25	300	63
CC*0045M^A+Z	ZS29KAE / MBA029	1/2	1 1/8	20	40	C3	30.25	43.875	29.25	327	63
CC*0050M^A+Z	ZS33KAE / MBA033	1/2	1 1/8	20	40	C3	30.25	43.875	29.25	330	63
CC*0055M^A+Z	ZS38K4E / MRA038	1/2	1 1/8	20	40	C3	30.25	43.875	29.25	332	63
CC*0060M^A+Z	ZS45K4E / MRA045	1/2	1 1/8	20	40	C3	30.25	43.875	29.25	335	63
CC*0006L^ACZ	ZF03KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	169	63
CC*0008L^ACZ	ZF04KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	171	63
CC*0010L^ACZ	ZF05KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	172	63
CC*0022L^ACZ	ZF07KAE	3/8	5/8	9	—	C1	28.25	24.625	19.75	173	63
CC*0025L^ACZ	ZF08K4E	1/2	7/8	14	20	C2	28.25	39.125	19.75	230	64
CC*0030L^ACZ	ZF09K4E	1/2	7/8	14	20	C2	28.25	39.125	19.75	230	64
CC*0035L^ACZ	ZF11K4E	1/2	7/8	14	20	C2	28.25	39.125	19.75	232	64
CC*0045L^ACZ	ZF13K4E	1/2	7/8	20	40	C3	30.25	43.875	29.25	317	64
CC*0055L^ACZ	ZF15K4E	1/2	7/8	20	40	C3	30.25	43.875	29.25	323	64
CC*0060L^ACZ	ZF18K4E	1/2	7/8	20	40	C3	30.25	43.875	29.25	327	64

Notes:

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

‡ C = Copeland, L = LG

a. Estimated sound pressure values are 10 feet from the unit. For estimating sound pressure from the unit at different distances, deduct the following from the unit values: 20 feet, deduct 6 dBA; for 40 feet, deduct 12 dBA; for 80 feet, deduct 18 dBA. This data is typical of "free field" conditions for horizontal air cooled condensing units at the outlet of the discharge air. The actual sound measurements may vary depending on the condensing unit installation. Factors such as reflecting walls, background noise and mounting conditions may have a significant influence on this data.

h. See Page 43 for dimensional drawings

ELECTRICAL DATA

Low Temperature Models - Copeland Scroll Compressors

Please consult AWEF table on page 29 to confirm DOE compliance per model

Model	Compressor	Power ^d	Remote Loads									
			Compressor		Condenser		Air Defrost or Remote Controller		Evap. Fan Amps	Defrost Htrs. Amps	Electric Defrost	
			RLA ^c	LRA	No. Fans	FLA	MCA	MOPD			MCA	MOPD
CC*0006LBACZ	ZF03KAE-PFV	208-230/1/60	5.4	42.3	1	0.5	15.0	15.0	5	15	20	20
CC*0006LCACZ	ZF03KAE-TF5	208-230/3/60	3.7	31.7	1	0.5	15.0	15.0	5	15	20	20
CC*0008LBACZ	ZF04KAE-PFV	208-230/1/60	6.6	40.3	1	0.5	15.0	15.0	5	15	20	20
CC*0008LCACZ	ZF04KAE-TF5	208-230/3/60	6.0	55.4	1	0.5	15.0	15.0	5	15	20	20
CC*0008LDACZ	ZF04KAE-TFD	460/3/60	3.0	28.0	1	0.5	15.0	15.0	5	15	20	20
CC*0010LBACZ	ZF05KAE-PFV	208-230/1/60	7.8	55.0	1	0.5	15.0	15.0	5	15	20	20
CC*0010LCACZ	ZF05KAE-TF5	208-230/3/60	6.6	58.0	1	0.5	15.0	15.0	5	15	20	20
CC*0010LDACZ	ZF05KAE-TFD	460/3/60	2.9	28.0	1	0.5	15.0	15.0	5	15	20	20
CC*0022LBACZ	ZF07KAE-PFV	208-230/1/60	12.4	75.0	1	0.5	20.0	25.0	5	15	21	30
CC*0022LCACZ	ZF07KAE-TF5	208-230/3/60	7.8	58.0	1	0.5	15.0	15.0	5	15	20	20
CC*0022LDACZ	ZF07KAE-TFD	460/3/60	3.6	28.0	1	0.5	15.0	15.0	5	15	20	20
CC*0025LBACZ	ZF08K4E-PFV	208-230/1/60	14.7	73.0	2	1	20.0	30.0	10	30	37.5	40
CC*0025LCACZ	ZF08K4E-TF5	208-230/3/60	8.7	63.0	2	1	15.0	20.0	9	23	28.8	30
CC*0025LDACZ	ZF08K4E-TFD	460/3/60	4.5	31.0	2	1	15.0	15.0	b	b	15	15
CC*0030LBACZ	ZF09K4E-PFV	208-230/1/60	12.8	88.0	2	1	20.0	25.0	10	30	37.5	40
CC*0030LCACZ	ZF09K4E-TF5	208-230/3/60	9.9	77.0	2	1	15.0	20.0	9	23	28.8	30
CC*0030LDACZ	ZF09K4E-TFD	460/3/60	4.5	39.0	2	1	15.0	15.0	b	b	15	15
CC*0035LBACZ	ZF11K4E-PFV	208-230/1/60	16.3	109.0	2	1	21.4	35.0	10	30	37.5	45
CC*0035LCACZ	ZF11K4E-TF5	208-230/3/60	12.2	88.0	2	1	20.0	25.0	9	23	28.8	35
CC*0035LDACZ	ZF11K4E-TFD	460/3/60	5.8	44.0	2	1	15.0	15.0	b	b	15	15
CC*0045LBACZ	ZF13K4E-PFV	208-230/1/60	24.0	129.0	1	3.5	33.5	50.0	10	30	43.5	60
CC*0045LCACZ	ZF13K4E-TF5	208-230/3/60	11.9	99.0	1	3.5	20.0	30.0	10	30	37.5	40
CC*0045LDACZ	ZF13K4E-TFD	460/3/60	6.4	49.5	1	1.9	15.0	15.0	9	23	28.8	30
CC*0055LBACZ	ZF15K4E-PFV	208-230/1/60	24.7	169.0	1	3.5	34.3	50.0	10	30	44.3	60
CC*0055LCACZ	ZF15K4E-TF5	208-230/3/60	17.0	123.0	1	3.5	24.7	40.0	10	30	37.5	50
CC*0055LDACZ	ZF15K4E-TFD	460/3/60	8.7	62.0	1	1.9	15.0	20.0	9	23	28.8	30
CC*0060LCACZ	ZF18K4E-TF5	208-230/3/60	21.5	156.0	1	3.5	30.3	50.0	10	30	40.3	60
CC*0060LDACZ	ZF18K4E-TFD	460/3/60	8.0	75.0	1	1.9	15.0	15.0	9	23	28.8	30

Notes:

* H = Outdoor, N = Indoor

b. Power supplied by customer

c. Per UL and NEC, RLA values have been calculated by dividing the Maximum Continuous Current (MCC) by 1.56.

d. Unless otherwise noted, model is available for 50 Hz. Consult factory for details.

AWEF DATA – LOW TEMPERATURE

Copeland Scroll Models - Indoor/Outdoor

If model has a numerical value in the table below, the following statement applies:

“This refrigeration system is designed and certified for use in walk-in freezer applications.”

Model	Indoor						Outdoor					
	R-404A/ R-507A	R-448A	R-449A	R-407A	R-407C	R-407F	R-404A/ R-507A	R-448A	R-449A	R-407A	R-407C	R-407F
CC*0006LBACZ	2.04	—	—	—	—	2.01	2.88	2.87	2.87	2.87	—	2.87
CC*0006CCACZ	2.04	—	—	—	—	2.01	2.88	2.87	2.87	2.87	—	2.87
CC*0008LBACZ	—	—	—	—	—	—	—	—	—	—	—	—
CC*0008CCACZ	—	—	—	—	—	2.07	2.93	2.91	2.90	2.91	2.89	2.91
CC*0008LDACZ	—	—	—	—	—	2.07	2.93	2.91	2.90	2.91	2.89	2.91
CC*0010LBACZ	2.16	—	—	—	—	—	2.97	2.94	2.94	2.94	2.91	2.94
CC*0010CCACZ	—	—	—	—	—	—	2.97	2.94	2.94	2.94	2.91	2.94
CC*0010LDACZ	—	—	—	—	—	—	2.97	2.94	2.94	2.94	2.91	2.94
CC*0022LBACZ	—	—	—	—	—	—	3.09	3.04	3.04	3.06	3.02	3.07
CC*0022CCACZ	—	—	—	—	—	—	3.09	3.04	3.04	3.06	3.02	3.07
CC*0022LDACZ	—	—	—	—	—	—	3.09	3.04	3.04	3.06	3.02	3.07
CC*0025LBACZ	—	—	—	X	X	X	3.15	3.14	3.13	X	X	X
CC*0025CCACZ	—	—	—	—	X	—	3.15	3.12	3.12	3.13	X	3.14
CC*0025LDACZ	—	—	—	—	X	—	3.15	3.12	3.12	3.13	X	3.14
CC*0030LBACZ	2.40	—	—	—	—	X	3.15	3.15	3.15	3.14	3.10	X
CC*0030CCACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.13	3.15
CC*0030LDACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.13	3.15
CC*0035LBACZ	—	—	—	—	—	X	3.15	3.15	3.15	—	3.15	X
CC*0035CCACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.15	3.15
CC*0035LDACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.15	3.15
CC*0045LBACZ	2.40	—	—	—	2.40	X	3.15	3.15	3.15	3.15	3.15	X
CC*0045CCACZ	2.40	—	—	—	—	2.40	3.15	3.15	3.15	3.15	3.15	3.15
CC*0045LDACZ	2.40	—	—	—	—	2.40	3.15	3.15	3.15	3.15	3.15	3.15
CC*0055LBACZ	2.40	—	—	—	—	X	3.15	3.15	3.15	3.15	3.15	X
CC*0055CCACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.15	3.15
CC*0055LDACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.15	3.15
CC*0060CCACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.15	3.15
CC*0060LDACZ	2.40	—	—	—	—	—	3.15	3.15	3.15	3.15	3.15	3.15

Notes:

*H = Outdoor, N = Indoor

X = model not suitable for this refrigerant

— = model is not DOE AWEF compliant



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InterLink™ is your link to a complete line of dependable and certified commercial refrigeration parts, accessories and innovative electronic controls for all Climate Control equipment. At InterLink, we provide our wholesalers with a comprehensive selection of product solutions and innovative technologies for the installed customer base. And every product is built to ensure the same high performance standards with which all Heatcraft Refrigeration Products brands are built — backed by a dedicated team to serve every customer need, delivering at the best lead times in the industry.

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REPLACEMENT PARTS

Replacement Parts				
Item	Cabinet			
	C1	C2	C3	
PSC Motor	N/A	25309101, 230/1	25309001, 230/1	25309002, 460/1
PSC Motor Capacitor	N/A	N/A	5779G	5599M
FSEC Motor	25322401, 230/1	25322401, 230/1	25319102, 230/1	25319102, 230/1 ^f
VSEC Motor	25319201, 230/1	25319201, 230/1	25319102, 230/1	25319102, 230/1 ^f
Fan Blade	22901601, 14"	22901601, 14"	7173156, 22"	
Orbus Controller	28962001	28962001	28962001	
Orbus Transducer, 0-500 psis	28911204	28911204	28911204	
Orbus Transducer Harness	22515101	22515101	22515101	
Smart Defrost Kit (SDK)	28999301	28999301	28999301	
SDK Temperature Sensor	28900311	28900311	28900311	
SDK Transducer, 0-300 psia	28911202	28911202	28911202	
SDK Transducer Harness	22515102	22515102	22515102	
Microchannel Coil, Uncoated	59517503	59517603	59517703	
Microchannel Coil, Coated	59517504	59517604	59517704	
Grille	24104001	24104101	24104201	

Notes:

f = 460/230V transformer is used in unit

REPLACEMENT PARTS

LG Scroll Compressors

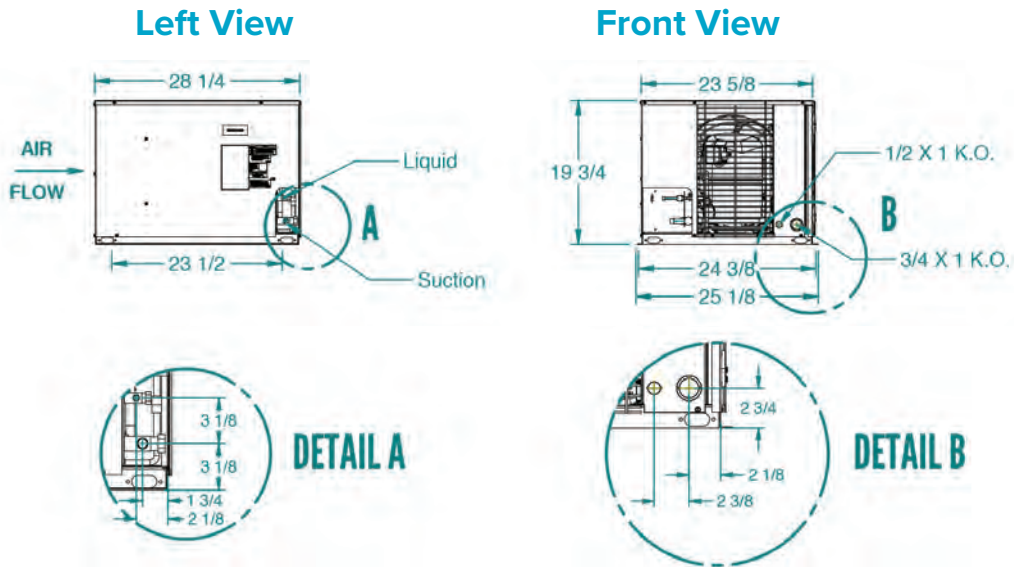
Unit Model Number	Compressor Model	Service Part Number
CC*0010MBALZ	MPA010KAA.A58LEXS	21518201S
CC*0010MCALZ	MPA010RAA.A58LEXS	21518202S
CC*0010MDALZ	MPA010SAA.A58LEXS	21518203S
CC*0015MBALZ	MPA013KAA.A58LEXS	21518204S
CC*0015MCALZ	MPA013RAA.A58LEXS	21518205S
CC*0015MDALZ	MPA013SAA.A58LEXS	21518206S
CC*0020MBALZ	MPA015KAA.A58LEXS	21518207S
CC*0020MCALZ	MPA015RAA.A58LEXS	21518208S
CC*0020MDALZ	MPA015SAA.A58LEXS	21518209S
CC*0025MBALZ	MPA019KAA.A58LEXS	21518210S
CC*0025MCALZ	MPA019RAA.A58LEXS	21518211S
CC*0025MDALZ	MPA019SAA.A58LEXS	21518212S
CC*0030MBALZ	MBA021KAA.A58LEXS	21518213S
CC*0030MCALZ	MBA021RAA.A58LEXS	21518214S
CC*0030MDALZ	MBA021SAA.A58LEXS	21518215S

Unit Model Number	Compressor Model	Service Part Number
CC*0035MBALZ	MBA026KAA.A58LEXS	21518216S
CC*0035MCALZ	MBA026RAA.A58LEXS	21518217S
CC*0035MDALZ	MBA026SAA.A58LEXS	21518218S
CC*0045MBALZ	MBA029KAA.A58LEXS	21518219S
CC*0045MCALZ	MBA029RAA.A58LEXS	21518220S
CC*0045MDALZ	MBA029SAA.A58LEXS	21518221S
CC*0050MBALZ	MBA033KAA.A58LEXS	21518222S
CC*0050MCALZ	MBA033RAA.A58LEXS	21518223S
CC*0050MDALZ	MBA033SAA.A58LEXS	21518224S
CC*0055MBALZ	MRA038KAA.A58LEXS	21518225S
CC*0055MCALZ	MRA038RAA.A58LEXS	21518226S
CC*0055MDALZ	MRA038SAA.A58LEXS	21518227S
CC*0060MCALZ	MRA045RAA.A58LEXS	21518228S
CC*0060MDALZ	MRA045SAA.A58LEXS	21518229S

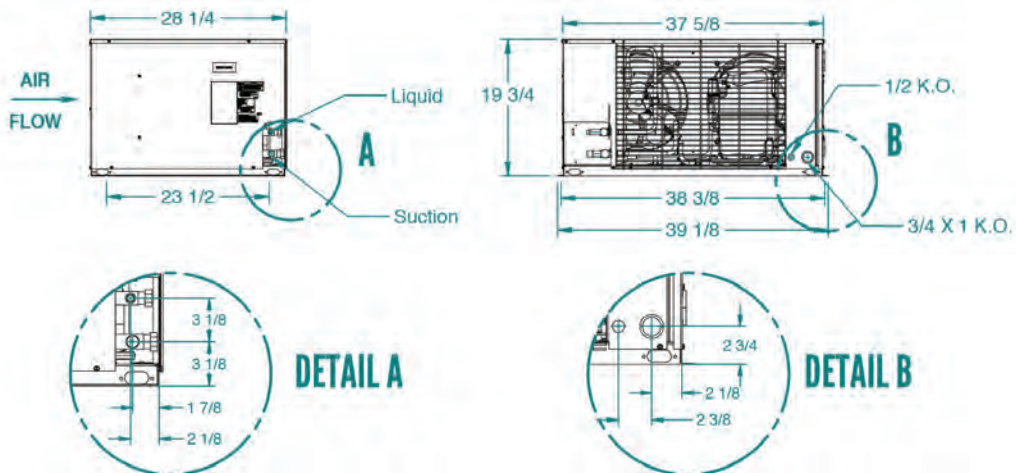
DIMENSIONAL DRAWINGS

Outdoor

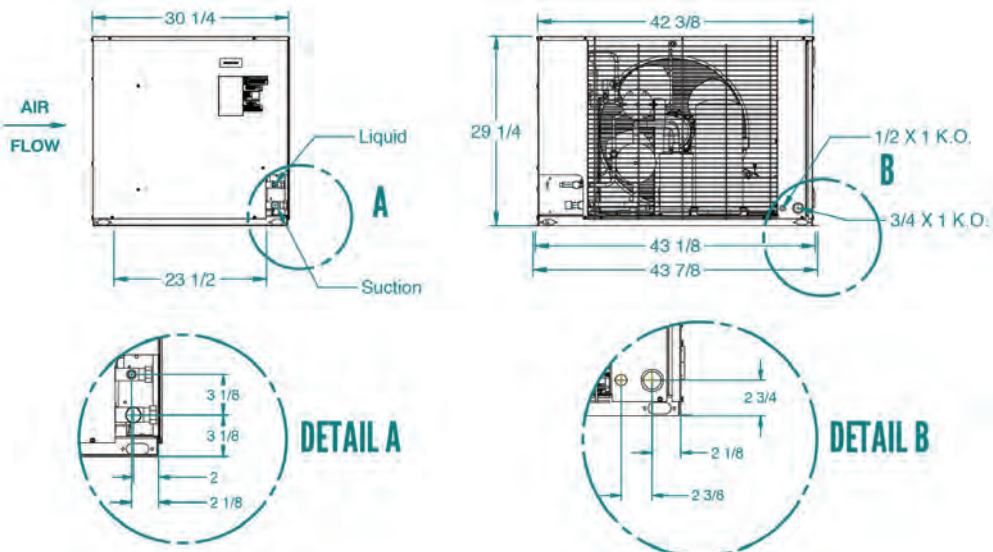
C1



C2



C3





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Since product improvement is a continuing effort, we reserve the right to make changes in specifications without notice.

CC-HTS-1020 | Version 002

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Installation and Operations Manual

H-IM-CU

February 2021

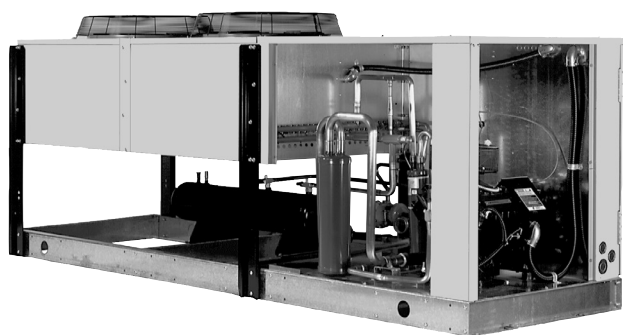
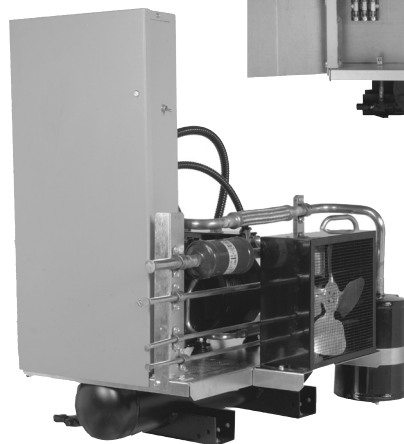
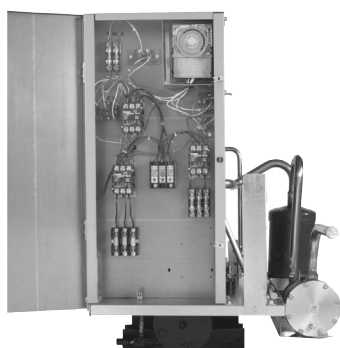
Part No. 25008101

Replaces January 2021

Condensing Units

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General Safety Information

1. Installation and maintenance to be performed only by qualified personnel who are familiar with this type of equipment.
2. Some units are pressurized with dry air or inert gas. Units charged with dry air or inert gas must be evacuated before charging the system with refrigerant.
3. Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
4. Avoid contact with sharp edges and coil surfaces. They are a potential injury hazard.
5. Make sure all power sources are disconnected before any service work is done on units.

WARNING: Refrigerant can be harmful if it is inhaled. Refrigerant must be used and recovered responsibly.
Failure to follow this warning may result in personal injury or death.

Inspection

Responsibility should be assigned to a dependable individual at the job site to receive material. Each shipment should be carefully checked against the bill of lading. The shipping receipt should not be signed until all items listed on the bill of lading have been accounted. Check carefully for concealed damage. Any shortage or damages should be reported to the delivering carrier. Damaged material becomes the delivering carrier's responsibility, and should not be returned to the manufacturer unless prior approval is given to do so. When uncrating, care should be taken to prevent damage. Heavy equipment should be left on its shipping base until it has been moved to the final location. Check the serial tag information with invoice. Report any discrepancies to your Heatcraft Refrigeration Products Sales Representative.

Warranty Statement

Seller warrants to its direct purchasers that products, including Service Parts, manufactured by SELLER shall be of a merchantable quality, free of defects in material or workmanship, under normal use and service for a period of one **(1) year from date of original installation, or eighteen (18) months from date of shipment** by SELLER, whichever first occurs. Any product covered by this order found to Seller's satisfaction to be defective upon examination at Seller's factory will at SELLER's option, be repaired or replaced and returned to Buyer via lowest common carrier, or SELLER may at its option grant Buyer a credit for the purchase price of the defective article. Upon return of a defective product to SELLER's plant, freight prepaid, by Buyer, correction of such defect by repair or replacement, and return freight via lowest common carrier, shall constitute full performance by SELLER of its obligations hereunder.

SELLER shall have no liability for expenses incurred for repairs made by Buyer except by prior, written authorization. Every claim on account of breach of warranty shall be made to SELLER in writing within the warranty period specified above – otherwise such claim shall be deemed waived. Seller shall have no warranty obligation whatsoever if its products have been subjected to alteration, misuse, negligence, free chemicals in system, corrosive atmosphere, accident, or if operation is contrary to SELLER's or manufacturer's recommendations, or if the serial number has been altered, defaced, or removed.

MOTOR COMPRESSORS:

Motor compressors furnished by SELLER are subject to the standard warranty terms set forth above, except products with LG model compressors which will have warranty of two (2) years from installation or thirty (30) months from shipment, " then continue on with that replacement should be made from nearest authorized compressor wholesaler. The replacement motor compressor shall be identical to the model of the motor compressor being replaced. Additional charges which may be incurred throughout the substitution of other than identical replacements are not covered by this warranty. An optional, non assignable, four (4) year extended compressor warranty may be purchased within the boundaries of the United States of America, its territories and possessions, and Canada. With this extended compressor warranty, replacements are administered by an authorized compressor distributor only. Replacements within the first year of the warranty area available through the distributor; the second through fifth years, the purchaser must submit a proof-of-purchase of a compressor and supply it to Heatcraft Refrigeration Products Warranty Claims for reimbursement.

Seller makes no express warranties except as noted above. All implied warranties are limited to the duration of the Express Warranty. Liability for incidental and consequential damages is excluded.

The forgoing is in lieu of all other warranties, express or implied, notwithstanding the provisions of the uniform commercial code, the Magnuson-Moss Warranty - Federal Trade Commission Improvement Act, or any other statutory or common law, federal or state.

SELLER makes no warranty, express or implied, of fitness for any particular purpose, or of any nature whatsoever, with respect to products manufactured or sold by seller hereunder, except as specifically set forth above and on the face hereof. It is expressly understood and agreed that SELLER shall not be liable to buyer, or any customer of buyer, for direct or indirect, special, incidental, consequential or penal damages, or for any expenses incurred by reason of the use or misuse by buyer or third parties of said products. To the extent said products may be considered "consumer products," As defined in Sec. 101 of the Magnuson-Moss Warranty - Federal Trade Commission Improvement Act, SELLER makes no warranty of any kind, express or implied, to "consumers," except as specifically set forth above and on the face hereof.

The following conditions should be adhered to when installing this unit to maintain the manufacturers warranty:

- a) System piping must be in accordance with good refrigeration practices.
- b) **Inert gas must be charged into the piping during brazing.**
- c) The power supply to the unit must meet the following conditions:
 - A. Three phase voltages must be +/- 10% of nameplate ratings. Single phase must be within +10% or -5% of nameplate ratings.
 - B. Phase imbalance cannot exceed 2%.
- d) All control and safety switch circuits must be properly connected according to the wiring diagram.
- e) The factory installed wiring and piping must not be changed without written factory approval.
- f) All equipment is installed in accordance with Heatcraft Refrigeration Products specified minimum clearances.

DOE Walk-In Cooler Freezer AWEF Set Points

Based on information currently available, following set points must be adhered to for DOE AWEF test conditions (when adjustable):

Condensing Unit Head pressure

LT - 100 psi

MT - 150 psi

Evaporator Superheat

6.5°F

Defrost Termination

LOP - 55°F

MP - 55°F

CM - 85°F

LUC - 55°F

LVCN - 80°F

Unloader Pressure Control

MT - Below 23°F SST LT - Below -22°F SST

Disclaimer: This communication is provided for informational purposes only and is based on information that is subject to change and interpretation. Heatcraft recommends customers review the applicable laws and regulations to ensure compliance with regulations. For DOE regulations, see US DOE Energy Efficiency and Renewable Energy website for Walk-In Coolers and Freezers at <https://www.regulations.doe.gov/ccms>

Space and Location Requirements for Air Cooled Condensing Units and Remote Condensers

The most important consideration which must be taken into account when deciding upon the location of air-cooled equipment is the provision for a supply of ambient air to the condenser, and removal of heated air from the condensing unit or remote condenser area. Where this essential requirement is not adhered to, it will result in higher head pressures, which cause poor operation and potential failure of equipment. Units must not be located in the vicinity of steam, hot air or fume exhausts. Corrosive atmospheres require custom designed condensers.

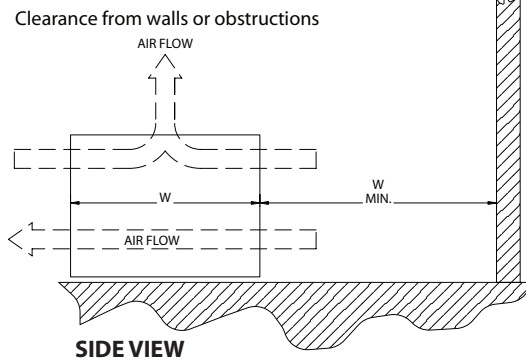
Another consideration which must be taken is that the unit should be mounted away from noise sensitive spaces and must have adequate support to avoid vibration and noise transmission into the building. Units should be mounted over corridors, utility areas, rest rooms and other auxiliary areas where high levels of sound are not an important factor. Sound and structural consultants should be retained for recommendations.

Figure 1. Space and Location Requirements for Condensing Units

Walls or Obstructions

The unit should be located so that air may circulate freely and not be recirculated. For proper air flow and access all sides of the unit should be a minimum of "W" away from any wall or obstruction. It is preferred that this distance be increased whenever possible. Care should be taken to see that ample room is left for maintenance work through access doors and panels. Overhead obstructions are not permitted. When the unit is in an area where it is enclosed by three walls the unit must be installed as indicated for units in a pit.

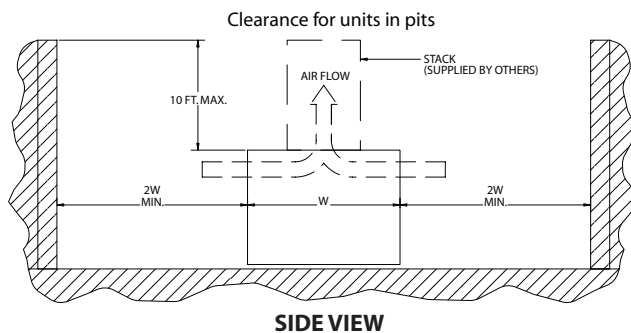
Units Near Walls or Obstructions



Units in Pits

The top of the unit should be level with the top of the pit, and side distance increased to "2W".

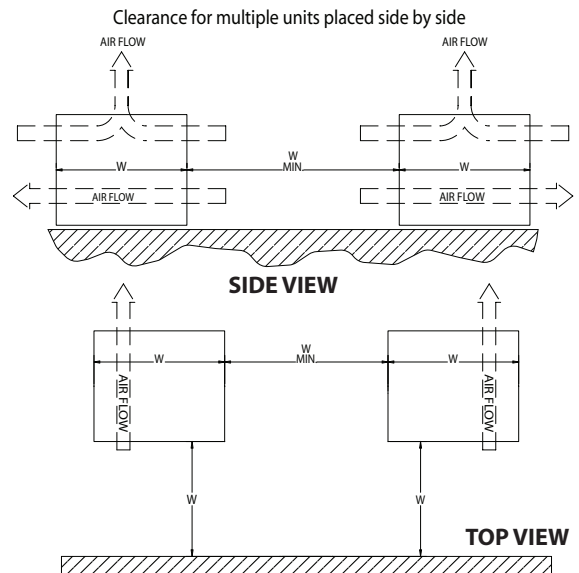
If the top of the unit is not level with the top of pit, discharge cones or stacks must be used to raise discharge air to the top of the pit. This is a minimum requirement.



Multiple Units

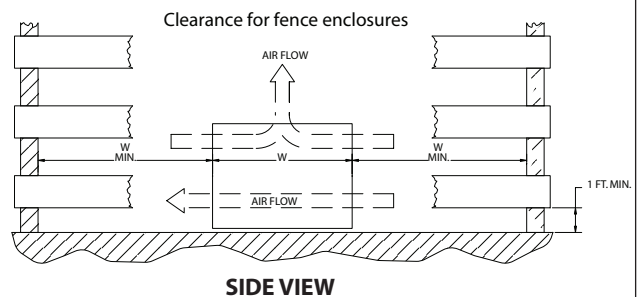
For units placed side by side, the minimum distance between units is the width of the largest unit. If units are placed end to end, the minimum distance between units is 4 feet.

Multiple Units Near Walls or Obstructions

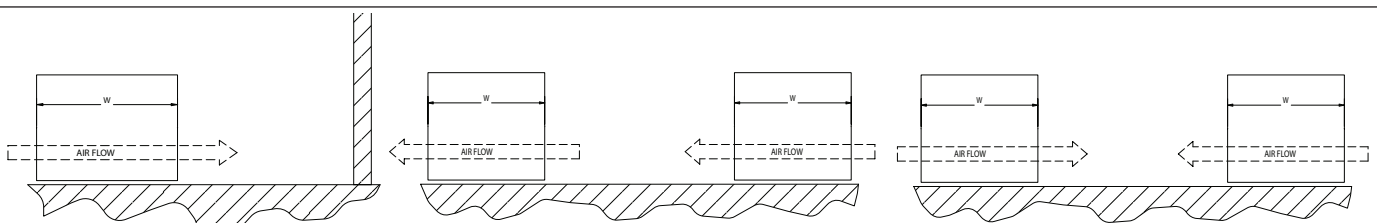


Units Inside Decorative Fence

Fences must have 50% free area, with 1 foot undercut, a "W" minimum clearance, and must not exceed the top of unit. If these requirements are not met, unit must be installed as indicated for "Units in pits".



CONFIGURATIONS BELOW ARE NOT RECOMMENDED



* "W" = Total width of the condensing unit

Condensing Unit Rigging and Mounting

Rigging holes are provided on all units. Caution should be exercised when moving these units. To prevent damage to the unit housing during rigging, cables or chains used must be held apart by spacer bars. The mounting platform or base should be level and located so as to permit free access of supply air.

Ground Mounting

Before tightening mounting bolts, recheck level of unit.

Roof Mounting

Roof mounted units should be installed level on steel channels or an I-beam frame capable of supporting the weight of the unit. Vibration absorbing pads or springs should be installed between the condensing unit legs or frame and the roof mounting assembly.

Spring Mounted Compressor

Compressors are secured rigidly to make sure there is no transit damage. Before operating the unit, it is necessary to follow these steps:

- Remove the upper nuts and washers.
- Discard the shipping spacers.
- Install the neoprene spacers. (Spacers located in the electrical panel or tied to compressor.)
- Replace the upper mounting nuts and washers.
- Allow 1/16 inch space between the mounting nut/washer and rubber spacer. Mounting spring must not be fully compressed when mounting nut is properly installed. See Figures 2 and 3.

Rigid Mounted Compressor

Some products use rigid mounted compressors. Check the compressor mounting bolts to insure they have not vibrated loose during shipment. See Figure 4.

Figure 2. Spring Mount

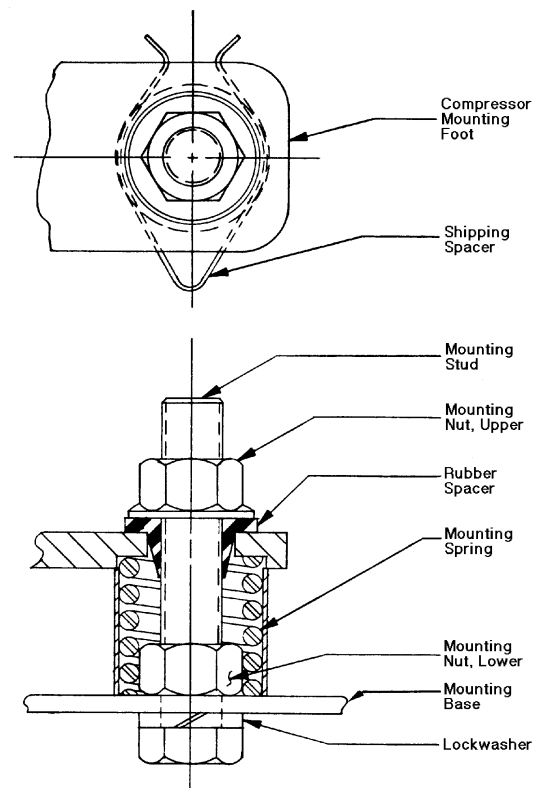
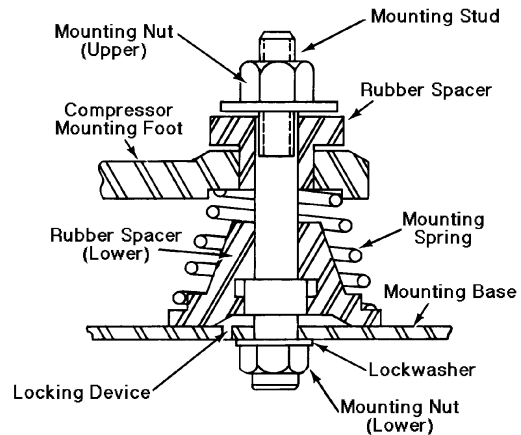


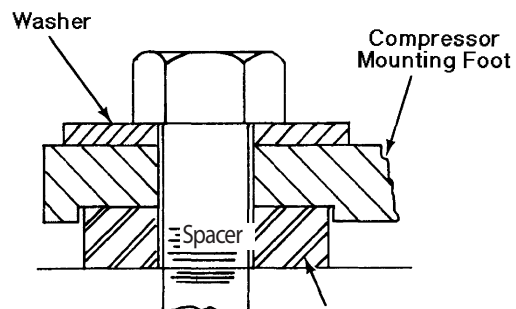
Figure 3. Spring Mount



Mount is shown in properly adjusted position.

Figure 4.

Solid Mount for Mobile or Deep Sump Application



Requirements for Remote and Water Cooled Condensing Units

General Installation

The indoor compressor units are designed to be used with a remote condenser. The water cooled units are similar, except that they have an integral water cooled condenser. Inlet and outlet water connections are to be made in the field. On units having a compressor water jacket, incoming water shall be routed through the jacket prior to entering the condenser. For cleaning purposes, condenser end plates can be removed to give access to the water tubes. Cleaning is accomplished by a simple spiral tool powered by an ordinary electric drill. During installation, allow space for cleaning the condenser. Commercial equipment of this type is intended for installation by qualified refrigeration mechanics.

Typical Arrangements

Diagram 1 illustrates a typical piping arrangement involving a remote condenser located at a higher elevation, as commonly encountered when the condenser is on a roof and the compressor and receiver are on grade level or in a basement equipment room.

In this case, the design of the discharge line is very critical. If properly sized for full load condition, the gas velocity might be too low at reduced loads to carry oil up through the discharge line and condenser coil. Reducing the discharge line size would increase the gas velocity sufficiently at reduced load conditions; however, when operating at full load, the line would be greatly undersized, and thereby creating an excessive refrigerant pressure drop. This condition can be overcome in one of two of the following ways:

1. The discharge line may be properly sized for the desired pressure drop at full load conditions and an oil separator installed at the bottom of the trap in the discharge line from the compressor.
2. A double riser discharge line may be used as shown in Diagram 2. Line "A" should be sized to carry the oil at minimum load conditions and the line "B" should be sized so that at the full load conditions both lines would have sufficient flow velocity to carry the oil to the condenser.

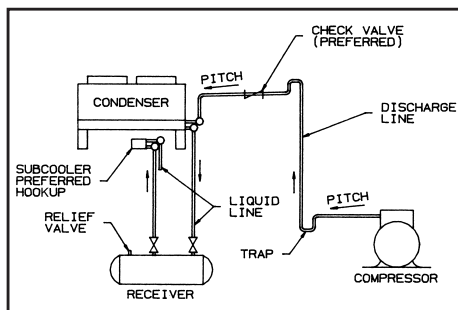


Diagram 1

Water Regulating Valve

Using this control on the water cooled condensing units, the head pressure can be maintained by adjusting the flow of water through the condenser section. This type control is most often located on the water entering side of the condenser and is regulated by the refrigerant condensing pressure.

Subcooler

Diagrams 1 and 2 below show typical subcooler piping. Diagram 1 is the preferred connection with receiver as it provides maximum subcooling. Diagram 2 may be used if the receiver is located far from the condenser.

NOTES:

1. All oil traps are to be as short in radius as possible. Common practice is to fabricate the trap using three 90 degree ells.
2. Pressure relief valves are recommended at the condenser for protection of the coil.
3. A pressure valve at the high point in the discharge line is recommended to aid in removing non-condensables.
4. The placement of a subcooler should be that it does not interfere with normal airflow of the condenser. Increased static of the unit could cause a decrease in system capacity and fan motor damage.

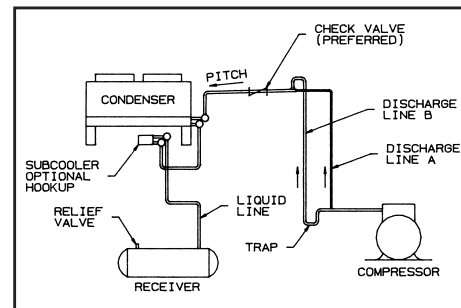


Diagram 2

City & Tower Water Connections

In the refrigeration industry "City" and "Tower" are designations of temperature and flow conditions, not applications. The term "City" refers to operating conditions where incoming water is 75°F, and condensing temperature is 105°F. "Tower" refers to a higher temperature relationship which is normally 85°F, incoming water and 105°F condensing temperature.

Water circuits in some condenser models provide a center, or Tower, outlet connection to allow divided inlet water flow. This extra water port reduces water velocity, water pressure drop, and condenser wear in applications such as cooling towers where higher inlet temperatures and water flows occur. See Figure 5

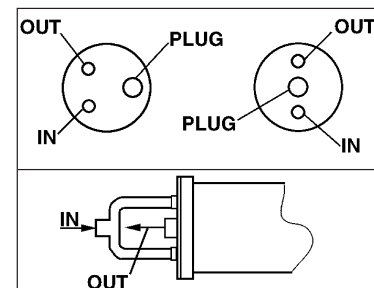
Water Connections for City

For City water (open system) high pressure applications, the Tower connections is plugged.

Water Connections for Tower

For Tower usage and low pressure applications, both normal water connections will be used as inlets and the tower connection as an outlet.

Figure 5. Water Connections



Head Pressure Control

Several types of head pressure control systems are available on condensing units:

- A. Dual Valve System. (See section on operation and adjustment.)
- B. Single Valve System. No adjustments are necessary. (See section on operation.)
- C. Ambient Fan Cycle Control. (See section on operation and adjustment.)
- D. Variable Speed Fan Control

A. Dual Valve System

The system employs an ORI (open on rise of inlet pressure) valve and an ORD (open on rise of differential pressure) valve. The high pressure discharge gas is introduced above the liquid in the receiver tank. The receiver discharge is regulated by the ORI valve.

The discharge pressure of the ORI valve must be adjusted to regulate the unit for proper operating conditions. Adjust the ORI valve shown on the following diagram to maintain a discharge pressure of 150 PSIG on medium temperature systems and 100 PSIG on low temperature systems, see Figure 6.

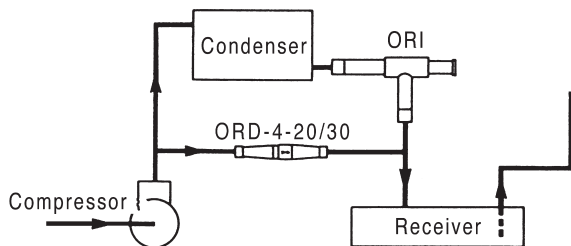
Operation and Adjustment

Condensing units with dual valves require sufficient charge to partially flood the condenser during low ambient conditions.

Valve adjustment should be made with gauges connected to the discharge port of the compressor. Adjustments should be made during mild or low ambient conditions. Turning the valve stem "clockwise" on the ORI valve will increase the discharge pressure, while turning the valve stem "counterclockwise" will decrease the discharge pressure.

If adjustments are made during warm ambient conditions, it may not be possible to adjust the regulator valve as low as desired. Readjustment may be necessary once cooler conditions prevail.

Figure 6. Dual Valve Piping Arrangement

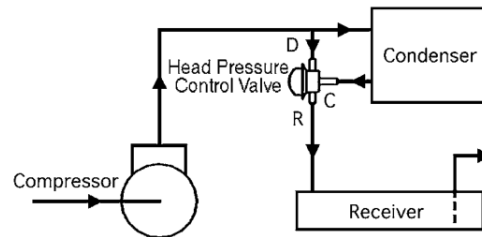


B. Single Valve System

The standard valve used on high pressure refrigerant systems controls the head pressure at approximately 180 PSIG. There is no adjustment for this valve. On low pressure refrigerant systems the valve controls pressure at approximately 100 PSIG. For energy efficiency, the 100 PSIG valve is sometimes used on high pressure refrigerant systems.

At condensing pressures above the valve setting, flow enters Port C and leaves Port R. When the condensing pressure falls below the valve setting, the valve modulates to permit discharge gas to enter Port D. Metering discharge gas into the refrigerant flow leaving the condenser produces a higher pressure at the condenser outlet, reduces the flow, and causes the level of liquid refrigerant to rise in the condenser. This "flooding" of the condenser with liquid refrigerant reduces the available condensing surface, holding the condensing pressure at the valve setting.

Figure 7. Single Valve Flooding Valve Piping Arrangement



C. Ambient Fan Cycle Control

This is an automatic winter control method which will maintain a condensing pressure within reasonable limits by cycling fan motors in response to outside air temperature. The thermostat(s) should be field adjusted to shut off the fan when the condensing temperature is reduced to approximately 70°F. Table 1 lists approximate settings for several system T.D.'s. These settings are approximate as they do not take into account variations in load.

Table 1. Ambient Fan Cycle Thermostat Settings

Models	Design	Thermostat Settings		
	T.D.	T1	T2	T3
2-fan units:	30	40		
	25	45		
	20	50		
4-fan units:	15	55		
	30	40	30	
	25	45	35	
3-fan units:	20	50	40	
	15	55	45	
6-fan units:	30	40	30	20
	25	45	35	25
	20	50	40	30
8-fan units:	15	55	45	35

NOTE: Cycle pairs of fans on double wide units.

D. Variable Speed Fan Control

Variable speed fan controls must be set to maintain a discharge pressure of 150 PSIG on medium temperature systems and 100 PSIG on low temperature systems.

Units using the Orbus Controller includes jumpers that can be set in the field as required. More information on the Variable Speed Motor with Orbus Controller can be found in the subsequent pages of this document.

For other variable speed controllers, consult control manufacturer information for details on how to set discharge pressure as required.

CAUTION:

Fans closest to the headers should not be cycled on standard temperature or pressure controls. Dramatic temperature and pressure changes at the headers as a result of fan action can result in possible tube failure. Fan motors are designed for continuous duty operation. Fan cycling controls should be adjusted to maintain a minimum of (5) minutes on and (5) minutes off. Short cycling of fans may result in a premature failure of motor and/or fan blade. Compressors operating below +10°F SST must have air flowing over the compressor at all times when the compressor is running. Under no circumstance should all condenser motors be allowed to cycle off on one control. At least one motor shall be wired to operate at all times. Under most circumstances, the condenser motor nearest the inlet header should remain on whenever the compressor is operating.

Phase Loss Monitor

When phase sequence is correct and full line voltage is present on all three phases, the relay is energized as the normal condition indicator light glows. If compressor fails to operate and the normal condition indicator light on the phase monitor does not glow, then the supplied electrical current is not in phase with the monitor. This problem is easily corrected by the following steps:

1. Turn power off at disconnect switch.
2. Swap any two of the three power input wires.
3. Turn power on. Indicator light should glow and compressor should start.
4. Observe motors for correct rotation.

Polyol Ester Lubricants

Hygroscopicity

Since moisture levels greater than 100 ppm will result in system corrosion and ultimate failure, it is imperative that compressors, components, containers and the entire system be kept sealed as much as possible. Lubricants will be packaged in specially designed, sealed containers. After opening, all the lubricant in a container should be used at once since it will readily absorb moisture if left exposed to the ambient. Any unused lubricant should be properly disposed of. Similarly, work on systems and compressors must be carried out with the open time as short as possible. Leaving the system or compressor open during breaks or overnight **MUST BE AVOIDED!**

Color

As received, the POE lubricant will be clear or straw colored. After use, it may acquire a darker color. This does not indicate a problem as the darker color merely reflects the activity of the lubricant's protective additive.

Oil Level

During Copeland's testing of Polyol ester oil, it was found that this lubricant exhibits a greater tendency to introduce oil into the cylinder during flooded start conditions. If allowed to continue, this condition will cause mechanical failure of the compressor.

A crankcase heater is required with condensing units and it must be turned on several hours before start-up.

Oil level must not exceed 1/4 sight glass.

Polyol Ester Lubricants

The preferred POE 32 is due to unique additives included in this lubricant. POE's **must** be used if HFC refrigerants are used in the system. They are also acceptable for use with any of the traditional refrigerants or interim blends and are compatible with mineral oils.

Refrigerant Piping

Install all refrigerant components in accordance with applicable local and national codes and in accordance with good practice for proper system operation. The thermostatic expansion valve must be the externally equalized type. It can be mounted inside the unit end compartment. Mount the expansion valve bulb on a horizontal run of suction line as close as possible to the suction header. Use the clamps provided with the valve to fasten the bulb securely so there is a tight line-to-line contact between the bulb and the suction line. Suction and hot gas connections are made on the outside of the unit.

Suction lines should be sloped towards the compressor at the rate of one (1) inch per ten (10) feet for good oil return. Vertical risers of more than four (4) feet should be trapped at the bottom with a P-trap. If a P-trap is used, the expansion valve bulb should be installed between the unit and the trap.

Recommended Refrigerant Piping Practices

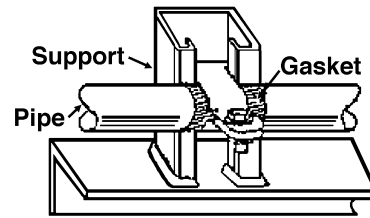
The system as supplied by **Heatcraft Refrigeration Products**, was thoroughly cleaned and dehydrated at the factory. Foreign matter may enter the system by way of the evaporator to condensing unit piping. Therefore, care must be used during installation of the piping to prevent entrance of foreign matter. Install all refrigeration system components in accordance with applicable local and national codes and in conformance with good practice required for the proper operation of the system.

The refrigerant pipe size should be selected from the Line Sizing Tables. The interconnecting pipe size is not necessarily the same size as the stub-out on the condensing unit or the evaporator.

The following procedures should be followed:

- Do not leave dehydrated compressors or filter-driers on condensing units open to the atmosphere any longer than is absolutely necessary.
- Use only refrigeration grade copper tubing, properly sealed against contamination.
- Suction lines should slope 1/4" per 10 feet towards the compressor.
- Suitable P-type oil traps should be located at the base of each suction riser to enhance oil return to the compressor.
- For desired method of superheat measurement, a pressure tap should be installed in each evaporator suction line in the proximity of the expansion valve bulb.
- When brazing refrigerant lines, an inert gas should be passed through the line at low pressure to prevent scaling and oxidation inside the tubing. Dry nitrogen is preferred.**
- Use only a suitable silver solder alloy on suction and liquid lines.
- Limit the soldering paste or flux to the minimum required to prevent contamination of the solder joint internally. Flux only the male portion of the connection, never the female. After brazing, remove excess flux.
- See line sizing tables for discharge and liquid drain line sizes for remote condenser connections.
- If isolation valves are installed at the evaporator, full port ball valves should be used.

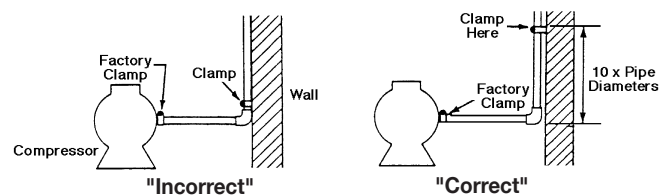
Figure 7. Example of Pipe Support



Refrigerant Pipe Support

- Normally, any straight run of tubing must be supported in at least two locations near each end of the run. Long runs require additional supports. The refrigerant lines should be supported and fastened properly. As a guide, 3/8 to 7/8 should be supported every 5 feet; 1-1/8 and 1-3/8 every 7 feet; and 1-5/8 and 2-1/8 every 9 to 10 feet. See Figure 9
- When changing directions in a run of tubing, no corner should be left unsupported. Supports should be placed a maximum of 2 feet in each direction from the corner. See Figure 10
- Piping attached to a vibrating object (such as a compressor or compressor base) must be supported in such a manner that will not restrict the movement of the vibrating object. Rigid mounting will fatigue the copper tubing.
- Do not use short radius ells. Short radius elbows have points of excessive stress concentration and are subject to breakage at these points.
- Thoroughly inspect all piping after the equipment is in operation and add supports wherever line vibration is significantly greater than most of the other piping. Extra supports are relatively inexpensive as compared to refrigerant loss.

Figure 8. Condensing Unit / Compressor to Wall Support



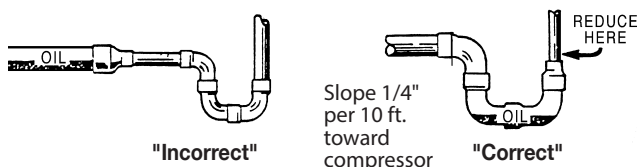
Suction Lines

Horizontal suction lines should slope away from the evaporator toward the compressor at the rate of 1/4 inch per 10 feet for good oil return. When multiple evaporators are connected in series using a common suction line, the branch suction lines must enter the top of the common suction line.

For dual or multiple evaporator systems, the branch lines to each evaporator should be sized for the evaporator capacity. The main common line should be sized for the total system capacity.

Suction lines that are outside of refrigerated space must be insulated.

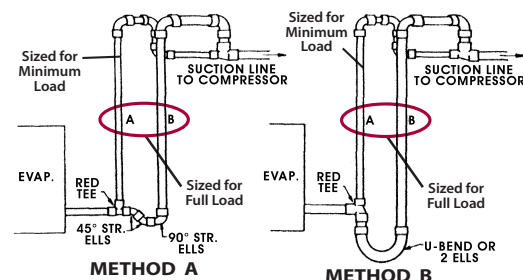
Figure 9. Suction P-Traps



Suction Line Risers

Prefabricated wrought copper traps are available, or a trap can be made by using two street ells and one regular ell. The suction trap must be the same size as the suction line. For long vertical risers, additional traps may be necessary. Generally, one trap is recommended for each length of pipe (approximately 20 feet) to insure proper oil movement. See Figure 9 and Figure 10 for methods of constructing proper suction line P-traps.

Figure 10. Double Suction Riser Construction



NOTE: A suction line trap must be installed at the point where piping changes the direction of refrigerant flow from any horizontal run to an upward vertical run.

Liquid Lines

Liquid lines should be sized for a minimum pressure drop to prevent "flashing". Flashing in the liquid lines would create additional pressure drop and poor expansion valve operation. If a system requires long liquid lines from the receiver to the evaporator or if the liquid has to rise vertically upward any distance, the losses should be calculated to determine whether or not a heat exchanger is required. The use of a suction to liquid heat exchanger may be used to subcool the liquid to prevent flashing. This method of subcooling will normally provide no more than 20°F subcooling

on high pressure systems. The amount of subcooling will depend on the design and size of the heat exchanger and on the operating suction and discharge pressures. An additional benefit from the use of the suction to liquid type heat exchanger is that it can help raise the superheat in the suction line to prevent liquid return to the compressor via the suction line. Generally, heat exchangers are not recommended on R-22 low temperature systems. However, they have proved necessary on short, well insulated suction line runs to provide superheat at the compressor.

Unit Cooler Piping

Pipe size example:

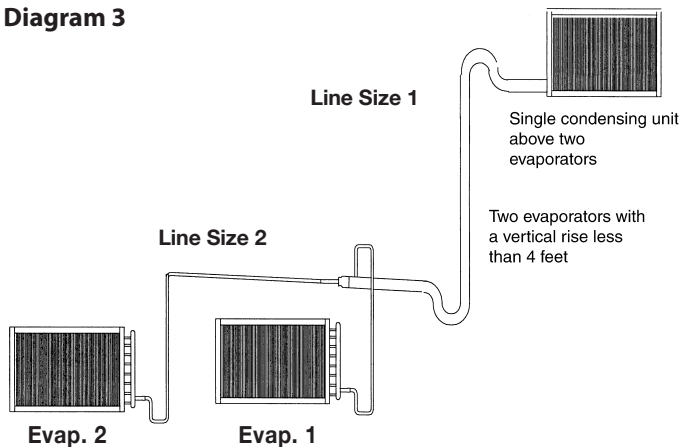
Given: **-10°F Freezer** with one system having (2) evaporators

- One condensing unit rated at 24,000 BTUH's @ -20°F SST R404A refrigerant.
- Two evaporators each rated at 12,000 BTUH's @ 10°F TD.
- 100 feet of actual line run between condensing unit to first evaporator and 20 feet of actual line run between the first evaporator and the second evaporator (see figure below).

How to figure line sizes:

1. Determine equivalent line run = actual run + valves and fitting allowances.
2. Use Line Sizing Tables to size lines.
3. Note any special considerations.

Diagram 3



Fittings in this system:

- (6) 90° elbows in main line plus a 90° turn through a tee.
- (5) additional 90° elbows to first evaporator.
- (4) additional 90° elbows to second evaporator.

Determine line size 1 (main line from condensing unit):

1. Main line from the condensing unit to be sized for the total capacity (balance) of the whole system of 24,000 BTUH's.
2. Refer to 24,000 @100 feet at -20°F SST R404A on the chart. You will find the suction line to be 1-3/8" and 1/2" liquid line.
3. For every 1-3/8" 90° elbow you must add 4 equivalent feet of pipe and 2.5 equivalent feet of pipe for each 1-3/8" tee.
Therefore, total equivalent line run =
Actual line run 100 feet
+ (6) 1-3/8" elbows @ 4' 24 feet
+ (1) 1-3/8" tee @ 2.5' 2.5 feet
Total equivalent line run 126.5 feet
4. For 126.5 total equivalent feet, the suction line size should be 1-3/8" and the liquid line stays at 1/2" line.

Note: On Table 6, for 24,000 BTUH's, the maximum suction riser is 1-1/8" to insure proper oil return and pressure drop from the bottom p-trap to the top p-trap.

Determine line size 2 (evaporators):

1. Line sizing to each evaporator is based on 12,000 BTUH's and equivalent run from condensing unit. First evaporator has an 105 ft. run and the second evaporator has a 120 ft. run.
2. Line sizing table indicates 1-1/8" suction for the first evaporator and indicates 1-1/8" suction for the second evaporator.
3. Refer to Table 4. Each 1-1/8" 90° elbow adds 3 equivalent feet of pipe. Each 90° turn through a 1-1/8" tee adds 6 equivalent feet.
4.
Actual line run (evap 1) 105 feet
+ (5) 1-1/8" elbows @ 3' 15 feet
+ (1) 90° turn through tee @ 6' 6 feet
Total equivalent line run 126 feet

Actual line run (evap 2) 120 feet
+ (4) 1-1/8" elbows @ 3' 12 feet
Total equivalent line run 132 feet
5. Table 6 indicates 1-1/8" suction line and 3/8" liquid line from main line to both evaporators.

Line Sizing

The following Tables 5-8 indicate liquid lines and suction lines for all condensing units for R-404A, R-507, R-407A/C/F, R-448A and R-449A

When determining the refrigerant line length, be sure to add an allowance for fittings. See Table 4. Total equivalent length of refrigerant lines is the sum of the actual linear footage and the allowance for fittings.

Table 2. Weight of Refrigerants in Copper Lines During Operation (Pounds per 100 lineal feet of type "L" tubing)

Line Size O.D. (Inches)	Refrigerant	Liquid Line	Hot Gas Line	Suction Line at Suction Temperature				
				-40°F	-20°F	0°F	+20°F	+40°F
3/8	R-407A, R-407C, R-407F	3.8	0.25	0.02	0.03	0.04	0.06	0.09
	R-448A, R-449A	3.6	0.24	0.02	0.03	0.04	0.06	0.09
	R-404A, R-507A	3.4	0.27	0.02	0.04	0.06	0.08	0.12
1/2	R-407A, R-407C, R-407F	7.0	0.46	0.03	0.05	0.07	0.11	0.16
	R-448A, R-449A	6.7	0.44	0.03	0.05	0.07	0.11	0.16
	R-404A, R-507A	6.3	0.51	0.04	0.07	0.11	0.15	0.22
5/8	R-407A, R-407C, R-407F	11.2	0.74	0.05	0.08	0.12	0.18	0.26
	R-448A, R-449A	10.8	0.71	0.05	0.08	0.12	0.18	0.26
	R-404A, R-507A	10.2	0.82	0.07	0.11	0.17	0.25	0.35
7/8	R-407A, R-407C, R-407F	23.3	1.54	0.10	0.16	0.25	0.37	0.55
	R-448A, R-449A	22.3	1.47	0.10	0.16	0.25	0.37	0.54
	R-404A, R-507A	21.1	1.70	0.15	0.23	0.35	0.51	0.74
1-1/8	R-407A, R-407C, R-407F	39.7	2.62	0.16	0.27	0.42	0.64	0.93
	R-448A, R-449A	38.1	2.51	0.17	0.27	0.42	0.64	0.92
	R-404A, R-507A	36.1	2.89	0.25	0.39	0.60	0.88	1.25
1-3/8	R-407A, R-407C, R-407F	60.5	4.00	0.25	0.41	0.64	0.97	1.42
	R-448A, R-449A	58.0	3.83	0.26	0.42	0.65	0.97	1.41
	R-404A, R-507A	54.9	4.41	0.38	0.60	0.91	1.34	1.91
1-5/8	R-407A, R-407C, R-407F	85.7	5.66	0.35	0.58	0.91	1.37	2.01
	R-448A, R-449A	82.1	5.42	0.36	0.59	0.92	1.37	1.99
	R-404A, R-507A	77.7	6.24	0.54	0.85	1.29	1.89	2.71
2-1/8	R-407A, R-407C, R-407F	149	9.84	0.61	1.01	1.58	2.39	3.50
	R-448A, R-449A	143	9.43	0.63	1.02	1.58	2.39	3.47
	R-404A, R-507A	135	10.85	0.94	1.48	2.24	3.29	4.71
2-5/8	R-407A, R-407C, R-407F	230	15.18	0.95	1.55	2.44	3.68	5.39
	R-448A, R-449A	220	14.54	0.97	1.58	2.46	3.68	5.35
	R-404A, R-507A	209	16.73	1.45	2.28	3.45	5.07	7.26
3-1/8	R-407A, R-407C, R-407F	328	21.66	0.35	2.22	3.48	5.26	7.69
	R-448A, R-449A	314	20.76	1.39	2.25	3.50	5.25	7.64
	R-404A, R-507A	298	23.88	2.06	3.25	4.93	7.24	10.36
3-5/8	R-407A, R-407C, R-407F	444	29.30	1.83	3.00	4.71	7.11	10.41
	R-448A, R-449A	425	28.07	1.87	3.05	4.74	7.10	10.33
	R-404A, R-507A	403	32.30	2.79	4.40	6.67	9.79	14.01
4-1/8	R-407A, R-407C, R-407F	577	38.08	2.37	3.90	6.12	9.24	13.53
	R-448A, R-449A	552	36.49	2.44	3.96	6.16	9.23	13.42
	R-404A, R-507A	523	41.99	3.63	5.72	8.67	12.72	18.21

Table 3. Pressure Loss of Liquid Refrigerants in Liquid Line Risers (Expressed in Pressure Drop, PSIG, and Subcooling Loss, °F)

Refrigerant	Liquid Line Rise in Feet																	
	10'		15'		20'		25'		30'		40'		50'		75'		100'	
	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
R-407A, R-407C, R-407F	4.3	1.4	6.4	2.0	8.5	2.7	10.6	3.4	12.8	4.1	17.0	5.4	21.3	6.8	31.9	10.1	42.5	13.5
R-448A, R-449A	4.3	1.1	6.5	1.7	8.7	2.3	10.9	2.8	13.0	3.4	17.4	4.5	21.7	5.6	32.6	8.3	43.5	10.9
R-507, R-404A	4.1	1.1	6.1	1.6	8.2	2.1	10.2	2.7	12.2	3.3	16.3	4.1	20.4	5.6	30.6	8.3	40.8	11.8

Based on 110°F liquid temperature at bottom of riser.

Table 4. Equivalent Feet of Pipe Due to Valve and Fitting Friction

Copper Tube, O.D., Type "L"	1/2	5/8	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8	5-1/8	6-1/8
Globe Valve (Open)	14	16	22	28	36	42	57	69	83	99	118	138	168
Angle Valve (Open)	7	9	12	15	18	21	28	34	42	49	57	70	83
90° Turn Through Tee	3	4	5	6	8	9	12	14	17	20	22	28	34
Tee (Straight Through) or Sweep Below	.75	1	1.5	2	2.5	3	3.5	4	5	6	7	9	11
90° Elbow or Reducing Tee (Straight Through)	1	2	2	3	4	4	5	7	8	10	12	14	16

Table 5. Recommended Remote Condenser Line Sizes

Net Evaporator Capacity	Total Equiv. Length	R-407A/C/F, R-448A & R-449A		R-507 & R-404A	
		Discharge Line (O.D.)	Liquid Line Cond. to Receiver (O.D.)	Discharge Line (O.D.)	Liquid Line Cond. to Receiver (O.D.)
3,000	50	3/8	3/8	3/8	3/8
	100	3/8	3/8	3/8	3/8
6,000	50	3/8	3/8	1/2	3/8
	100	1/2	3/8	1/2	3/8
9,000	50	1/2	3/8	1/2	3/8
	100	1/2	3/8	1/2	3/8
12,000	50	1/2	3/8	1/2	3/8
	100	5/8	3/8	5/8	1/2
18,000	50	5/8	3/8	5/8	1/2
	100	5/8	3/8	7/8	1/2
24,000	50	5/8	3/8	5/8	1/2
	100	7/8	1/2	7/8	5/8
36,000	50	7/8	1/2	7/8	5/8
	100	7/8	5/8	7/8	7/8
48,000	50	7/8	5/8	7/8	5/8
	100	7/8	7/8	1-1/8	7/8
60,000	50	7/8	5/8	7/8	7/8
	100	1-1/8	7/8	1-1/8	7/8
72,000	50	7/8	7/8	1-1/8	7/8
	100	1-1/8	7/8	1-1/8	1-1/8
90,000	50	1-1/8	7/8	1-1/8	7/8
	100	1-1/8	7/8	1-1/8	1-1/8
120,000	50	1-1/8	7/8	1-1/8	1-1/8
	100	1-3/8	1-1/8	1-3/8	1-3/8
180,000	50	1-3/8	1-1/8	1-3/8	1-3/8
	100	1-5/8	1-3/8	1-5/8	1-5/8
240,000	50	1-3/8	1-3/8	1-5/8	1-3/8
	100	1-5/8	1-3/8	2-1/8	1-5/8
300,000	50	1-5/8	1-3/8	1-5/8	1-5/8
	100	2-1/8	1-5/8	2-1/8	2-1/8
360,000	50	1-5/8	1-5/8	2-1/8	1-5/8
	100	2-1/8	2-1/8	2-1/8	2-1/8
480,000	50	2-1/8	1-5/8	2-1/8	2-1/8
	100	2-1/8	2-1/8	2-1/8	2-5/8
600,000	50	2-1/8	2-1/8	2-1/8	2-1/8
	100	2-5/8	2-5/8	2-5/8	2-5/8
720,000	50	2-1/8	2-1/8	2-1/8	2-5/8
	100	2-5/8	2-5/8	2-5/8	3-1/8
840,000	50	2-1/8	2-1/8	2-5/8	2-5/8
	100	2-5/8	2-5/8	2-5/8	3-1/8
960,000	50	2-5/8	2-5/8	2-5/8	2-5/8
	100	2-5/8	3-1/8	3-1/8	3-5/8
1,080,000	50	2-5/8	2-5/8	2-5/8	3-1/8
	100	3-1/8	3-1/8	3-1/8	3-5/8
1,200,000	50	2-5/8	2-5/8	2-5/8	3-1/8
	100	3-1/8	3-1/8	3-5/8	4-1/8
1,440,000	50	2-5/8	3-1/8	3-1/8	3-5/8
	100	3-1/8	3-5/8	3-5/8	4-1/8
1,680,000	50	3-1/8	3-1/8	3-1/8	3-5/8
	100	3-5/8	3-5/8	3-5/8	4-1/8

Table 6. Recommended Line Sizes for R-404A, R-507*

Capacity BTUH	Suction Line Size												Maximum Suction Line Riser Size							
	Suction Temperature												R-404A /507 Suction Temperature							
	+40°F Equivalent Lengths				+20°F Equivalent Lengths				+10°F Equivalent Lengths											
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'								
1,000	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2
3,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	1/2	1/2	1/2	1/2	1/2	1/2
4,000	3/8	1/2	1/2	1/2	3/8	1/2	1/2	5/8	1/2	1/2	5/8	5/8	3/8	1/2	1/2	1/2	1/2	5/8	5/8	5/8
6,000	1/2	1/2	1/2	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	1/2	1/2	1/2	5/8	5/8	7/8
9,000	1/2	5/8	5/8	5/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	5/8	7/8	7/8	7/8	7/8	7/8
12,000	1/2	5/8	7/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	1/2	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8
15,000	5/8	5/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8
18,000	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	5/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8
24,000	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-1/8	5/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
30,000	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
36,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
42,000	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
48,000	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
54,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
60,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
66,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
72,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
78,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
84,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8
90,000	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	2-1/8
120,000	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8
150,000	1-3/8	1-3/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8
180,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	2-5/8
210,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	2-5/8	2-5/8	3-1/8
240,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	2-5/8	3-1/8	3-1/8
300,000	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	2-5/8	3-5/8	3-5/8
360,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	3-5/8	3-5/8	3-5/8	4-1/8
480,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	2-5/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	3-5/8	3-5/8	3-5/8	4-1/8
600,000	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-1/8	3-5/8	3-1/8	3-5/8	3-5/8	3-5/8	3-5/8	3-5/8	4-1/8	4-1/8

*** NOTES:**

- Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size.
Properly placed suction traps must also be used for adequate oil return.
All sizes shown are for O.D. Type L copper tubing.
- Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.
- Recommended liquid line size may increase with reverse cycle hot gas systems.
- If system load drops below 40% of design, consideration to installing double suction risers should be made.

Table 6a. Recommended Line Sizes for R-404A, R-507* (cont.)

Capacity BTUH	Suction Line Size																Liquid Line Size			
	Suction Temperature																Receiver to Expansion Valve Equivalent Lengths			
	-10 °F Equivalent Lengths				-20°F Equivalent Lengths				-30°F Equivalent Lengths				-40°F Equivalent Lengths							
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'
1,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	3/8	3/8
3,000	1/2	1/2	5/8	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	3/8	3/8	3/8	3/8
4,000	1/2	5/8	5/8	7/8	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	7/8	7/8	3/8	3/8	3/8	3/8
6,000	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	3/8	3/8	3/8	3/8
9,000	5/8	7/8	7/8	7/8	5/8	7/8	7/8	1-1/8	5/8	7/8	7/8	1-1/8	5/8	7/8	7/8	1-1/8	3/8	3/8	3/8	3/8
12,000	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
15,000	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	1/2
18,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	3/8	3/8	1/2	1/2
24,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	3/8	1/2	1/2
30,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	1/2	1/2	1/2
36,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	1/2	1/2
42,000	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	1/2	5/8
48,000	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	5/8	5/8
54,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
60,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
66,000	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
72,000	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	5/8	5/8	5/8
78,000	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	1-5/8	2-1/8	5/8	5/8	5/8	5/8
84,000	1-3/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	5/8	5/8	5/8	7/8
90,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	5/8	5/8	7/8	7/8
120,000	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	5/8	5/8	7/8	7/8
150,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	5/8	7/8	7/8	7/8
180,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	7/8	7/8	7/8	1-1/8
210,000	2-1/8	2-1/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	7/8	7/8	1-1/8	1-1/8
240,000	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	7/8	7/8	1-1/8	1-1/8
300,000	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-5/8	3-5/8	7/8	1-1/8	1-1/8	1-3/8
360,000	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	4-1/8	1-1/8	1-1/8	1-3/8	1-3/8
480,000	2-5/8	3-1/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	3-1/8	3-5/8	4-1/8	4-1/8	3-1/8	3-5/8	4-1/8	4-1/8	1-1/8	1-1/8	1-3/8	1-5/8
600,000	3-1/8	3-1/8	3-5/8	4-1/8	3-1/8	3-1/8	3-5/8	3-5/8	3-1/8	3-5/8	4-1/8	4-1/8	3-1/8	3-5/8	4-1/8	4-1/8	1-1/8	1-3/8	1-5/8	1-5/8

*** NOTES:**

- Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size. Properly placed suction traps must also be used for adequate oil return.
All sizes shown are for O.D. Type L copper tubing.
- Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.
- Recommended liquid line size may increase with reverse cycle hot gas systems.
- If system load drops below 40% of design, consideration to installing double suction risers should be made.

Table 7. Recommended Line Sizes for R-407A/R-407C/R-407F*

Capacity BTUH	Suction Line Size												Maximum Suction Line Riser Size							
	Suction Temperature												R-407A/C/F Suction Temperature							
	+40°F Equivalent Lengths				+20°F Equivalent Lengths				+10°F Equivalent Lengths											
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	+40	+20	+10	-10	-20	-30	-40	
1,000	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	
3,000	3/8	3/8	3/8	1/2	3/8	3/8	1/2	1/2	1/2	1/2	1/2	5/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	
4,000	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	1/2	5/8	5/8	5/8	1/2	1/2	1/2	1/2	5/8	5/8	5/8	
6,000	3/8	1/2	1/2	5/8	1/2	1/2	5/8	5/8	1/2	5/8	7/8	7/8	1/2	1/2	1/2	5/8	5/8	7/8	7/8	
9,000	1/2	1/2	5/8	5/8	1/2	5/8	7/8	7/8	5/8	7/8	7/8	7/8	5/8	5/8	5/8	5/8	7/8	7/8	1-1/8	
12,000	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	5/8	7/8	7/8	1-1/8	1-3/8	
15,000	5/8	5/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	7/8	7/8	7/8	1-1/8	1-3/8	1-3/8	
18,000	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	7/8	1-1/8	1-1/8	1-3/8	1-5/8	
24,000	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	1-1/8	1-1/8	1-1/8	7/8	1-1/8	7/8	1-1/8	1-3/8	1-5/8	1-5/8	
30,000	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	1-5/8	1-5/8	2-1/8	
36,000	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-1/8	1-5/8	1-5/8	1-5/8	2-1/8	
42,000	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-5/8	2-1/8	2-1/8	
48,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-5/8	2-1/8	2-5/8	
54,000	7/8	1-1/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	2-1/8	2-1/8	2-5/8	
60,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	2-1/8	2-5/8	2-5/8	
66,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-5/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	2-1/8	2-5/8	3-1/8	
72,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-3/8	1-5/8	2-1/8	2-1/8	2-5/8	3-1/8	
78,000	7/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-3/8	1-5/8	2-1/8	2-5/8	2-5/8	3-1/8	
84,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	2-5/8	3-1/8	3-1/8	
90,000	1-1/8	1-3/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	2-5/8	3-1/8	3-1/8	
120,000	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	1-5/8	1-5/8	2-5/8	3-1/8	3-1/8	3-5/8	
150,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-5/8	3-1/8	3-1/8	3-5/8	4-1/8	
180,000	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	3-1/8	3-5/8	3-5/8	4-1/8	
210,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	3-5/8	3-5/8	4-1/8	5-1/8	
240,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8	2-5/8	2-1/8	2-1/8	3-1/8	3-5/8	3-5/8	4-1/8	5-1/8	
300,000	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8	5-1/8	5-1/8	
360,000	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-5/8	4-1/8	5-1/8	5-1/8	5-1/8	
480,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	3-1/8	3-1/8	3-5/8	2-5/8	3-1/8	3-5/8	5-1/8	5-1/8	6-1/8	6-1/8	
600,000	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	3-1/8	3-5/8	3-5/8	3-1/8	3-1/8	4-1/8	5-1/8	5-1/8	6-1/8	8-1/8	

*** NOTES:**

- Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size. Properly placed suction traps must also be used for adequate oil return. All sizes shown are for O.D. Type L copper tubing.
- Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.
- Recommended liquid line size may increase with reverse cycle hot gas systems.
- If system load drops below 40% of design, consideration to installing double suction risers should be made.

Table 7a. Recommended Line Sizes for R-407A/R-407C/R-407F* (cont.)

Capacity BTUH	Suction Line Size																Liquid Line Size			
	Suction Temperature																Receiver to Expansion Valve Equivalent Lengths			
	-10°F Equivalent Lengths				-20°F Equivalent Lengths				-30°F Equivalent Lengths				-40°F Equivalent Lengths							
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'
1,000	3/8	3/8	1/2	1/2	3/8	1/2	1/2	1/2	3/8	1/2	1/2	5/8	3/8	5/8	5/8	5/8	3/8	3/8	3/8	3/8
3,000	1/2	1/2	5/8	5/8	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	3/8	3/8	3/8	3/8
4,000	1/2	5/8	7/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	1-1/8	3/8	3/8	3/8	3/8
6,000	5/8	5/8	7/8	7/8	5/8	5/8	7/8	1-1/8	7/8	7/8	1-1/8	1 1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
9,000	5/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	3/8	3/8	3/8
12,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	3/8	3/8	3/8	3/8
15,000	7/8	1-1/8	1-1/8	1-1/8	7/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	3/8	3/8	3/8	3/8
18,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	3/8	3/8	3/8	1/2
24,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	2-1/8	2-1/8	3/8	3/8	1/2	1/2
30,000	1-1/8	1-1/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	3/8	1/2	1/2	1/2
36,000	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	3/8	1/2	1/2	5/8
42,000	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	3/8	1/2	1/2	5/8
48,000	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	1/2	1/2	5/8	5/8
54,000	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	1/2	1/2	5/8	5/8
60,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	1/2	1/2	5/8	5/8
66,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	1/2	1/2	5/8	5/8
72,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	1/2	5/8	5/8	5/8
78,000	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	1/2	5/8	5/8	7/8
84,000	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	1/2	5/8	5/8	7/8
90,000	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	3-1/8	3-1/8	1/2	5/8	7/8	7/8
120,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	3-1/8	2-1/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	5/8	5/8	7/8	7/8
150,000	2-1/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	5/8	7/8	7/8	7/8
180,000	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	3-1/8	3-1/8	3-5/8	2-5/8	3-1/8	3-5/8	4-1/8	7/8	7/8	7/8	1-1/8
210,000	2-1/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	3-1/8	3-5/8	4-1/8	4-1/8	7/8	7/8	7/8	1-1/8
240,000	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	3-1/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	4-1/8	3-1/8	3-5/8	4-1/8	5-1/8	7/8	7/8	1-1/8	1-1/8
300,000	2-5/8	3-1/8	3-1/8	3-5/8	2-5/8	3-1/8	3-5/8	4-1/8	3-1/8	3-5/8	4-1/8	4-1/8	3-5/8	3-5/8	5-1/8	5-1/8	7/8	7/8	1-1/8	1-1/8
360,000	2-5/8	3-1/8	3-5/8	3-5/8	3-1/8	3-5/8	4-1/8	4-1/8	3-1/8	3-5/8	4-1/8	5-1/8	3-5/8	4-1/8	5-1/8	5-1/8	7/8	1-1/8	1-1/8	1-1/8
480,000	3-1/8	3-5/8	4-1/8	4-1/8	3-1/8	3-5/8	4-1/8	5-1/8	3-5/8	4-1/8	5-1/8	5-1/8	4-1/8	5-1/8	5-1/8	6-1/8	7/8	1-1/8	1-3/8	1-3/8
600,000	3-1/8	3-5/8	4-1/8	5-1/8	3-5/8	4-1/8	5-1/8	5-1/8	4-1/8	5-1/8	5-1/8	6-1/8	4-1/8	5-1/8	6-1/8	6-1/8	1-1/8	1-1/8	1-3/8	1-3/8

*** NOTES:**

- Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size. Properly placed suction traps must also be used for adequate oil return.
All sizes shown are for O.D. Type L copper tubing.
- Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.
- Recommended liquid line size may increase with reverse cycle hot gas systems.
- If system load drops below 40% of design, consideration to installing double suction risers should be made.

Table 8. Recommended Line Sizes for R-448A/R-449A*

Capacity BTUH	Suction Line Size												Maximum Suction Line Riser Size							
	Suction Temperature												R-448A/R-449A Suction Temperature							
	+40°F Equivalent Lengths				+20°F Equivalent Lengths				+10°F Equivalent Lengths											
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	+40	+20	+10	-10	-20	-30	-40	
1,000	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	
3,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	1/2	1/2	1/2	1/2	5/8	
4,000	3/8	1/2	1/2	1/2	3/8	1/2	1/2	5/8	1/2	1/2	5/8	5/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	
6,000	1/2	1/2	1/2	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	1/2	1/2	5/8	5/8	7/8	
9,000	1/2	5/8	5/8	5/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	5/8	7/8	7/8	7/8	7/8	
12,000	1/2	5/8	5/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	1/2	7/8	7/8	7/8	7/8	1-1/8	1-1/8	
15,000	5/8	5/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	5/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	
18,000	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	5/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	
24,000	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-1/8	5/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	
30,000	5/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	
36,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	
42,000	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8	
48,000	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8	
54,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8	
60,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	
66,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	
72,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	
78,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	
84,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	
90,000	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	2-1/8	
120,000	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8	
150,000	1-3/8	1-3/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8	
180,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	
210,000	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	3-1/8	3-1/8	
240,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	2-5/8	2-5/8	3-1/8	3-1/8	
300,000	1-5/8	2-1/8	2-1/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	2-5/8	2-5/8	2-5/8	3-1/8	3-1/8	
360,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	3-1/8	3-5/8	3-5/8	
480,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	2-5/8	3-5/8	3-1/8	3-1/8	3-5/8	3-5/8	3-5/8	4-1/8	4-1/8	
600,000	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-1/8	3-5/8	3-1/8	3-5/8	3-5/8	3-5/8	3-5/8	4-1/8	4-1/8	

*** NOTES:**

- Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size. Properly placed suction traps must also be used for adequate oil return.
All sizes shown are for O.D. Type L copper tubing.
- Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.
- Recommended liquid line size may increase with reverse cycle hot gas systems.
- If system load drops below 40% of design, consideration to installing double suction risers should be made.

Table 8a. Recommended Line Sizes for R-448A/R-449A* (cont.)

Capacity BTUH	Suction Line Size																Liquid Line Size			
	Suction Temperature																Receiver to Expansion Valve Equivalent Lengths			
	-10°F Equivalent Lengths				-20°F Equivalent Lengths				-30°F Equivalent Lengths				-40°F Equivalent Lengths							
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'
1,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	3/8	3/8
3,000	1/2	1/2	5/8	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	3/8	3/8	3/8	3/8
4,000	1/2	5/8	5/8	7/8	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	7/8	7/8	3/8	3/8	3/8	3/8
6,000	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	3/8	3/8	3/8	3/8
9,000	5/8	7/8	7/8	7/8	5/8	7/8	7/8	1-1/8	5/8	7/8	7/8	1-1/8	5/8	7/8	7/8	1-1/8	3/8	3/8	3/8	3/8
12,000	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
15,000	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
18,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	3/8	3/8	3/8	1/2
24,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	3/8	1/2	1/2
30,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	3/8	1/2	1/2
36,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	3/8	1/2	1/2	1/2
42,000	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	3/8	1/2	1/2	1/2
48,000	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	1/2	1/2
54,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	1/2	5/8
60,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
66,000	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
72,000	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
78,000	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	1-5/8	2-1/8	1/2	1/2	5/8	5/8
84,000	1-3/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1/2	5/8	5/8	5/8
90,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1/2	5/8	5/8	7/8
120,000	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	5/8	5/8	7/8	7/8
150,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	5/8	7/8	7/8	7/8
180,000	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	2-1/8	2-1/8	2-5/8	2-5/8	5/8	7/8	7/8	7/8
210,000	2-1/8	2-1/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	7/8	7/8	7/8	7/8
240,000	2-1/8	2-5/8	2-5/8	3-1/8	2-1/8	2-5/8	2-5/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-1/8	7/8	7/8	7/8	1-1/8
300,000	2-5/8	2-5/8	3-1/8	3-1/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-5/8	3-5/8	7/8	7/8	1-1/8	1-1/8
360,000	2-5/8	2-5/8	3-1/8	3-5/8	2-5/8	2-5/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	4-1/8	7/8	7/8	1-1/8	1-1/8
480,000	2-5/8	3-1/8	3-5/8	3-5/8	2-5/8	3-1/8	3-5/8	3-5/8	3-1/8	3-5/8	4-1/8	4-1/8	3-1/8	3-5/8	4-1/8	4-1/8	1-1/8	1-1/8	1-1/8	1-3/8
600,000	3-1/8	3-1/8	3-5/8	4-1/8	3-1/8	3-1/8	3-5/8	3-5/8	3-1/8	3-5/8	4-1/8	4-1/8	3-1/8	3-5/8	4-1/8	4-1/8	1-1/8	1-1/8	1-1/8	1-3/8

*** NOTES:**

- Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size. Properly placed suction traps must also be used for adequate oil return.
All sizes shown are for O.D. Type L copper tubing.
- Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.
- Recommended liquid line size may increase with reverse cycle hot gas systems.
- If system load drops below 40% of design, consideration to installing double suction risers should be made.

Evacuation and Leak Detection

Due to the smaller molecule size of HFC's, they will tend to leak more readily than CFC's. Consequently, it is of the utmost importance that proper system evacuation and leak detection procedures be employed.

1. After completing all necessary piping connections and joints, ensure that all service valves are open
2. Pressurize the system to 150 psig with dry nitrogen (or dry CO₂). Do not use compressed air or oxygen for pressure or leak testing.
3. After a period of 12 hours, verify that the system is still pressurized to 150 psig
4. Vent the nitrogen pressure from the system
5. Attach an appropriate vacuum pull and pull a vacuum of 1,500 microns
6. Break the vacuum using dry nitrogen (or dry CO₂) until pressure rises above 0 psig
7. Pull a second vacuum on the system, this time achieving at least a 500 micron vacuum
8. Isolate the vacuum pump from the system and recheck the vacuum after one hour
9. If the vacuum has not increased more than 50 microns, break the vacuum with the system specified refrigerant and carry out the system charging procedure
10. Repeat this operation a second time.
11. Open the compressor service valves and evacuate the entire system to 500 microns absolute pressure. Raise the pressure to 2 psig with the refrigerant and remove the vacuum pump.

NOTE:

Refrigerant used during evacuation cannot be vented. Reclaim all used refrigerant. EPA regulations are constantly being updated. Ensure your procedure follows correct regulations.

WARNING:

HFC-134a has been shown to be combustible at pressure as low as 5.5 psig (at 350°F) when mixed with air at concentrations more than 60% air by volume. At lower temperature, higher pressures are required to support combustion. Therefore, air should never be mixed with HFC-134a for leak detection.

Evacuation

CAUTION:

Do not use the refrigeration compressor to evacuate the system. Do not start the compressor while it is in a vacuum.

A deep vacuum pump should be connected to both the low and high side of the system with large diameter, short length copper tubing or high vacuum hoses (1/4" ID minimum). A shut off valve between the vacuum pump and the system must be provided to allow the pressure to be checked during and after evacuation. Do not turn off the vacuum pump when connected to an evacuated system without first closing the shut off valve. A vacuum gauge capable of displaying pressure in microns must be connected to the system downstream of the vacuum pump shut off valve.

NOTE:

Refrigerant used during evacuation cannot be vented. Reclaim all used refrigerant. EPA regulations are constantly being updated. Ensure your procedure follows correct regulations.

Refrigerant Charging Instructions

1. A liquid line filter drier should be installed between the refrigerant supply container and the system access point. This extra drier will ensure that all refrigerant supplied to the system is clean and dry.
2. When initially charging a system that is in a vacuum, liquid refrigerant may be added directly into the receiver tank.
3. Refrigerant charge must be calculated per installation. Refrigerant charge includes receiver volume (15-20% for liquid seal), condenser volume, refrigerant line volumes, and any additional seasonal charge that may be required. The specific values for charge amounts can be found in the equipment technical bulletins (receiver volume), and weight of refrigerant table (Table 2 of this manual). Do not add more refrigerant than prescribed.

Charging Procedure

NOTE:

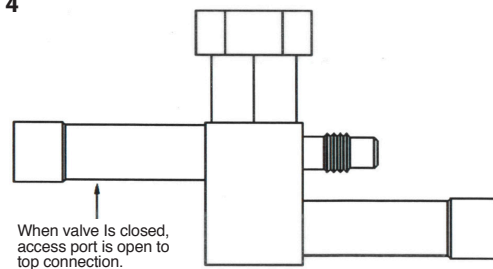
Head Pressure Systems- If you are charging the system by using a clear sight glass as an indication of proper charge the following must be considered. Check the condensing temperature. It must be above 105°F. If not, it will be necessary to reduce the amount of air going through the condenser from fans still running. Simply reduce the effective condenser face area to raise the discharge pressure above the equivalent 105°F condensing temperature and then proceed to charge to clear the sight glass. Adjust evaporator superheat at this time. Return to full condenser face area and allow the system to balance.

- 1) Connect charging hoses to the receiver and compressor suction line
- 2) Ensure compressor service valves are open, if equipped
- 3) Ensure service and isolation valves are open, where applicable
- 4) Weigh the refrigerant container before charging
 - 4a) An accurate record of the weight of refrigerant put into the system must be kept
- 5) Charge liquid refrigerant into the receiver
- 6) When refrigerant flow slows, and system pressure exceeds the cut in pressure of the low pressure switch, energize the compressor
- 7) Add refrigerant to the compressor suction line, as a vapor only, until bubbles are no longer present in the sight glass. Be careful not to exceed charge required.
 - 7a) A system operating above the design target room temperature, with operation at or near design temperature is required to complete charging procedure.
- 8) Allow the system to operate and reach the temperature setpoint
- 9) Verify that the sight glass remains free of bubbles when the room is at or near set point temperature.

NOTE:

Refrigerant used during evacuation cannot be vented. Reclaim all used refrigerant. EPA regulations are constantly being updated. Ensure your procedure follows correct regulations. Refrigerant used during evacuation cannot be vented. Reclaim all used refrigerant. EPA regulations are constantly being updated. Ensure your procedure follows correct regulations.

Diagram 4



Corrective Maintenance Leaking

Within the last several years, manufacturers have developed fluorescent dye leak detection systems for use with refrigerants. These dyes mix with the lubricant and, when exposed to an ultraviolet light "fluoresce," indicates the location of leaks. For units with Copeland compressors it has been tested and approved with the Rigid "System Safe" dye and found it to be compatible with the compressor materials in systems.

Refrigerant Flooding Charge

The following tables summarize the coil charges for High Side products (CU and ACC).

Winter charge assumes a 90% flooded coil; Summer charge assumes a 10% flooded coil (For units without subcooling circuit).

Winter charge assumes a 90% flooded coil; Summer charge assumes a 25% flooded coil (For units with subcooling circuit).

These charges are approximate and should not be used as absolute rules for charging the system.

To determine total system charge, the liquid line and unit cooler must be taken into account.

Table 9. HTS 1/2 - 6hp (Microchannel Coil)

R-404A (lbs)							
Group	Model	Microchannel			RTPF		
		Summer	Winter	Additional	Summer	Winter	Additional
Hermetic Low Temp	#C*0011L^ACH	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0014L^ACH	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0019L^ACH	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0025L^ACH	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0031L^ACH	1.0	2.0	1.0	2.5	5.5	3.0
Hermetic Medium Temp	#C*0015M^ACH	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0020M^ACH	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0025M^ACH	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0030M^ACH	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0032M^ACH	1.5	3.5	2.0	4.5	10.0	5.5
Scroll Low Temp	#C*0006L^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0008L^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0010L^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0022L^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0025L^ACZ	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0030L^ACZ	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0035L^ACZ	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0045L^ACZ	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0055L^ACZ	1.5	3.5	2.0	4.5	10.0	5.5
Scroll Medium Temp	#C*0060L^ACZ	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0005M^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0008M^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0009M^ACZ	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0010M^A‡Z	0.5	1.5	1.0	1.5	3.5	2.0
	#C*0015M^A‡Z	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0020M^A‡Z	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0025M^A‡Z	1.0	2.0	1.0	2.5	5.5	3.0
	#C*0030M^A‡Z	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0035M^A‡Z	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0045M^A‡Z	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0050M^A‡Z	1.5	3.5	2.0	4.5	10.0	5.5
	#C*0055M^A‡Z	1.5	3.5	2.0	4.0	10.0	6.0
	#C*0060M^A‡Z	1.5	3.5	2.0	4.0	10.0	6.0

NOTES:

B = Bohn, L = Larkin, C = Climate Control, H = Chandler

* H = Outdoor, N = Indoor

^ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

‡ C = Copeland, L = LG

Charge amounts are estimated operating values only and do not take into account actual system configurations.

Charge amounts should be adjusted to match actual system requirements.

For refrigerant charges with other refrigerants, use the correction factor table.

Correction Factor Table

Refrigerant	Charge Factor
R-404A	1.00
R-407A	1.04
R-407C	1.05
R-407F	1.07
R-448A	1.05
R-449A	1.05
R-507A	1.00

Table 10. HCU 1 and 2-Fan standard chassis 3-22hp

R-404A (lbs)				
Group	Model	RTPF		
		Summer	Winter	Additional
Discus Medium Temp	#C*0050M@ACD	5.0	11.5	6.5
	#C*0051M@ACD	5.0	11.5	6.5
	#C*0075M@ACD	7.0	15.5	8.5
	#C*0076M@ACD	6.5	15.0	8.5
	#C*0080M@ACD	8.5	19.5	11.0
	#C*0100M@ACD	8.5	19.5	11.0
	#C*0120M@ACD	8.5	19.5	11.0
	#C*0150M@ACD	12.0	27.0	15.0
Discus Low Temp	#C*0030L@ACD	3.5	7.5	4.0
	#C*0040L@ACD	3.5	7.5	4.0
	#C*0060L@ACD	3.5	7.5	4.0
	#C*0061L@ACD	3.5	7.5	4.0
	#C*0075L@ACD	5.0	11.5	6.5
	#C*0090L@ACD	6.5	15.0	8.5
	#C*0100L@ACD	6.5	15.0	8.5
	#C*0120L@ACD	12.5	27.5	15.0
	#C*0150L@ACD	12.5	27.5	15.0
	#C*0220L@ACD	12.0	27.5	15.5
Scroll Medium Temp	#C*0065M@ACZ	7.0	15.5	8.5
	#C*0070M@ACZ	6.5	15.0	8.5
	#C*0075M@ACZ	9.0	19.5	10.5
	#C*0086M@ACZ	8.5	19.5	11.0
	#C*0100M@ACZ	8.5	19.5	11.0
	#C*0141M@ACZ	12.0	27.0	15.0
Scroll Low Temp	#C*0075L@ACZ	5.5	11.5	6.0
	#C*0100L@ACZ	7.0	15.5	8.5
	#C*0130L@ACZ	9.0	19.5	10.5
	#C*0150L@ACZ	9.0	19.5	10.5
Bitzer Medium Temp	#C*0056M@ABX	6.5	15.0	8.5
	#C*0076M@ABX	9.0	19.5	10.5
	#C*0091M@ABX	12.0	27.5	15.5
	#C*0101M@ABX	12.0	27.5	15.5
Bitzer Low Temp	#C*0041L@ABX	3.5	7.5	4.0
	#C*0056L@ABX	5.5	11.5	6.0
	#C*0061L@ABX	4.5	10.0	5.5
	#C*0062L@ABX	4.5	10.0	5.5
	#C*0076L@ABX	6.5	15.0	8.5
	#C*0101L@ABX	9.0	20.0	11.0
	#C*0121L@ABX	12.5	27.5	15.0
	#C*0131L@ABX	12.5	27.5	15.0

NOTES:

B = Bohn, L = Larkin, C = Climate Control, H = Chandler

* H = Outdoor, N = Indoor

@ B = 208-230/1/60, C = 208-230/3/60, D = 460/3/60

Charge amounts are esitimated operating values only and do not take into account actual system configurations.

Charge amounts should be adjusted to match actual system requirements.

For refrigerant charges with other refrigerants, use the correction factor table.

Correction Factor Table

Refrigerant	Charge Factor
R-404A	1.00
R-407A	1.04
R-407C	1.05
R-407F	1.07
R-448A	1.05
R-449A	1.05
R-507A	1.00

Table 11. (D)VCU 12-110hp

R-404A (lbs)				
Group	Model	RTPF		
		Summer	Winter	Additional
Discus Medium Temp	#CV0150M^ACD	20.5	44.5	24.0
	#CV0200M^ACD	20.0	44.5	24.5
	#CV0250M^ACD	20.0	44.5	24.5
	#CV0260M^ACD	15.0	33.5	18.5
	#CV0300M^ACD	20.0	44.5	24.5
	#CV0350M^ACD	21.5	49.5	28.0
	#CV0400M^ACD	38.0	86.0	48.0
	#CV0151M^ACD	15.0	33.5	18.5
	#CV0201M^ACD	14.5	33.5	19.0
	#CV0251M^ACD	22.0	49.5	27.5
	#CV0301M^ACD	29.5	66.5	37.0
	#CV0351M^ACD	68.0	153.0	85.0
	#CV0401M^ACD	67.0	152.5	85.5
Discus Low Temp	#CV0120L^ACD	21.0	44.5	23.5
	#CV0150L^ACD	21.0	44.5	23.5
	#CV0220L^ACD	20.5	44.5	24.0
	#CV0270L^ACD	20.5	44.5	24.0
	#CV0300L^ACD	20.0	44.5	24.5
Bitzer Medium Temp	#CV0150M^ABX	15.0	33.5	18.5
	#CV0200M^ABX	15.0	33.5	18.5
	#CV0220M^ABX	20.0	44.5	24.5
	#CV0250M^ABX	20.0	44.5	24.5
	#CV0300M^ABX	39.0	86.0	47.0
	#CV0330M^ABX	38.5	86.0	47.5
	#CV0350M^ABX	52.0	115.0	63.0
	#CV0400M^ABX	68.5	153.0	84.5
	#CV0500M^ABX	68.0	152.5	84.5
Bitzer Low Temp	#CV0130L^ABX	15.5	33.5	18.0
	#CV0150L^ABX	15.5	33.5	18.0
	#CV0200L^ABX	21.0	44.5	23.5
	#CV0220L^ABX	15.5	33.5	18.0
	#CV0250L^ABX	21.0	44.5	23.5
	#CV0300L^ABX	20.5	44.5	24.0
	#CV0400L^ABX	54.5	115.0	60.5
Mohave Medium Temp	#CM0077M^ACD	28.5	58.0	29.5
	#CM0078M^ACD	28.0	58.0	30.0
	#CM0082M^ACD	38.0	77.5	39.5
	#CM0102M^ACD	37.5	77.5	40.0
	#CM0122M^ACD	37.0	77.5	40.5
	#CM0152M^ACD	27.0	58.0	31.0
	#CM0202M^ACD	36.0	77.0	41.0
	#CM0252M^ACD	39.5	86.5	47.0
	#CM0302M^ACD	39.0	86.0	47.0
	#CM0352M^ACD	52.0	115.0	63.0
	#CM0402M^ACD	52.0	114.5	62.5

Table 12. (D)VCU 12-110hp (cont.)

R-404A (lbs)				
Group	Model	RTPF		
		Summer	Winter	Additional
Mohave Low Temp	#CM0062L^ACD	30.0	58.0	28.0
	#CM0077L^ACD	39.5	77.5	38.0
	#CM0092L^ACD	39.0	77.5	38.5
	#CM0102L^ACD	38.5	77.5	39.0
	#CM0122L^ACD	38.5	77.5	39.0
	#CM0152L^ACD	38.0	77.5	39.5
	#CM0222L^ACD	37.5	77.5	40.0
	#CM0272L^ACD	37.0	77.5	40.5
	#CM0302L^ACD	36.5	77.5	41.0
Dual-Discus Medium Temp	#CD0300M^ACD	41.0	89.0	48.0
	#CD0400M^ACD	40.5	89.0	48.5
	#CD0500M^ACD	40.0	89.0	49.0
	#CD0520M^ACD	29.5	66.5	37.0
	#CD0600M^ACD	39.5	89.0	49.5
	#CD0700M^ACD	43.0	99.5	56.5
	#CD0800M^ACD	76.0	172.0	96.0
Dual-Discus Low Temp	#CD0240L^ACD	42.0	89.5	47.5
	#CD0300L^ACD	41.5	89.5	48.0
	#CD0440L^ACD	41.0	89.5	48.5
	#CD0540L^ACD	41.0	89.0	48.0
	#CD0600L^ACD	40.0	89.5	49.5
Dual-Bitzer Medium Temp	#CD0300M^ABX	32.5	67.0	34.5
	#CD0400M^ABX	32.0	67.0	35.0
	#CD0440M^ABX	43.5	89.5	46.0
	#CD0500M^ABX	43.0	89.5	46.5
	#CD0600M^ABX	83.5	173.0	89.5
	#CD0660M^ABX	83.5	173.0	89.5
	#CD0700M^ABX	112.0	231.0	119.0
	#CD0800M^ABX	147.0	306.5	159.5
	#CD1100M^ABX	145.0	306.5	161.5
Dual-Bitzer Low Temp	#CD0260L^ABX	31.5	67.0	35.5
	#CD0300L^ABX	31.0	67.0	36.0
	#CD0400L^ABX	41.5	89.5	48.0
	#CD0440L^ABX	31.0	67.0	36.0
	#CD0500L^ABX	41.5	89.0	47.5
	#CD0600L^ABX	41.0	89.0	48.0
	#CD0800L^ABX	109.0	230.5	121.5
Dual-Discus Medium Temp (Alternate (Non-EC))	#CD0520M^ACD, Alternate (non-EC)	29.5	66.5	37.0
	#CD0600M^ACD, Alternate (non-EC)	39.5	89.0	49.5
	#CD0700M^ACD, Alternate (non-EC)	43.0	99.5	56.5
	#CD0800M^ACD, Alternate (non-EC)	76.0	172.0	96.0

NOTES:

B = Bohn, L = Larkin, C = Climate Control, H = Chandler

^ C = 208-230/3/60, D = 460/3/60, K = 230/3/60, E = 575/3/60

Charge amounts are esitimated operating values only and do not take into account actual system configurations.

Charge amounts should be adjusted to match actual system requirements.

For refrigerant charges with other refrigerants, use the correction factor table.

Correction Factor Table

Refrigerant	Charge Factor
R-404A	1.00
R-407A	1.04
R-407C	1.05
R-407F	1.07
R-448A	1.05
R-449A	1.05
R-507A	1.00

Field Wiring

WARNING:

All wiring must be done in accordance with applicable codes and local ordinances.

The field wiring should enter the areas as provided on the unit. The wiring diagram for each unit is located on the inside of the electrical panel door. All field wiring should be done in a professional manner and in accordance with all governing codes. Before operating unit, double check all wiring connections, including the factory terminals. Factory connections can vibrate loose during shipment.

1. The serial data tag on the unit is marked with the electrical characteristic for wiring the unit.
2. Consult the wiring diagram in the unit cooler and in the condensing unit for proper connections.
3. Wire type should be of copper conductor only and of the proper size to handle the connected load.
4. The unit must be grounded.
5. For multiple evaporator systems, the defrost termination controls should be wired in series. Follow the wiring diagrams for multiple evaporator systems carefully. This will assure complete defrost of all evaporators in the system.
6. Multiple evaporator systems should operate off of one thermostat.
7. If a remote defrost timer is to be used, the timer should be located outside the refrigerated space.
8. For air cooled condensers, due to multiple low amp motors, we recommend using time delay fuse protection instead of circuit breakers.

Check Out and Start Up

After the installation has been completed, the following points should be covered before the system is placed in operation:

- a) Check all electrical and refrigerant connections. Be sure they are all tight.
- b) Observe compressor oil level before start-up. The oil level should be at or slightly above the 1/4 level of the sight glass. Refer to compressor manufacturers OEM instruction and operations manual for oil specifications before adding.
- c) Remove upper mounting nuts on the compressor feet. Remove the shipping spacers. Install the neoprene washers onto the compressor feet. Replace the upper mounting nuts and washers, allowing 1/16" space between the mounting nut and the neoprene spacer.
- d) Check high and low pressure controls, pressure regulating valves, oil pressure safety controls, and all other safety controls, and adjust if necessary.
- e) Check the room thermostat for normal operation and adjust.
- f) Wiring diagrams, instruction bulletins, etc. attached to the condensing units should be read and filed for future reference.
- g) All fan motors should be checked for proper rotation. Fan motor mounts should be carefully checked for tightness and proper alignment.
- h) Electric and hot gas evaporator fan motors should be temporarily wired for continuous operation until the room temperature has stabilized.
- i) Observe system pressures during charging and initial operation. Do not add oil while the system is short of refrigerant unless oil level is dangerously low.
- j) Continue charging until system has sufficient refrigerant for proper operation. Do not overcharge. Remember that bubbles in a sight glass may be caused by a restriction as well as a shortage of refrigerant.
- k) Do not leave unit unattended until the system has reached normal operating conditions and the oil charge has been properly adjusted to maintain the oil level between 1/4 and bottom of the sight glass.
- l) Make sure all Schrader valve caps are in place and tight.
- m) Make sure ALL service valves are properly back-seated and tighten valve packing if necessary.

CAUTION:

Extreme care must be taken in starting compressors for the first time after system charging. At this time, all of the oil and most of the refrigerant might be in the compressor creating a condition which could cause compressor damage due to slugging. Activating the crankcase heater for 24 hours prior to start-up is required. If no crankcase heater is present, then directing a 500 watt heat lamp or other safe heat source on the lower shell of the compressor for approximately thirty minutes will be beneficial in eliminating this condition which might never reoccur.

WARNING:

Scroll compressor is directional dependent. If noisy, change phase of input wiring.

Operational Check Out

After the system has been charged and has operated for at least two hours at normal operating conditions without any indication of malfunction, it should be allowed to operate overnight on automatic controls. Then a thorough recheck of the entire system operation should be made as follows:

- Check compressor discharge and suction pressures. If not within system design limits, determine why and take corrective action.
- Check liquid line sight glass and expansion valve operation. If there are indications that more refrigerant is required, leak test all connections and system components and repair any leaks before adding refrigerant.
- Observe oil level in compressor crankcase sight glass. Add oil as necessary to bring level to bottom 1/4 of the sight glass.
- Thermostatic expansion valves must be checked for proper superheat settings. Feeler bulbs must be in positive contact with the suction line and should be insulated. Valves set at high superheat will lower refrigeration capacity. Low superheat promotes liquid slugging and compressor bearing washout.
- Using suitable instruments, carefully check line voltage and amperage at the compressor terminals. Voltage must be within 10% of that indicated on the condensing unit nameplate. If high or low voltage is indicated, notify the power company. If amperage draw is excessive, immediately determine the cause and take corrective action. On three phase motor compressors, check to see that a balanced load is drawn by each phase.
- The maximum approved settings for high pressure controls on our air cooled condensing equipment is 425 psig. On air cooled systems, check as follows:
Disconnect the fan motors or block the condenser inlet air. Watch high pressure gauge for cutout point. Recheck all safety and operating controls for proper operation and adjust if necessary.
- Check defrost controls for initiation and termination settings, and length of defrost period. Set fail safe at length of defrost + 25%.
Example: 20 minute defrost + 5 minutes = 25 minute fail safe
- Check drain pan for proper drainage.
- Check winter head pressure controls for pressure setting.
- Check crankcase heater operation if used.
- Install instruction card and control system diagram for use of building manager or owner.

System Balancing - Compressor Superheat

IMPORTANT:

In order to obtain the maximum capacity from a system, and to ensure trouble-free operation, it is necessary to balance each and every system.

This is extremely important with any refrigeration system.

The critical value which must be checked is suction superheat.

Suction superheat should be checked **at the compressor** as follows:

- Measure the suction pressure at the suction service valve of the compressor and determine the saturation temperature corresponding to this pressure from a "Temperature-Pressure" chart.
- Measure the suction temperature of the suction line about one foot back from the compressor using an accurate thermometer.
- Subtract the saturated temperature from the actual suction line temperature. The difference is superheat.

Too low a suction superheat can result in liquid being returned to the compressor. This will cause dilution of the oil and eventual failure of the bearings and rings or in the extreme case, valve failure.

Too high a suction superheat will result in excessive discharge temperatures which cause a break down of the oil and results in piston ring wear, piston and cylinder wall damage.

It should also be remembered that the system capacity decreases as the suction superheat increases. For maximum system capacity, suction superheat should be kept as low as is practical. We recommend that the superheat **at the compressor** be between 20°F and 30°F, to meet compressor manufacture guidelines.

If adjustments to the suction superheat need to be made, the expansion valve at the evaporator should be adjusted.

NOTE:

All adjustable controls and valves must be field adjusted to meet desired operation. There are no factory preset controls or valve adjustments. This includes low pressure, high pressure, adjustable head pressure systems and expansion valves.

Table 13. Recommended Low Pressure Control Settings for Outdoor Air Cooled Condensing Units

*Minimum Expected Ambient Temperature	Cut-In PSIG		Box Set-point Temperature	Cut-Out PSIG	
	R-404A / R-407A / R-448A	R-407C		R-404A / R-407A / R-448A	R-407C
50	30	25	50	5	5
40	30	25	40	5	5
30	30	25	30	5	5
20	30	25	20	5	5
10	30	25	10	5	5
0	20	15	0	5	5
-10*	15	10	-10	2	0
-20*	12	8	-20	1	0
-30*	8	5	-30	0	0

* Low Ambient Kit should be considered to assist compressor start-up

(1) The standard preset low pressure switch used for pumpdown is set for 15 PSIG cut-in / 5 PSIG cut-out and is a good setting for most pumpdown systems

(2) ZB Scroll compressors should be set for 25 PSI cut-in / 17 PSI cut-out (R-404A / R-507) and 20 PSI cut-in / 9 PSI cut-out (R-407A / R-407C / R-448A)

* Minimum ambient or box temperature anticipated, high pressure control setting: R-22, 360 PSI; R-404A, R-507, 400 PSI

* The standard preset low pressure switch used for pumpdown is set for 15 PSI cut in / 4 PSI cut out and is a good setting for most pumpdown systems

* ZB Scroll compressors should be set for 25 PSI cut in / 17 PSI cut out (R-404A / R-507)

General Sequence of Operation

Refrigeration Cycle

1. Power is supplied to the timer at terminals "1" and "N".
2. The fan delay and the defrost termination thermostat is closed in the fan delay position and open in the defrost termination position. The unit cooler fans run continuously.
3. The defrost heaters are off.
4. The room thermostat closes when the temperature rises above the desired setting.
5. The liquid line solenoid is energized and opens, which allows liquid refrigerant to flow through the unit cooler.
6. The low pressure control closes when the suction pressure rises above the cutin setting of the control.
7. On systems with oil pumps, the oil safety control is closed. If the net oil pressure is less than 9 PSIG for more than 120 seconds, the oil safety opens, thus breaking the circuit to the compressor contactor holding coil. The compressor will not operate. This control is reset manually and must be reset before the compressor can be restarted.
8. The compressor contactor closes. The compressor and condenser fan start simultaneously.
9. The room temperature gradually decreases to the desired temperature.
10. Once the desired temperature is reached, the thermostat opens and the liquid line solenoid closes, stopping refrigerant flow through the evaporator.
11. Suction pressure decreases and the compressor contactor opens when the pressure drops below the cutout setting on the low pressure control. The compressor and condenser fan stop running.
12. This cycle is repeated as many times as necessary to satisfy the room thermostat.
13. Frost starts to form on the evaporator coil and continues to form until the defrost cycle is initiated.

Defrost Cycle

1. The defrost cycle starts automatically by the timer at predetermined times. Typical settings are two to four defrost cycles per day for freezers. For heavier frost loads additional settings may be required.
2. Switch "2" to "4" opens in the timer which breaks the circuit to the room thermostat, liquid line solenoid, and evaporator fan motors, allowing the compressor to pump down and shut off. Simultaneously switch "1" to "3" closes in the timer allowing current to flow to one side of the defrost heater contactor. When the compressor shuts off, an auxiliary contact will send power to the contactor holding coil; thus, energizing the defrost heaters.
3. The heaters raise the temperature of the coil to 32°F causing the frost to melt off the coil.
4. When the coil warms to 45°F to 55°F, the defrost termination thermostat closes, which allows current to the switching solenoid in the timer allowing the refrigeration cycle to begin again.
5. The evaporator heaters are off. If the termination thermostat fails to close, the fail-safe set on the timer will terminate defrost.
6. The low pressure control closes and the compressor will start.
7. When the coil temperature reaches 23°F to 30°F, the fan delay closes. This allows the current to flow to the fan motors. The fan motors start running.
8. The system will now operate in the refrigeration cycle until another defrost period is initiated by the timer.

Copeland Demand Cooling for Discus L6 Models

Energy efficiency regulations drive continuous change in the availability of refrigerants to the marketplace. With the introduction of R-22 as a replacement for R-502, compressors began to experience internal discharge temperatures that exceed the safe operational limits for long term stability of refrigerant oil. In response to this, Demand Cooling was developed as a reliable method to keep discharge temperatures reduced to a safe level without inhibiting the operating limits of the compressor. With the phase out of R-22, the following refrigerants have become viable alternatives: R-407A/C/F and R-448A/R-449-A. All of these refrigerants require special attention to discharge temperature control. Also for this reason suction to liquid heat exchangers are not recommended unless they are necessary to prevent another potential problem.

The Copeland Demand Cooling System

It is required for all single stage R-22, R-407A/C/F or R-448A/R-449-A applications with saturated suction temperatures below 0°F.

The Demand Cooling module uses the signal of a discharge head temperature sensor to monitor discharge gas temperature. If a critical temperature is reached, the module energizes along life injection valve which meters a controlled amount of saturated refrigerant into the compressor suction cavity to cool the suction gas.

This process controls the discharge temperature to a safe level. If for some reason the discharge temperature rises above a preset maximum level, the Demand Cooling module will turn the compressor off (requiring a manual reset) and actuate its alarm contact. To minimize the amount of refrigerant which must be injected, the suction gas cooling process is performed after the gas has passed around and through the motor.

Operating Range

Demand Cooling is designed to protect the compressor from high discharge temperatures over the evaporating and condensing temperature ranges shown in Figure 12 at a maximum return gas temperature of 65°F.

Demand Cooling System Design

When Demand Cooling operates, it "diverts" refrigeration capacity in the form of injected saturated refrigerant from the evaporator to the compressor.

1. Compressor Return Gas Temperature: Suction lines should be well insulated to reduce suction line heat gain. Return gas superheat should be as low as possible consistent with safe compressor operation.
2. Condensing Temperatures: It is important when using R-22, R-407 A/C/F or R-448A/449A as a low temperature refrigerant that condensing temperatures be minimized to reduce compression ratios and compressor discharge temperature.
3. Suction Pressure: Evaporator design and system control settings should provide the maximum suction pressure consistent with the application in order to have as low a compression ratio as possible.

In most cases, with floating head systems where condensing temperatures are low during most of the year, Demand Cooling will operate primarily as a compressor protection control much as the oil failure control protects the compressor during periods of low oil pressure. Demand Cooling will be allowed to operate only during those periods when condensing temperatures and return gas temperatures are high or in periods where a system failure (such as an ice evaporator, an expansion valve which does not control superheat, blocked condenser, or a failed condenser fan) raises condensing temperatures or return gas temperatures to abnormally high levels or lowers suction pressure to abnormally low levels.

Electric Defrost Troubleshooting

The electric defrost units are relatively simple and trouble-free in operation:

Timer

If the system does not go through its proper sequence, check timer operation through a defrost cycle. Check for loose wires or terminals. Before replacing timer, check other components.

Operation of Paragon Timer

To set time of day grasp knob which is in the center of the inner (fail-safe) dial and rotate it in a counter-clockwise direction. This will cause the outer (24 hour) dial to revolve. Line up the correct time of day on the outer dial with the time pointer. Do not try to set the time control by grasping the other (24 hour) dial. Place pins in the outer dial at the time of day that defrost is required.

Operation of Electronic Timer

To set the time, turn the minute hand clockwise until the time of day (and AM or PM) on the outer dial is aligned with the triangle marker on the inner dial. **Do not rotate minute hand counter-clockwise.** Move the white tab (tripper) on the outer dial outward at each desired initiation time. Each white tab (tripper) is a 15 minute interval and provides 15 minutes of defrost. For longer defrost duration, move additional tabs (following in time) from the initiation tab. For example, if a 45 minute defrost is to start at 7:00 AM, move the tabs outward that lie between 7:00 - 7:15, 7:15 - 7:30 and 7:30 - 7:45 on the AM side of the dial. The defrost will initiate at 7:00 AM and time terminate at 7:45 AM (if temperature termination does not occur first). For models with plastic cover on timer assembly; re-install cover after adjustment.

NOTE:

After correcting faulty condition it is essential that the coil and unit be free of ice before placing unit back on automatic operation.

NOTES:

1. Lockout relays or normally closed switch of auxiliary contact on the compressor contactor may be wired to defrost contactor. Its purpose is to prevent energizing of the defrost heaters until the compressor has pumped down and stopped, thus keeping power demand to a minimum.
2. If the control voltage is to remain energized for any period of time with the compressor disabled, remove the defrost clock pins to prevent the defrost heaters from energizing.
3. A Preventative Maintenance schedule should be set up as soon as possible after start-up to maintain equipment integrity.

Optional Variable Speed EC Motor with Orbus Controller

How does the Orbus Controller work?

Orbus is a simple way for variable speed head pressure control. It reads the system pressure via a transducer and then outputs a 0-10 VDC signal that is linearly proportional to fan speed. All of the communication electronics necessary for variable speed are built into the motor housing. To control the speed of the motor, an analog signal (0-10VDC) is supplied to the motor. The motor interprets the analog signal and changes the speed proportionally to match the input signal.

Sensor

Requires 0-500 psig pressure transducer

- Transducer should supply 0.5VDC at 0 psig
- Transducer should supply 4.5VDC at 500 psig

Jumpers

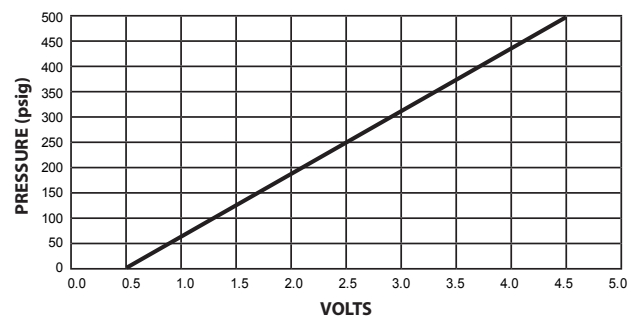
- Jumper #1 – 150 psig, 100 throttling range
- Jumper #2 – 125 psig, 100 throttling range
- Jumper #3 – 100 psig, 100 throttling range
- All three – Test condition, output ramps up and down

Status LED

- Control board status is indicated by a multi-color LED
- On startup, LED cycles from red to yellow to green
- Blinking green means everything ok
 - Length of flash is an indicator of speed
 - Short on, long off indicates low speed
 - Long on, short off indicates high speed
- Alternating green and one red
 - Transducer is missing, open or shorted
 - Fan runs full speed
- Alternating green and two red
 - Main oscillator dead, running on backup
 - Normal function still available
- Three reds in a row indicate both oscillator failure and transducer failure

The Orbus Controller measures system head pressure, compares the measurements to the head pressure set point, and through a proprietary algorithm outputs a 0-10V signal to the variable speed EC Motor. The Orbus board requires a 24VAC for operation. The controller has two predefined set points selectable by a jumper. For R-404A systems the set point is 150 psig. To diagnose issues it has a blinking LED that will provide status/error codes to aid in troubleshooting.

Diagram 5



Troubleshooting

- To check transducer operation, measure DC voltage between Signal and Common
- Compare transducer value to pressure measured using gage set
- Unplugging sensor will cause output to be 0VDC and should produce one red blink
- If system pressure is above set point plus throttling range, control board should output 0VDC
- If system pressure is below set point, control board should output 10VDC

ORBUS™ CONTROL BOARD

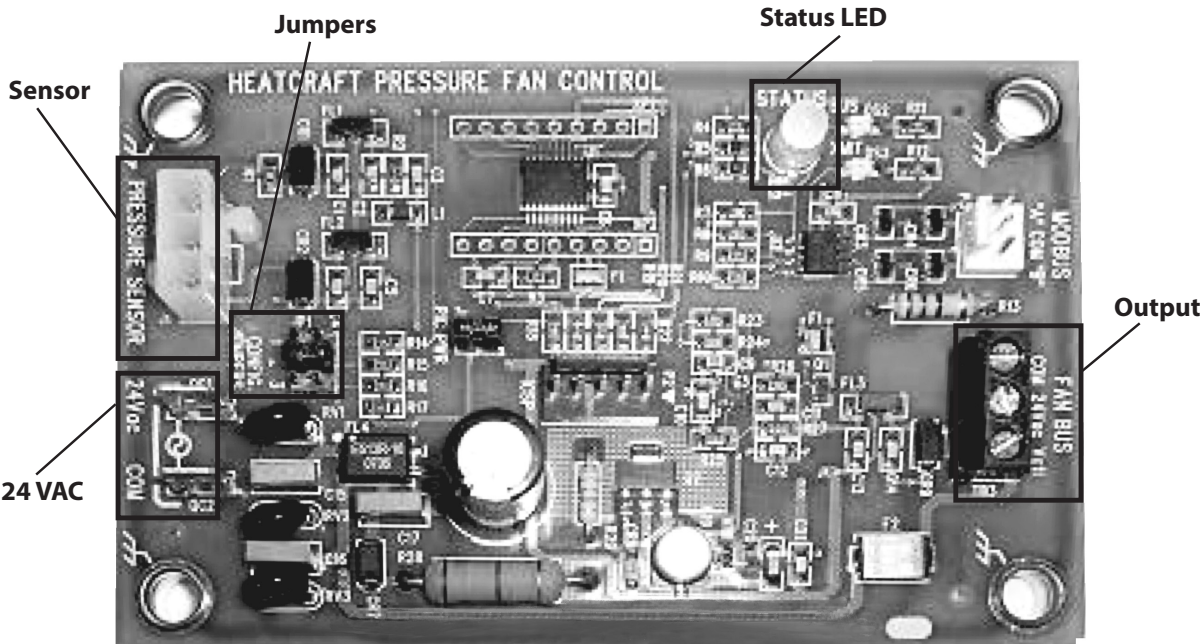


Table 14. System Troubleshooting Chart

PROBLEM	POSSIBLE CAUSES	POSSIBLE CORRECTIVE STEPS
Compressor will not run	<ol style="list-style-type: none"> 1. Main switch open. 2. Fuse blown. 3. Thermal overloads tripped. 4. Defective contactor or coil. 5. System shut down by safety devices. 6. No cooling required. 7. Liquid line solenoid will not open. 8. Motor electrical trouble. 9. Loose wiring. 10. Phase loss monitor inoperative. 	<ol style="list-style-type: none"> 1. Close switch. 2. Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse after fault is corrected. 3. Overloads are automatically reset. Check unit closely when unit comes back on line. 4. Repair or replace. 5. Determine type and cause of shutdown and correct it before resetting safety switch. 6. None. Wait until calls for cooling. 7. Repair or replace coil. 8. Check motor for open windings, short circuit or burn out. 9. Check all wire junctions. Tighten all terminal screws. 10. Refer to page 17.
Compressor noisy or vibrating	<ol style="list-style-type: none"> 1. Flooding of refrigerant into crankcase. 2. Improper piping support on suction or liquid line. 3. Worn compressor. 4. Scroll compressor rotation reversed. 	<ol style="list-style-type: none"> 1. Check setting of expansion valves. 2. Relocate, add or remove hangers. 3. Replace. 4. Rewire for phase change.
High discharge pressure	<ol style="list-style-type: none"> 1. Non-condensables in system. 2. System overcharges with refrigerant. 3. Discharge shutoff valve partially closed. 4. Fan not running. 5. Head pressure control setting. 6. Dirty condenser coil. 	<ol style="list-style-type: none"> 1. Remove the non-condensables. 2. Remove excess. 3. Open valve. 4. Check electrical circuit. 5. Adjust. 6. Clean.
Low discharge pressure	<ol style="list-style-type: none"> 1. Faulty condenser temperature regulation. 2. Suction shutoff valve partially closed. 3. Insufficient refrigerant in system. 4. Low suction pressure. 5. Variable head pressure valve. 	<ol style="list-style-type: none"> 1. Check condenser control operation. 2. Open valve. 3. Check for leaks. Repair and add charge. 4. See corrective steps for low suction pressure. 5. Check valve setting.
High suction pressure	<ol style="list-style-type: none"> 1. Excessive load. 2. Expansion valve overfeeding. 	<ol style="list-style-type: none"> 1. Reduce load or add additional equipment. 2. Check remote bulb. Regulate superheat.
Low suction pressure	<ol style="list-style-type: none"> 1. Lack of refrigerant. 2. Evaporator dirty or iced. 3. Clogged liquid line filter drier. 4. Clogged suction line or compressor suction gas strainers. 5. Expansion valve malfunctioning. 6. Condensing temperature too low. 7. Improper TXV. 	<ol style="list-style-type: none"> 1. Check for leaks. Repair and add charge. 2. Clean. 3. Replace cartridge(s). 4. Clean strainers. 5. Check and reset for proper superheat. 6. Check means for regulating condensing temperature. 7. Check for proper sizing.
Little or no oil pressure	<ol style="list-style-type: none"> 1. Clogged suction oil strainer. 2. Excessive liquid in crankcase. 3. Low oil pressure safety switch defective. 4. Worn oil pump. 5. Oil pump reversing gear stuck in wrong position. 6. Worn bearings. 7. Low oil level. 8. Loose fitting on oil lines. 9. Pump housing gasket leaks. 	<ol style="list-style-type: none"> 1. Clean. 2. Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. 3. Replace. 4. Replace. 5. Reverse direction of compressor rotation. 6. Replace compressor. 7. Add oil and/or through defrost. 8. Check and tighten system. 9. Replace gasket.
Compressor loses oil	<ol style="list-style-type: none"> 1. Lack of refrigerant. 2. Excessive compression ring blow by. 3. Refrigerant flood back. 4. Improper piping or traps. 	<ol style="list-style-type: none"> 1. Check for leaks and repair. Add refrigerant. 2. Replace compressor. 3. Maintain proper superheat at compressor. 4. Correct piping.
Compressor thermal protector switch open	<ol style="list-style-type: none"> 1. Operating beyond design conditions. 2. Discharge valve partially shut. 3. Blown valve plate gasket. 4. Dirty condenser coil. 5. Overcharged system. 	<ol style="list-style-type: none"> 1. Add components to bring conditions within acceptable limits (i.e., CPR/EPR valves, additional condenser surface, liquid injection, etc.). 2. Open valve. 3. Replace gasket. 4. Clean coil. 5. Reduce charge.

Replacement Parts by

InterLink™ Commercial Refrigeration Parts is your link to a complete line of dependable and certified commercial refrigeration parts, accessories and innovative electronic controls for all Heatcraft Refrigeration Products (HRP) brands - including Bohn, Larkin, Climate Control and Chandler. At InterLink, we provide our wholesalers with a comprehensive selection of product solutions and innovative technologies for the installed customer base. And every product is built to ensure the same high performance standards with which all HRP brands are built — backed by a dedicated team to serve every customer need, delivering at the best lead times in the industry.

Replacement parts should be obtained from your local InterLink wholesaler. Replacement parts, which are covered under the terms of the warranty statement on page 2 of this manual, will be reimbursed for total part cost only. The original invoice from the parts supplier must accompany all warranty claims for replacement part reimbursement. Heatcraft Refrigeration Products reserves the right to adjust the compensation amount paid on any parts submitted for warranty reimbursement when a parts supplier's original invoice is not provided with a claim. **For more information, call 800-686-7278 or visit www.interlinkparts.com.**

Preventive Maintenance Guidelines

Air-Cooled Condensing Units

Quarterly

1) Visually inspect unit

- Look for signs of oil stains on interconnection piping and condenser coil. Pay close attention to areas around solder joints, building penetrations and pipe clamps. Check any suspect areas with an electronic leak detector. Repair any leaks found and add refrigerant as needed.
- Check condition of moisture indicator/sightglass in the sight glass if so equipped. Replace liquid line drier if there is indication of slight presence of moisture. Replace refrigerant, oil and drier if moisture concentration is indicated to be high.
- Check moisture indicator/sightglass for flash gas. If found check entire system for refrigerant leaks and add refrigerant as needed after repairing any leaks.
- Check compressor sightglass (if equipped) for proper oil level.
- Check condition of condenser. Look for accumulation of dirt and debris (clean as required).
- Check for unusual noise or vibration. Take corrective action as required.
- Inspect wiring for signs of wear or discoloration and repair if needed.
- Check and tighten all flare connections.

Semi-Annually

2) Repeat all quarterly inspection items.

3) Clean condenser coil and blades

- Periodic cleaning can be accomplished by using a brush, pressurized water and a commercially available foam coil cleaner. If foam cleaner is used, it should not be an acid based cleaner. Follow label directions for appropriate use.
- Rinse until no residue remains.

4) Check operation of condenser fans

- Check that each fan rotates freely and quietly. Replace any fan motor that does not rotate smoothly or makes excessive noise.
- Check all fan blade set screws and tighten as required.
- Check all fan blades for signs of cracks, wear or stress. Pay close attention to the hub and spider. Replace blades as required.
- Verify that all motors are mounted securely.
- Lubricate motors if applicable. Do not lubricate permanently sealed, ball bearing motors.

5) Inspect electrical wiring and components

- Verify that all electrical and ground connections are secure, tighten as required.
- Check condition of compressor and heater contactors. Look for discoloration and pitting. Replace as required.
- Check operation and calibration of all timers, relays pressure controls and safety controls.
- Clean electrical cabinet. Look for signs of moisture, dirt, debris, insects and wildlife. Take corrective action as required.
- Verify operation of crankcase heater by measuring amp draw.

6) Check refrigeration cycle

- Check suction, discharge and net oil pressure readings. If abnormal take appropriate action.
- Check operation of demand cooling, liquid injection or unloaders if so equipped.
- Check pressure drop across all filters and driers. Replace as required.
- Verify that superheat at the compressor conforms to specification. (30°F to 45°F)
- Check pressure and safety control settings and verify proper operation.

Annually

7) In addition to quarterly and semiannual maintenance checks, submit an oil sample for analysis

- Look for high concentrations of acid or moisture. Change oil and driers until test results read normal.
- Investigate source of high metal concentrations, which normally are due to abnormal bearing wear. Look for liquid refrigerant in the crankcase, low oil pressure or low superheat as a possible source.

8) Inspect suction accumulator (if equipped)

- If the accumulator is insulated remove insulation and inspect for leaks and corrosion.
- Pay close attention to all copper to steel brazed connections
- Wire brush all corroded areas and peeling paint.
- Apply an anticorrosion primer and paint as required. Re-insulate if applicable.

ELECTRICAL CONNECTIONS - SINGLE EVAPORATOR

Diagram 6

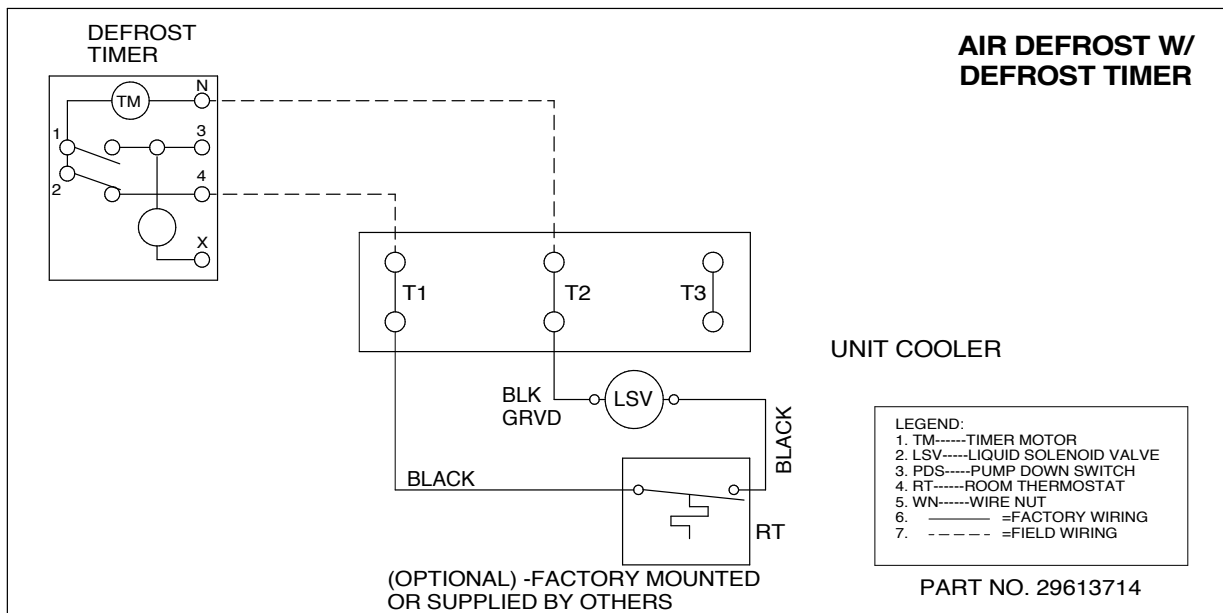


Diagram 7

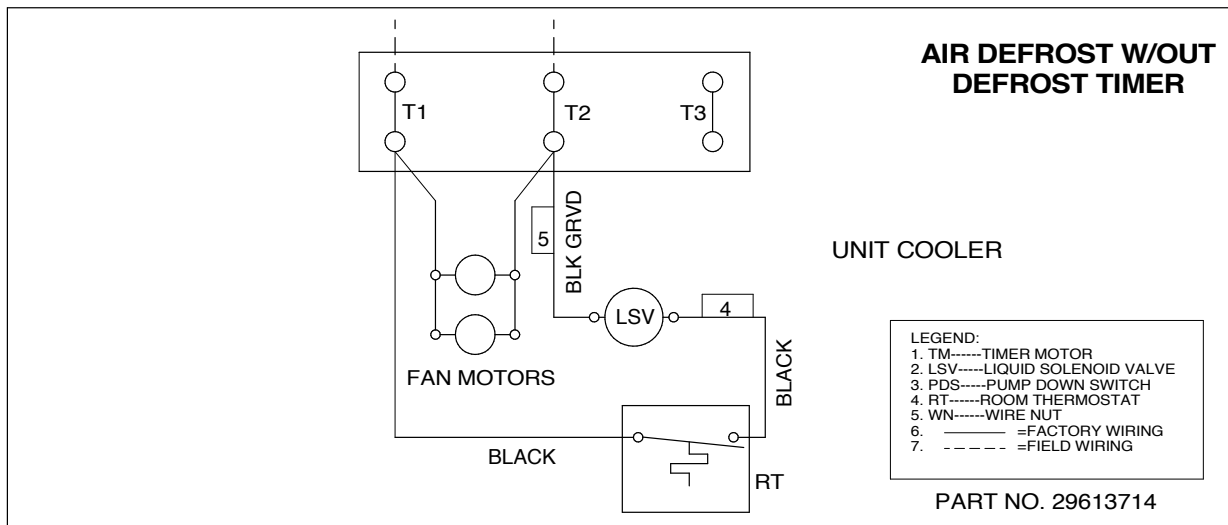


Diagram 8

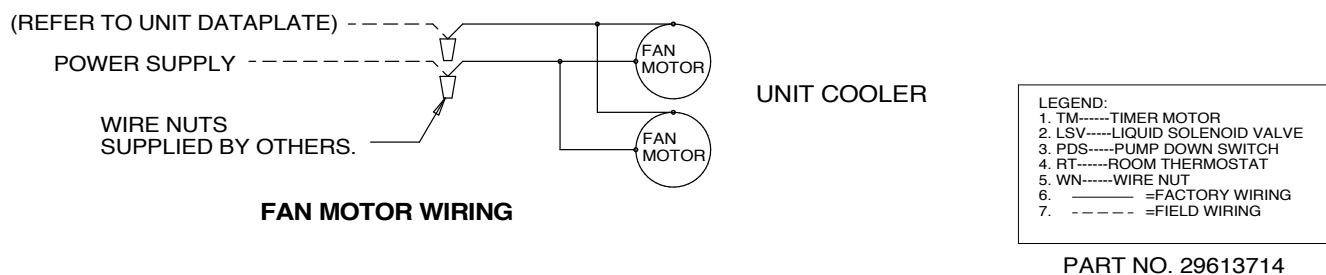


Diagram 9. Typical Wiring Diagram for Single Evaporator with and without Defrost Timer

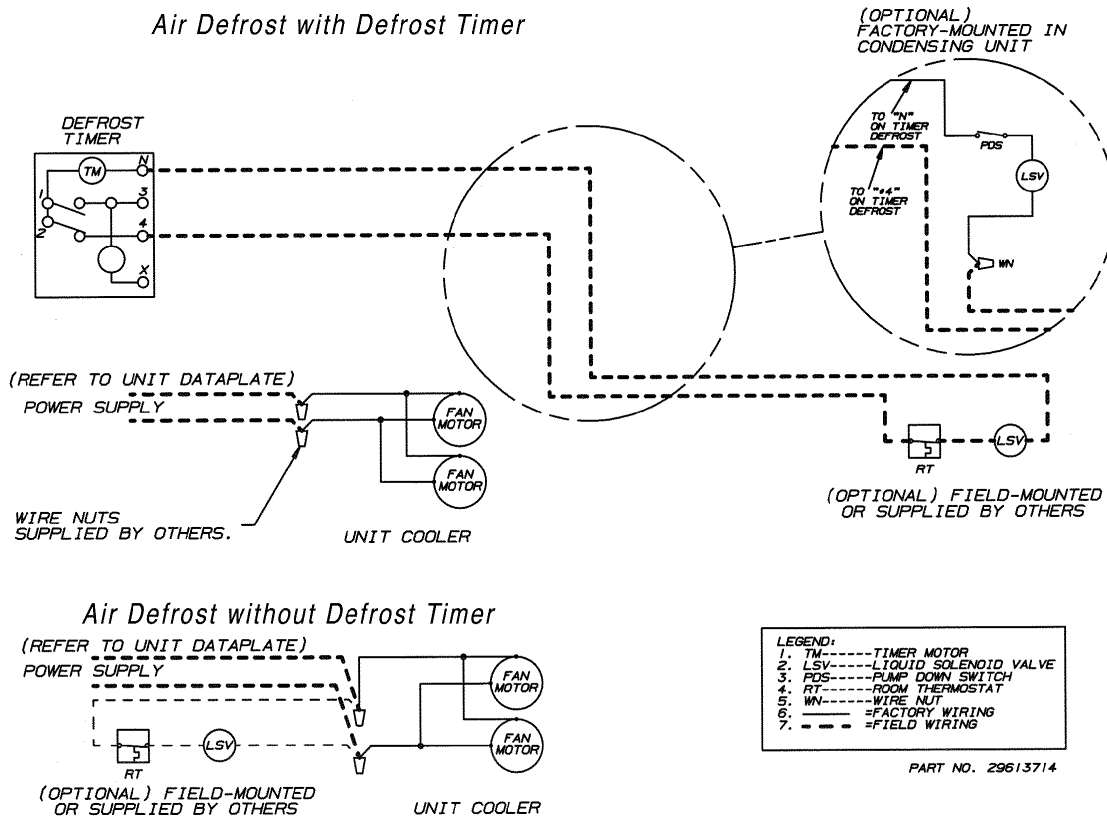


Diagram 10. Typical Wiring Diagram for Single Evaporator with Defrost Timer Only

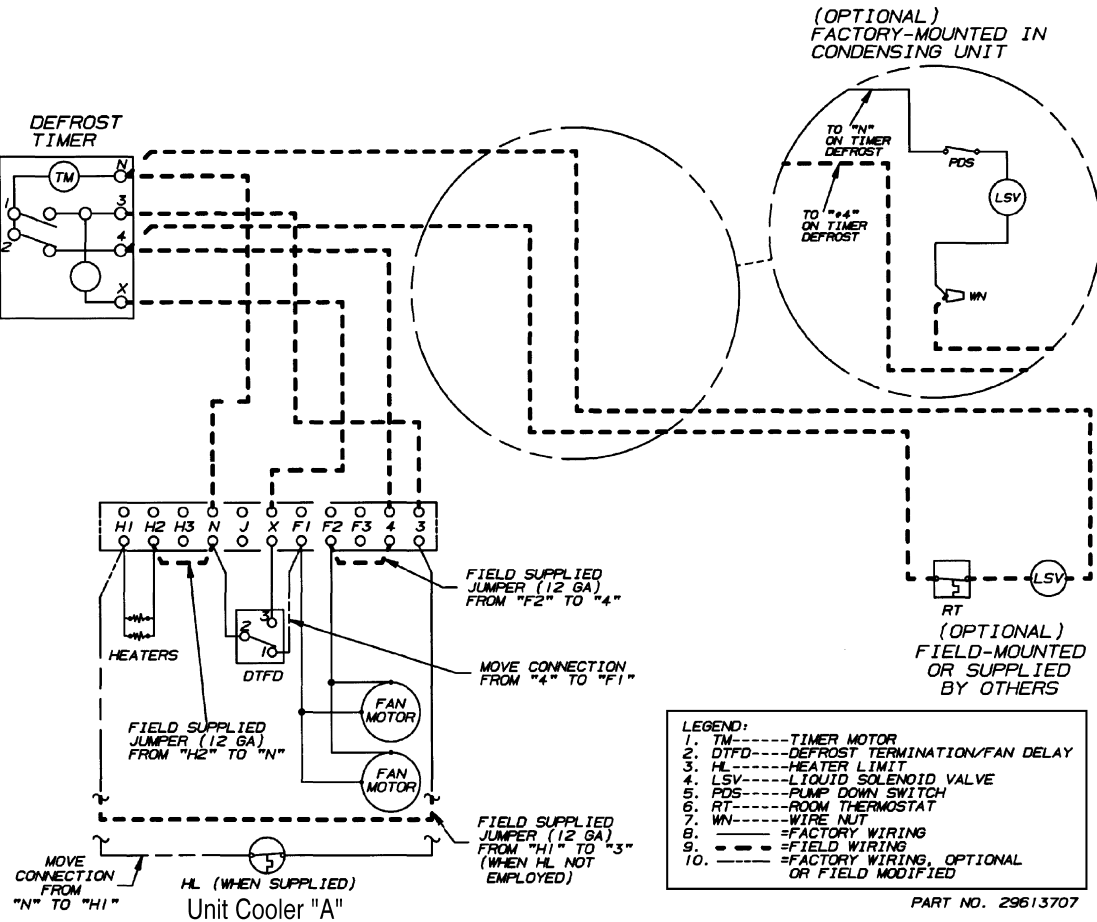


Diagram 11. Typical Wiring Diagram for Multiple Evaporators with Defrost Timer Only

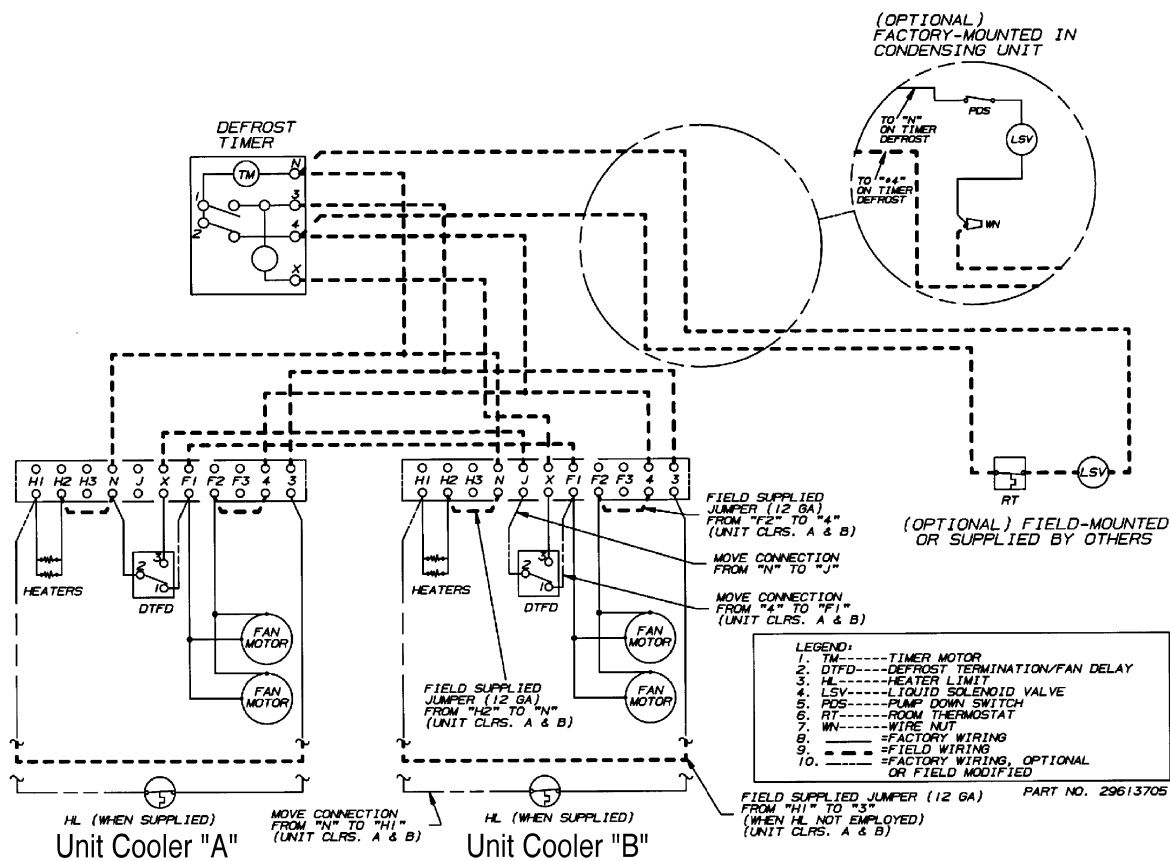


Diagram 12. Typical Wiring Diagram for Single Evaporator / Single Phase Defrost and Evaporator Fan Contactors

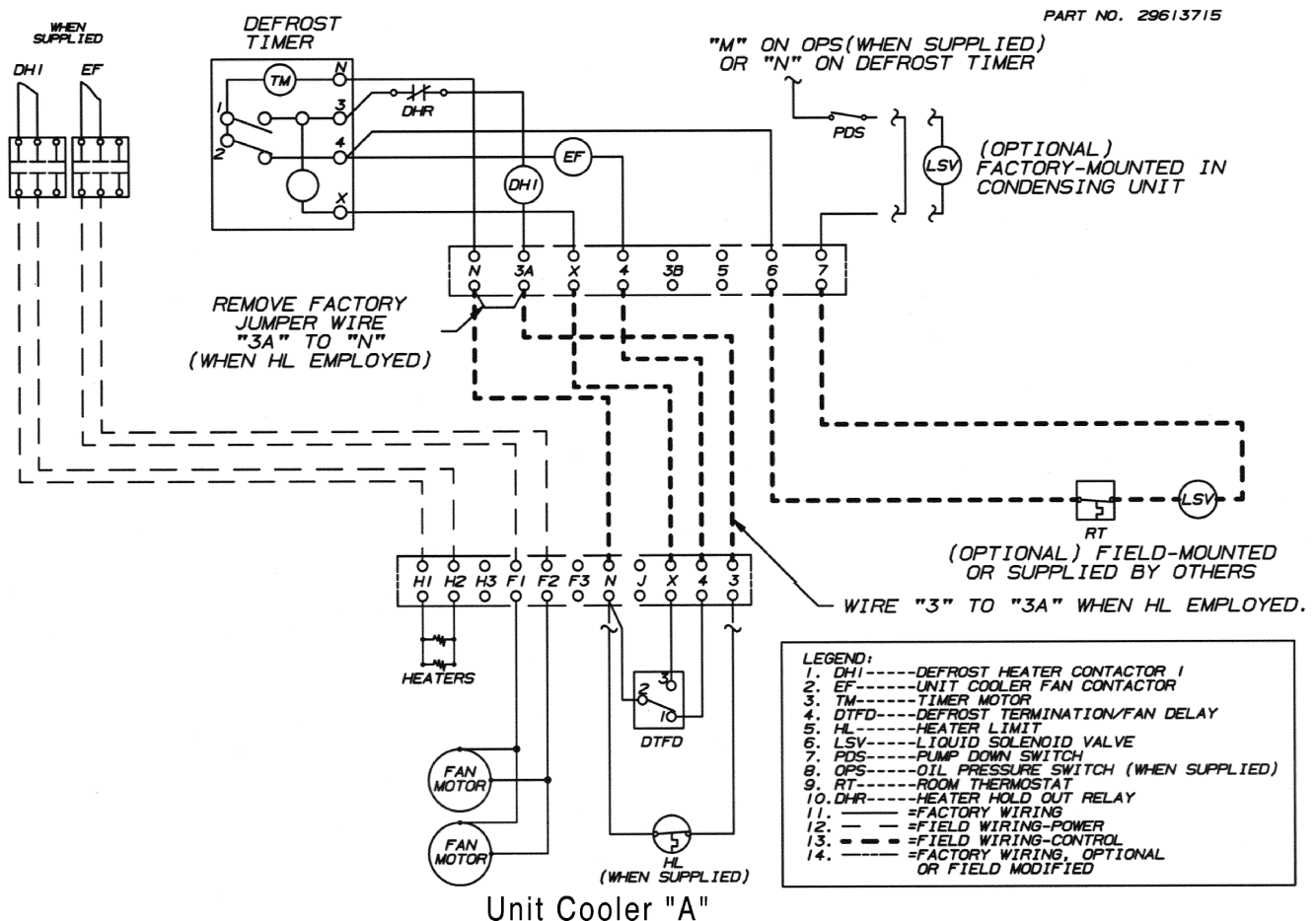


Diagram 13. Typical Wiring Diagram for Single Evaporator Defrost and Evaporator Fan Contactors

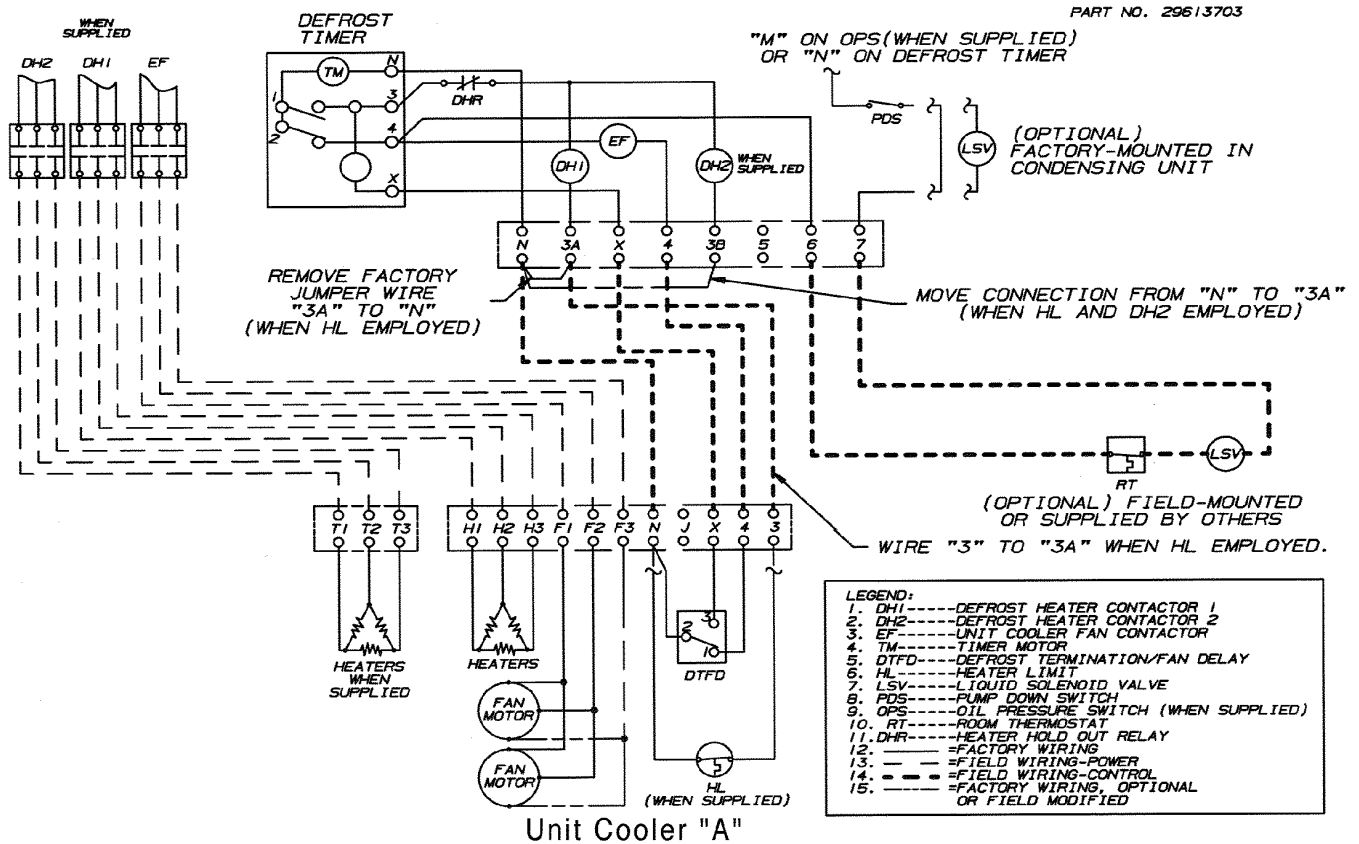


Diagram 14. Typical Wiring Diagram for Multiple Evaporators with Evaporator Fan Contactors/without Heater Limit Defrost

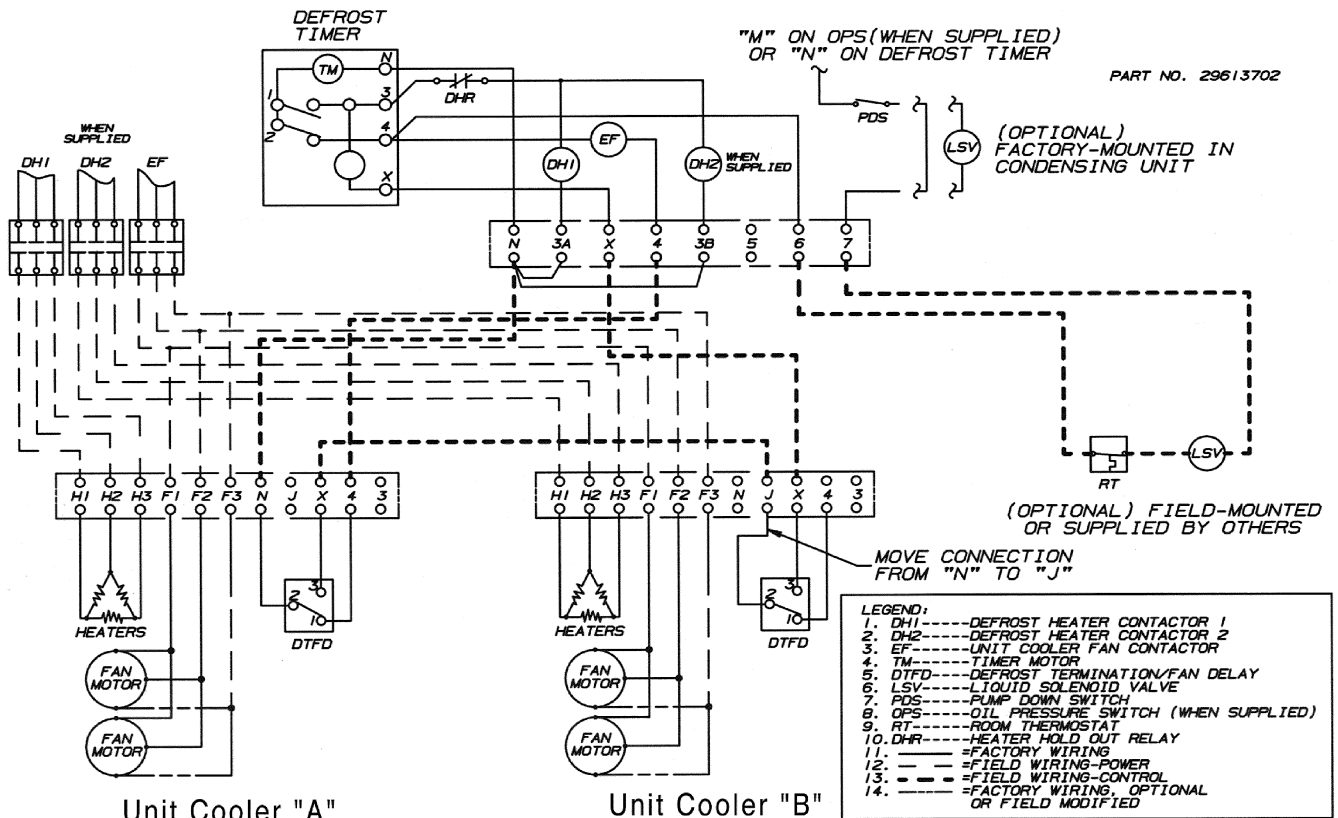


Diagram 15. Typical Wiring Diagram for Multiple Evaporators with Heater Limit Defrost and Evaporator Fan Contactors

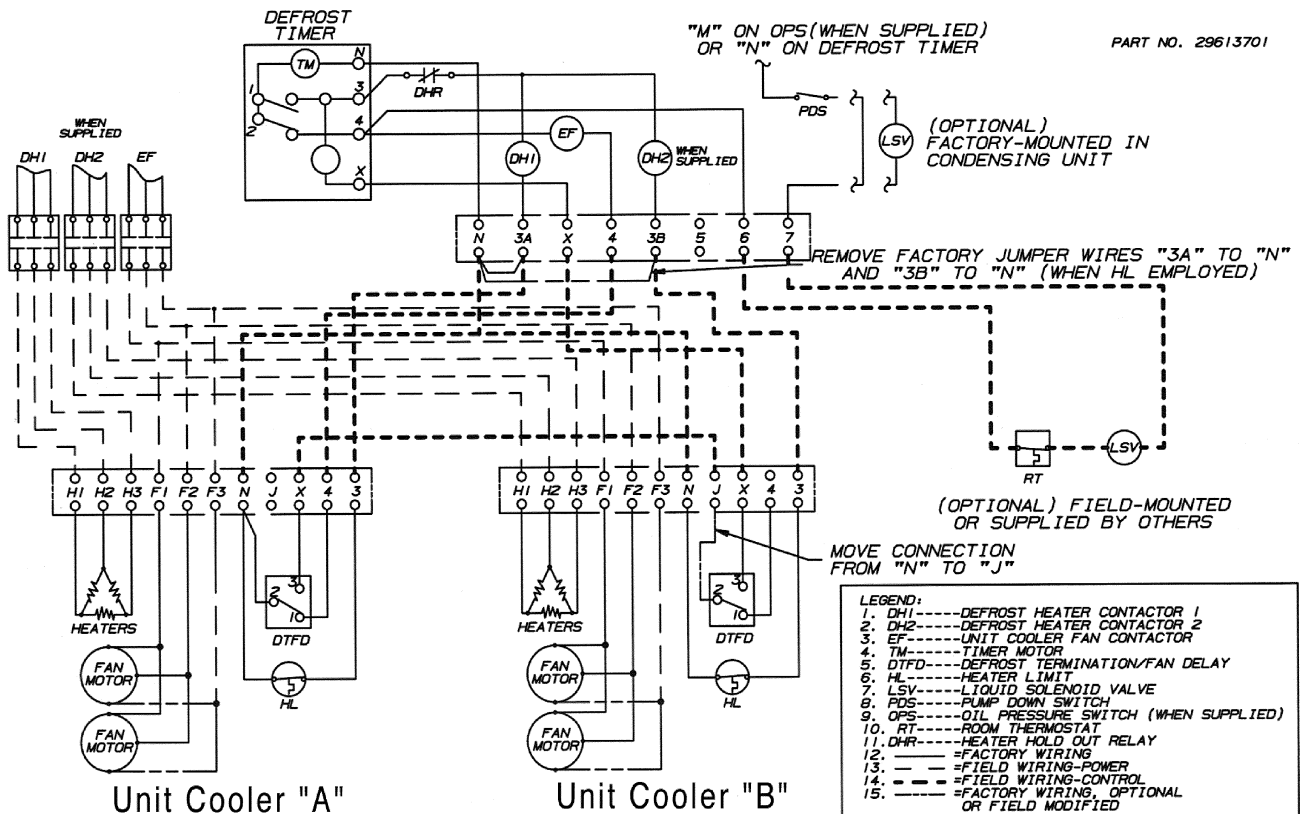
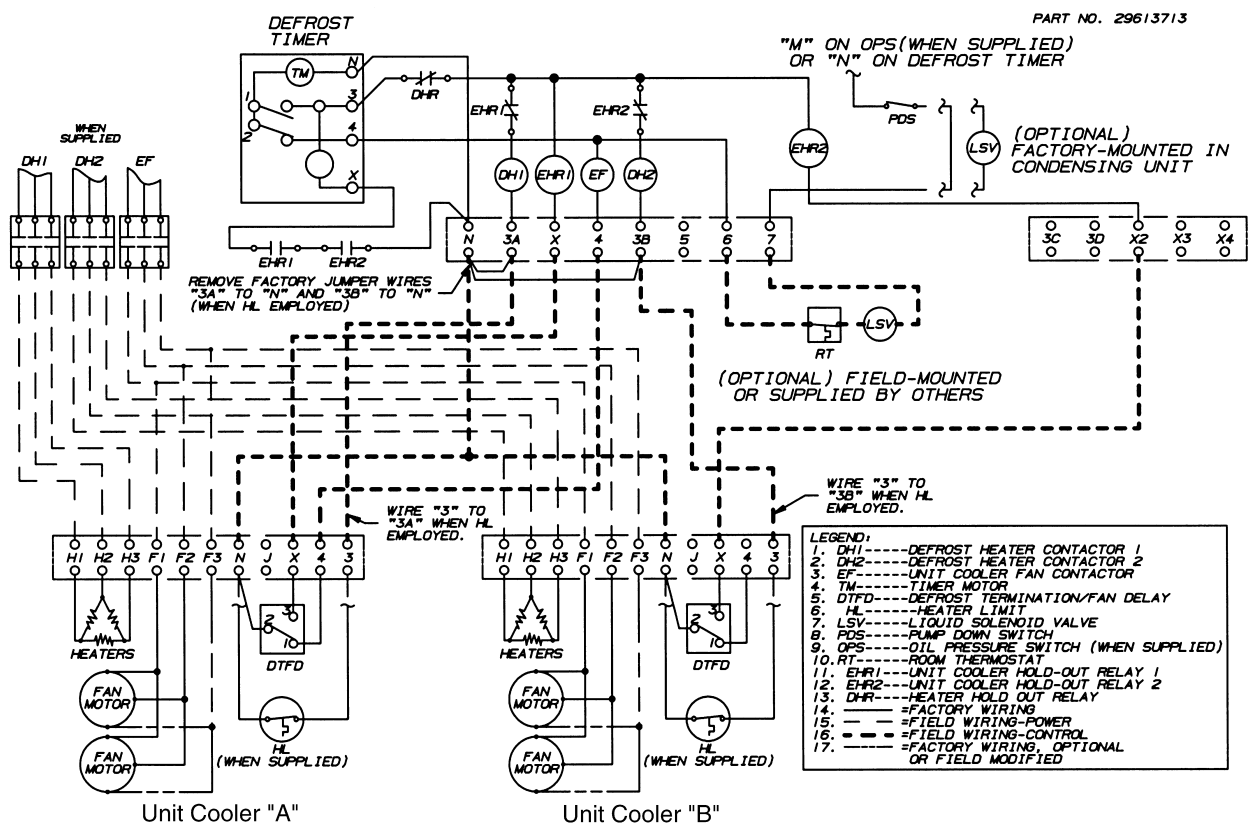


Diagram 16. Typical Wiring Diagram for Multiple Evaporators Defrost and Evaporator Fan Contactors with Unit Cooler Holdout Relay



Since product improvement is a continuing effort, we reserve the right to make changes in specifications without notice.

The name behind the brands you trust.™



WA/WAS Series Ball Valves

WA Series — No Access Fitting

WAS Series — Includes Access Fitting

INTEGRA-SEAL®

A robotically welded body joint.
Full-size ports for unrestricted flow.
These ball valves employ the latest robotic welding technology. Every continuous welded body joint is 100% factory tested to ensure positively leak-free performance. Dual Teflon® ball seals surround a polished brass or carbon steel ball at each end. A secondary seal becomes effective if foreign material scores the primary seal — even in extremely unfavorable conditions such as compressor burnout — a Superior exclusive!

WA/WAS Series Ball Valves are constructed using a forged brass body with copper tube extensions on all sizes. Mechanical internal forged stops ensure positive open or closed positions — another Superior exclusive. Full open to full close with ¼ turn.

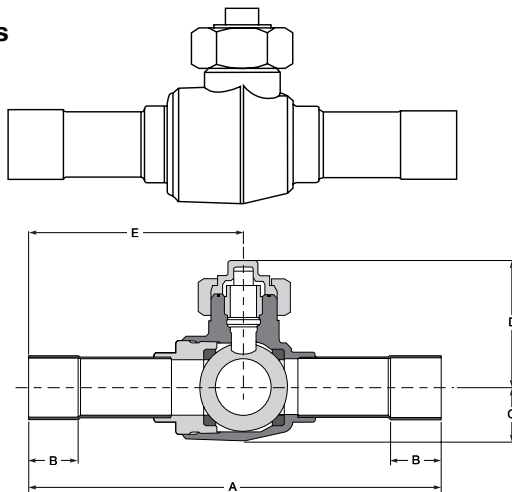
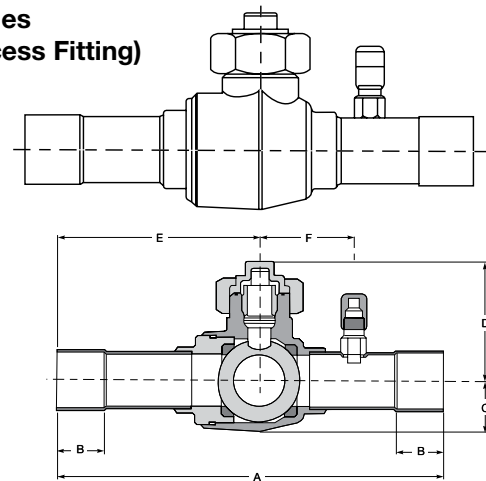
All sizes incorporate a dual stem seal design utilizing Teflon packing compressed by an internal packing nut forming the primary seal. The unique seal cap design permits valve operation without removal of the seal cap and uses

Teflon gaskets to provide a secondary seal — a third Superior exclusive! There are no synthetic O-rings. Ball internal relief port design ensures shut-off in either direction of flow — even during evacuation of the system. Full flow ports in all sizes ¾" through 3½". These ball valves are non-directional flow valves and may be installed in any position.

Teflon is a registered trademark of Dupont.

** Metric sizes available upon request.*

WA Series

WAS Series
(with Access Fitting)

Without Access Fitting	IBCA Number	With Access Fitting	IBCA Number	Connection (ODS)	Ball Port Diameter	Weight (lbs.) WA	Weight (lbs.) WAS
586WA-4ST	23767	—	—	¼"	0.50	0.7	N/A
586WA-6ST	58651	586WAS-6ST	59726	¾"	0.50	0.7	0.77
586WA-8ST	58652	586WAS-8ST	59727	1½"	0.50	0.7	0.77
586WA-10ST	58564	586WAS-10ST	59728	¾"	0.50	0.7	0.77
587WA-12ST	58659	—	—	¾"	0.75	1.0	N/A
587WA-14ST	58584	587WAS-14ST	59729	7/8"	0.75	1.0	1.10
591WA-11ST	58756	591WAS-11ST	59730	1½"	1.00	2.2	2.42
592WA-13ST	58790	592WAS-13ST	60072	1½"	1.50	3.8	4.18
593WA-15ST	58793	593WAS-15ST	59731	1½"	1.50	3.8	4.18
594WA-21ST	58865	594WAS-21ST	59732	2"	2.01	8.0	8.80
594WA-25ST**	58864	—	—	2½"	2.01	11.0	N/A
594WA-31ST**	58863	—	—	3½"	2.01	11.0	N/A
595WA-25ST	60235	595WAS-25ST	60316	2½"	2.44	15.0	15.80
596WA-31ST	59143	596WAS-31ST	59733	3½"	2.91	25.0	26.00
596WA-35ST**	59146	—	—	3½"	2.91	26.0	N/A
596WA-41ST**	59150	—	—	4½"	2.91	27.0	N/A

** Reduced ports.



Seal Cap

Exclusive Seal Cap design permits operation of valve without removal.
Markings on cap top designate at-a-glance open or closed ball position.



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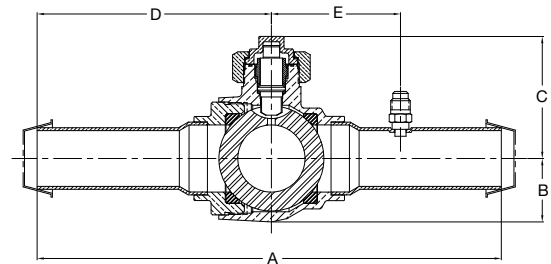
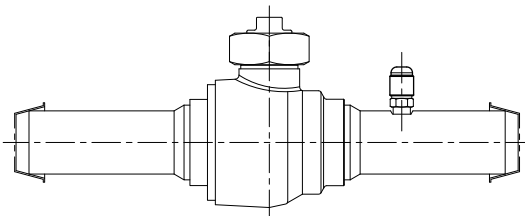
WA Series — No Access Fitting**WAS Series — Includes Access Fitting****MST Series — Male Soldered Tube**

- Full refrigeration service temperature range of -40° F to +325° F (-40° C to +149° C).
- Design working pressure: 700 PSIG.
- UL® and cUL Listed, File No. SA3462 (N), except for metric sizes and oxygen.
- WAS Series includes access fitting, strategically located on tube extension.
- No synthetic O-ring seals. Double seal protection provides a Superior stem design.
- Polished brass or carbon steel ball.
- Forged brass body and seal cap.
- Seal cap design permits valve operation without removal of seal cap.
- For use with CO₂, CFC, HFC and HCFC refrigerants listed in CAN/CSA B52 and ANSI/ASHRAE 15 Section 9.2.
- Spare Parts List on pp. 36–37.

* Metric sizes available upon request.

Without Access Fitting	With Access Fitting	Dimensions (Inches)						Maximum Width	C _v
		A	B	C	D	E	F		
586WA-4ST	—	6.50	0.31	0.56	1.80	3.44	N/A	1.38	N/A
586WA-6ST	586WAS-6ST	6.50	0.31	0.56	1.80	3.44	1.75	1.38	3.60
586WA-8ST	586WAS-8ST	6.50	0.38	0.56	1.80	3.44	1.75	1.38	7.40
586WA-10ST	586WAS-10ST	6.50	0.50	0.56	1.80	3.44	1.75	1.38	14.60
587WA-12ST	—	6.56	0.63	0.73	1.96	3.46	N/A	1.88	22.30
587WA-14ST	587WAS-14ST	6.56	0.75	0.73	1.96	3.46	1.75	1.88	30.00
591WA-11ST	591WAS-11ST	7.69	0.94	1.03	2.37	4.01	1.75	2.31	62.00
592WA-13ST	592WAS-13ST	8.88	1.00	1.42	2.73	4.49	2.21	3.19	110.00
593WA-15ST	593WAS-15ST	9.13	1.09	1.42	2.73	4.62	2.21	3.19	135.00
594WA-21ST	594WAS-21ST	9.88	1.34	1.85	3.11	5.07	2.57	4.06	270.00
594WA-25ST**	—	12.88	1.44	1.85	3.11	6.57	N/A	4.06	250.00
594WA-31ST**	—	13.75	1.63	1.85	3.11	7.01	N/A	4.06	240.00
595WA-25ST	595WAS-25ST	12.92	1.50	2.30	3.95	6.52	3.35	4.65	340.00
596WA-31ST	596WAS-31ST	16.31	1.69	2.75	4.35	8.32	3.63	5.63	480.00
596WA-35ST**	—	16.03	1.94	2.75	4.35	8.32	N/A	5.63	455.00
596WA-41ST**	—	16.03	1.94	2.75	4.35	8.32	N/A	5.63	430.00

** Reduced ports.

MST Series — Male Soldered Tube

Part Number	IBCA Number	Male Connection (ODS)	Ball Port Diameter	Weight (lbs.)	Dimensions (Inches)					Maximum Width	C _v
					A	B	C	D	E		
586WAS-10MST	30172	3/8"	0.50	0.76	8.00	0.56	1.80	4.19	1.68	1.38	14.60
587WAS-14MST	30173	1/2"	0.75	1.08	8.00	0.73	1.96	4.18	1.83	1.88	30.00
591WAS-11MST	30177	1"	1.00	2.49	12.47	1.03	2.37	6.41	2.31	2.31	62.00
592WAS-13MST	30175	1 1/8"	1.50	3.91	10.36	1.42	2.73	5.23	2.88	2.88	110.00
593WAS-15MST	30176	1 1/4"	1.50	4.10	10.14	1.42	2.73	5.12	3.02	3.02	135.00
594WAS-21MST	30157	2"	2.01	7.94	12.25	1.85	3.11	6.25	3.50	3.50	270.00

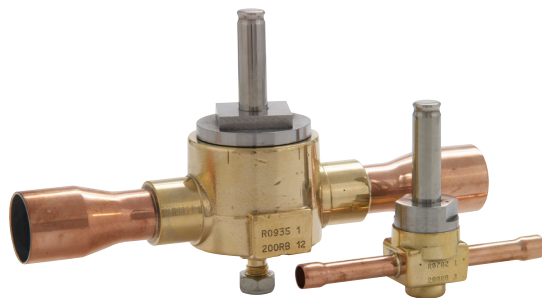
The 200RB is a pilot-operated, 2-way, normally closed valve. 200RB valves are used for liquid, discharge, or suction gas refrigerant service.

Features

- One coil fits all valve sizes
- Extended ends for easy installation (standard)
- Long-life molded coils
- PTFE O-ring for superior external sealing

Options

- Available in 8 orifice sizes
- Manual stem or mounting stud
- Bi-Flow operation-conversion either factory assembled or with kit (except 200RB 7, 9 & 12)



Specifications

- Maximum fluid temperature: 250°F
- Maximum working pressure: 500 psig
- Minimum operating pressure drop: 2 psi
- MOPD: 300 psig
- UL/CUL file number: MP604

NOTE: Mounting enclosing tube more than 90° off vertical up position is not recommended.

Nomenclature example: 200RB 4T3M VLC

200R	B	4	T	3	M	VLC
Valve Series	Design Series	Port Size (in 1/16")	Connection Type F = SAE S = ODF P = NPTF T = Copper Extended Ends	Connection Size (in 1/8")	M = manual stem T = mounting stud (optional)	Coil*

*NOTE: Valves are shipped without the solenoid coils (VLC = Valve Less Coil). See coil assemblies for availability.

Ordering Information and Nominal* Liquid Capacity Table – Tons (kW)

PCN			Description	Connection Size	R-12	R-134a	R-22	R-407C	R-404A/R-507	R-502
Standard Valve	Mounting Stud ¹	Manual Stem ²								
053104	--	N/A	200RB 2 F 2	1/4 SAE	2.3 (8.1)	2.7 (9.5)	3.6 (12.7)	3.4 (12.0)	1.9 (6.7)	1.9 (6.7)
062611	--	N/A	200RB 2 F 3	3/8 SAE						
053105	053236	N/A	200RB 2 T 2	1/4 ODF						
053106	054170	N/A	200RB 2 T 3	3/8 ODF						
052725	--	--	200RB 3 F 2	1/4 SAE	3.0 (10.6)	3.6 (12.7)	4.8 (16.9)	4.5 (15.8)	2.5 (8.8)	2.6 (9.1)
052726	056438	--	200RB 3 F 3	3/8 SAE						
052727	055855	--	200RB 3 F 4	1/2 SAE						
049608	--	--	200RB 3 T 2	1/4 ODF						
049609	049585	065620	200RB 3 T 3	3/8 ODF	5.0 (17.6)	6.0 (21.1)	8.0 (28.1)	7.5 (26.4)	4.2 (14.8)	4.2 (14.8)
049692	--	065621	200RB 3 T 4	1/2 ODF						
047506	047508	047507	200RB 4 F 3	3/8 SAE						
059728	047510	047509	200RB 4 P 3	3/8 NPTF						
047511	047513	047512	200RB 4 S 3	3/8 ODF X 1/2 ODM	5.2 (18.3)	6.2 (21.8)	8.2 (28.8)	7.7 (27.1)	4.3 (15.1)	4.5 (15.8)
047516	047515	047514	200RB 4 S 4	1/2 ODF X 5/8 ODM						
047517	049162	049186	200RB 4 T 3	3/8 ODF						
047518	049163	049187	200RB 4 T 4	1/2 ODF						
058950	058045	056518	200RB 4 T 5	5/8 ODF	6.0 (21.1)	7.2 (25.3)	9.5 (33.4)	8.9 (31.3)	5.0 (17.6)	5.1 (17.9)
047519	047521	047520	200RB 5 F 4	1/2 SAE						
059729	047523	047522	200RB 5 F 5	5/8 SAE						
047524	047526	047525	200RB 5 S 4	1/2 ODF X 5/8 ODM						
049201	047528	047527	200RB 5 S 5	5/8 ODF	10.8 (38.0)	12.7 (44.7)	17.0 (59.8)	16.2 (57.0)	9.1 (32.0)	9.2 (32.4)
061227	054323	--	200RB 5 T 3	3/8 ODF						
057206	049164	049188	200RB 5 T 4	1/2 ODF						
059730	049165	049189	200RB 5 T 5	5/8 ODF						
059731	047531	047530	200RB 6 F 4	1/2 SAE	19.6 (68.9)	23.6 (83.0)	30.5 (107.3)	29.0 (102.0)	16.4 (57.7)	16.2 (57.0)
059732	047534	047533	200RB 6 F 5	5/8 SAE						
059733	047536	047535	200RB 6 P 3	3/8 NPTF						
047537	047539	047538	200RB 6 S 4	1/2 ODF X 5/8 ODM						
047540	047542	047541	200RB 6 S 5	5/8 ODF	22.5 (79.1)	27.1 (95.3)	34.9 (122.7)	33.2 (116.8)	18.8 (66.1)	18.5 (65.1)
047544	047546	047545	200RB 6 T 4	1/2 ODF						
056766	047548	047547	200RB 6 T 5	5/8 ODF						
064037	--	--	200RB 7 S 5	5/8 ODF X 7/8 ODM						
064062	--	--	200RB 7 T 4	1/2 ODF	22.5 (79.1)	27.1 (95.3)	34.9 (122.7)	33.2 (116.8)	18.8 (66.1)	18.5 (65.1)
064063	064562	064267	200RB 7 T 5	5/8 ODF						
064282	064284	064283	200RB 7 T 7	7/8 ODF						
064762	064764	064763	200RB 9 T 5	5/8 ODF						
064645	064766	064765	200RB 9 T 7	7/8 ODF	22.5 (79.1)	27.1 (95.3)	34.9 (122.7)	33.2 (116.8)	18.8 (66.1)	18.5 (65.1)
064767	064769	064768	200RB 9 T 9	1 1/8 ODF						
064818	064820	064819	200RB 12 T 7	7/8 ODF						
064821	064823	064822	200RB 12 T 9	1 1/8 ODF						

¹ Add "T" to the end of description for Mounting Stud

² Add "M" to the end of the description for Manual Stem

Capacities based on 100°F liquid and 40°F saturated evaporator per ARI standard 760-87.

All ratings are based on largest connection size.

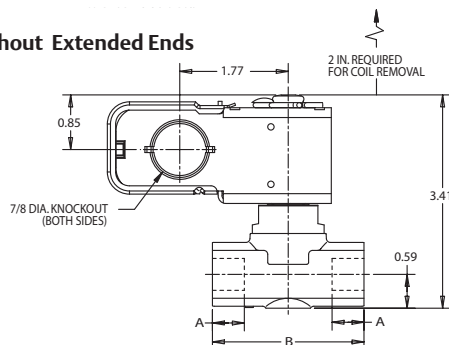
*See Extended Capacity Tables for ratings at a wide range of conditions.

Ordering Information and Nominal Liquid Capacity Table for Bi-Flow Solenoids - Tons (kW)

PCN			Description	Connection Size	R-12	R-134a	R-22	R-407C	R-404A/R-507	R-502
Standard Valve	Mounting Stud	Manual Stem								
009689	--	--	200RB GS-1925 3 T 3	3/8 ODF	3.7 (13.0)	4.4 (15.6)	4.8 (17.0)	4.5 (16.0)	3.2 (11.3)	3.1 (11.0)
009690	--	--	200RB GS-1926 4 T 3	3/8 ODF	4.4 (15.6)	5.3 (18.6)	5.6 (19.8)	5.3 (18.8)	3.7 (13.1)	3.6 (12.7)
009692	--	--	200RB GS-1928 5 T 4	1/2 ODF	6.5 (23.0)	7.8 (27.7)	8.2 (29.0)	7.8 (27.6)	54. (19.1)	5.3 (18.8)
009693	--	--	200RB GS-1929 5 T 5	5/8 ODF	7.8 (27.7)	9.4 (33.4)	10.0 (35.4)	9.5 (33.6)	6.5 (23.0)	6.5 (23.0)

200RB2-6 Dimensional Data (in)

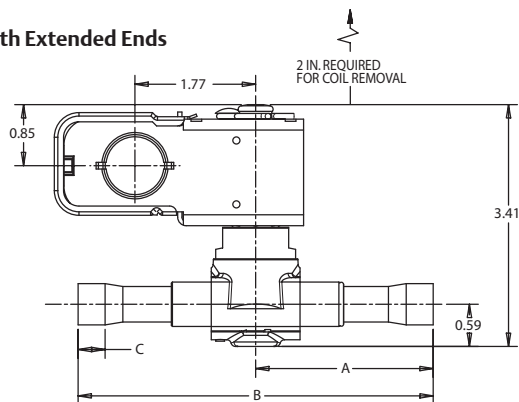
Without Extended Ends



Without Extended Ends

Valve	Port Size	Conn. Size & Style	A	B
200RB 4P2	1/4	1/4 NPTF	-	2.37
200RB 4P3		3/8 NPTF		
200RB 4S3		3/8 ODF x 1/2 ODM		
200RB 4S4		1/2 ODF x 5/8 ODM		
200RB 4F3	5/16	3/8 SAE (male flare)	-	3.12
200RB 5P3		3/8 NPTF		
200RB 5S4		1/2 ODF x 5/8 ODM		
200RB 5S5		5/8 ODF		
200RB 5F4	3/8	1/2 SAE (male flare)	0.56	2.37
200RB 5F5		5/8 SAE (male flare)		
200RB 6P3		3/8 NPTF		
200RB 6S4		1/2 ODF x 5/8 ODM		
200RB 6S5	3/8	5/8 ODF	-	2.37
200RB 6F4		1/2 SAE (male flare)		
200RB 6F5		5/8 SAE (male flare)		

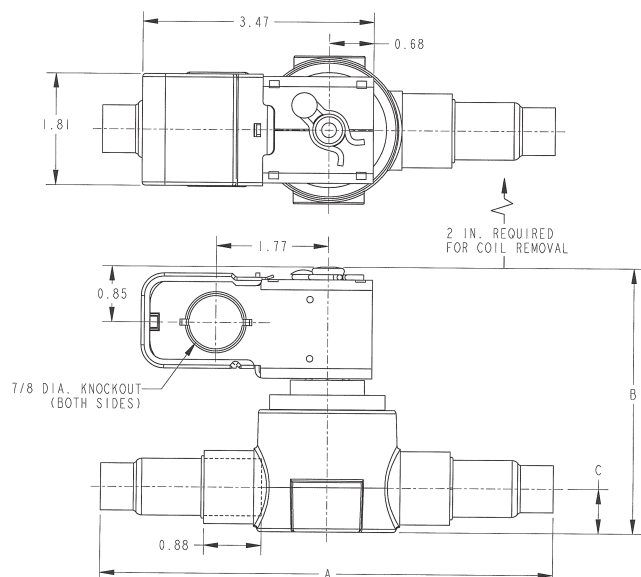
With Extended Ends



With Extended Ends

Valve	Port Size	Conn. Size & Style	A	B	C
200RB 2T2	1/8	1/4 ODF	2.42	4.62	0.25
200RB 2T3		3/8 ODF			0.31
200RB 3T2	3/16	1/4 ODF	2.50	5.00	0.25
200RB 3T3		3/8 ODF			0.31
200RB 3T4	1/4	1/2 ODF	3.25	6.50	0.38
200RB 4T4		5/8 ODF			0.50
200RB 4T5	5/16	3/8 ODF	2.31	4.62	0.31
200RB 5T3		1/2 ODF			0.38
200RB 5T4	3/8	5/8 ODF	2.31	4.62	0.50
200RB 5T5		3/8 ODF			0.31
200RB 6T3	3/8	1/2 ODF	3.25	6.50	0.38
200RB 6T4		5/8 ODF			0.50

200RB7, 9 and 12 Dimensional Data (in)



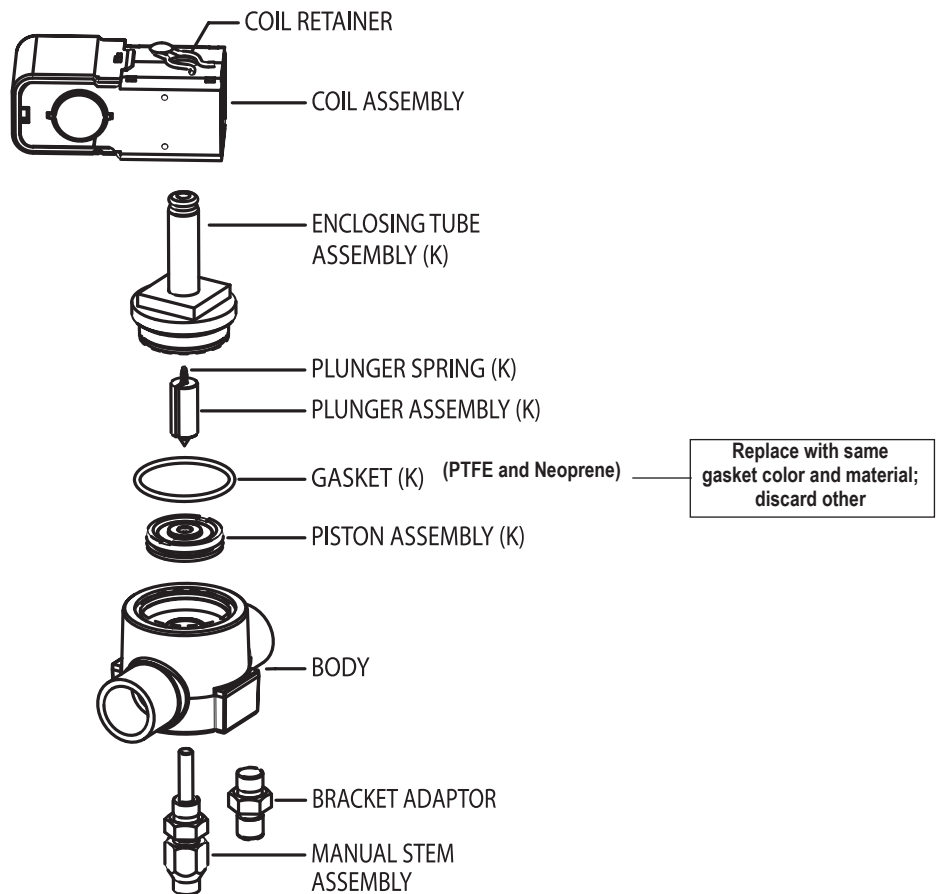
Valve	Port Size	Conn. Size & Style	A	B	C
200RB7S5	7/16	5/8 ODF x 7/8 ODM	2.98	3.69	0.53
200RB7T5		5/8 ODF x 5/8 ODF	6.88		
200RB7T7		7/8 ODF x 7/8 ODF	7.13		
200RB9T5	9/16	5/8 ODF x 5/8 ODF	6.88	4.05	0.68
200RB9T6		3/4 ODF x 3/4 ODF	7.38		
200RB9T7		7/8 ODF x 7/8 ODF	7.13		
200RB9T9	3/4	1 1/8 ODF x 1 1/8 ODF	8.50	8.50	0.68
200RB12T7		7/8 ODF x 7/8 ODF	7.50		
200RB12T9		1 1/8 ODF x 1 1/8 ODF	8.50		

Exploded View & Parts Kit Data

Valve Repair Kit
"K" indicates part is supplied in
valve repair kit **KS30386**. (PCN 066223)

Gasket Kit
Gasket Kit **KG10025** (PCN 049190)
(contains 12 pieces - each of
PTFE and neoprene O-rings)

Coil Assembly
See coil assemblies for availability.



Valve Kits

Valve	Complete Kit	PCN	Manual Opening Kit	PCN	Bi-Flow Kit	PCN	Gasket Kit	PCN
200RB2	KS30386	066223	N/A	N/A	KS30387	066224	KG10025	049190
200RB3	KS30386	066223	KS30377	065695	KS30387	066224	KG10025	049190
200RB4	KS30386	066223	KS30117	053959	KS30387	066224	KG10025	049190
200RB5	KS30386	066223	KS30117	053959	KS30387	066224	KG10025	049190
200RB6	KS30386	066223	KS30117	053959	KS30387	066224	KG10025	049190
200RB7	KS30354	064263	KS30361	064831	N/A	N/A	KG00002	064262
200RB9	KS30362	064825	KS30364	064832	N/A	N/A	KG00003	064830
200RB12	KS30365	064826	KS30364	064832	N/A	N/A	KG00004	064833

200RB Bi-Flow Conversion

Standard 200RB uni-directional valves can be converted to Bi-Flow operation by replacing the internal parts with the components in kit KS30387 (PCN 066224). Unlike the standard valve which permits flow in one direction only when energized, the Bi-Flow version allows the valve to flow in either direction, depending on differential pressures, when energized. If the valve is not energized when flowing in the reverse direction, valve "flutter" will occur. Also, with the valve de-energized, a higher downstream pressure than upstream (back-flow) will force the valve open.

NOTE: A 200RB7, 200RB9 and 200RB12 cannot be converted to a Bi-Flow valve.

Features

- Compact designs
- Coil windings are insulated to provide shock and vibration protection
- ASC2 is designed to provide weather protection
- Interchangeable housings

Voltage Options

- 24V 50/60 Hz
- 120V 50/60 Hz (standard)
- 208-220/208-240V 50/60 Hz
- 480V 50/60 Hz
- 120-240V 50/60 Hz
- 12V D.C. (MM Series recommended)
- 24V D.C. (MM Series recommended)

Nomenclature

Coil Code		
A	M	G
Series	Insulation	Enclosure
A = 12 Watt B = 15 Watt C = 18 Watt D = 7 Watt M = 4 Watt	B or G = Class B M = Class F H = Class H	C = Conduit Connection F = Open Frame Leads G = Junction Box L = Grommet 18" Leads S = Spade Connection

ASC2 – DIN



Requires ASC2 female connector
(PCN 059261).

MMG – Special DC



AMC - 1/2" Conduit



AMG - Junction Box



AMS - Open Frame



MAGMAX Coil (Type MM): For Use On DC Applications Only

Voltage	Amperes Holding	Watts Holding
12VDC	0.4	4
24VDC	0.4	4

Solenoid Coil Prefix Selection Table

Valve Type	J-Box	Conduit	Leads	Spades	Molded-DIN With Connector
50RB	-	-	SML*	-	-
100RB	AMG	AMC	AMF	AMS	ASC2
200RB / 200RD	AMG	AMC	AMF	AMS	ASC2
222CB (Steam)	AHG	AHC	-	-	-
500RB	DMG	-	DMF	DMS	-
540RA	-	-	-	DMS	ASC2
222CB (Water)	AMG	AMC	AMF	AMS	ASC2
Special DC Application	MMG	-	MMF	-	-

* SML is OEM - RMF is Wholesale replacement

Note - All coils NEMA1 except ASC2 NEMA2

AM/EM Coil:

204CD

214CB

211CA

222CB

210CA

Nominal Voltage and Frequency	Applied Voltage and Frequency	204CD		214C		211CA		222CB		210CA	
		Inrush	Holding	Inrush	Holding	Inrush	Holding	Inrush	Holding	Inrush	Holding
24/60	24/60	1.23	0.61	1.17	0.61	0.92	0.61	1.00	0.74	0.92	0.61
120/60	120/60	0.23	0.14	0.22	0.14	0.17	0.14	0.19	0.16	0.17	0.14
240/60	240/60	0.13	0.08	0.12	0.08	0.10	0.08	0.11	0.08	0.10	0.08
480/60	480/60	0.06	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04

See the MM (MAGMAX) Series Coil for DC Applications

AM Coil: 702RA

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	1.70	1.00	24	17/12	Class F Molded
24-50/60	24/60	1.41	0.64	15		
120-50/60	120/50	0.38	0.24	29		
120-50/60	120/60	0.32	0.16	19		
208-220/50 208-240/60	208/50	0.17	0.10	21		
208-220/50 208-240/60	208/60	0.15	0.06	13		
208-220/50 208-240/60	220/50	0.20	0.14	33		
208-220/50 208-240/60	240/60	0.22	0.09	22		
480-50/60	480/50	0.10	0.07	33		
480-50/60	480/60	0.09	0.04	22		

See the MM (MAGMAX) Series Coil for DC Applications

AM Coil: 100RB 240RA 710/713RA

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA	Watts Max.	Coil Insulation
		Inrush	Holding	Holding		
24-50/60	24/50	1.20	.96	23	17/12	Class F Molded
24-50/60	24/60	1.0	.74	18		
120-50/60	120/50	.25	.21	25		
120-50/60	120/60	.19	.16	19		
208-220/50 208-240/60	208/50	.14	.08	17		
208-220/50 208-240/60	208/60	.12	.06	12		
208-220/50 208-240/60	220/50	.16	.10	24		
208-220/50 208-240/60	240/60	.13	.08	19		
480-50/60	480/50	.06	.05	24		
480-50/60	480/60	.05	.04	19		

See the MM (MAGMAX) Series Coil for DC Applications

AM Coil: 200RB/200RD

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	2.00	.96	23	17/12	Class F Molded
24-50/60	24/60	1.6	.74	18		
120-50/60	120/50	.45	.21	25		
120-50/60	120/60	.36	.16	19		
208-220/50 208-240/60	208/50	.19	.08	17		
208-220/50 208-240/60	208/60	.15	.06	12		
208-220/50 208-240/60	220/50	.24	.10	24		
208-220/50 208-240/60	240/60	.19	.08	19		
480-50/60	480/50	.11	.05	24		
480-50/60	480/60	.09	.04	19		

See the MM (MAGMAX) Series Coil for DC Applications

ASC2 Coil: 200RB/200RD 540RA

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	2.18	1.07	26	15/12	Class H Molded
24-50/60	24/60	1.90	.81	19		
120-50/60	120/50	.43	.21	25		
120-50/60	120/60	.38	.16	19		
240-50/60	240/50	.24	.12	30		
240-50/60	240/60	.21	.09	22		

DM Coil: 500RB

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	1.80	.71	17	17/12	Class F Molded
24-50/60	24/60	1.56	.52	12		
120-50/60	120/50	.36	.14	17		
120-50/60	120/60	.31	.10	12		
240-50/60	240/50	.19	.08	19		
240-50/60	240/60	.17	.06	14		

ASC2 Coil: 100RB 240RA 710/713RA

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	1.67	1.10	26	15/12	Class H Molded
24-50/60	24/60	1.41	.83	20		
120-50/60	120/50	.31	.22	26		
120-50/60	120/60	.26	.16	20		
240-50/60	240/50	.17	.13	31		
240-50/60	240/60	.15	.10	23		

DM Coil: 100RB 240RA 710/713RA

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	1.21	.72	17	17/12	Class F Molded
24-50/60	24/60	1.02	.52	13		
120-50/60	120/50	.24	.14	17		
120-50/60	120/60	.20	.10	12		
240-50/60	240/50	.13	.08	20		
240-50/60	240/60	.11	.06	14		

RMS/RMF Coil: 50RB

Nominal Voltage and Frequency	Applied Voltage and Frequency	Amperes		VA Holding	Watts Max.	Coil Insulation
		Inrush	Holding			
24-50/60	24/50	.87	.50	12	RMF/7 RMS/10	Class F Molded
24-50/60	24/60	.90	.40	10		
120-50/60	120/50	.19	.19	22		
120-50/60	120/60	.17	.09	10		
208-50/60	208/60	.08	.03	7		
220-50/60	220/50	.10	.05	11		
240-50/60	240/50	.11	.06	14		
240-50/60	240/60	.10	.04	11		

Ordering Information

AMG Junction Box



6" Leads

AMC - 1/2" Conduit



18" Leads

AMS - Open Frame



18" Leads or
1.4" Spades

Voltage / Frequency	Description	PCN	Description	PCN	Description	PCN
24V 50/60 Hz	AHG 24V 50/60 Hz	057669	AMC 24V 50/60 Hz	057631	AMF 24V 50/60 Hz	057539
	AMG 24V 50/60 Hz	057341	AHC 24V 50/60 Hz	057736	AMF 24V 50/60 Hz	057538
	--	--	--	--	DMS 24V 50/60 Hz	062013
	DMG 24V 50/60 Hz	055129	--	--	RMF 24V 50/60 Hz	065677
	--	--	--	--	AMS 24V 50/60 Hz	057603
120V 50/60 Hz	--	--	--	--	RMS 24V 50/60 Hz	065680
	AHG 120V 50/60 Hz	057673	AMC 120V 50/60 Hz	057598	RMF 120V 50/60 Hz	065678
	AMG 120V 50/60 Hz	057331	AHC 120V 50/60 Hz	057743	AMS 120V 50/60 Hz	057349
	DMG 120V 50-60 Hz	054762	--	--	RMS 120V 50/60 Hz	065204
208-220/208-240 50/60 Hz	AHG 208-220/208-240 50/60 Hz	057671	--	--	AMF 208-220/208-240 50/60 Hz	057540
	AMG 208-220/208-240 50/60 Hz	057342	AMC 208-220/208-240 50/60 Hz	057594	RMF 208-220/208-240 50/60 Hz	065679
	DMG 208-220/208-240 50/60 Hz	054764	--	--	AMS 208-220/208-240 50/60 Hz	057531
	--	--	--	--	RMS 208-220/208-240 50/60 Hz	065681
	--	--	--	--	DMS 208-220/208-240 50/60 Hz	063399
480V 50/60 Hz	AMG 480V 50/60 Hz	057527	--	--	AMF 480V 50/60 Hz	057534
120-240V 50/60 Hz	AMG 120-240V 50/60 Hz	057343	AMC 120-240V 50/60 Hz	057730	AMF 120-240V 50/60 Hz	062410
277V 60 Hz	AMG 277V 60 Hz	057528	--	--	AMF 277V 50/60 Hz	057533
	--	--	--	--	AMS 277V 50/60 Hz	057714
12V DC	AMG 12V DC	057521	AMC 12V DC	057596	--	--
24V DC	AMG 24V DC	057523	AMC 24V DC	057633	--	--

ASC2 – DIN



MMG

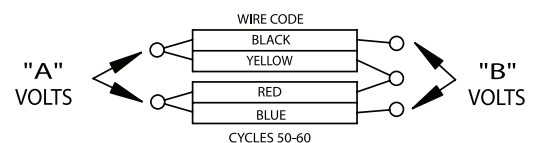


RMF



Voltage/Frequency	Description	PCN	Description	PCN
24V 50/60 Hz	ASC2 24/50-60	062792	--	--
24V 50/60 Hz	ASC2L 24/50-60	063542	--	--
120V 50/60 Hz	ASC2 120/50-60	062462	--	--
120V 50/60 Hz	ASC2 GS-2562-1	015384	--	--
208-220/208-240 50-60 Hz	ASC2 208-240/50-60	062463	--	--
208-220/208-240 50-60 Hz	ASC2 GS-2562-2	015383	--	--
12V DC	--	--	MMG 12V DC	063524
12V DC	--	--	MMF 12V DC	062972
24V DC	ASC2 24V DC	064375	MMG 24V DC	063526

Dual Voltage Wiring Diagram



AM and ASC 2 style DC coils should not be used for direct replacements on OEM equipment. The use of this coil on new applications may result in the valve not opening. New applications should use the MM coil because of the significant increase in opening power of the MM Coil over the standard AM and ASC 2 style DC coil.

Coil Enclosure Options

Options	Code
Junction Box	G
Conduit - 18" Leads	C
Open Frame - 18" Leads	F
Open Frame - Spades	S

A	B
120	240
240	480

REFRIGERATION & AIR CONDITIONING

Emerson Flow Controls Refrigeration Solenoid Valves

Order #	Mfg. #	Port Size	Conn. Size	R12 Capacity	R22 Capacity	R404A Capacity	For Use With	Each	10 Lot
B12-233	100RB2F3	7/64"	3/8" SAE	0.80	1.27	0.85	—	95.00	85.00
B12-234	100RB2S2	7/64"	1/4" ODF	0.80	1.27	0.85	—	95.00	85.00
B12-235	100RB2S3	7/64"	3/8" ODF	0.80	1.27	0.85	—	95.00	85.00
B13-579	100RB2S4	1/8"	1/2" ODF	0.80	1.27	0.83	—	95.00	89.00
B14-082	X-11981-1	Spanner Wrench	—	—	—	—	100RB Valves	15.49	13.99



Coils And Parts For Solenoid Type Valves

- B12-310 through B12-313 are UL listed; CSA approved

Warning: Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Order #	Mfg. #	Description	Each	Order #	Mfg. #	Description	Each
B13-894	AHG-208/240	208/240V High Temperature Coil	215.00	B13-930	AMS-24	24V Spade Style Coil	125.00
B13-895	AHG-24	24V High Temperature Coil	215.00	B13-931	AMS-120	120V Spade Style Coil	125.00
B13-896	AHG-120	120V High Temperature Coil	215.00	B12-416	KS30117	Manual Stem Kit for 200RB Series Valves	85.00
B12-310	AMG-24	24V Solenoid Coil	109.00	B17-999	KS30386	Repair Kit for 200RD2-6	175.00
B12-311	AMG-120	120V Solenoid Coil	109.00	B12-316	KS30321	Repair Kit for 240RA8 Valve	215.00
B12-312	AMG-240	240V Solenoid Coil	109.00	B12-317	KS30322	Repair Kit for 240RA9 Valve	215.00
B12-313	AMG-120/240	120/240V Dual Voltage Coil	145.00	B13-293	KS30323	Repair Kit for 240RA12 Valve	215.00
B13-908	AMG-277	277V Coil	145.00	B13-294	KS30324	Repair Kit for 240RA16 Valve	229.00
B13-909	AMG-480	480V Coil	145.00	B13-295	KS30325	Repair Kit for 240RA20 Valve	369.00
B13-906	AMG-12DC	12V DC Coil	145.00	B18-001	KS30387	Biflow Conversion Kit for 200RD2-6	105.00
B13-907	AMG-24DC	24V DC Coil	145.00	B12-318	KS30066	Manual Stem Kit for 240RA8 Valve	135.00
B13-929	AMS-208-240	208/240V Spade Style Coil	125.00	B12-319	KS30067	Manual Stem Kit for 240RA9 Valve	135.00



200RB Series Pilot-Operated Solenoid Valves

- Pilot-operated, normally closed valves; all valves less coil
- Snap-on coil retainer eases installation and removal
- 285°F maximum fluid temperature; 300 PSI MOPD
- T models include mounting bracket adapter, 1/4" port and larger convert to manual stem; M models include manual stem

- Listed capacity ratings are suggested nominal tonnage
- B13-788 through B13-792 are biflow solenoids
- 200RD R410A approved solenoid available

Warning: Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Order #	Mfg. #	Port Size	Conn. Size	R12 Capacity	R22 Capacity	R404A Capacity	Each
B13-749	200RB2T2	1/8"	1/4" ODF	2.0	3.1	2.0	105.00
B13-750	200RB2T2T	1/8"	1/4" ODF	2.0	3.1	2.0	109.00
B13-582	200RB2F3	1/8"	3/8" SAE	2.0	3.1	2.0	105.00
B12-528	200RB2T3	1/8"	3/8" ODF	2.0	3.1	2.1	105.00
B13-751	200RB2T3T	1/8"	3/8" ODF	2.0	3.1	2.0	109.00
B13-752	200RB3F3	3/16"	3/8" SAE	3.0	4.8	3.1	129.00
B13-753	200RB3F3-T	3/16"	3/8" SAE	3.0	4.8	3.1	129.00
B12-236	200RB3T3	3/16"	3/8" ODF	3.0	4.0	3.1	125.00
B13-754	200RB3F4	3/16"	1/2" SAE	3.0	4.8	3.1	129.00
B13-755	200RB3F4-T	3/16"	1/2" SAE	3.0	4.8	3.1	129.00
B13-756	200RB3T2	3/16"	1/4" ODF	3.0	4.8	3.1	125.00
B13-757	200RB3T3T	3/16"	3/8" ODF	3.0	4.8	3.1	125.00
B12-529	200RB3T4	3/16"	1/2" ODF	3.0	4.8	3.2	125.00
B13-758	200RB4F3	1/4"	3/8" SAE	3.6	5.6	3.6	165.00
B13-759	200RB4F3-M	1/4"	3/8" SAE	3.6	5.6	3.6	209.00
B12-237	200RB4F3-T	1/4"	3/8" SAE	3.6	5.6	3.7	159.00
B13-760	200RB4T3	1/4"	3/8" ODF	3.6	5.6	3.6	159.00
B12-238	200RB4T3-T	1/4"	3/8" ODF	3.6	5.6	3.7	159.00
B12-773	200RB4T3-M	1/4"	3/8" ODF	3.6	5.6	3.7	199.00
B13-761	200RB4T4	1/4"	1/2" ODF	3.6	5.6	3.6	165.00
B12-530	200RB4T4-T	1/4"	1/2" ODF	3.6	5.6	3.7	159.00
B12-774	200RB4T4M	1/4"	1/2" ODF	3.6	5.6	3.7	199.00
B13-762	200RB4T5	1/4"	5/8" ODF	3.6	5.6	3.6	165.00
B13-763	200RB4T5M	1/4"	5/8" ODF	3.6	5.6	3.6	209.00
B13-764	200RB4T5T	1/4"	5/8" ODF	3.6	5.6	3.6	165.00
B13-770	200RB5T3	5/16"	3/8" ODF	5.3	8.2	5.3	199.00
B13-771	200RB5T3T	5/16"	3/8" ODF	5.3	8.2	5.3	205.00
B13-765	200RB5F4	5/16"	1/2" SAE	5.3	8.2	5.3	205.00
B13-766	200RB5F4-M	5/16"	1/2" SAE	5.3	8.2	5.3	249.00
B13-767	200RB5F4-T	5/16"	1/2" SAE	5.3	8.2	5.3	205.00
B13-772	200RB5T4	5/16"	1/2" ODF	5.3	8.2	5.3	199.00
B12-239	200RB5T4-T	5/16"	1/2" ODF	5.3	8.2	5.4	199.00

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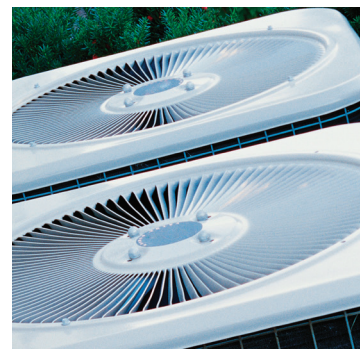


aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



Thermostatic and Automatic Expansion Valves

Catalog E-1, July 2012



ENGINEERING YOUR SUCCESS.

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Failure or improper selection or improper use of the products described herein or related items can cause death, personal injury and property damage.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

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FOR USE ON REFRIGERATION and/or AIR CONDITIONING SYSTEMS ONLY

Catalog E-1, July 2012, supersedes Catalog E-1, October 2007 and all prior publications.

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A7 Series AEV

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AS Series AEV

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A2 Series AEV

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A3 Series AEV

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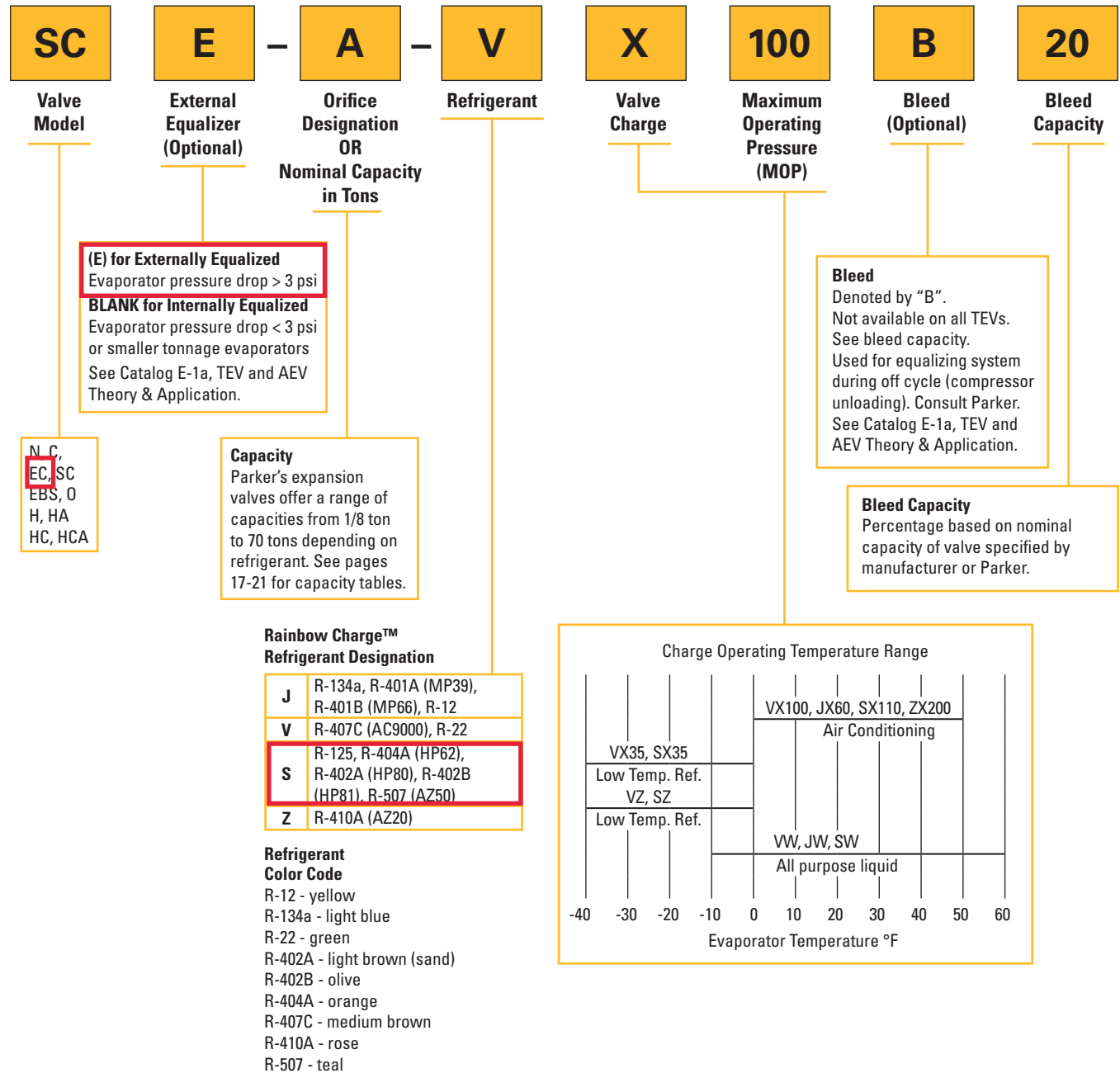
A4 Series AEV

page 23

Applications:
Ice Cream/Slush
Machines,
Hot Gas Bypass,
Freeze Protection,
Refrigerant Reclaim,
Vending, Ice Machines

TEV Model Number Selection Guide

Nomenclature (Example)



†Charge Type

"W" (all-purpose) liquid charge maintains nearly flat superheat control over a -10°F to +60°F (-23°C to +15°C) evaporator temperature range.

"Z" (low temperature) charge provides fast pulldown benefits like a gas charge with the non-migrating benefits of a liquid charge; usable over a -40°F to 0°F (-40°C to -18°C) evaporator temperature range.

"X" (damped response) gas charge provides a pressure limiting (MOP) charge with anti-hunt characteristics over a -40°F to +60°F (-40°C to +15°C) evaporator temperature range.

Notes: M.O.P. not available on "W" or "Z" charge.

- Maximum operational pressure 500 psig (35 bar) high side and 275 psig (19 bar) low side.
- Maximum storage temperature 130°F (55°C).
- Consult Parker for pressure and temperature exceptions.
- Do not use "W" or "Z" liquid charges in applications where bulb temperatures can exceed 130°F (55°C). For these applications use type "X" MOP gas charge **only**.

EC(E) Series

The EC(E) series features extended ODF solder connections, brass body and balanced port design. It is suited for both refrigeration and air conditioning applications.

Applications

- Small Chillers
- Air Conditioning Units
- Freezers
- Walk-in Boxes
- Refrigerated Cases
- Mobile Refrigeration

Features and Benefits

- Extended ODF connections
- Balanced port design
- 60" capillary tube
- Removable power element
- Field adjustable superheat
- 1/4" ODF external equalizer
- Weight: 1.0 lbs / 0.45 kg



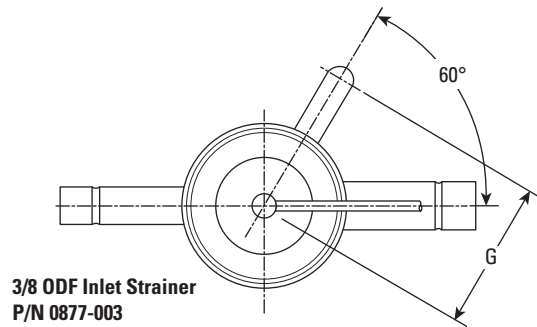
Specifications

Refrigerant	Refrigerant Designation	Orifice Designation	Nominal Capacity (Tons)	Capacity Range of Valve to be Replaced (Tons)	Valve Description		Rainbow Charges™	Connection - (Inches) Bold figures are standard		External Equalizer Connection (Inches)
					Internally Equalized	Externally Equalized		Inlet	Outlet	
R-12 R-134a R-401A R-401B	J	AA	1/4	1/6 to 1/4	EC-AA-J	ECE-AA-J	W X60	1/4 ODF	1/2 ODF	1/4 ODF
		A	1	1/2 to 1	EC-A-J	ECE-A-J		3/8 ODF	1/2 ODF	
		B	2	1 to 2	EC-B-J	ECE-B-J		3/8 ODF 1/2 ODF	1/2 ODF 5/8 ODF	
		C	3	2 to 3	EC-C-J	ECE-C-J		3/8 ODF 1/2 ODF 5/8 ODF	1/2 ODF 5/8 ODF 7/8 ODF	
		D	5	3 to 5	N/A	ECE-D-J		1/2 ODF 5/8 ODF	7/8 ODF	
R-402A R-402B R-404A R-502 R-507	S	AA	1/4	1/6 to 1/4	EC-AA-S	ECE-AA-S	W Z X110 X35	1/4 ODF	1/2 ODF	1/4 ODF
		A	1	1/2 to 1	EC-A-S	ECE-A-S		3/8 ODF	1/2 ODF	
		B	2	1 to 2	EC-B-S	ECE-B-S		3/8 ODF 1/2 ODF	1/2 ODF 5/8 ODF	
		C	3-1/2	2 to 3-1/2	EC-C-S	ECE-C-S		3/8 ODF 1/2 ODF 5/8 ODF	1/2 ODF 5/8 ODF 7/8 ODF	
		D	6	3-1/2 to 6	N/A	ECE-D-S		1/2 ODF 5/8 ODF	7/8 ODF	
R-22 R-407C R-422D	V	AA	1/2	1/3 to 1/2	EC-AA-V	ECE-AA-V	W Z X100 X35	1/4 ODF	1/2 ODF	1/4 ODF
		A	1-1/2	3/4 to 1-1/2	EC-A-V	ECE-A-V		3/8 ODF	1/2 ODF	
		B	3	1-1/2 to 3	EC-B-V	ECE-B-V		3/8 ODF 1/2 ODF	1/2 ODF 5/8 ODF	
		C	5	3 to 5	EC-C-V	ECE-C-V		3/8 ODF 1/2 ODF 5/8 ODF	1/2 ODF 5/8 ODF 7/8 ODF	
		D	8	5 to 8	N/A	ECE-D-V		1/2 ODF 5/8 ODF	7/8 ODF	
R-410A	Z	AA	1/2	1/3 to 1/2	EC-AA-Z	ECE-AA-Z	X200	1/4 ODF	1/2 ODF	1/4 ODF
		A	1-1/2	3/4 to 1-1/2	EC-A-Z	ECE-A-Z		3/8 ODF	1/2 ODF	
		B	3	1-1/2 to 3	EC-B-Z	ECE-B-Z		3/8 ODF 1/2 ODF	1/2 ODF 5/8 ODF	
		C	5	3 to 5	EC-C-Z	ECE-C-Z		3/8 ODF 1/2 ODF 5/8 ODF	1/2 ODF 5/8 ODF 7/8 ODF	
		D	8	5 to 8	N/A	ECE-D-Z		1/2 ODF 5/8 ODF	7/8 ODF	
		N/A	12-1/2	8 to 12-1/2	N/A	ECE-12-1/2-Z		5/8 ODF	7/8 ODF	
		N/A	15	12-1/2 to 15	N/A	ECE-15-Z		5/8 ODF	1-1/8 ODF	

EC(E) Series

Dimensions

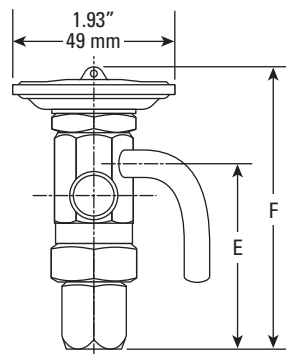
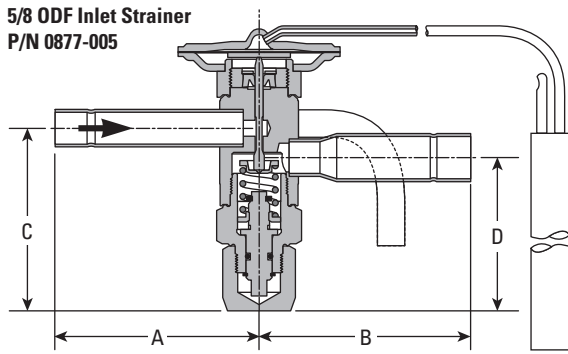
ECE-AA, -A, -B, -C, -D



3/8 ODF Inlet Strainer
P/N 0877-003

1/2 ODF Inlet Strainer
P/N 0877-004

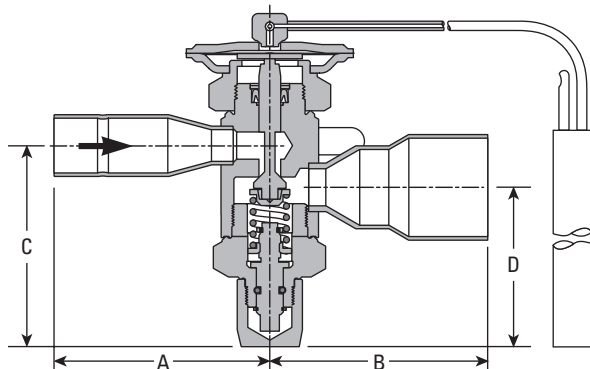
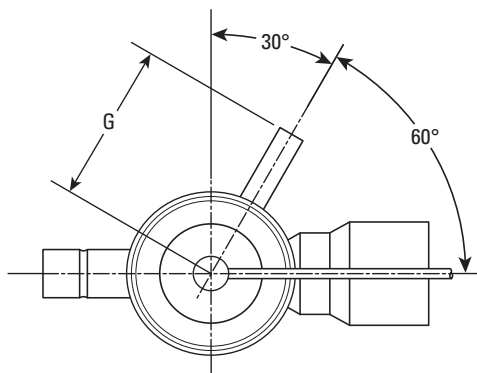
5/8 ODF Inlet Strainer
P/N 0877-005



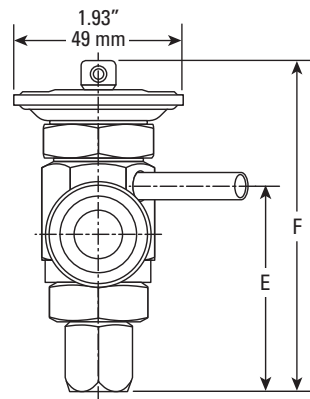
Replacement Elements

Refrigerant Designation	Element
V	KT-46-VW KT-46-VX100
J	KT-46-JW
S	KT-46-SZ KT-46-SW KT-46-SX35
Z	KT-46-ZX200

ECE-12-1/2-Z and ECE-15-Z Only



Fitting Size	A	B	C	D	E	F	G
1/4	—	—	—	—	2.36" 60 mm	3.79" 96 mm	1.90" 48 mm
5/8	2.48" 63 mm	—	2.30" 58 mm	—	—	3.79" 96 mm	—
7/8	—	2.51" 64 mm	—	1.83" 46 mm	—	3.79" 96 mm	—
1-1/8	—	2.51" 64 mm	—	1.83" 46 mm	—	3.79" 96 mm	—



Replacement Elements

Refrigerant Designation	Element
Z	KT-46-5-ZX200*

* For ECE-12-1/2-Z and ECE-15-Z only.

Capacity Tables

R-22 Capacities in Tons (R-407C Refrigerant & Liquid Temperature Correction Factor below)

Valve Type	Nominal Capacity (Tons) or Orifice Designation	Evaporator Temperature°F																							
		40°F								20°F								0°F							
		Pressure Drop (PSI)																							
		75	100	125	150	175	200	225	250	75	100	125	150	175	200	225	250	75	100	125	150	175	200	225	250
N	1	0.87	1.0	1.1	1.2	1.3	1.4	1.5	1.6	0.85	0.98	1.1	1.2	1.3	1.4	1.5	1.5	0.75	0.87	0.97	1.1	1.2	1.2	1.3	1.4
N	3	2.6	3.0	3.4	3.7	4.0	4.3	4.5	4.7	2.5	2.9	3.3	3.6	3.9	4.1	4.4	4.6	2.3	2.6	2.9	3.2	3.5	3.7	3.9	4.1
H(E), HC(E)	1-1/2	1.3	1.5	1.7	1.8	2.0	2.1	2.3	2.4	1.3	1.5	1.6	1.8	1.9	2.1	2.2	2.3	1.1	1.3	1.5	1.6	1.8	1.9	2.0	2.1
H(E), HC(E)	3	2.6	3.0	3.4	3.7	4.0	4.2	4.4	4.5	2.6	2.9	3.3	3.6	3.9	4.2	4.3	4.4	2.3	2.6	3.0	3.2	3.5	3.7	3.8	3.9
H(E), HC(E)	5	4.3	5.0	5.6	6.1	6.6	7.1	7.2	7.3	4.2	4.9	5.5	6.0	6.5	6.9	7.0	7.1	3.8	4.4	4.9	5.4	5.8	6.2	6.3	6.4
SCE	AAA	0.30	0.35	0.39	0.43	0.46	0.50	0.53	0.55	0.30	0.34	0.38	0.42	0.45	0.48	0.51	0.54	0.26	0.30	0.33	0.37	0.40	0.42	0.45	0.47
C(E), EC(E), SCE	AA	0.52	0.60	0.67	0.73	0.79	0.85	0.90	0.95	0.51	0.58	0.65	0.72	0.77	0.83	0.88	0.92	0.44	0.51	0.57	0.63	0.68	0.72	0.77	0.81
C(E), EC(E), SCE	A	1.5	1.8	2.0	2.1	2.3	2.5	2.6	2.8	1.5	1.7	1.9	2.1	2.3	2.4	2.6	2.7	1.3	1.5	1.7	1.9	2.0	2.2	2.3	2.4
C(E), EC(E), SCE	B	2.8	3.2	3.6	3.9	4.2	4.5	4.8	5.1	2.7	3.1	3.5	3.8	4.1	4.4	4.7	4.9	2.4	2.8	3.1	3.4	3.7	3.9	4.2	4.4
C(E), EC(E), SCE	C	4.3	5.0	5.6	6.1	6.6	7.1	7.5	7.9	4.2	4.9	5.5	6.0	6.5	6.9	7.3	7.7	3.8	4.4	4.9	5.3	5.8	6.2	6.5	6.9
C(E), EC(E), SCE	D	6.9	8.0	9.0	9.8	10.6	11.3	12.0	12.7	6.8	7.8	8.7	9.6	10.3	11.0	11.7	12.3	6.0	7.0	7.8	8.5	9.2	9.9	10.5	11.0
EBSE	8	7.4	8.5	9.5	10.4	11.2	12.0	12.8	13.4	6.8	7.9	8.8	9.6	10.4	11.1	11.8	12.4	5.7	6.5	7.3	8.0	8.6	9.2	9.8	10.3
EBSE	11	10.0	11.5	12.9	14.1	15.2	16.3	17.3	18.2	9.2	10.7	11.9	13.0	14.1	15.1	16.0	16.8	7.6	8.8	9.9	10.8	11.7	12.5	13.2	14.0
EBSE	15	13.4	15.5	17.3	18.9	20.5	21.9	23.2	24.4	12.6	14.6	16.3	17.8	19.3	20.6	21.9	23.0	9.4	10.9	12.2	13.3	14.4	15.4	16.3	17.2
EBSE	20	19.3	22.3	25.0	27.4	29.5	31.6	33.5	35.3	17.7	20.4	22.8	25.0	27.0	28.9	30.6	32.3	13.1	15.1	16.9	18.5	20.0	21.4	22.7	23.9
OE	15	13.0	15.0	16.8	18.4	19.8	21.2	22.5	23.7	12.0	13.9	15.5	17.0	18.4	19.6	20.8	22.0	10.1	11.7	13.0	14.3	15.4	16.5	17.5	18.4
OE	20	19.2	22.2	24.8	27.2	29.4	31.4	33.3	35.1	17.8	20.6	23.0	25.2	27.2	29.1	30.8	32.5	14.9	17.2	19.3	21.1	22.8	24.4	25.9	27.3
OE	30	26.4	30.5	34.1	37.4	40.4	43.1	45.8	48.2	24.5	28.2	31.6	34.6	37.4	39.9	42.4	44.7	20.5	23.7	26.5	29.0	31.3	33.5	35.5	37.5
OE	40	34.9	40.3	45.1	49.4	53.3	57.0	60.5	63.7	33.7	38.9	43.5	47.6	51.5	55.0	58.3	61.5	24.8	28.6	32.0	35.1	37.9	40.5	42.9	45.3
OE	55	47.6	55.0	61.5	67.4	72.8	77.8	82.5	87.0	46.0	53.1	59.3	65.0	70.2	75.1	79.6	83.9	33.8	39.1	43.7	47.9	51.7	55.3	58.6	61.8
OE	70	63.2	73.0	81.6	89.4	96.6	103	110	115	61.0	70.5	78.8	86.3	93.2	99.6	106	111	44.9	51.9	58.0	63.5	68.6	73.3	77.8	82.0

These ratings are based on vapor free 100°F liquid refrigerant entering the expansion valve, and a maximum of 7°F change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	0°F	20°F	40°F	60°F	80°F	100°F	120°F	140°F
	Correction Factor							
R-22	1.57	1.45	1.34	1.23	1.12	1.00	0.88	0.76
R-407C	1.58	1.45	1.32	1.18	1.04	0.89	0.74	0.57

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of 0°F. However, they may be used for any evaporator temperature from 0°F to 40°F since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an SCE-B using R-407C at a 40°F evaporator, 125 psi pressure drop across the TEV, and a 80°F liquid temperature entering the TEV = 3.58 (from rating chart) x 1.04 (CF liquid temperature) = 3.72 tons

R-22 Capacities in Kilowatts (R-407C Refrigerant & Liquid Temperature Correction Factor below)

Valve Type	Nominal Capacity (kW) or Orifice Designation	Evaporator Temperature °C																							
		5°C								-5°C								-15°C							
		Pressure Drop (BAR)																							
		4	6	8	10	12	14	16	18	4	6	8	10	12	14	16	18	4	6	8	10	12	14	16	18
N	4	2.6	3.2	3.7	4.2	4.5	4.9	5.3	5.6	2.6	3.1	3.6	4.1	4.4	4.8	5.1	5.4	2.4	2.9	3.3	3.7	4.1	4.4	4.7	5.0
N	11	7.9	9.7	11.2	12.5	13.6	14.7	15.8	16.7	7.7	9.4	10.9	12.2	13.3	14.3	15.4	16.3	7.0	8.6	9.9	11.2	12.2	13.1	14.1	14.9
H(E), HC(E)	5	4.0	4.9	5.7	6.4	7.0	7.5	8.0	8.5	3.9	4.8	5.6	6.2	6.8	7.4	7.9	8.3	3.6	4.4	5.0	5.6	6.2	6.7	7.1	7.6
H(E), HC(E)	11	8.0	9.8	11.4	12.7	13.9	15.0	16.1	17.0	7.9	9.6	11.1	12.4	13.6	14.7	15.7	16.7	7.1	8.7	10.1	11.3	12.3	13.3	14.3	15.1
H(E), HC(E)	18	13.4	16.4	18.9	21.2	23.2	25.1	26.8	28.4	13.1	16.1	18.5	20.7	22.7	24.5	26.2	27.8	11.9	14.6	16.8	18.8	20.6	22.2	23.8	25.2
SCE	AAA	0.92	1.1	1.3	1.5	1.6	1.7	1.8	2.0	0.90	1.1	1.3	1.4	1.6	1.7	1.8	1.9	0.81	0.99	1.1	1.3	1.4	1.5	1.6	1.7
C(E), EC(E), SCE	AA	1.6	1.9	2.2	2.5	2.7	2.9	3.1	3.3	1.5	1.9	2.2	2.4	2.7	2.9	3.1	3.3	1.4	1.7	2.0	2.2	2.4	2.6	2.8	2.9
C(E), EC(E), SCE	A	4.6	5.6	6.5	7.3	8.0	8.6	9.2	9.7	4.5	5.5	6.3	7.1	7.8	8.4	9.0	9.5	4.1	5.0	5.8	6.5	7.1	7.7	8.2	8.7
C(E), EC(E), SCE	B	8.4	10.3	11.9	13.3	14.5	15.7	16.8	17.8	8.2	10.0	11.6	13.0	14.2	15.3	16.4	17.4	7.5	9.2	10.6	11.9	13.0	14.0	15.0	15.9
C(E), EC(E), SCE	C	13.1	16.1	18.5	20.7	22.7	24.5	26.2	27.8	12.8	15.7	18.1	20.3	22.2	24.0	25.6	27.2	11.7	14.4	16.6	18.6	20.3	22.0	23.5	24.9
C(E), EC(E), SCE	D	21.0	25.7	29.7	33.2	36.3	39.2	42.0	44.5	20.5	25.1	29.0	32.4	35.5	38.3	41.0	43.5	18.8	23.0	26.5	29.7	32.5	35.1	37.5	39.8
EBSE	28	22.4	27.4	31.6	35.4	38.7	41.8	44.7	47.4	20.9	25.5	29.5	33.0	36.1	39.0	41.7	44.2	17.9	22.0	25.3	28.3	31.0	33.5	35.8	38.0
EBSE	39	30.3	37.0	42.8	47.8	52.4	56.6	60.5	64.2	28.2	34.6	39.9	44.6	48.9	52.8	56.4	59.9	24.3	29.7	34.3	38.3	42.0	45.4	48.5	51.4
EBSE	53	40.6	49.8	57.5	64.2	70.4	76.0	81.3	86.2	38.5	47.1	54.4	60.9	66.7	72.0	77.0	81.6	30.9	37.8	43.6	48.8	53.5	57.7	61.7	65.5
EBSE	70	58.8	72.0	83.1	92.9	102	110	118	125	54.2	66.4	76.7	85.7	93.9	101	108	115	43.0	52.6	60.8	67.9	74.4	80.4	85.9	91.2
OE	53	39.5	48.3	55.8	62.4	68.3	73.8	78.9	83.7	36.8	45.1	52.0	58.2	63.7	68.9	73.6	78.1	31.9	39.1	45.1	50.5	55.3	59.7	63.8	67.7
OE	70	58.4	71.5	82.6	92.3	101	109	117	124	54.5	66.7	77.0	86.1	94.3	102	109	116	47.2	57.8	66.8	74.7	81.8	88.4	94.5	100
OE	105	80.2	98.3	113	127	139	150	160	170	74.8	91.6	106	118	130	140	150	159	64.9	79.5	91.8	103	112	121	130	138
OE	141	106	130	150	167	183	198	212	224	102	125	145	162	177	192	205	217	81.5	99.8	115	129	141	152	163	173
OE	193	144	177	204	228	250	270	289	306	140	171	198	221	242	261	279	296	111	136	157	176	193	208	222	236
OE	246	192	235	271	303	332	359	383	407	185	227	262	293	321	347	371	393	148	181	209	233	256	276	295	313

These ratings are based on vapor free 40°C liquid refrigerant entering the expansion valve, and a maximum of 4°C change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	-10°C	0°C	10°C	20°C	30°C	40°C	50°C	60°C
	Correction Factor							
R-22	1.52	1.42	1.32	1.21	1.11	1.00	0.89	0.78
R-407C	1.53	1.41	1.28	1.15	1.02	0.88	0.74	0.59

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of -15°C . However, they may be used for any evaporator temperature from -15°C to 5°C since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an SCE-B using R-407C at a 5°C evaporator, 8 bar pressure drop across the TEV, and a 30°C liquid temperature entering the TEV = 12.1 (from rating chart) x 1.02 (CF liquid temperature) = 12.3 kW

Capacity Tables

R-134a Capacities in Tons (R-401A, R-409A Refrigerant & Liquid Temperature Correction Factor below)

Valve Type	Nominal Capacity (Tons) or Orifice Designation	Evaporator Temperature °F																							
		40°F								20°F								0°F							
		Pressure Drop (PSI)																							
		40	60	80	100	120	140	160	180	40	60	80	100	120	140	160	180	40	60	80	100	120	140	160	180
N	1/2	0.59	0.72	0.83	0.93	1.0	1.1	1.2	1.3	0.56	0.69	0.79	0.89	0.98	1.1	1.1	1.2	0.49	0.61	0.70	0.78	0.85	0.92	0.99	1.1
N	2	1.8	2.2	2.5	2.8	3.1	3.3	3.5	3.8	1.7	2.1	2.4	2.7	2.9	3.1	3.4	3.6	1.5	1.8	2.1	2.3	2.6	2.8	3.0	3.1
C(E), EC(E), SCE	AA	0.35	0.43	0.50	0.56	0.61	0.66	0.70	0.74	0.34	0.41	0.47	0.53	0.58	0.63	0.67	0.71	0.32	0.39	0.45	0.50	0.55	0.60	0.64	0.68
C(E), EC(E), SCE	A	1.0	1.3	1.5	1.6	1.8	1.9	2.1	2.2	0.99	1.2	1.4	1.6	1.7	1.8	2.0	2.1	0.86	1.1	1.2	1.4	1.5	1.6	1.7	1.8
C(E), EC(E), SCE	B	1.9	2.3	2.7	3.0	3.3	3.5	3.8	4.0	1.8	2.2	2.6	2.9	3.1	3.4	3.6	3.8	1.6	1.9	2.2	2.5	2.7	3.0	3.2	3.4
C(E), EC(E), SCE	C	3.0	3.6	4.2	4.7	5.1	5.5	5.9	6.3	2.8	3.5	4.0	4.5	4.9	5.3	5.6	6.0	2.5	3.0	3.5	3.9	4.3	4.6	4.9	5.2
C(E), EC(E), SCE	D	4.7	5.8	6.7	7.5	8.2	8.8	9.4	10.0	4.5	5.5	6.4	7.1	7.8	8.4	9.0	9.6	3.9	4.8	5.6	6.2	6.8	7.4	7.9	8.4
EBSE	5	5.0	6.1	7.1	7.9	8.7	9.4	10.0	10.6	4.0	4.9	5.6	6.3	6.9	7.4	7.9	9.4	3.4	4.2	4.8	5.4	5.9	6.4	6.8	7.2
EBSE	7	6.9	8.4	9.7	10.9	11.9	12.9	13.8	14.6	5.5	6.7	7.7	8.6	9.5	10.2	10.9	11.6	4.7	5.8	6.6	7.4	8.1	8.8	9.4	10.0
EBSE	9	9.1	11.2	12.9	14.4	15.8	17.1	18.2	19.4	6.9	8.4	9.7	10.9	11.9	12.9	13.7	14.6	5.5	6.8	7.8	8.7	9.6	10.3	11.0	11.7
EBSE	12	13.1	16.0	18.5	20.7	22.6	24.4	26.1	27.7	9.9	12.1	14.0	15.6	17.1	18.5	19.7	20.9	7.7	9.5	10.9	12.2	13.4	14.5	15.4	16.4
OE	9	8.9	10.8	12.5	14.0	15.3	16.6	17.7	18.8	7.6	9.3	10.8	12.0	13.2	14.2	15.2	16.1	6.6	8.1	9.3	10.4	11.4	12.6	13.2	14.0
OE	12	11.5	14.1	16.3	18.2	19.9	21.5	23.0	24.4	9.9	12.1	14.0	15.6	17.1	18.5	19.8	21.0	8.6	10.5	12.1	13.6	14.9	16.0	17.1	18.2
OE	16	15.2	18.7	21.6	24.1	26.4	28.5	30.5	32.3	13.1	16.0	18.5	20.7	22.7	24.5	26.2	27.8	11.4	13.9	16.1	18.0	19.7	21.3	22.7	24.1
OE	23	22.6	27.7	32.0	35.8	39.2	42.3	45.2	48.0	21.2	25.9	29.9	33.5	36.7	39.6	42.3	44.9	17.5	21.4	24.7	27.6	30.3	32.7	34.9	37.1
OE	32	31.5	38.6	44.5	49.8	54.5	58.9	63.0	66.8	29.5	36.1	41.7	46.6	51.0	55.1	58.9	62.5	24.3	29.8	34.4	38.4	42.1	45.5	48.6	51.6
OE	40	39.3	48.2	55.6	62.2	68.1	73.6	78.7	83.5	36.8	45.1	52.1	58.2	63.8	68.9	73.6	78.1	30.4	37.2	43.0	48.0	52.6	56.9	60.8	64.5

These ratings are based on vapor free 100°F liquid refrigerant entering the expansion valve, and a maximum of 7°F change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	0°F	20°F	40°F	60°F	80°F	100°F	120°F	140°F
	Correction Factor							
R-134a	1.69	1.56	1.42	1.29	1.14	1.00	0.85	0.71
R-401A	1.75	1.62	1.49	1.36	1.23	1.09	0.95	0.81
R-409A	1.65	1.54	1.42	1.31	1.19	1.06	0.94	0.81

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of 0°F. However, they may be used for any evaporator temperature from 0°F to 40°F since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an SCE-B using R-409A at a 20°F evaporator, 120 psi pressure drop across the TEV, and a 80°F liquid temperature entering the TEV = 3.12 (from rating chart) x 1.19 (CF liquid temperature) = 3.72 tons

R-134a Capacities in Kilowatts (R-401A, R-409A Refrigerant & Liquid Temperature Correction Factor below)

Valve Type	Nominal Capacity (kW) or Orifice Designation	Evaporator Temperature °C																							
		5°C									-5°C									-15°C					
		Pressure Drop (BAR)																							
		2.5	4.0	5.5	7.0	8.5	10.0	11.5	13.0	2.5	4.0	5.5	7.0	8.5	10.0	11.5	13.0	2.5	4.0	5.5	7.0	8.5	10.0	11.5	13.0
N	3	1.9	2.4	2.9	3.2	3.6	3.9	4.1	4.4	1.9	2.3	2.7	3.1	3.4	3.7	4.0	4.2	1.7	2.1	2.5	2.8	3.1	3.3	3.6	3.8
N	7	5.8	7.3	8.6	9.7	10.7	11.5	12.4	13.2	5.5	7.0	8.2	9.3	10.2	11.1	11.9	12.7	5.0	6.3	7.4	8.3	9.2	9.9	10.7	11.3
C(E), EC(E), SCE	AA	1.2	1.5	1.7	1.9	2.1	2.3	2.5	2.6	1.1	1.4	1.6	1.8	2.0	2.2	2.4	2.5	1.1	1.3	1.6	1.8	1.9	2.1	2.3	2.4
C(E), EC(E), SCE	A	3.4	4.3	5.0	5.6	6.2	6.7	7.2	7.7	3.2	4.1	4.8	5.4	6.0	6.5	6.9	7.4	2.9	3.7	4.3	4.9	5.4	5.8	6.2	6.6
C(E), EC(E), SCE	B	6.2	7.8	9.2	10.3	11.4	12.3	13.2	14.1	5.9	7.5	8.8	9.9	10.9	11.8	12.7	13.5	5.3	6.7	7.9	8.9	9.8	10.6	11.4	12.1
C(E), EC(E), SCE	C	9.6	12.2	14.3	16.1	17.8	19.3	20.7	22.0	9.2	11.7	13.7	15.5	17.0	18.5	19.8	21.1	8.3	10.5	12.3	13.9	15.3	16.6	17.8	18.9
C(E), EC(E), SCE	D	15.4	19.5	22.9	25.8	28.4	30.8	33.1	35.2	14.8	18.7	21.9	24.7	27.3	29.6	31.7	33.7	13.3	16.8	19.7	22.2	24.5	26.5	28.5	30.3
EBSE	18	16.5	20.8	24.4	27.6	30.4	33.0	35.3	37.6	13.4	17.0	19.9	22.5	24.7	26.8	28.8	30.6	11.6	14.6	17.1	19.3	21.3	23.1	24.8	26.3
EBSE	25	22.7	28.7	33.7	38.0	41.9	45.4	48.7	51.8	18.5	23.4	27.4	30.9	34.1	37.0	39.7	42.2	15.9	20.1	23.6	26.6	29.4	31.9	34.2	36.3
EBSE	32	30.2	38.2	44.7	50.5	55.6	60.3	64.7	68.8	23.5	29.7	34.9	39.3	43.3	47.0	50.4	53.6	19.1	24.1	28.3	31.9	35.2	38.2	40.9	43.5
EBSE	42	43.2	54.6	64.1	72.3	79.6	86.4	92.6	98.5	33.7	42.7	50.0	56.4	62.2	67.4	72.3	76.9	26.9	34.0	39.9	45.0	49.6	53.8	57.7	61.4
OE	32	29.1	36.8	43.2	48.7	53.7	58.2	62.4	66.4	25.4	32.2	37.7	42.6	46.9	50.9	54.6	58.0	22.3	28.3	33.1	37.4	41.2	44.7	47.9	50.9
OE	42	37.8	47.9	56.1	63.3	69.8	75.7	81.2	86.3	33.1	41.8	49.0	55.3	61.0	66.1	70.9	75.4	29.0	36.7	43.1	48.6	53.5	58.1	62.3	66.2
OE	56	50.1	63.4	74.4	83.9	92.4	100	108	114	43.8	55.4	65.0	73.3	80.8	87.6	93.9	100	38.5	48.7	57.1	64.4	70.9	76.9	82.5	87.7
OE	81	74.1	93.7	110	124	137	148	159	169	69.8	88.3	104	117	129	140	150	159	60.0	75.9	89.0	100	111	120	129	137
OE	110	103	130	153	172	190	206	221	235	97.2	123	144	163	179	194	208	222	83.4	106	124	140	154	167	179	190
OE	140	129	163	191	216	238	258	276	294	121	154	180	203	224	243	260	277	104	132	155	175	192	209	224	238

These ratings are based on vapor free 40°C liquid refrigerant entering the expansion valve, and a maximum of 4°C change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	-10°C	0°C	10°C	20°C	30°C	40°C	50°C	60°C
	Correction Factor							
R-134a	1.64	1.52	1.39	1.26	1.13	1.00	0.87	0.73
R-401A	1.70	1.59	1.46	1.34	1.22	1.09	0.96	0.83
R-409A	1.61	1.50	1.40	1.29	1.18	1.07	0.95	0.83

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of -15°C. However, they may be used for any evaporator temperature from -15°C to 5°C since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an SCE-B using R-409A at a -5°C evaporator, 8.5 bar pressure drop across the TEV, and a 30°C liquid temperature entering the TEV = 11.2 (from rating chart) x 1.18 (CF liquid temperature) = 13.2 kW

Capacity Tables

R-404A Capacities in Tons (R-507 Refrigerant & Liquid Temperature Correction Factor below)

Valve Type	Nominal Capacity (Tons) or Orifice Designation	Evaporator Temperature °F															
		40°F								20°F							
		Pressure Drop (PSI)															
		75	100	125	150	175	200	225	250	75	100	125	150	175	200	225	250
N	1/2	0.57	0.66	0.74	0.81	0.87	0.94	1.0	1.1	0.54	0.63	0.70	0.77	0.83	0.89	0.94	1.0
N	2	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.1	1.6	1.9	2.1	2.3	2.5	2.7	2.8	3.0
SCE	AAA	0.20	0.23	0.26	0.28	0.30	0.33	0.34	0.36	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.34
C(E), EC(E), SCE	AA	0.34	0.39	0.44	0.48	0.52	0.56	0.59	0.62	0.32	0.37	0.42	0.46	0.49	0.53	0.56	0.59
C(E), EC(E), SCE	A	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	0.95	1.1	1.2	1.3	1.5	1.6	1.7	1.7
C(E), EC(E), SCE	B	1.8	2.1	2.4	2.6	2.8	3.0	3.2	3.3	1.7	2.0	2.2	2.5	2.7	2.8	3.0	3.2
C(E), EC(E), SCE	C	2.9	3.3	3.7	4.1	4.4	4.7	5.0	5.2	2.7	3.1	3.5	3.8	4.2	4.4	4.7	5.0
C(E), EC(E), SCE	D	4.6	5.3	5.9	6.5	7.0	7.5	7.9	8.4	4.3	5.0	5.6	6.1	6.6	7.1	7.5	7.9
EBSE	6	4.9	5.7	6.4	7.0	7.6	8.1	8.6	9.0	4.4	5.0	5.6	6.2	6.7	7.1	7.5	8.0
EBSE	7-1/2	6.7	7.7	8.7	9.5	10.2	11.0	11.6	12.2	5.9	6.8	7.6	8.4	9.0	9.7	10.2	10.8
EBSE	10	8.3	9.5	10.7	11.7	12.6	13.5	14.3	15.1	7.5	8.6	9.6	10.5	11.4	12.2	12.9	13.6
EBSE	13	11.8	13.6	15.2	16.7	18.0	19.3	20.5	21.6	10.8	12.5	14.0	15.3	16.5	17.7	18.7	19.8
OE	9	8.4	9.7	10.8	11.9	12.8	13.7	14.5	15.3	7.2	8.3	9.2	10.1	10.9	11.7	12.4	13.1
OE	12	11.5	13.2	14.8	16.2	17.5	18.7	19.9	20.9	9.8	11.3	12.6	13.8	14.9	16.0	16.9	17.9
OE	21	18.5	21.4	23.9	26.2	28.3	30.3	32.1	33.8	15.8	18.3	20.4	22.4	24.1	25.8	27.4	28.9
OE	30	26.6	30.8	34.4	37.7	40.7	43.5	46.2	48.7	25.0	28.9	32.3	35.4	38.2	40.8	43.3	45.7
OE	35	30.9	35.7	39.9	43.7	47.2	50.4	53.5	56.4	29.0	33.5	37.4	41.0	44.3	47.3	50.2	52.9
OE	45	39.7	45.9	51.3	56.2	60.7	65	69	73	37.3	43.0	48.1	52.7	56.9	60.8	65	68

Valve Type	Nominal Capacity (Tons) or Orifice Designation	Evaporator Temperature °F															
		0°F								-10°F							
		Pressure Drop (PSI)															
		75	100	125	150	175	200	225	250	75	100	125	150	175	200	225	250
N	1/2	0.47	0.54	0.61	0.66	0.72	0.77	0.81	0.86	0.30	0.35	0.39	0.43	0.46	0.49	0.52	0.55
N	2	1.4	1.6	1.8	2.0	2.2	2.3	2.4	2.6	0.93	1.1	1.2	1.3	1.4	1.5	1.6	1.7
SCE	AAA	0.18	0.21	0.23	0.25	0.27	0.29	0.31	0.32	0.17	0.20	0.22	0.24	0.26	0.28	0.30	0.31
C(E), EC(E), SCE	AA	0.30	0.35	0.39	0.43	0.46	0.50	0.53	0.56	0.28	0.32	0.36	0.39	0.42	0.45	0.48	0.51
C(E), EC(E), SCE	A	0.8	1.0	1.1	1.2	1.3	1.3	1.4	1.5	0.53	0.61	0.68	0.75	0.81	0.86	0.91	0.96
C(E), EC(E), SCE	B	1.5	1.7	1.9	2.1	2.3	2.5	2.6	2.7	0.99	1.2	1.3	1.4	1.5	1.6	1.7	1.8
C(E), EC(E), SCE	C	2.4	2.7	3.0	3.3	3.6	3.8	4.1	4.3	1.5	1.7	1.9	2.1	2.3	2.4	2.6	2.7
C(E), EC(E), SCE	D	3.8	4.3	4.9	5.3	5.7	6.1	6.5	6.9	1.9	2.2	2.5	2.7	2.9	3.1	3.3	3.5
EBSE	6	3.6	4.1	4.6	5.1	5.5	5.8	6.2	6.5	2.9	3.4	3.8	4.1	4.5	4.8	5.1	5.4
EBSE	7-1/2	4.8	5.6	6.3	6.9	7.4	7.9	8.4	8.8	3.7	4.3	4.8	5.3	5.7	6.1	6.5	6.8
EBSE	10	5.6	6.5	7.3	7.9	8.6	9.2	9.7	10.3	4.8	5.5	6.1	6.7	7.3	7.8	8.2	8.7
EBSE	13	7.9	9.1	10.2	11.2	12.1	12.9	13.7	14.4	6.8	7.8	8.7	9.5	10.3	11.0	11.7	12.3
OE	9	5.6	6.5	7.2	7.9	8.6	9.2	9.7	10.2	4.3	5.0	5.6	6.1	6.6	7.1	7.5	7.9
OE	12	7.7	8.9	9.9	10.8	11.7	12.5	13.3	14.0	6.9	7.9	8.9	9.7	10.5	11.2	11.9	12.6
OE	21	11.1	12.8	14.3	15.7	16.9	18.1	19.2	20.2	8.2	9.5	10.6	11.7	12.6	13.5	14.3	15.1
OE	30	17.8	20.6	23.0	25.2	27.2	29.1	30.9	32.5	12.3	14.3	15.9	17.5	18.9	20.2	21.4	22.5
OE	35	20.7	23.8	26.7	29.2	31.5	33.7	35.8	37.7	13.4	15.5	17.3	19.0	20.5	21.9	23.2	24.5
OE	45	26.6	30.7	34.3	37.6	40.6	43.4	46	49	15.4	17.8	19.9	21.8	23.6	25.2	26.8	28.2

These ratings are based on vapor free 100°F liquid refrigerant entering the expansion valve, and a maximum of 7°F change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	0°F	20°F	40°F	60°F	80°F	100°F	120°F	140°F
	Correction Factor							
R-404A	2.04	1.84	1.64	1.43	1.22	1.00	0.77	0.53
R-507	1.95	1.76	1.56	1.37	1.18	0.98	0.76	0.50

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of 0°F. However, they may be used for any evaporator temperature from -10°F to 40°F since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an SCE-B using R-507 at a 20°F evaporator, 175 psi pressure drop across the TEV, and a 80°F liquid temperature entering the TEV = 1.91 (from rating chart) x 1.18 (CF liquid temperature) = 2.25 tons

Capacity Tables

R-404A Capacities in Kilowatts (R-507 Refrigerant & Liquid Temperature Correction Factor below)

Valve Type	Nominal Capacity (kW) or Orifice Designation	Evaporator Temperature °C															
		5°C								-5°C							
		Pressure Drop (BAR)															
		4	6	8	10	12	14	16	18	4	6	8	10	12	14	16	18
N	3	1.7	2.1	2.4	2.7	3.0	3.2	3.4	3.6	1.6	2.0	2.3	2.6	2.8	3.0	3.3	3.4
N	7	5.1	6.2	7.2	8.1	8.8	9.6	10.2	10.8	4.9	5.9	6.9	7.7	8.4	9.1	9.7	10.3
SCE	AAA	0.59	0.72	0.84	0.93	1.0	1.1	1.2	1.3	0.56	0.69	0.80	0.89	0.97	1.1	1.1	1.2
C(E), EC(E), SCE	AA	1.0	1.2	1.4	1.6	1.8	1.9	2.0	2.2	0.97	1.2	1.4	1.5	1.7	1.8	1.9	2.1
C(E), EC(E), SCE	A	3.0	3.7	4.2	4.7	5.2	5.6	6.0	6.3	2.8	3.5	4.0	4.5	4.9	5.3	5.7	6.0
C(E), EC(E), SCE	B	5.4	6.7	7.7	8.6	9.4	10.2	10.9	11.5	5.2	6.3	7.3	8.2	9.0	9.7	10.3	11.0
C(E), EC(E), SCE	C	8.5	10.4	12.0	13.5	14.8	15.9	17.0	18.1	8.1	9.9	11.5	12.8	14.0	15.2	16.2	17.2
C(E), EC(E), SCE	D	13.6	16.7	19.3	21.5	23.6	25.5	27.3	28.9	13.0	15.9	18.3	20.5	22.5	24.3	25.9	27.5
EBSE	21	14.4	17.7	20.4	22.8	25.0	27.0	28.9	30.6	12.9	15.8	18.3	20.4	22.4	24.1	25.8	27.4
EBSE	26	19.6	24.0	27.7	31.0	33.9	36.7	39.2	41.6	17.5	21.5	24.8	27.7	30.3	32.8	35.0	37.2
EBSE	35	24.1	29.5	34.1	38.1	41.8	45.1	48.2	51.2	22.0	27.0	31.1	34.8	38.1	41.2	44.0	46.7
EBSE	46	34.4	42.2	48.7	54.4	59.6	64.4	68.9	73.0	31.9	39.0	45.1	50.4	55.2	59.6	63.7	67.6
OE	32	24.5	30.0	34.7	38.8	42.5	45.9	49.1	52.0	21.3	26.1	30.1	33.7	36.9	39.9	42.6	45.2
OE	42	33.6	41.1	47.5	53.1	58.1	62.8	67.1	71.2	29.2	35.7	41.2	46.1	50.5	54.5	58.3	61.8
OE	74	54.2	66.4	76.7	85.7	93.9	101	108	115	47.1	57.7	66.6	74.5	81.6	88.1	94.2	99.9
OE	110	77.6	95.1	110	123	134	145	155	165	73.4	89.9	104	116	127	137	147	156
OE	120	90.0	110	127	142	156	168	180	191	85.1	104	120	134	147	159	170	180
OE	160	116	142	164	183	200	216	231	245	109	134	155	173	189	205	219	232

Valve Type	Nominal Capacity (kW) or Orifice Designation	Evaporator Temperature °C															
		-15°C								-25°C							
		Pressure Drop (BAR)															
		4	6	8	10	12	14	16	18	4	6	8	10	12	14	16	18
N	3	1.4	1.8	2.0	2.3	2.5	2.7	2.9	3.1	0.86	1.1	1.2	1.4	1.5	1.6	1.7	1.8
N	7	4.3	5.3	6.1	6.8	7.5	8.1	8.6	9.2	2.6	3.2	3.7	4.2	4.6	5.0	5.3	5.6
SCE	AAA	0.53	0.65	0.75	0.84	0.92	1.0	1.1	1.1	0.48	0.59	0.68	0.77	0.84	0.91	1.0	1.0
C(E), EC(E), SCE	AA	0.91	1.1	1.3	1.4	1.6	1.7	1.8	1.9	0.79	1.0	1.1	1.2	1.4	1.5	1.6	1.7
C(E), EC(E), SCE	A	2.5	3.1	3.6	4.0	4.4	4.7	5.1	5.4	1.5	1.8	2.1	2.4	2.6	2.8	3.0	3.2
C(E), EC(E), SCE	B	4.6	5.6	6.5	7.3	8.0	8.6	9.2	9.8	2.8	3.5	4.0	4.5	4.9	5.3	5.6	6.0
C(E), EC(E), SCE	C	7.2	8.8	10.2	11.4	12.5	13.5	14.4	15.3	4.2	5.2	6.0	6.7	7.3	7.9	8.4	8.9
C(E), EC(E), SCE	D	11.5	14.1	16.3	18.2	20.0	21.6	23.1	24.5	5.3	6.5	7.5	8.4	9.2	9.9	10.6	11.3
EBSE	21	10.9	13.4	15.5	17.3	18.9	20.5	21.9	23.2	8.0	9.8	11.3	12.6	13.8	14.9	16.0	16.9
EBSE	26	14.8	18.2	21.0	23.5	25.7	27.8	29.7	31.5	10.2	12.4	14.4	16.1	17.6	19.0	20.3	21.6
EBSE	35	17.6	21.6	24.9	27.9	30.5	33.0	35.2	37.4	13.1	16.0	18.5	20.7	22.7	24.5	26.2	27.8
EBSE	46	25.0	30.6	35.4	39.5	43.3	46.8	50.0	53.0	18.6	22.8	26.4	29.5	32.2	34.9	37.3	39.6
OE	32	17.4	21.3	24.6	27.5	30.1	32.5	34.8	36.9	12.1	14.8	17.0	19.1	20.9	22.5	24.1	25.6
OE	42	23.8	29.1	33.6	37.6	41.2	44.5	47.6	50.5	19.2	23.5	27.2	30.4	33.3	35.9	38.4	40.7
OE	74	35.5	43.5	50.2	56.1	61.5	66.4	71.0	75.3	23.0	28.2	32.5	36.4	39.9	43.1	46.0	48.8
OE	110	56.8	69.6	80.4	89.9	98.5	106	114	121	34.5	42.2	48.7	54.5	59.7	64.5	68.9	73.1
OE	120	65.9	80.7	93.2	104	114	123	132	140	37.4	45.8	52.9	59.2	64.8	70.0	74.8	79.4
OE	160	84.7	104	120	134	147	158	169	180	43.1	52.8	61.0	68.2	74.7	80.7	86.3	91.5

These ratings are based on vapor free 40°C liquid refrigerant entering the expansion valve, and a maximum of 4°C change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	-10°C	0°C	10°C	20°C	30°C	40°C	50°C	60°C
	Correction Factor							
R-404A	1.98	1.79	1.60	1.41	1.21	1.00	0.79	0.56
R-507	1.89	1.71	1.53	1.35	1.17	0.98	0.78	0.53

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of -15°C. However, they may be used for any evaporator temperature from -25°C to 5°C since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an SCE-B using R-507 at a -5°C evaporator, 12 bar pressure drop across the TEV, and a 30°C liquid temperature entering the TEV = 6.72 (from rating chart) x 1.17 (CF liquid temperature) = 7.86 kW

Capacity Tables

R-410A Capacities in Tons

Valve Type	Nominal Capacity (Tons) or Orifice Designation	Evaporator Temperature °F																	
		40°F						20°F						0°F					
		Pressure Drop (PSI)																	
		120	160	200	240	280	320	120	160	200	240	280	320	120	160	200	240	280	320
H(E), HC(E)	1-1/2	1.3	1.5	1.7	1.8	2.0	2.1	1.3	1.5	1.6	1.8	1.9	2.1	1.2	1.4	1.6	1.7	1.9	2.0
H(E), HC(E)	3	2.6	3.0	3.4	3.7	4.0	4.2	2.6	2.9	3.3	3.6	3.9	4.2	2.4	2.8	3.2	3.5	3.7	4.0
H(E), HC(E)	5	4.3	5.0	5.6	6.1	6.6	7.1	4.4	4.9	5.5	6.0	6.5	6.9	4.1	4.7	5.3	5.8	6.2	6.7
ECE	AA	0.62	0.72	0.80	0.88	0.95	1.0	0.61	0.70	0.78	0.86	0.93	0.99	0.53	0.61	0.69	0.75	0.81	0.87
ECE	A	1.8	2.1	2.3	2.6	2.8	3.0	1.8	2.1	2.3	2.5	2.7	2.9	1.6	1.8	2.0	2.2	2.4	2.6
ECE	B	3.3	3.8	4.3	4.7	5.1	5.4	3.2	3.7	4.2	4.6	5.0	5.3	2.9	3.3	3.7	4.1	4.4	4.7
ECE	C	5.2	6.0	6.7	7.3	7.9	8.5	5.1	5.9	6.5	7.2	7.7	8.3	4.5	5.2	5.8	6.4	6.9	7.4
ECE	D	8.3	9.6	10.7	11.7	12.7	13.6	8.1	9.4	10.5	11.5	12.4	13.2	7.2	8.4	9.3	10.2	11.1	11.8
ECE	12-1/2	10.8	12.5	14.0	15.3	16.5	17.7	10.6	12.2	13.6	14.9	16.1	17.2	9.4	10.9	12.2	13.3	14.4	15.4
ECE	15	12.6	14.5	16.2	17.8	19.2	20.5	12.3	14.1	15.8	17.3	18.7	20.0	10.9	12.6	14.1	15.5	16.7	17.9
OE	20	17.3	20.0	22.4	24.5	26.5	28.3	16.9	19.5	21.8	23.9	25.8	27.6	15.9	18.4	20.6	22.5	24.3	26.0
OE	25	20.8	24.0	26.8	29.4	31.7	33.9	20.3	23.4	26.2	28.7	31.0	33.1	19.1	22.1	24.7	27.0	29.2	31.2
OE	35	28.6	33.0	36.9	40.4	43.7	46.7	27.9	32.2	36.0	39.4	42.6	45.5	26.3	30.3	33.9	37.2	40.1	42.9
OE	50	43.3	50.0	55.9	61.2	66.1	70.7	42.2	48.8	54.5	59.7	64.5	69.0	39.8	46.0	51.4	56.3	60.8	65.0
OE	60	52.0	60.0	67.1	73.5	79.4	84.8	50.7	58.5	65.4	71.7	77.4	82.8	47.8	55.2	61.7	67.5	73.0	78.0

These ratings are based on vapor free 100°F liquid refrigerant entering the expansion valve, and a maximum of 7°F change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	0°F	20°F	40°F	60°F	80°F	100°F	120°F	140°F
	Correction Factor, CF Liquid Temperature							
R-410A	1.79	1.63	1.47	1.32	1.16	1.00	0.83	0.62

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of 0°F. However, they may be used for any evaporator temperature from 0°F to 40°F since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an HCE-3 using R-410A at a 40°F evaporator, 160 psi pressure drop across the TEV, and a 80°F liquid temperature entering the TEV = 3.00 (from rating chart) x 1.16 (CF liquid temperature) = 3.48 tons

R-410A Capacities in Kilowatts

Valve Type	Nominal Capacity (kW) or Orifice Designation	Evaporator Temperature °C																	
		5°C						-5°C						-15°C					
		Pressure Drop (BAR)																	
		8	11	14	17	20	23	8	11	14	17	20	23	8	11	14	17	20	23
H(E), HC(E)	5	4.5	5.3	5.9	6.6	7.1	7.6	4.4	5.2	5.8	6.4	6.9	7.5	4.3	5.0	5.7	6.3	6.7	7.3
H(E), HC(E)	11	9.0	10.5	11.9	13.1	14.2	15.2	8.8	10.3	11.6	12.8	13.9	14.9	8.6	10.0	11.3	12.5	13.3	14.5
H(E), HC(E)	18	15.0	17.6	19.8	21.8	23.7	25.4	14.7	17.2	19.4	21.4	23.2	24.9	14.3	16.7	18.9	20.8	22.3	24.2
ECE	AA	2.1	2.5	2.8	3.0	3.3	3.5	2.0	2.4	2.7	3.0	3.2	3.5	1.8	2.2	2.4	2.7	2.9	3.1
ECE	A	6.1	7.1	8.1	8.9	9.6	10.3	6.0	7.0	7.9	8.7	9.4	10.1	5.5	6.4	7.2	8.0	8.6	9.3
ECE	B	11.1	13.1	14.7	16.2	17.6	18.9	10.9	12.8	14.4	15.9	17.2	18.5	10.0	11.7	13.2	14.5	15.8	16.9
ECE	C	17.4	20.4	23.0	25.4	27.5	29.5	17.0	19.9	22.5	24.8	26.9	28.8	15.6	18.3	20.6	22.7	24.6	26.4
ECE	D	27.8	32.6	36.8	40.6	44.0	47.2	27.2	31.9	36.0	39.7	43.0	46.2	24.9	29.2	33.0	36.3	39.4	42.3
ECE	44	36.3	42.5	48.0	52.9	57.4	61.5	35.5	41.6	46.9	51.7	56.1	60.2	32.5	38.1	43.0	47.4	51.4	55.1
ECE	53	42.1	49.5	55.7	61.4	66.5	71.4	41.2	48.3	54.4	60.0	65.1	69.8	37.7	44.2	49.9	54.9	59.6	63.9
OE	70	57.3	67.1	75.8	83.5	90.5	97.1	56.2	65.9	74.3	81.9	88.8	95.2	53.7	62.9	70.9	78.1	84.7	90.9
OE	88	68.7	80.6	90.9	100	109	117	67.4	79.0	89.2	98.2	107	114	64.3	75.4	85.1	93.8	102	109
OE	123	94.5	111	125	138	149	160	92.7	109	123	135	147	157	88.4	104	117	129	140	150
OE	176	143	168	189	209	226	243	140	165	186	205	222	238	134	157	177	195	212	227
OE	211	172	201	227	250	272	291	168	198	223	246	266	286	161	189	213	234	254	273

These ratings are based on vapor free 40°C liquid refrigerant entering the expansion valve, and a maximum of 4°C change in superheat.

Refrigerant	Liquid Temperature Entering TEV							
	-10°C	0°C	10°C	20°C	30°C	40°C	50°C	60°C
	Correction Factor, CF Liquid Temperature							
R-410A	1.73	1.59	1.44	1.30	1.15	1.00	0.84	0.65

These factors include corrections for liquid refrigerant density and net refrigerating effect, and are based on an evaporator temperature of -15°C. However, they may be used for any evaporator temperature from -15°C to 5°C since the variation in the actual factors across this range is insignificant.

TEV Capacity = TEV Rating x CF Liquid Temperature – Example: Actual capacity of an HCE-3 using R-410A at a 5°C evaporator, 11 bar pressure drop across the TEV, and a 30°C liquid temperature entering the TEV = 10.5 (from rating chart) x 1.15 (CF liquid temperature) = 12.1 kW

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The goods, services or work (referred to as the "Products") offered by **Parker-Hannifin Corporation, CIC Group Aftermarket** ("Seller") are offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any Products described in its document or the attached proposal, quote or offer, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer.

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4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery or 2,000 hours of normal use, whichever occurs first. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within 12 months from the date of the alleged breach or other alleged event, without regard to the date discovered.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE WITHIN A REASONABLE PERIOD OF TIME. **IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

7. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of

the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller retains a security interest in all Products delivered to Buyer and this agreement is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

11. Improper use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

12. Cancellations and Changes. Buyer may not modify or cancel any order for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

13. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

14. Force Majeure. Seller does not assume the risk and is not liable for delay or failure to perform any of Seller's obligations by reason of events or circumstances beyond its reasonable control (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

15. Waiver and Severability. Failure to enforce any provision of this agreement will not invalidate that provision; nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

16. Termination. Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days advance written notice. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appointments a trustee, receiver

or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.

17. Governing Law. This agreement and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

18. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller is not liable for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

19. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that it is familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

For Products sold by CIC Group Aftermarket Division, the following additional terms apply:

- Payment Terms: Subject to credit approval, 1% 10th-Prox; Net 30 days
- Freight prepaid on \$1,500 net order value



Parker Hannifin Corporation
Climate and Industrial Controls Group
2445 South 25th Avenue • Broadview, IL 60155-3891 USA
phone 800 742 2681 • fax 800 241 2872
www.parker.com/coolparts

CHART
HEATER CONTROL PANEL – 5KW / 15KW
WITH CONDENSER

INDEX FOR DRAWING SET

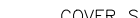
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Section 000				
SHEET	COLUMNS			DESCRIPTION
000				TITLE PAGE
000A				SYMBOL LEGEND
Section 1 - POWER DISTRIBUTION				
SHEET	COLUMNS			DESCRIPTION
001	1	2	3	ELECTRICAL DRAWING
Section 300 - PLC WIRING				
SHEET	COLUMNS			DESCRIPTION
300	300	301	302	PLC I/O WIRING
Section 400 - ENCLOSURE ASSEMBLIES				
SHEET				DESCRIPTION
400				PANEL LAYOUT
401				SUBPANEL LAYOUT AND BILL OF MATERIALS
402				TERMINAL BLOCK LAYOUT

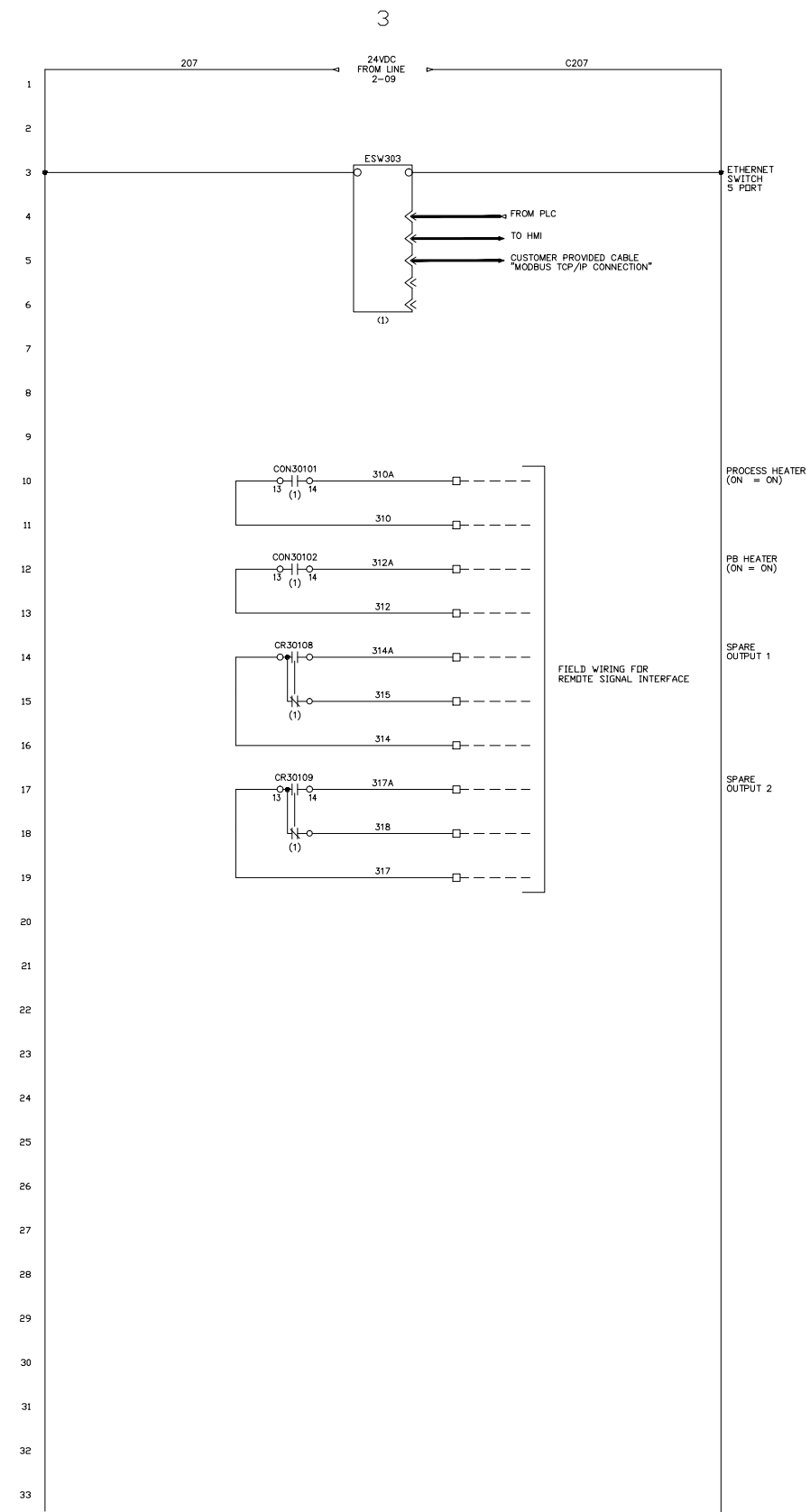
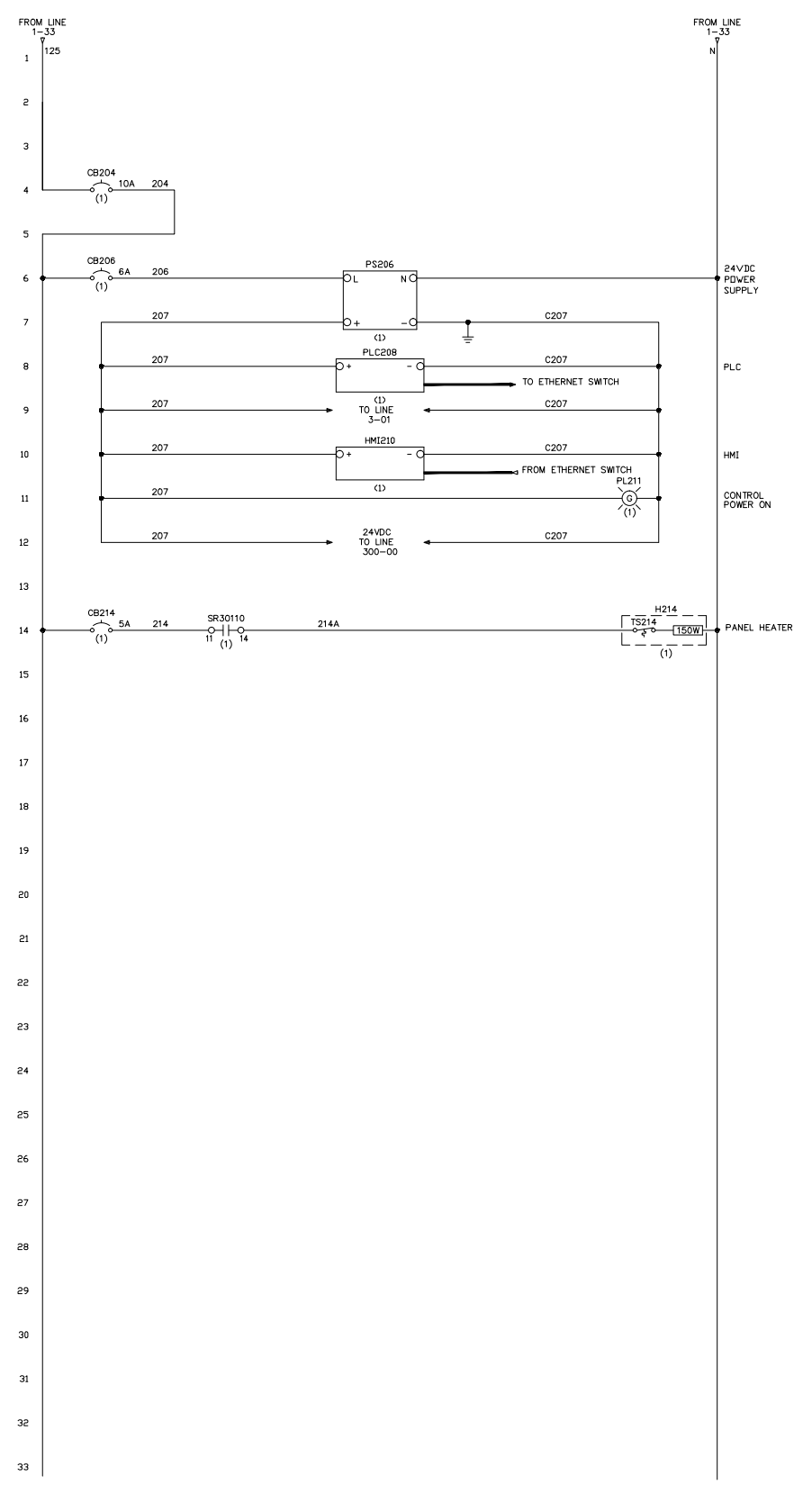
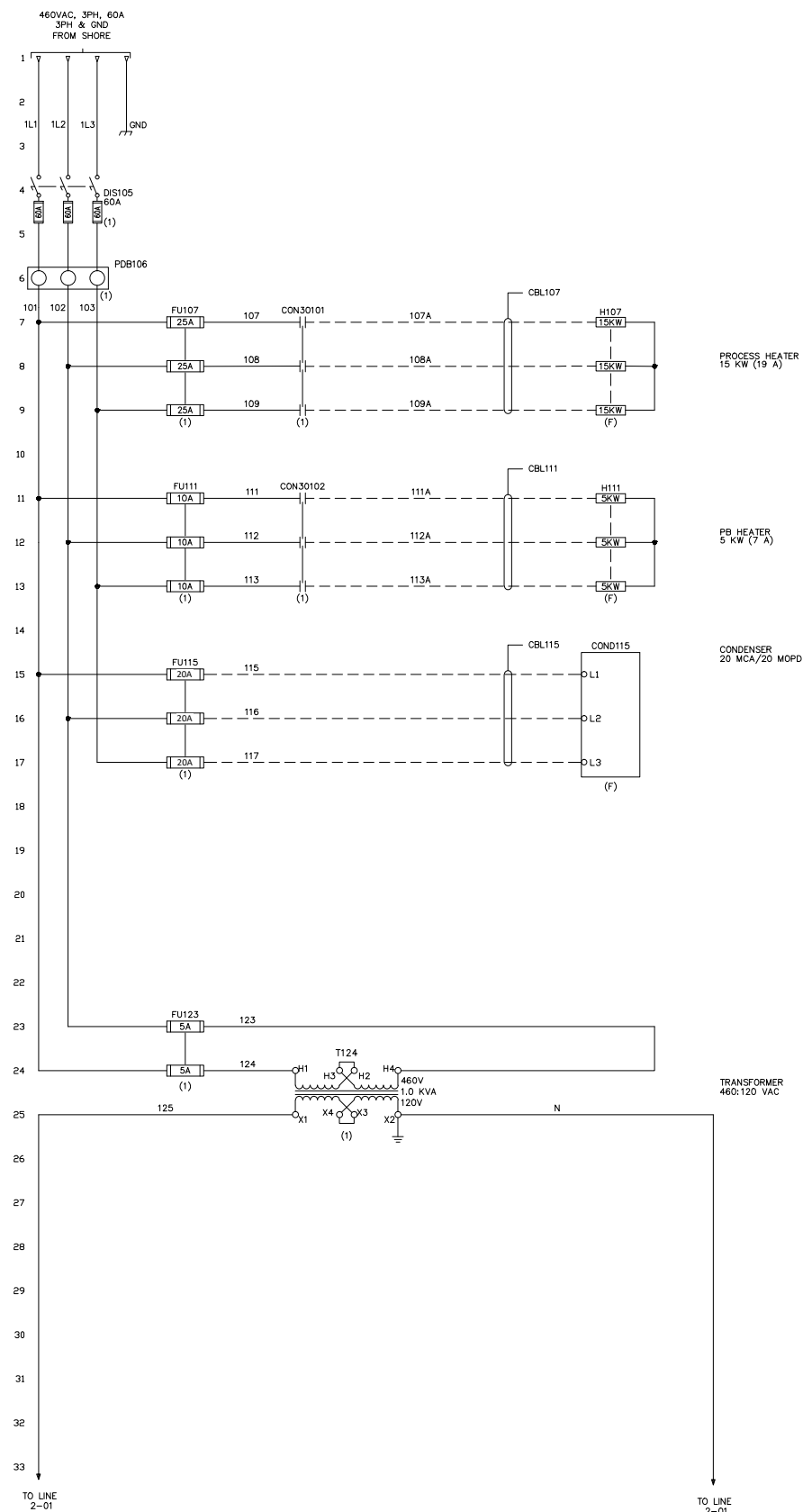
MAJOR EQUIPMENT		
LOC CODE	PANEL CODE	DESCRIPTION
(F)	FIELD	
(1)	CP1	HEATER CONTROL PANEL

SUBMITTAL
CURRENTLY UNDER
ENGINEER'S
REVIEW

NOTES:

1. 24VDC CONTROL CIRCUITS SHALL BE KEPT SEPARATE FROM ALL POWER CIRCUITS. RUN IN SEPARATE CONDUIT AND KEEP TWO INCHES MINIMUM SEPARATION INSIDE THE ENCLOSURES. IF IT IS UNAVOIDABLE FOR 24VDC CONTROL WIRING TO CROSS POWER WIRING, IT MUST CROSS AT RIGHT ANGLES.
2. ALL FIELD CONTROL WIRE TO BE MINIMUM 14AWG 75°C COPPER, UNLESS OTHERWISE NOTED.

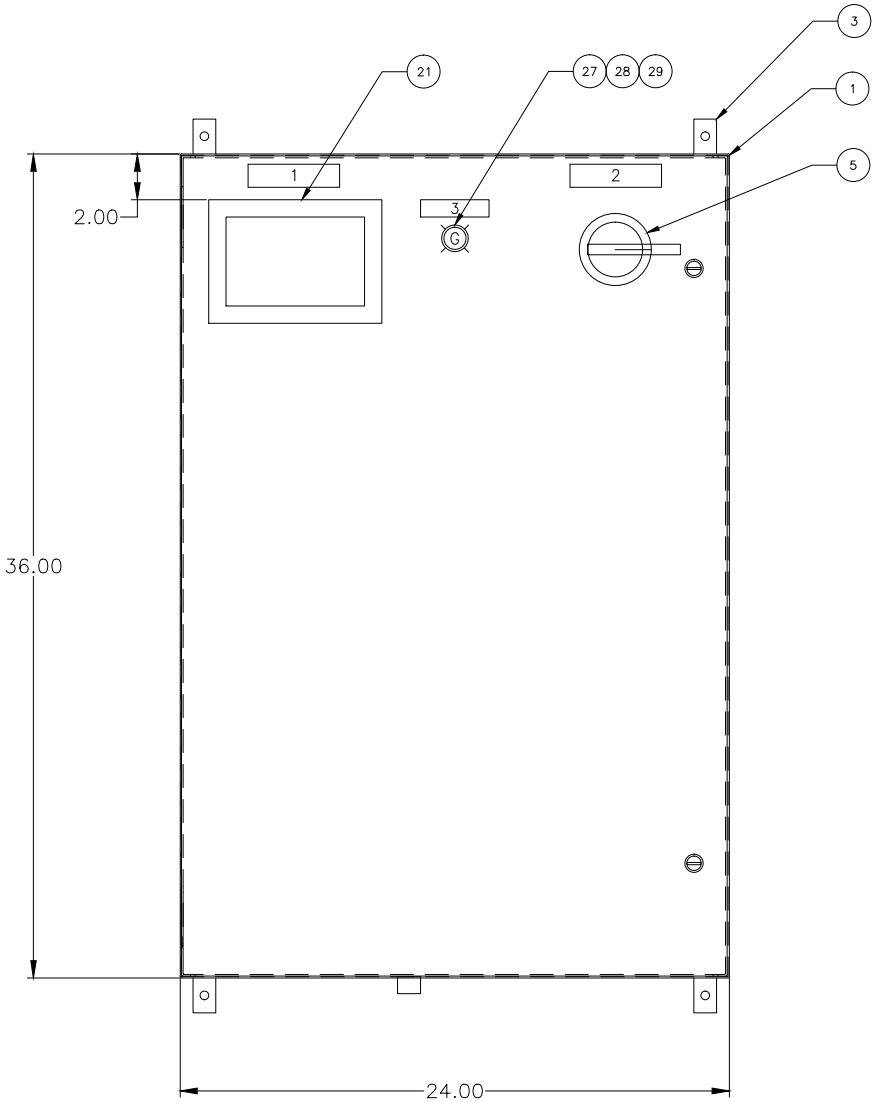
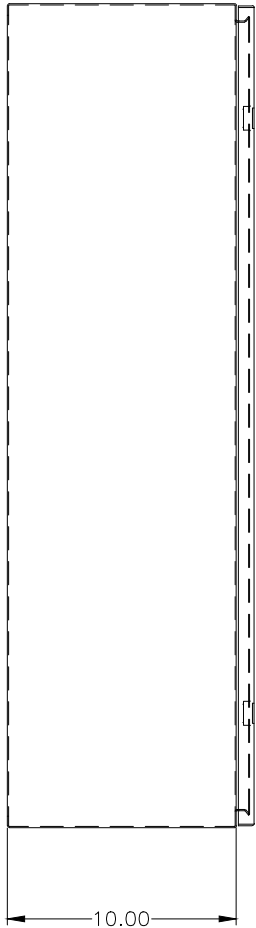
1	10/14/21	GAR	JDA	ORIGINAL ISSUE											1.	<div> BW<u>SYSTEMS, INC.</u> 290 Bridgepoint Drive, Suite 100 St. Paul, MN 55075 651-665-9060</div>	DRAWN BY GAR	DATE 10/14/21	TITLE COVER SHEET			
														2.	APPROVED JDA		DATE 10/16/21	CLIENT NAME CHART HEATER CONTROL PANEL				
														3.	DRAWING SCALE NONE							
														4.	CAD FILE NUMBER 21883046-001.DWG							
														5.	PROJECT NUMBER 21-8345		DRAWING NUMBER 21883046		SHEET 000			
														6.								
REV	DATE	DWN	APVD	DESCRIPTION				REV	DATE	DWN	APVD	DESCRIPTION				DRAWING NOTES						

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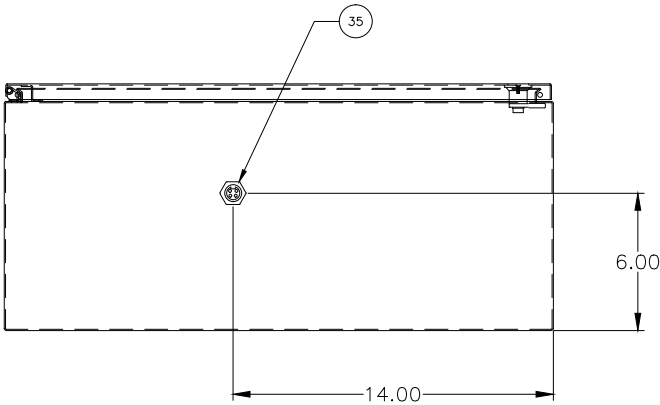
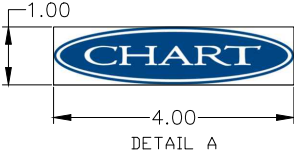


BW SYSTEMS, INC.
100 Bridgepoint Drive, Suite 100
St. Paul, MN 55075
651-665-9060

HEATER CONTROL PANEL
CHA# 21883046



NAMEPLATE LEGEND SCHEDULE		
ITEM	SIZE	NAMEPLATE TEXT
1	1" x 4"	SEE DETAIL A
2	1" x 4"	HEATER CONTROL PANEL
3	0.75" x 3"	POWER ON



1	10/14/21	GAR	JDA	ORIGINAL ISSUE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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Technical drawing of a 19-inch rack-mountable device, showing front and side views with numbered callouts (1-48) and dimensions (34.20 and 22.20).

Front View Callouts:

- 15, 16: Top left corner mounting holes.
- 22, 23, 24: Top center mounting holes.
- 13, 14: Top right corner mounting holes.
- 32: Top right corner mounting hole.
- 4, 6, 7: Top right corner mounting holes.
- 2: Top right corner mounting hole.
- 9, 10: Left side mounting holes (top).
- 9, 11: Left side mounting holes (middle).
- 9, 10: Left side mounting holes (bottom).
- 17, 18: Left side mounting holes (bottom).
- 26: Left side mounting hole (bottom).
- 20: Left side mounting hole (bottom).
- 31: Left side mounting hole (bottom).
- 30: Left side mounting hole (bottom).
- 36, 37, 38, 39, 40, 41: Bottom center mounting holes.
- 42, 43, 44, 45, 46, 47: Bottom center mounting holes.
- 48: Bottom center mounting hole.

Side View Callouts:

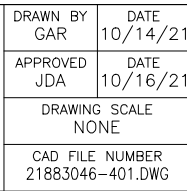
- 12: Right side mounting hole.
- 8: Right side mounting hole.
- 19: Right side mounting hole.
- 25: Right side mounting hole.

Dimensions:

- 34.20: Overall height of the device.
- 22.20: Overall width of the device.

1	10/14/21	GAR	JDA	ORIGINAL ISSUE									
REV	DATE	DWN	APVD	DESCRIPTION				REV	DATE	DWN	APVD	DESCRIPTION	

- | | |
|---------------|--|
| DRAWING NOTES | |
|---------------|--|



SHEET
401

1	10/14/21	GAR	JDA	ORIGINAL ISSUE								
REV	DATE	DWN	APVD	DESCRIPTION				REV	DATE	DWN	APVD	DESCRIPTION

1.	
2.	
3.	
4.	
5.	
6.	
DRAWING NOTES	



DRAWN BY GAR	DATE 10/14/21	TITLE TERMINAL BLOCK LAYOUT		
APPROVED JDA	DATE 10/16/21	CLIENT NAME CHART HEATER CONTROL PANEL		
DRAWING SCALE NONE				
CAD FILE NUMBER 21883046-402.DWG		PROJECT NUMBER 21-8345	DRAWING NUMBER 21883046	SHEET 402

PRELIMINARY SUBMITTAL FOR ELECTRICAL SUBMITTAL (ROYAL SCOPE W/ BOM)



Switchgear Bill of Material

October 27, 2021

Project Name: **Camrosa - Conejo Treatment Plant**

Proposal Number: ***ROYAL SCOPE***

Quoted By: Mason Luna

Royal Industrial Solutions

Ventura, CA

1. FREIGHT TERMS AND VALIDITY OF QUOTED PRICE:

- A. FOB Destination.
- B. Quote valid for 30 days. After 30 days, this quotation is subject to reevaluation and revision.
- C. Payment: NET 10 Days upon delivery of equipment via ACH
- D. Standard CED terms and conditions apply. Full terms and conditions available upon request.

2. NOT INCLUDED IN QUOTED PRICE:

- A. Miscellaneous Materials that are not specifically identified on this bill of material.
- B. Services and Labor that are not specifically identified on this bill of material.

3. CORONAVIRUS NOTE

Royal Industrial Solutions shall not be responsible for any failure to perform, or delay in performance of, its obligations resulting from the COVID-19 pandemic or any future epidemic, and Buyer shall not be entitled to any damages resulting thereof. Royal Industrial Solutions is not responsible for Acts of God.

Item	Qty	Description
1	1	MSB - per attached IEM BOM (ASCO ATS Start Up is Included)
2	1	Integrated Power Center - per attached IEM BOM *PLC Components and Installation of those components are Included. See attached BOM.
3	1	MCC-2 _ Per attached Rockwell BOM
4	1	MCC-3 _ Per attached Rockwell BOM
5	1	MCC-4 _ Per attached Rockwell BOM

Project Specific Clarifications:

(IEM) *PLC components and installation of those components into the PCM section of the ICP, has been added to this proposal per the direction of Camrosa.

(Rockwell) *Drawings show the MCC's as Main Lug Only. Main breakers have been added to each MCC per the direction of Camrosa, since MSB will not be in line of sight.

*The VFD's have been changed from PowerFlex 753 to PowerFlex 755 per the direction of Camrosa.

*2-Year Warranty for VFD'S has been added per the direction of Camrosa.

*A DV/DT Filter has been added to MCC-4 per the direction of Camrosa.

*Pricing for Class II Wiring was factored in previously, and is accounted for in this proposal as well.

*Pricing for the UPS's to be mounted in PLC section has been added per the direction of Camrosa.

**Installation of the UPS's is by others.



Industrial Electric Mfg™
48205 Warm Springs Blvd
Fremont CA 94539

dir 510.656.1600
fax 510.656.6250

www.iemfg.com

BOM

Date: 10/22/2021

To: ROYAL

Project: CAMROSA WATER DISTRICT - CONEJO TREATMENT PLANT

IEM is pleased to offer the following quotation for your consideration. Any order resulting from this quotation will be accepted by IEM only on the basis of IEM's General Terms and Conditions of Sale. Notice of exception to any conflicting requirements is hereby given. This quotation will expire thirty calendar days from the date of issue and can be withdrawn by notice within that period. Any order is subject to credit review and/or arrangements for payment in a manner acceptable to IEM prior to acceptance by IEM. Specifically excluded from this quotation is any IEM warrant of merchantability or fitness for a particular purpose for the IEM equipment described.

ITEM	QTY	DESCRIPTION
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1	1	MAIN / DISTRIBUTION SWBD – NEMA 3R OUTDOOR ANSI #49 3PH-4W 277/480V UL 891 2000 AMP CU BUS BRACED FOR 65KA, CONSISTING OF: 1 - EURSERC UTILITY CABLE PULL, CT & METERING COMPARTMENT SECTION: 1 - MAIN BREAKER SECTION: 1 - 2000A E.O. FIXED-MOUNT SIEMENS WL 65KAIC INSULATED CASE POWER BREAKER ETU776 LSIG (GRAPHICAL DISPLAY, GF ALARM & TRIP) PROGRAMMER WITH 4A/4B AUX SW'S AND THESE ACCESSORIES: EMO,ST,RCS,OC,PBC,MBM 1 - ARC FLASH MAINTENANCE SWITCH 1 - VOLTAGE/CURRENT TEST SWITCH (10-PT) 1 - POWER METER W/DISPLAY (ALLEN BRADLEY AB 5000) 1 - CPT W/CLF 3 - 2000:5 CT'S 3 - PT'S W/CLF 1 - 200KA/PH SPD W/DISCONNECT 1 - ATS SECTION: 1 - ASCO 7000 SERIES BYPASS TRANSFER SWITCH - AUTOMATIC DELAYED TRANSITION - G FRAME 480V/60HZ, 3 POLE, 3P/4W - G7ADTBA32000N5X0,31BG,37B,44G,82E,150B 1 - WIREWAY SECTION: 1 - DISTRIBUTION SECTION: 2 - 1200A FRAME/3P 65KAIC MOLDED CASE BREAKER W/ LSI TRIP 2 - ARC FLASH MAINTENANCE SWITCHES
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1 - 600A FRAME/3P 65KAIC MOLDED CASE BREAKER W/ LSI TRIP
1 - ARC FLASH MAINTENANCE SWITCH
5 - 60A FRAME/3P 65KAIC MOLDED CASE BREAKER
1 - (LOT) MTG HDWE
1 – LOT MISCELLANEOUS COMPONENTS:
1 - LOT OF CRIMP LUGS
4 - STRIP HEATERS
2 - THERMOSTATS
2 - GCFI RECEPTACLE
4 - LED LIGHTS
DESIG:MSB

2 1 INTEGRAL POWER CENTER – NEMA 3R OUTDOOR
1 - PMC SECTION 36"W X 30"D X 90"H
1 - TRANSFORMER AND LIGHTING PANEL SECTION 38"W X 36"D X 90"H
1 – 480V - 60A FRAME/3P 65KAIC MOLDED CASE BREAKER
1 – 208/120V - 150A FRAME/3P 65KAIC MOLDED CASE BREAKER
1 - (LOT) MTG HDWE
1 - PIU PANEL - INDOOR 3PH-4W 120/208V 10KAIC MCB 42 CIRCUIT 150A CU "LP1"
42 - 15-60/1
1 - DRY TYPE XFMR - INDOOR 3PH 480V-120/208V
150 DEG C RISE CU WOUND DOE 2016 RATED
45 KVA (TX-L1)
1 - MISCELLANEOUS COMPONENTS
2 - STRIP HEATERS
1 - THERMOSTAT
DESIG:POWER CENTER

3 1 DAY ASCO ATS START-UP

This quotation is per this bill of material only, any change to bill of material will result in a change in price. This quotation represents IEM's best interpretation.

Drawings: **4 – 5 weeks after receipt of order**

Shipment: **28 – 30 weeks after release for manufacturing**



Notes:

1. Safety switches, enclosed circuit breakers, starters, lighting contactors, or other miscellaneous equipment are not included unless listed as a separate item within this bill of material.
2. No field installation, testing, training, power study, arc flash study, or seismic calculations are included.
3. No fuses are provided with this bill of material.
4. No panel schedule were provided for this quotation. Any changes to the bill of material above will change the total package price.
5. IEM takes exception to Square D I-Line interior and breakers. IEM has provide a Siemens for this proposal.
6. MCC's are not included with this proposal and are by others.
7. Sales tax is not included; IEM only collects tax in California, Massachusetts and North Carolina
8. Quote is valid for 30 days.
9. Freight prepaid and allowed (F.O.B. Point of Shipment).



PLC Component BOM – PCM Section in Integrated Power Center

Item	Product	Qty	Notes	Delivery Program
1768 / 1769 CompactLogix System Group Selection				
1	1769-L33ERM <i>CompactLogix 5370 L3 Controllers, Dual Ethernet w/DLR capability, 2MB memory, 16 I/O Expansion, 32 Ethernet IP Nodes, 8 Axis CIP motion with Kinematics function. Controllers are shipped with 1GB SD card and can support up to 2GB SD card.</i>	1		Preferred Availability
2	1769-IF8 <i>8 Channel Analog Current/Voltage Input Module</i>	3		Preferred Availability
3	1769-OF8C <i>8 Channel Analog Current Output Module</i>	1		Preferred Availability
4	1769-IA16 <i>16 Point 120 VAC Input Module</i>	5		Preferred Availability
5	1769-PA4 <i>L3x & L3y CompactLogix Power Supplies 120/240 VAC Input 4A @ 5VDC, 2A @ 24VDC</i>	1		Preferred Availability
6	1769-ECR <i>Right End Cap/Terminator</i>	1		Preferred Availability
7	1492-H4 <i>1492-H Finger-Safe Terminal Blocks, H-Block, Single Circuit Fuse Block, Code 4, Neon Blown Fuse Indicator, #30 - #12 AWG, Black (Standard), No Bulk Pack (Single Block)</i>	80		Preferred Availability
8	1492-N37 <i>1492 Terminal Block Accessories End Barrier , Grey (Standard)</i>	4		Preferred Availability
9	1492-EAHJ35 <i>1492 Terminal Block Accessories End Anchor, End Anchor</i>	4		Preferred Availability
10	1492-H5 <i>1492-H Finger-Safe Terminal Blocks, H-Block, Single Circuit Fuse Block, Code 5, LED Blown Fuse Indicator, #30 - #12 AWG, Black (Standard), No Bulk Pack (Single Block)</i>	32		Preferred Availability
11	1492-N37 <i>1492 Terminal Block Accessories End Barrier , Grey (Standard)</i>	10		Preferred Availability
12	1492-EAHJ35 <i>1492 Terminal Block Accessories End Anchor, End Anchor</i>	10		Preferred Availability
13	199-DR1 <i>DIN Mounting Rail, Zinc Plated, Chromated Steel, 35mm x 7.5mm DIN Rail, 1 Meter (Pkg. Qty. 10)</i>	6		Preferred Availability
14	1492-J4 <i>1492-J IEC Terminal Block, One-Circuit Feed-Through Block, 4 mm (# 22 AWG - # 10 AWG) or 2.5 mm (# 22 AWG - # 12 AWG), Standard Feedthrough, Gray (Standard),</i>	250		Preferred Availability

15	1492-EBJ16 <i>1492 Terminal Block Accessories , Grey (Standard)</i>	6		Preferred Availability
16	1606-XLE240E <i>1606-XLE240E: Essential Power Supply, 24-28V DC, 240 W, 120/240V AC Input Voltage</i>	1		Preferred Availability
17	1492-JG4 <i>1492-J IEC Terminal Block, One-Circuit Feed-Through Ground Block, 4 mm (# 22 AWG - # 10 AWG) or 2.5 mm (# 22 AWG - # 12 AWG), Standard Feedthrough, Green / Yellow Stripe (Standard),</i>	80		Preferred Availability
18	1497-K-BASX-0-N <i>1497 - CCT Standard Transformer, 1000VA, 240/480V 60Hz / 220/440V 50Hz Primary, 110V 50Hz / 120V 60Hz Secondary, 0 Pri - 0 Sec Fuse Blocks, No Cover/ No Sec. Fuse</i>	2		Preferred Availability
19	KDRL5H <i>KDR Optimized Drive Reactor -, Open480 VACHigh-Z, NEC Motor HP: 450, NEC Motor Current: 515, Minimum Cab Size:</i>	1		
20	DRUB15 <i>5-15R Din Rail mounted recepticle</i>	2		

Rockwell Automation

Centerline 2100 Motor Control Center

MCC Details

Project Name: CWD - Conejo Wells
Project Item: MCC-2 - N3R
Project ID #: 5271772/4

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:02

The details of the proposed motor control center are as follows:

Category	Description
Total Section(s)	9
Total Shipping Block(s)	8
Section Depth	Front Mounted, 20" Deep
Section Height	90" High
Enclosure	3R - Outdoor Non-Walk-In
Designed For Use With	Power System Type: Wye, 3-phase, 4-wire with solidly grounded neutral
MCC Connection Type	Main Circuit Breaker
Incoming Cable Entry	Bottom, Section 1
Main Bus Rating	1200A
Main Bus Material	Copper / Tin Plated
Main Bus Bracing	65kA (rms symmetrical)
Horizontal Neutral Bus Rating	Half of Main Bus Rating
Horizontal Neutral Bus Location	Below Main Bus
Horizontal Neutral Bus Supplied	In Section(s): 1, 2
Horizontal Ground Bus	1/4" X 1", Bottom, Unplated Copper
Vertical Ground Bus	Unit Load Copper and Plug-in Copper
Stab Opening Protection	Automatic Shutters
Master Nameplate	No

Rockwell Automation

Centerline 2100 Motor Control Center

Basic Structure Information

Project Name: CWD - Conejo Wells
Project Item: MCC-2 - N3R
Project ID #: 5271772/4

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:02

Motor Control Center Details

This MCC(s) was developed using an available fault current of 50,001 to 65,000 A.
MCC configuration & pricing subject to change, if actual Available Fault Current differs.

Motor Control Center Details

Power System Type: Wye, 3-phase, 4-wire with solidly grounded neutral
Voltage: 480 Volts / 60 Hertz
Available Fault Current: 50,001 to 65,000 A
Unit Nameplate Type: Acrylic - Black letters on white
Wiring Type: B-T Control and Power Terminal Blocks
Wiring Diagram Location: Central location
Class II Diagram: TBD
Class II Wire Count: 1
Class II Wire Through: Top Wireway
Arc Resistant MCC: No
IntelliCENTER Network: Ethernet
IMC Device Firmware: Upgraded to latest available version (saves up to 1 hour of customer configuration time per section)

Incoming Line Details

MCC Connection Type: Main Circuit Breaker
Incoming Line Cable Entry: Bottom Mounted

Bus Details

Main Bus Rating: 1200A
Main Bus Material: Copper / Tin Plated
Main Bus Bracing: 65kA (rms symmetrical)
Insulated Bus: None Selected

Horizontal Ground Bus Size: 1/4" X 1"
Horizontal Ground Bus Plating: Unplated Copper
Horizontal Ground Bus Location: Bottom
Vertical Ground Bus Type: Unit Load Copper and Plug-in Copper
Incoming Ground Lug Size: #6 AWG - 250 kcmil (2 Supplied as Standard)
Incoming Ground Cable Size: None Selected

Horizontal Neutral Bus Rating: Half of Main Bus Rating
Horizontal Neutral Bus Location: Below Main Bus

Enclosure Details

Enclosure Type: 3R - Outdoor Non-Walk-In
NEMA 3R/4 Lifting Angle: No
Section Depth: Front Mounted, 20" Deep
Enclosure Depth: Front Mounted, 30.12" Deep
Section Height: 90" High
Stab Opening Protection: Automatic Shutters
Wireway Tie Bar: Yes
Space Heater Voltage: 120V
Space Heater Thermostat: 1 Per Section

Total Shipping Block(s): 8
Total Section(s): 9
Total Unit(s): 17

Ethernet Network Information

Full Ethernet Network Information can be found on the One Line Diagram associated with this project item. This drawing can be obtained by requesting Pre-order drawings through PowerControl Builder.

Section Modifications (Qty/Mods)

MCC Level Mods:

Class II interwiring or Limited Class II between units in MCC (30 wires max; a 15% adder is applied if more than 30 wires) (List price is per wire 30 and under).

Section 1 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 2 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 3 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 4 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 5 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 6 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 7 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 8 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 9 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section Number	Section Width (inches)	Options/Modifications
1	20"	600A Vertical Bus Horizontal Neutral Bus

2	20"	600A Vertical Bus Horizontal Neutral Bus
3	25"	N/A
4	25"	N/A
5	25"	N/A
6	25"	N/A
7	25"	N/A
8	20"	N/A
9	30"	N/A

Rockwell Automation

Centerline 2100 Motor Control Center

Unit List

Project Name: CWD - Conejo Wells
 Project Item: MCC-2 - N3R
 Project ID #: 5271772/4

Salesperson: Juan Campos
 Created By: Juan Campos
 Date/Time: 10/25/21 - 21:02

ID	QTY	Catalog Number / Unit Description
1	1	2100-EPS8KB-30TGM-79U-751M-751S-768C / Ethernet Power Supply Unit with Circuit Breaker Thermal Magnetic (15A Trip)
2	1	2190-CKB-56M-79U-86W54CXB-751M-751S / Metering Unit - Bul 1426-M5 PM 5000 w/Ethernet
3	1	2100-SPKB-3-751M-751S / Surge Protective Device Unit - Wye w/solidly grd neut, 4-wire
4	2	2193F-AKB-79L-79U-751M-4031TGM / Feeder Circuit Breaker - 125A Frame Rating with 100A/20A Trip
5	1	2193F-AKB-79L-79U-751M-3434TGM / Feeder Circuit Breaker - 125A Frame Rating with 40A/40A Trip
6	5	2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A / PowerFlex 755 AC Drive w/CB - 125 HP with Circuit Breaker Thermal Magnetic (250A Trip)
-	1	<i>Customer Load Cables Exit(Bottom)</i>
7	1	2197-WKBH-37TGM-79L-79U-751M-790A / Control & Lighting Transformer w/CB - 45.0 kVA with Circuit Breaker Thermal Magnetic (70A Trip)
8	1	2193LE-AKB327-40WT-31A27-111-751M / Lighting Panel Unit with Main Circuit Breaker - 100A - 27 Total Circuits
9	1	2100-GKC2X3B-31TGM-120-751M / Full Sect Blank Mtg Plate w/ or w/o Disc with Circuit Breaker Thermal Magnetic (20A Trip)
-	1	<i>Customer Load Cables Exit(Bottom)</i>
10	1	2100-ESW20K-T10FDP-114-751M-751S / Stratix 5700 20-Port
11	1	2100-BK05 / Blank Unit Door - 0.5 Space Factor
12	1	2193MB-GKC-56TNMG-88HN-751M / Main Circuit Breaker - 1200A Frame Rating - Bottom Mounted with 1200A Trip w/ Maintenance Mode

Rockwell Automation

Centerline 2100 Motor Control Center

Unit Description

Project Name: CWD - Conejo Wells
Project Item: MCC-2 - N3R
Project ID #: 5271772/4

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:02

General Information

Line Voltage / Frequency: 480 Volts / 60 Hertz
Power System Configuration: Wye, 3-phase, 4-wire with solidly grounded neutral
Class I Wiring Type: B-T Control and Power Terminal Blocks
NEMA Enclosure Type: 3R - Outdoor Non-Walk-In
Available Fault Current: 50,001 to 65,000 A
Unit Nameplate Type: Acrylic - Black letters on white
Delivery Program: ENG

Unit Information

Description	Unit Features
Unit Loc: 01A Del Prog: SCII Unit ID: 4 FCB - Feeder Circuit Breaker <u>Rating</u> Dual 100A/20A <u>Wiring Diagram</u> 10006415294 <u>Name Plate Information</u> SPARE <u>Dual Unit</u> SPARE <u>Overload Relay(s)</u> Motor Full Load Current (FLC) = Not Available	Catalog Number: 2193F-AKB-79L-79U-751M-4031TGM Total Space Factor = 1 Circuit Breaker: Thermal Magnetic, 65kA at 480V (100) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 100A/20A Trip Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase <u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) Mylar Device Markers (-751M)
Unit Loc: 01C Del Prog: PEII Unit ID: 3 SPD - Surge Protective Device Unit <u>Wiring Diagram</u> 10006415263 <u>Name Plate Information</u> SPD	Catalog Number: 2100-SPKB-3-751M-751S Total Space Factor = 0.5 Surge Protector Type: Wye w/solidly grd neut, 4-wire <u>Features Included</u> Mylar Device Markers (-751M) Sleeve Type Markers (-751S)

<div>Unit Loc: 01DDel Prog: FT1</div> <div>Unit ID: 12</div> <div>MCB - Main Circuit Breaker</div> <div>Rating1200A</div>	<div>Catalog Number: 2193MB-GKC-56TNMG-88HN-751M</div> <div>Total Space Factor = 4.5</div> <div>Circuit Breaker: Electronic (LSIG) - Maint. Mode, 65kA at 480V (1200) with Frame Rating of 1200A (N6I Frame) w/ Maintenance Mode, Bottom Mounted, 1200A Trip, with Internal Ground Fault Protection</div> <div>Lugs Supplied: Std Mech/Lug Pads, 500 kcmil Size Wire, 4 Cables per Phase</div> <div>Features Included</div> <div>INC_NEUT_BUS Half-rated (-88HN)</div> <div>Engineered Spec(s)/Modification(s)</div> <div>(1) 140G Maintenance Mode - Switch Mode Selector Switch, Blue Indicator Light, & Control components for K,M,N & R Frame.</div> <div>(1) Engineered Modification and/or Custom Diagram</div>						
<div>Unit Loc: 02ADel Prog: PEII</div> <div>Unit ID: 10</div> <div>ENSW - Stratix 5700 20-Port</div> <div>Wiring Diagram10006415251</div> <div>Name Plate Information</div> <div>ETHERNET SWITCH</div> <div>Ethernet Information</div> <table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2100-ESW</td><td>192.168.1.3</td><td>255.255.255.0</td></tr></table> <div>No Cable Length</div> <div>Ethernet Switch Firmware Version : LATEST</div>	Device Type	IP Address	Subnet Mask	2100-ESW	192.168.1.3	255.255.255.0	<div>Catalog Number: 2100-ESW20K-T10FDP-114-751M-751S</div> <div>Total Space Factor = 1</div> <div>Full Stratix 5700 Firmware</div> <div>NAT (CIP Sync & Gigabit Ports)</div> <div>Power Adapters (w/Unit Mtg)</div> <div>Features Included</div> <div>Locking Latch Provision (-114)</div> <div>Mylar Device Markers (-751M)</div> <div>Sleeve Type Markers (-751S)</div>
Device Type	IP Address	Subnet Mask					
2100-ESW	192.168.1.3	255.255.255.0					
<div>Unit Loc: 02CDel Prog: SCII</div> <div>Unit ID: 1</div> <div>ENPS - Ethernet Power Supply Unit</div> <div>Rating125A</div> <div>Wiring Diagram10006415245</div> <div>Name Plate Information</div> <div>ETHERNET</div> <div>POWER SUPPLY</div>	<div>Catalog Number: 2100-EPS8KB-30TGM-79U-751M-751S-768C</div> <div>Total Space Factor = 1.5</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (15A Trip)</div> <div>Disconnect Type = Circuit Breaker</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div>Features Included</div> <div>Unit Grd Stab Unplated Cu (-79U)</div> <div>Mylar Device Markers (-751M)</div> <div>Sleeve Type Markers (-751S)</div> <div>Redundant ENet Power Supply (-768C)</div>						

<div>Unit Loc: 02F Del Prog: ENG</div> <div>Unit ID: 2</div> <div>METR - Metering Unit</div> <div><div>Wiring Diagram</div><div>10006415275</div></div> <div><div>Name Plate Information</div><div>POWER</div><div>METER</div></div> <div><div>Ethernet Information</div><div><div>Device Type</div><div>IP Address</div><div>Subnet Mask</div><div>2190</div><div>192.168.1.1</div><div>255.255.255.0</div><div>2190</div><div>192.168.1.2</div><div>255.255.255.0</div></div><div>Cable Length : 2.49 m</div><div>Power Monitor Firmware Version : LATEST</div></div>	<div>Catalog Number: 2190-CKB-56M-79U-86W54CXB-751M-751S</div> <div>Total Space Factor = 1.5</div> <div>Metering Type: Bul 1426-M5 PM 5000 w/Ethernet</div> <div>Ammeter Scale 1200</div> <div><div>Features Included</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Upgrade PM 5000 from M5 to M6,1426-M6E</div><div>(1) Engineered Modification and/or Custom Diagram</div></div>
<div>Unit Loc: 02J Del Prog: SCII</div> <div>Unit ID: 5</div> <div>FCB - Feeder Circuit Breaker</div> <div><div>Rating</div><div>Dual 40A/40A</div></div> <div><div>Wiring Diagram</div><div>10006415287</div></div> <div><div>Name Plate Information</div><div>SPARE</div></div> <div><div>Dual Unit</div><div>SPARE</div></div> <div><div>Overload Relay(s)</div><div>Motor Full Load Current (FLC) = Not Available</div></div>	<div>Catalog Number: 2193F-AKB-79L-79U-751M-3434TGM</div> <div>Total Space Factor = 1</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (40) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 40A/40A Trip</div> <div>Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</div> <div><div>Features Included</div><div>Unit Ground Load Connector Unplated Cu (-79L)</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div></div>
<div>Unit Loc: 02L Del Prog: SCII</div> <div>Unit ID: 4</div> <div>FCB - Feeder Circuit Breaker</div> <div><div>Rating</div><div>Dual 100A/20A</div></div> <div><div>Wiring Diagram</div><div>10006415294</div></div> <div><div>Name Plate Information</div><div>SPARE</div></div> <div><div>Dual Unit</div><div>SPARE</div></div> <div><div>Overload Relay(s)</div><div>Motor Full Load Current (FLC) = Not Available</div></div>	<div>Catalog Number: 2193F-AKB-79L-79U-751M-4031TGM</div> <div>Total Space Factor = 1</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (100) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 100A/20A Trip</div> <div>Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</div> <div><div>Features Included</div><div>Unit Ground Load Connector Unplated Cu (-79L)</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div></div>

<div>Unit Loc: 03A Del Prog: ENG</div> <div>Unit ID: 6</div> <div>VFD - PowerFlex 755 AC Drive w/CB</div> <div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div> <div><div>Wiring Diagram</div><div>10006435909</div></div> <div><div>Name Plate Information</div><div>WELL NO. 4</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.4</td><td>255.255.255.0</td></tr></table><div>Cable Length : 2.9 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.4	255.255.255.0	<div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div> <div>Total Space Factor = 6</div> <div>Wiring: NEMA Type B wiring</div> <div>Output Current Rating: 156A</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div> <div>Human Interface Module: LCD full numeric keypad - Door Mounted</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.4	255.255.255.0					

<div><div>Unit Loc: 04A</div><div>Del Prog: ENG</div><div>Unit ID: 6</div><div>VFD - PowerFlex 755 AC Drive w/CB</div></div> <div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div> <div><div>Wiring Diagram</div><div>10006435909</div></div> <div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>2A-BSTR-PMP</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.5</td><td>255.255.255.0</td></tr></table><div>Cable Length : 3.66 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.5	255.255.255.0	<div><div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div><div>Total Space Factor = 6</div><div>Wiring: NEMA Type B wiring</div><div>Output Current Rating: 156A</div><div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div><div>Human Interface Module: LCD full numeric keypad - Door Mounted</div><div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div><div>Control Wiring: #16 AWG MTW(TEW) Cu</div></div> <div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.5	255.255.255.0					

<div><div><div>Unit Loc: 05A</div><div>Del Prog: ENG</div></div><div><div>Unit ID: 6</div><div>VFD - PowerFlex 755 AC Drive w/CB</div></div><div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div><div><div>Wiring Diagram</div><div>10006435909</div></div><div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>2B-BSTR-PMP</div></div><div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.6</td><td>255.255.255.0</td></tr></table><div>Cable Length : 4.42 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.6	255.255.255.0	<div><div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div><div>Total Space Factor = 6</div><div>Wiring: NEMA Type B wiring</div><div>Output Current Rating: 156A</div><div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div><div>Human Interface Module: LCD full numeric keypad - Door Mounted</div><div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div><div>Control Wiring: #16 AWG MTW(TEW) Cu</div><div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div><div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.6	255.255.255.0					

<div>Unit Loc: 06A</div> <div>Del Prog: ENG</div> <div>Unit ID: 6</div> <div>VFD - PowerFlex 755 AC Drive w/CB</div> <div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div> <div><div>Wiring Diagram</div><div>10006435909</div></div> <div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>40-PMP-01</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.7</td><td>255.255.255.0</td></tr></table><div>Cable Length : 5.18 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.7	255.255.255.0	<div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div> <div>Total Space Factor = 6</div> <div>Wiring: NEMA Type B wiring</div> <div>Output Current Rating: 156A</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div> <div>Human Interface Module: LCD full numeric keypad - Door Mounted</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.7	255.255.255.0					

<div>Unit Loc: 07A Del Prog: ENG</div> <div>Unit ID: 6</div> <div>VFD - PowerFlex 755 AC Drive w/CB</div> <div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div> <div><div>Wiring Diagram</div><div>10006435909</div></div> <div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>40-PMP-02</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.8</td><td>255.255.255.0</td></tr></table><div>Cable Length : 5.95 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.8	255.255.255.0	<div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div> <div>Total Space Factor = 6</div> <div>Wiring: NEMA Type B wiring</div> <div>Output Current Rating: 156A</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div> <div>Human Interface Module: LCD full numeric keypad - Door Mounted</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.8	255.255.255.0					
<div>Unit Loc: 08A Del Prog: SCII</div> <div>Unit ID: 11</div> <div>DOOR - Blank Unit Door</div>	<div>Catalog Number: 2100-BK05</div> <div>Total Space Factor = 0.5</div>						
<div>Unit Loc: 08B Del Prog: ENG</div> <div>Unit ID: 8</div> <div>LPAN - Lighting Panel Unit</div> <div><div>Wiring Diagram</div><div>10005989973</div></div> <div><div>Name Plate Information</div><div>LP2</div></div>	<div>Catalog Number: 2193LE-AKB327-40WT-31A27-111-751M</div> <div>Total Space Factor = 2.5</div> <div>Panel Type & Rating: Three Phase, 4-Wire, 120/208V, 100A, 27 total circuits</div> <div>Bolt-On Branch Breakers: None</div> <div><div>Features Included</div><div>(27) 20A 1-P CB (-31A27)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) 2193LE, Lighting Panel - Copper bus, unplated (Aluminum is standard), 100A (30 circuit maximum, 1or 3 phase)</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 2193LE, Lighting Panel - Wire panel to transformer, 100A</div></div>						

<p>Unit Loc: 08G Del Prog: SCII Unit ID: 7 XFMR - Control & Lighting Transformer w/CB</p> <p><u>Wiring Diagram</u> 10006415299</p> <p><u>Name Plate Information</u> TX-LP2</p>	<p>Catalog Number: 2197-WKBH-37TGM-79L-79U-751M-790A Total Space Factor = 3 Secondary Wiring Fusing & Rating: 3-Phase, 120/208V, 3 Fuse, 45.0 kVA Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (70A Trip)</p> <p><u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) 1 Aux and 1 Alarm-Internal-CB (-790A)</p>
<p>Unit Loc: 09A Del Prog: ENG Unit ID: 9 PLAT - Full Sect Blank Mtg Plate w/ or w/o Disc</p> <p><u>Rating</u> 20A</p> <p><u>Wiring Diagram</u> 10006415257</p>	<p>Catalog Number: 2100-GKC2X3B-31TGM-120-751M Total Space Factor = 6</p> <p>Rating: 20A Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (20A Trip) Disconnect Type = Circuit Breaker Required Section Width 30" Wide Working Depth 14" Deep</p> <p><u>Features Included</u> Omit horizontal power bus (-120)</p> <p><u>Engineered Spec(s)/Modification(s)</u> (1) Customer Load Cables Exit(Bottom) (1) Compact Logix 2MB Motion Controller,1769-L33ERM (1) Engineered Modification and/or Custom Diagram (4) 120V AC INPUT MODULE,1769-IA16 (2) 8 ANALOG INPUTS,1769-IF8 (1) POWER SUPPLY,1769-PA4 (2) Power Supply, 120W, 24VDC, 5A output, 120-240VAC input,1606-XLS120E Note - 1606-XLE240E (1) END CAP RIGHT,1769-ECR (2) 1000VA Control Transformer-Fusing/Fuse Block Included ,1497-K-BASX-0-N Note - 1.6KVA XFMR (30) IEC Terminal Blocks,1492-JG4,6,10? (200) I/O Wiring to terminal blocks within a PLC, SLC or ControlLogix unit (per wire) (200) Finger-Safe High Density Terminal Blocks,1492-H1,2,4,5,6,7? (2) Receptacle, Duplex, GFI, 120V, 15A maximum, mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12 , power source not included (4) Panduit Wiring Duct and Covers (White, 6 ft length) (Width, Height determined by adding PCB# Note) (2) 8 CURRENT ANALOG OUTPUTS,1769-OF8C (2) 120/240V AC OUTPUT MODULE,1769-OA16 (1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</p>

Rockwell Automation

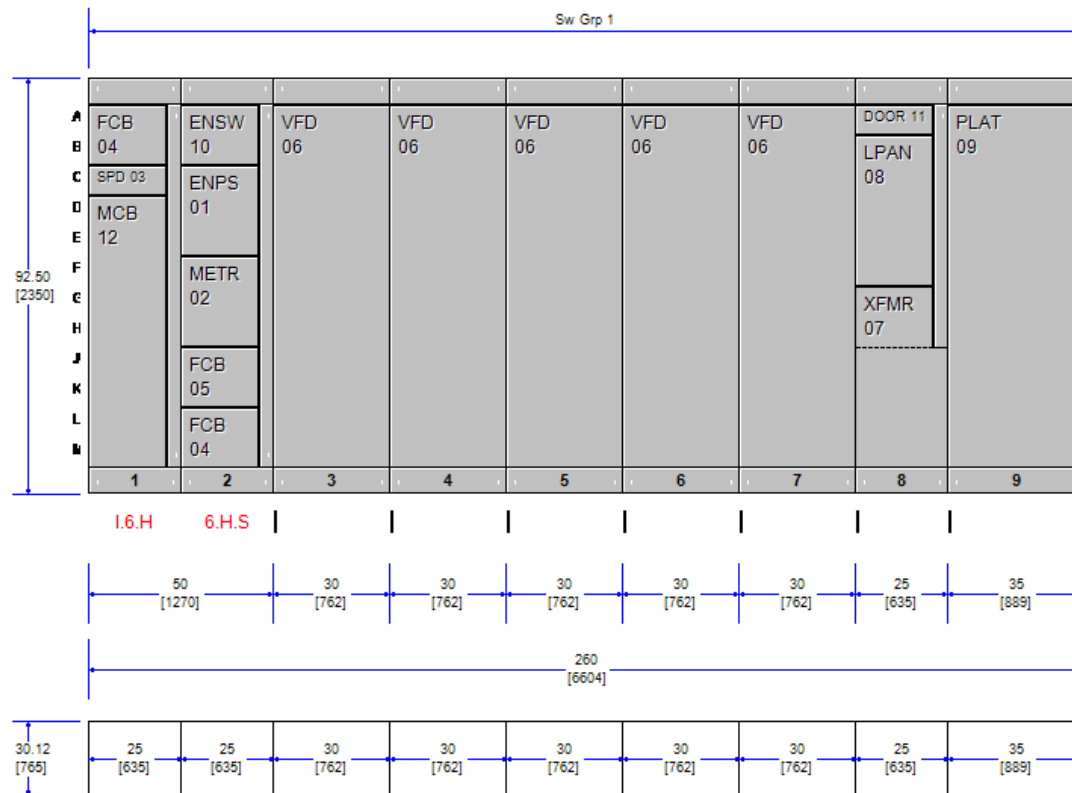
Centerline 2100 Motor Control Center

Front Elevation

Project Name: CWD - Conejo Wells
 Project Item: MCC-2 - N3R
 Project ID #: 5271772/4

Salesperson: Juan Campos
 Created By: Juan Campos
 Date/Time: 10/25/21 - 21:02

Rockwell Automation/Allen-Bradley
 PowerControl Builder Lineup



NOTE: Dimensions are subject to change after design review.

ENCLOSURE: NEMA Type 3R (Outdoor Non-Walk-In: the external width of each NEMA Type 3R cabinet is 5" wider and 10" deeper than its internal section)

Estimated Heat Loss: 13583 watts

BTU/hr Required: 46348

Air Conditioning Tons: 3.88

Estimated Weight: 6750 lb (3062 kg)

Heat loss values are for estimating purposes only.

Rockwell Automation

Centerline 2100 Motor Control Center

Unit Nameplate Report

Project Name: CWD - Conejo Wells
Project Item: MCC-2 - N3R
Project ID #: 5271772/4

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:02

Master Nameplate Type - No Master Nameplate Supplied

Unit Nameplate Type - Acrylic - Black letters on white (3 lines)
(Maximum characters per line is 17 / 15 / 17)

IP Address - IP Address Not Included on Nameplate

Section 1

Location: 01A FCB Left Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 01C SPD Space Factor: 0.5 Wiring Diagram Number: 10006415263
SPD

Location: 01A FCB Right Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 01D MCB Space Factor: 4.5 Wiring Diagram Number: N/A

Section 2

Location: 02A ENSW Space Factor: 1 Wiring Diagram Number: 10006415251
ETHERNET SWITCH

Location: 02C ENPS Space Factor: 1.5 Wiring Diagram Number: 10006415245
ETHERNET
POWER SUPPLY

Location: 02F METR Space Factor: 1.5 Wiring Diagram Number: 10006415275
POWER
METER

Location: 02L FCB Left Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02J FCB Left Space Factor: 1 Wiring Diagram Number: 10006415287
SPARE

Location: 02L FCB Right Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02J FCB Right Space Factor: 1 Wiring Diagram Number: 10006415287
SPARE

Section 3

Location: 03A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
WELL NO. 4

Section 4

Location: 04A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
2A-BSTR-PMP

Section 5

Location: 05A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
2B-BSTR-PMP

Section 6

Location: 06A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
40-PMP-01

Section 7

Location: 07A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
40-PMP-02

Section 8

Location: 08A DOOR Space Factor: 0.5 Wiring Diagram Number: 10002277146

Location: 08G XFMR Space Factor: 3 Wiring Diagram Number: 10006415299
TX-LP2

Location: 08B LPAN Space Factor: 2.5 Wiring Diagram Number: 10005989973
LP2

Section 9

Location: 09A PLAT Space Factor: 6 Wiring Diagram Number: 10006415257

Unit Details - CWD - Conejo Wells

Master Nameplate Type: No Master Nameplate

Unit Nameplate Type: Acrylic - Black letters on white (3 lines)

Location	Type	HP	KW	Rating	Nameplate L1	Nameplate L2	Nameplate L3	Nameplate L4	Switch Location	IP/Subnet Address	Dual IP Address	Switch Port	Dual Switch Port
1A	FCB	0	0	100	SPARE								
1C	SPD	0	0	0	SPD								
1D	MCB	0	0	1200									
2C	ENPS	0	0	30	ETHERNET	POWER SUPPLY							
2F	METR	0	0	0	POWER	METER			02A-R	192.168.1.1	192.168.1.2	01	02
2J	FCB	0	0	40	SPARE								
2L	FCB	0	0	100	SPARE								
3A	VFD	125	0	250.0	WELL NO. 4				02A-R	192.168.1.4 255.255.255.0		03	
4A	VFD	125	0	250.0	BOOSTER PUMP	2A-BSTR-PMP			02A-R	192.168.1.5 255.255.255.0		04	
5A	VFD	125	0	250.0	BOOSTER PUMP	2B-BSTR-PMP			02A-R	192.168.1.6 255.255.255.0		05	
6A	VFD	125	0	250.0	BOOSTER PUMP	40-PMP-01			02A-R	192.168.1.7 255.255.255.0		06	
7A	VFD	125	0	250.0	BOOSTER PUMP	40-PMP-02			02A-R	192.168.1.8 255.255.255.0		07	
8A	DOOR	0	0	0									
8B	LPAN	0	0	0	LP2								
8G	XFMR	0	0	70	TX-LP2								
9A	PLAT	0	0	20									
2A	ENSW	0	0	0	ETHERNET SWITCH				2A-R	192.168.1.3 255.255.255.0			

Ethernet Switch Port Capacity

Uplink	Switch group	Section	Consumed Switch Ports		Available Switch Ports
1	1	1	0	7	9
		2	2		
		3	1		
		4	1		
		5	1		
		6	1		
		7	1		
		8	0		
		9	0		

Rockwell Automation

Centerline 2100 Motor Control Center

MCC Details

Project Name: CWD - Conejo Wells
Project Item: MCC-3 - N3R
Project ID #: 5271772/5

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:03

The details of the proposed motor control center are as follows:

Category	Description
Total Section(s)	9
Total Shipping Block(s)	8
Section Depth	Front Mounted, 20" Deep
Section Height	90" High
Enclosure	3R - Outdoor Non-Walk-In
Designed For Use With	Power System Type: Wye, 3-phase, 4-wire with solidly grounded neutral
MCC Connection Type	Main Circuit Breaker
Incoming Cable Entry	Bottom, Section 1
Main Bus Rating	1200A
Main Bus Material	Copper / Tin Plated
Main Bus Bracing	65kA (rms symmetrical)
Horizontal Neutral Bus Rating	Half of Main Bus Rating
Horizontal Neutral Bus Location	Below Main Bus
Horizontal Neutral Bus Supplied	In Section(s): 1, 2
Horizontal Ground Bus	1/4" X 1", Bottom, Unplated Copper
Vertical Ground Bus	Unit Load Copper and Plug-in Copper
Stab Opening Protection	Automatic Shutters
Master Nameplate	No

Rockwell Automation

Centerline 2100 Motor Control Center

Basic Structure Information

Project Name: CWD - Conejo Wells
Project Item: MCC-3 - N3R
Project ID #: 5271772/5

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:03

Motor Control Center Details

This MCC(s) was developed using an available fault current of 50,001 to 65,000 A.
MCC configuration & pricing subject to change, if actual Available Fault Current differs.

Motor Control Center Details

Power System Type: Wye, 3-phase, 4-wire with solidly grounded neutral
Voltage: 480 Volts / 60 Hertz
Available Fault Current: 50,001 to 65,000 A
Unit Nameplate Type: Acrylic - Black letters on white
Wiring Type: B-T Control and Power Terminal Blocks
Wiring Diagram Location: Central location
Class II Diagram: TBD
Class II Wire Count: 1
Class II Wire Through: Top Wireway
Arc Resistant MCC: No
IntelliCENTER Network: Ethernet
IMC Device Firmware: Upgraded to latest available version (saves up to 1 hour of customer configuration time per section)

Incoming Line Details

MCC Connection Type: Main Circuit Breaker
Incoming Line Cable Entry: Bottom Mounted

Bus Details

Main Bus Rating: 1200A
Main Bus Material: Copper / Tin Plated
Main Bus Bracing: 65kA (rms symmetrical)
Insulated Bus: None Selected

Horizontal Ground Bus Size: 1/4" X 1"
Horizontal Ground Bus Plating: Unplated Copper
Horizontal Ground Bus Location: Bottom
Vertical Ground Bus Type: Unit Load Copper and Plug-in Copper
Incoming Ground Lug Size: #6 AWG - 250 kcmil (2 Supplied as Standard)
Incoming Ground Cable Size: None Selected

Horizontal Neutral Bus Rating: Half of Main Bus Rating
Horizontal Neutral Bus Location: Below Main Bus

Enclosure Details

Enclosure Type: 3R - Outdoor Non-Walk-In
NEMA 3R/4 Lifting Angle: No
Section Depth: Front Mounted, 20" Deep
Enclosure Depth: Front Mounted, 30.12" Deep
Section Height: 90" High
Stab Opening Protection: Automatic Shutters
Wireway Tie Bar: Yes
Space Heater Voltage: 120V
Space Heater Thermostat: 1 Per Section

Total Shipping Block(s): 8
Total Section(s): 9
Total Unit(s): 17

Ethernet Network Information

Full Ethernet Network Information can be found on the One Line Diagram associated with this project item. This drawing can be obtained by requesting Pre-order drawings through PowerControl Builder.

Section Modifications (Qty/Mods)

MCC Level Mods:

Class II interwiring or Limited Class II between units in MCC (30 wires max; a 15% adder is applied if more than 30 wires) (List price is per wire 30 and under).

Section 1 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 2 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 3 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 4 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 5 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 6 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 7 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 8 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 9 Modifications (Quantity/Mods)

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section Number	Section Width (inches)	Options/Modifications
1	20"	600A Vertical Bus Horizontal Neutral Bus

2	20"	600A Vertical Bus Horizontal Neutral Bus
3	25"	N/A
4	25"	N/A
5	25"	N/A
6	25"	N/A
7	25"	N/A
8	20"	N/A
9	30"	N/A

Rockwell Automation

Centerline 2100 Motor Control Center

Unit List

Project Name: CWD - Conejo Wells
 Project Item: MCC-3 - N3R
 Project ID #: 5271772/5

Salesperson: Juan Campos
 Created By: Juan Campos
 Date/Time: 10/25/21 - 21:03

ID	QTY	Catalog Number / Unit Description
1	1	2100-EPS8KB-30TGM-79U-751M-751S-768C / Ethernet Power Supply Unit with Circuit Breaker Thermal Magnetic (15A Trip)
2	1	2190-CKB-56M-79U-86W54CXB-751M-751S / Metering Unit - Bul 1426-M5 PM 5000 w/Ethernet
3	1	2100-SPKB-3-751M-751S / Surge Protective Device Unit - Wye w/solidly grd neut, 4-wire
4	2	2193F-AKB-79L-79U-751M-4031TGM / Feeder Circuit Breaker - 125A Frame Rating with 100A/20A Trip
5	1	2193F-AKB-79L-79U-751M-3434TGM / Feeder Circuit Breaker - 125A Frame Rating with 40A/40A Trip
6	5	2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A / PowerFlex 755 AC Drive w/CB - 125 HP with Circuit Breaker Thermal Magnetic (250A Trip)
-	1	<i>Customer Load Cables Exit(Bottom)</i>
7	1	2197-WKBH-37TGM-79L-79U-751M-790A / Control & Lighting Transformer w/CB - 45.0 kVA with Circuit Breaker Thermal Magnetic (70A Trip)
8	1	2193LE-AKB327-40WT-31A27-111-751M / Lighting Panel Unit with Main Circuit Breaker - 100A - 27 Total Circuits
9	1	2100-GKC2X3B-31TGM-120-751M / Full Sect Blank Mtg Plate w/ or w/o Disc with Circuit Breaker Thermal Magnetic (20A Trip)
-	1	<i>Customer Load Cables Exit(Bottom)</i>
10	1	2100-ESW20K-T10FDP-114-751M-751S / Stratix 5700 20-Port
11	1	2100-BK05 / Blank Unit Door - 0.5 Space Factor
12	1	2193MB-GKC-56TNMG-88HN-751M / Main Circuit Breaker - 1200A Frame Rating - Bottom Mounted with 1200A Trip w/ Maintenance Mode

Rockwell Automation

Centerline 2100 Motor Control Center

Unit Description

Project Name: CWD - Conejo Wells
Project Item: MCC-3 - N3R
Project ID #: 5271772/5

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:03

General Information

Line Voltage / Frequency: 480 Volts / 60 Hertz
Power System Configuration: Wye, 3-phase, 4-wire with solidly grounded neutral
Class I Wiring Type: B-T Control and Power Terminal Blocks
NEMA Enclosure Type: 3R - Outdoor Non-Walk-In
Available Fault Current: 50,001 to 65,000 A
Unit Nameplate Type: Acrylic - Black letters on white
Delivery Program: ENG

Unit Information

Description	Unit Features
<p>Unit Loc: 01A Del Prog: SCII Unit ID: 4 FCB - Feeder Circuit Breaker</p> <p><u>Rating</u> Dual 100A/20A</p> <p><u>Wiring Diagram</u> 10006415294</p> <p><u>Name Plate Information</u> PANEL CHEM FEED BUILDING</p> <p><u>Dual Unit</u> SPARE</p> <p><u>Overload Relay(s)</u> Motor Full Load Current (FLC) = Not Available</p>	<p>Catalog Number: 2193F-AKB-79L-79U-751M-4031TGM Total Space Factor = 1 Circuit Breaker: Thermal Magnetic, 65kA at 480V (100) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 100A/20A Trip Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</p> <p><u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) Mylar Device Markers (-751M)</p>
<p>Unit Loc: 01C Del Prog: PEII Unit ID: 3 SPD - Surge Protective Device Unit</p> <p><u>Wiring Diagram</u> 10006415263</p> <p><u>Name Plate Information</u> SPD</p>	<p>Catalog Number: 2100-SPKB-3-751M-751S Total Space Factor = 0.5 Surge Protector Type: Wye w/solidly grd neut, 4-wire</p> <p><u>Features Included</u> Mylar Device Markers (-751M) Sleeve Type Markers (-751S)</p>

<div>Unit Loc: 01D Del Prog: FT1</div> <div>Unit ID: 12</div> <div>MCB - Main Circuit Breaker</div> <div><div>Rating</div><div>1200A</div></div>	<div>Catalog Number: 2193MB-GKC-56TNMG-88HN-751M</div> <div>Total Space Factor = 4.5</div> <div>Circuit Breaker: Electronic (LSIG) - Maint. Mode, 65kA at 480V (1200) with Frame Rating of 1200A (N6I Frame) w/ Maintenance Mode, Bottom Mounted, 1200A Trip, with Internal Ground Fault Protection</div> <div>Lugs Supplied: Std Mech/Lug Pads, 500 kcmil Size Wire, 4 Cables per Phase</div> <div><div>Features Included</div><div>INC_NEUT_BUS Half-rated (-88HN)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) 140G Maintenance Mode - Switch Mode Selector Switch, Blue Indicator Light, & Control components for K,M,N & R Frame.</div><div>(1) Engineered Modification and/or Custom Diagram</div></div>						
<div>Unit Loc: 02A Del Prog: PEII</div> <div>Unit ID: 10</div> <div>ENSW - Stratix 5700 20-Port</div> <div><div>Wiring Diagram</div><div>10006415251</div></div> <div><div>Name Plate Information</div><div>ETHERNET SWITCH</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2100-ESW</td><td>192.168.1.3</td><td>255.255.255.0</td></tr></table><div>No Cable Length</div><div>Ethernet Switch Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2100-ESW	192.168.1.3	255.255.255.0	<div>Catalog Number: 2100-ESW20K-T10FDP-114-751M-751S</div> <div>Total Space Factor = 1</div> <div>Full Stratix 5700 Firmware</div> <div>NAT (CIP Sync & Gigabit Ports)</div> <div>Power Adapters (w/Unit Mtg)</div> <div><div>Features Included</div><div>Locking Latch Provision (-114)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div></div>
Device Type	IP Address	Subnet Mask					
2100-ESW	192.168.1.3	255.255.255.0					
<div>Unit Loc: 02C Del Prog: SCII</div> <div>Unit ID: 1</div> <div>ENPS - Ethernet Power Supply Unit</div> <div><div>Rating</div><div>125A</div></div> <div><div>Wiring Diagram</div><div>10006415245</div></div> <div><div>Name Plate Information</div><div>ETHERNET POWER SUPPLY</div></div>	<div>Catalog Number: 2100-EPS8KB-30TGM-79U-751M-751S-768C</div> <div>Total Space Factor = 1.5</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (15A Trip)</div> <div>Disconnect Type = Circuit Breaker</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div><div>Features Included</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>Redundant ENet Power Supply (-768C)</div></div>						

<div>Unit Loc: 02F Del Prog: ENG</div> <div>Unit ID: 2</div> <div>METR - Metering Unit</div> <div><div>Wiring Diagram</div><div>10006415275</div></div> <div><div>Name Plate Information</div><div>POWER</div><div>METER</div></div> <div><div>Ethernet Information</div><div><div>Device Type</div><div>IP Address</div><div>Subnet Mask</div><div>2190</div><div>192.168.1.1</div><div>255.255.255.0</div><div>2190</div><div>192.168.1.2</div><div>255.255.255.0</div></div><div>Cable Length : 2.49 m</div><div>Power Monitor Firmware Version : LATEST</div></div>	<div>Catalog Number: 2190-CKB-56M-79U-86W54CXB-751M-751S</div> <div>Total Space Factor = 1.5</div> <div>Metering Type: Bul 1426-M5 PM 5000 w/Ethernet</div> <div>Ammeter Scale 1200</div> <div><div>Features Included</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Upgrade PM 5000 from M5 to M6,1426-M6E</div><div>(1) Engineered Modification and/or Custom Diagram</div></div>
<div>Unit Loc: 02J Del Prog: SCII</div> <div>Unit ID: 5</div> <div>FCB - Feeder Circuit Breaker</div> <div><div>Rating</div><div>Dual 40A/40A</div></div> <div><div>Wiring Diagram</div><div>10006415287</div></div> <div><div>Name Plate Information</div><div>SPARE</div></div> <div><div>Dual Unit</div><div>SPARE</div></div> <div><div>Overload Relay(s)</div><div>Motor Full Load Current (FLC) = Not Available</div></div>	<div>Catalog Number: 2193F-AKB-79L-79U-751M-3434TGM</div> <div>Total Space Factor = 1</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (40) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 40A/40A Trip</div> <div>Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</div> <div><div>Features Included</div><div>Unit Ground Load Connector Unplated Cu (-79L)</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div></div>
<div>Unit Loc: 02L Del Prog: SCII</div> <div>Unit ID: 4</div> <div>FCB - Feeder Circuit Breaker</div> <div><div>Rating</div><div>Dual 100A/20A</div></div> <div><div>Wiring Diagram</div><div>10006415294</div></div> <div><div>Name Plate Information</div><div>SPARE</div></div> <div><div>Dual Unit</div><div>SPARE</div></div> <div><div>Overload Relay(s)</div><div>Motor Full Load Current (FLC) = Not Available</div></div>	<div>Catalog Number: 2193F-AKB-79L-79U-751M-4031TGM</div> <div>Total Space Factor = 1</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (100) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 100A/20A Trip</div> <div>Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</div> <div><div>Features Included</div><div>Unit Ground Load Connector Unplated Cu (-79L)</div><div>Unit Grd Stab Unplated Cu (-79U)</div><div>Mylar Device Markers (-751M)</div></div>

<div><div>Unit Loc: 03A</div><div>Del Prog: ENG</div><div>Unit ID: 6</div><div>VFD - PowerFlex 755 AC Drive w/CB</div></div> <div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div> <div><div>Wiring Diagram</div><div>10006435909</div></div> <div><div>Name Plate Information</div><div>WELL NO. 2</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.4</td><td>255.255.255.0</td></tr></table><div>Cable Length : 2.9 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.4	255.255.255.0	<div><div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div><div>Total Space Factor = 6</div><div>Wiring: NEMA Type B wiring</div><div>Output Current Rating: 156A</div><div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div><div>Human Interface Module: LCD full numeric keypad - Door Mounted</div><div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div><div>Control Wiring: #16 AWG MTW(TEW) Cu</div></div> <div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.4	255.255.255.0					

<div><div><div>Unit Loc: 04A</div><div>Del Prog: ENG</div></div><div><div>Unit ID: 6</div><div>VFD - PowerFlex 755 AC Drive w/CB</div></div><div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div><div><div>Wiring Diagram</div><div>10006435909</div></div><div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>P4-BSTR-PMP</div></div><div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.5</td><td>255.255.255.0</td></tr></table><div>Cable Length : 3.66 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.5	255.255.255.0	<div><div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div><div>Total Space Factor = 6</div><div>Wiring: NEMA Type B wiring</div><div>Output Current Rating: 156A</div><div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div><div>Human Interface Module: LCD full numeric keypad - Door Mounted</div><div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div><div>Control Wiring: #16 AWG MTW(TEW) Cu</div><div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div><div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div></div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.5	255.255.255.0					

<div><div><div>Unit Loc: 05A</div><div>Del Prog: ENG</div></div><div><div>Unit ID: 6</div><div>VFD - PowerFlex 755 AC Drive w/CB</div></div><div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div><div><div>Wiring Diagram</div><div>10006435909</div></div><div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>P5-BSTR-PMP</div></div><div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.6</td><td>255.255.255.0</td></tr></table><div>Cable Length : 4.42 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.6	255.255.255.0	<div><div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div><div>Total Space Factor = 6</div><div>Wiring: NEMA Type B wiring</div><div>Output Current Rating: 156A</div><div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div><div>Human Interface Module: LCD full numeric keypad - Door Mounted</div><div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div><div>Control Wiring: #16 AWG MTW(TEW) Cu</div><div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div><div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div></div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.6	255.255.255.0					

<div><div><div>Unit Loc: 06A</div><div>Del Prog: ENG</div></div><div><div>Unit ID: 6</div><div>VFD - PowerFlex 755 AC Drive w/CB</div></div><div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div><div><div>Wiring Diagram</div><div>10006435909</div></div><div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>P6-BSTR-PMP</div></div><div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.7</td><td>255.255.255.0</td></tr></table><div>Cable Length : 5.18 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.7	255.255.255.0	<div><div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div><div>Total Space Factor = 6</div><div>Wiring: NEMA Type B wiring</div><div>Output Current Rating: 156A</div><div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div><div>Human Interface Module: LCD full numeric keypad - Door Mounted</div><div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div><div>Control Wiring: #16 AWG MTW(TEW) Cu</div><div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div><div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.7	255.255.255.0					

<div>Unit Loc: 07A Del Prog: ENG</div> <div>Unit ID: 6</div> <div>VFD - PowerFlex 755 AC Drive w/CB</div> <div><div>Rating</div><div>125 HP</div><div>(Heavy Duty)</div></div> <div><div>Wiring Diagram</div><div>10006435909</div></div> <div><div>Name Plate Information</div><div>BOOSTER PUMP</div><div>P7-BSTR-PMP</div></div> <div><div>Ethernet Information</div><table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.8</td><td>255.255.255.0</td></tr></table><div>Cable Length : 5.95 m</div><div>PowerFlex 755 Firmware Version : LATEST</div></div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.8	255.255.255.0	<div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div> <div>Total Space Factor = 6</div> <div>Wiring: NEMA Type B wiring</div> <div>Output Current Rating: 156A</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div> <div>Human Interface Module: LCD full numeric keypad - Door Mounted</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div><div>Features Included</div><div>Selector Switch: HAND-OFF-AUTO (-3F)</div><div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div><div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div><div>Thermostat Door Mounted (-14FCT)</div><div>Dualport Ethernet (for VFD) (-14GER)</div><div>Drive Line Reactor (-14RLX)</div><div>Mylar Device Markers (-751M)</div><div>Sleeve Type Markers (-751S)</div><div>1 Aux and 1 Alarm-Internal-CB (-790A)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) Customer Load Cables Exit(Bottom)</div><div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div><div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div><div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div><div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div><div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div><div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div></div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.8	255.255.255.0					
<div>Unit Loc: 08A Del Prog: SCII</div> <div>Unit ID: 11</div> <div>DOOR - Blank Unit Door</div>	<div>Catalog Number: 2100-BK05</div> <div>Total Space Factor = 0.5</div>						
<div>Unit Loc: 08B Del Prog: ENG</div> <div>Unit ID: 8</div> <div>LPAN - Lighting Panel Unit</div> <div><div>Wiring Diagram</div><div>10005989973</div></div> <div><div>Name Plate Information</div><div>LP3</div></div>	<div>Catalog Number: 2193LE-AKB327-40WT-31A27-111-751M</div> <div>Total Space Factor = 2.5</div> <div>Panel Type & Rating: Three Phase, 4-Wire, 120/208V, 100A, 27 total circuits</div> <div>Bolt-On Branch Breakers: None</div> <div><div>Features Included</div><div>(27) 20A 1-P CB (-31A27)</div></div> <div><div>Engineered Spec(s)/Modification(s)</div><div>(1) 2193LE, Lighting Panel - Copper bus, unplated (Aluminum is standard), 100A (30 circuit maximum, 1or 3 phase)</div><div>(1) Engineered Modification and/or Custom Diagram</div><div>(1) 2193LE, Lighting Panel - Wire panel to transformer, 100A</div></div>						

<p>Unit Loc: 08G Del Prog: SCII Unit ID: 7 XFMR - Control & Lighting Transformer w/CB</p> <p><u>Wiring Diagram</u> 10006415299</p> <p><u>Name Plate Information</u> TX-LP3</p>	<p>Catalog Number: 2197-WKBH-37TGM-79L-79U-751M-790A Total Space Factor = 3 Secondary Wiring Fusing & Rating: 3-Phase, 120/208V, 3 Fuse, 45.0 kVA Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (70A Trip)</p> <p><u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) 1 Aux and 1 Alarm-Internal-CB (-790A)</p>
<p>Unit Loc: 09A Del Prog: ENG Unit ID: 9 PLAT - Full Sect Blank Mtg Plate w/ or w/o Disc</p> <p><u>Rating</u> 20A</p> <p><u>Wiring Diagram</u> 10006415257</p>	<p>Catalog Number: 2100-GKC2X3B-31TGM-120-751M Total Space Factor = 6</p> <p>Rating: 20A Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (20A Trip) Disconnect Type = Circuit Breaker Required Section Width 30" Wide Working Depth 14" Deep</p> <p><u>Features Included</u> Omit horizontal power bus (-120)</p> <p><u>Engineered Spec(s)/Modification(s)</u> (1) Customer Load Cables Exit(Bottom) (1) Compact Logix 2MB Motion Controller,1769-L33ERM (1) Engineered Modification and/or Custom Diagram (4) 120V AC INPUT MODULE,1769-IA16 (2) 8 ANALOG INPUTS,1769-IF8 (1) POWER SUPPLY,1769-PA4 (2) Power Supply, 120W, 24VDC, 5A output, 120-240VAC input,1606-XLS120E Note - 1606-XLE240E (1) END CAP RIGHT,1769-ECR (2) 1000VA Control Transformer-Fusing/Fuse Block Included ,1497-K-BASX-0-N Note - 1.6KVA XFMR (30) IEC Terminal Blocks,1492-JG4,6,10? (200) I/O Wiring to terminal blocks within a PLC, SLC or ControlLogix unit (per wire) (200) Finger-Safe High Density Terminal Blocks,1492-H1,2,4,5,6,7? (2) Receptacle, Duplex, GFI, 120V, 15A maximum, mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12 , power source not included (4) Panduit Wiring Duct and Covers (White, 6 ft length) (Width, Height determined by adding PCB# Note) (2) 8 CURRENT ANALOG OUTPUTS,1769-OF8C (2) 120/240V AC OUTPUT MODULE,1769-OA16 (1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</p>

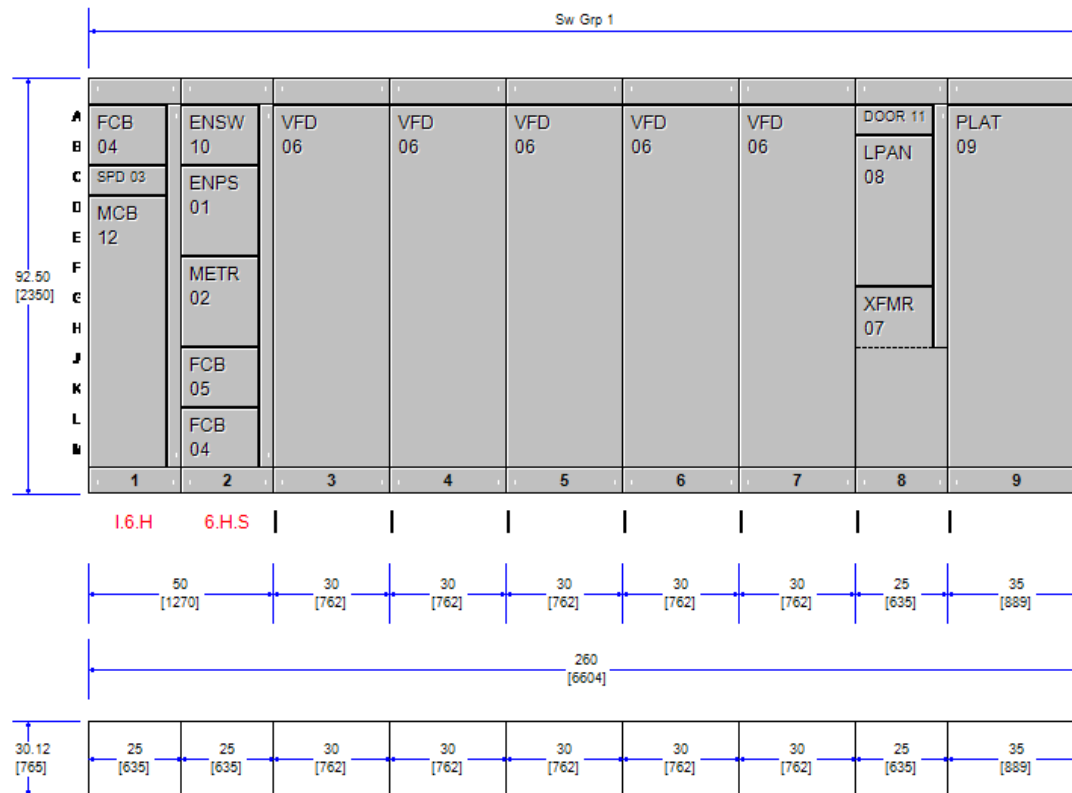
Rockwell Automation

Centerline 2100 Motor Control Center Front Elevation

Project Name: CWD - Conejo Wells
 Project Item: MCC-3 - N3R
 Project ID #: 5271772/5

Salesperson: Juan Campos
 Created By: Juan Campos
 Date/Time: 10/25/21 - 21:03

Rockwell Automation/Allen-Bradley
 PowerControl Builder Lineup



NOTE: Dimensions are subject to change after design review.

ENCLOSURE: NEMA Type 3R (Outdoor Non-Walk-In: the external width of each NEMA Type 3R cabinet is 5" wider and 10" deeper than its internal section)

Estimated Heat Loss: 13583 watts

BTU/hr Required: 46348

Air Conditioning Tons: 3.88

Estimated Weight: 6750 lb (3062 kg)

Heat loss values are for estimating purposes only.

Rockwell Automation

Centerline 2100 Motor Control Center

Unit Nameplate Report

Project Name: CWD - Conejo Wells
Project Item: MCC-3 - N3R
Project ID #: 5271772/5

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:03

Master Nameplate Type - No Master Nameplate Supplied

Unit Nameplate Type - Acrylic - Black letters on white (3 lines)
(Maximum characters per line is 17 / 15 / 17)

IP Address - IP Address Not Included on Nameplate

Section 1

Location: 01A FCB Left Space Factor: 1 Wiring Diagram Number: 10006415294
PANEL CHEM
FEED BUILDING

Location: 01C SPD Space Factor: 0.5 Wiring Diagram Number: 10006415263
SPD

Location: 01A FCB Right Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 01D MCB Space Factor: 4.5 Wiring Diagram Number: N/A

Section 2

Location: 02A ENSW Space Factor: 1 Wiring Diagram Number: 10006415251
ETHERNET SWITCH

Location: 02C ENPS Space Factor: 1.5 Wiring Diagram Number: 10006415245
ETHERNET
POWER SUPPLY

Location: 02F METR Space Factor: 1.5 Wiring Diagram Number: 10006415275
POWER
METER

Location: 02L FCB Left Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02J FCB Left Space Factor: 1 Wiring Diagram Number: 10006415287
SPARE

Location: 02L FCB Right Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02J FCB Right Space Factor: 1 Wiring Diagram Number: 10006415287
SPARE

Section 3

Location: 03A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
WELL NO. 2

Section 4

Location: 04A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
P4-BSTR-PMP

Section 5

Location: 05A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
P5-BSTR-PMP

Section 6

Location: 06A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
P6-BSTR-PMP

Section 7

Location: 07A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
BOOSTER PUMP
P7-BSTR-PMP

Section 8

Location: 08A DOOR Space Factor: 0.5 Wiring Diagram Number: 10002277146

Location: 08G XFMR Space Factor: 3 Wiring Diagram Number: 10006415299
TX-LP3

Location: 08B LPAN Space Factor: 2.5 Wiring Diagram Number: 10005989973
LP3

Section 9

Location: 09A PLAT Space Factor: 6 Wiring Diagram Number: 10006415257

Unit Details - CWD - Conejo Wells

Master Nameplate Type: No Master Nameplate

Unit Nameplate Type: Acrylic - Black letters on white (3 lines)

Location	Type	HP	KW	Rating	Nameplate L1	Nameplate L2	Nameplate L3	Nameplate L4	Switch Location	IP/Subnet Address	Dual IP Address	Switch Port	Dual Switch Port
1A	FCB	0	0	100	PANEL CHEM	FEED BUILDING							
1C	SPD	0	0	0	SPD								
1D	MCB	0	0	1200									
2C	ENPS	0	0	30	ETHERNET	POWER SUPPLY							
2F	METR	0	0	0	POWER	METER			02A-R	192.168.1.1	192.168.1.2	01	02
2J	FCB	0	0	40	SPARE								
2L	FCB	0	0	100	SPARE								
3A	VFD	125	0	250.0	WELL NO. 2				02A-R	192.168.1.4 255.255.255.0		03	
4A	VFD	125	0	250.0	BOOSTER PUMP	P4-BSTR-PMP			02A-R	192.168.1.5 255.255.255.0		04	
5A	VFD	125	0	250.0	BOOSTER PUMP	P5-BSTR-PMP			02A-R	192.168.1.6 255.255.255.0		05	
6A	VFD	125	0	250.0	BOOSTER PUMP	P6-BSTR-PMP			02A-R	192.168.1.7 255.255.255.0		06	
7A	VFD	125	0	250.0	BOOSTER PUMP	P7-BSTR-PMP			02A-R	192.168.1.8 255.255.255.0		07	
8A	DOOR	0	0	0									
8B	LPAN	0	0	0	LP3								
8G	XFMR	0	0	70	TX-LP3								
9A	PLAT	0	0	20									
2A	ENSW	0	0	0	ETHERNET SWITCH				2A-R	192.168.1.3 255.255.255.0			

Ethernet Switch Port Capacity

Uplink	Switch group	Section	Consumed Switch Ports		Available Switch Ports
1	1	1	0	7	9
		2	2		
		3	1		
		4	1		
		5	1		
		6	1		
		7	1		
		8	0		
		9	0		

Rockwell Automation

Centerline 2100 Motor Control Center

MCC Details

Project Name: CWD - Conejo Wells
Project Item: MCC-4 - N3R
Project ID #: 5271772/6

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:03

The details of the proposed motor control center are as follows:

Category	Description
Total Section(s)	7
Total Shipping Block(s)	6
Section Depth	Front Mounted, 20" Deep
Section Height	90" High
Enclosure	3R - Outdoor Non-Walk-In
Designed For Use With	Power System Type: Wye, 3-phase, 4-wire with solidly grounded neutral
MCC Connection Type	Main Circuit Breaker
Incoming Cable Entry	Bottom, Section 1
Main Bus Rating	600A
Main Bus Material	Copper / Tin Plated
Main Bus Bracing	65kA (rms symmetrical)
Horizontal Neutral Bus Rating	Half of Main Bus Rating
Horizontal Neutral Bus Location	Below Main Bus
Horizontal Neutral Bus Supplied	In Section(s): 1, 2
Horizontal Ground Bus	1/4" X 1", Bottom, Unplated Copper
Vertical Ground Bus	Unit Load Copper and Plug-in Copper
Stab Opening Protection	Automatic Shutters
Master Nameplate	No

Rockwell Automation

Centerline 2100 Motor Control Center

Basic Structure Information

Project Name: CWD - Conejo Wells
Project Item: MCC-4 - N3R
Project ID #: 5271772/6

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:03

Motor Control Center Details

This MCC(s) was developed using an available fault current of 50,001 to 65,000 A.
MCC configuration & pricing subject to change, if actual Available Fault Current differs.

Motor Control Center Details

Power System Type: Wye, 3-phase, 4-wire with solidly grounded neutral
Voltage: 480 Volts / 60 Hertz
Available Fault Current: 50,001 to 65,000 A
Unit Nameplate Type: Acrylic - Black letters on white
Wiring Type: B-T Control and Power Terminal Blocks
Wiring Diagram Location: Central location
Class II Diagram: TBD
Class II Wire Count: 1
Class II Wire Through: Top Wireway
Arc Resistant MCC: No
IntelliCENTER Network: Ethernet
IMC Device Firmware: Upgraded to latest available version (saves up to 1 hour of customer configuration time per section)

Incoming Line Details

MCC Connection Type: Main Circuit Breaker
Incoming Line Cable Entry: Bottom Mounted

Bus Details

Main Bus Rating: 600A
Main Bus Material: Copper / Tin Plated
Main Bus Bracing: 65kA (rms symmetrical)
Insulated Bus: None Selected

Horizontal Ground Bus Size: 1/4" X 1"
Horizontal Ground Bus Plating: Unplated Copper
Horizontal Ground Bus Location: Bottom
Vertical Ground Bus Type: Unit Load Copper and Plug-in Copper
Incoming Ground Lug Size: #6 AWG - 250 kcmil (2 Supplied as Standard)
Incoming Ground Cable Size: None Selected

Horizontal Neutral Bus Rating: Half of Main Bus Rating
Horizontal Neutral Bus Location: Below Main Bus

Enclosure Details

Enclosure Type: 3R - Outdoor Non-Walk-In
NEMA 3R/4 Lifting Angle: No
Section Depth: Front Mounted, 20" Deep
Enclosure Depth: Front Mounted, 30.12" Deep
Section Height: 90" High
Stab Opening Protection: Automatic Shutters
Wireway Tie Bar: Yes
Space Heater Voltage: 120V
Space Heater Thermostat: 1 Per Section

Total Shipping Block(s): 6
Total Section(s): 7
Total Unit(s): 20

Ethernet Network Information

Full Ethernet Network Information can be found on the One Line Diagram associated with this project item. This drawing can be obtained by requesting Pre-order drawings through PowerControl Builder.

Section Modifications (Qty/Mods)

MCC Level Mods:

Class II interwiring or Limited Class II between units in MCC (30 wires max; a 15% adder is applied if more than 30 wires) (List price is per wire 30 and under).

Custom Shipping Block (Per Block)

Note - SECTIONS 4 & 5.

Section 1 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 2 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

Section 3 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

Section 4 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

Section 6 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

Section 7 Modifications (Quantity/Mods)

(1) NEMA 3R/4 fluorescent lighting fixture

(1) Light Switch, 120V, 15A maximum, Mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12, power source not included

(1) Door Switch, 120V, mounted on door flange, power source not included

(1) Vented 3R door with hood (Hurricane Vent) AND/OR filtered exhaust fan(s) as needed for SMC, VFD and lighting transformers wired to TB"S for customer use or internal power source.

Section Number	Section Width (inches)	Options/Modifications
1	20"	600A Vertical Bus Horizontal Neutral Bus
2	20"	600A Vertical Bus Horizontal Neutral Bus
3	25"	N/A
4	25"	N/A
5	20"	N/A
6	20"	N/A
7	30"	N/A

Rockwell Automation

Centerline 2100 Motor Control Center

Unit List

Project Name: CWD - Conejo Wells
 Project Item: MCC-4 - N3R
 Project ID #: 5271772/6

Salesperson: Juan Campos
 Created By: Juan Campos
 Date/Time: 10/25/21 - 21:03

ID	QTY	Catalog Number / Unit Description
1	1	2100-EPS8KB-30TGM-79U-751M-751S-768C / Ethernet Power Supply Unit with Circuit Breaker Thermal Magnetic (15A Trip)
2	1	2190-CKB-56M-79U-86W54CXB-751M-751S / Metering Unit - Bul 1426-M5 PM 5000 w/Ethernet
3	1	2100-SPKB-3-751M-751S / Surge Protective Device Unit - Wye w/solidly grd neut, 4-wire
4	2	2193F-AKB-79L-79U-751M-4031TGM / Feeder Circuit Breaker - 125A Frame Rating with 100A/20A Trip
5	1	2193F-AKB-79L-79U-751M-3434TGM / Feeder Circuit Breaker - 125A Frame Rating with 40A/40A Trip
6	2	2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A / PowerFlex 755 AC Drive w/CB - 125 HP with Circuit Breaker Thermal Magnetic (250A Trip)
-	1	<i>Customer Load Cables Exit(Bottom)</i>
7	1	2197-WKBH-37TGM-79L-79U-751M-790A / Control & Lighting Transformer w/CB - 45.0 kVA with Circuit Breaker Thermal Magnetic (70A Trip)
8	1	2193LE-AKB327-40WT-31A27-111-751M / Lighting Panel Unit with Main Circuit Breaker - 100A - 27 Total Circuits
9	1	2100-GKC2X3B-31TGM-120-751M / Full Sect Blank Mtg Plate w/ or w/o Disc with Circuit Breaker Thermal Magnetic (20A Trip)
-	1	<i>Customer Load Cables Exit(Bottom)</i>
10	1	2100-ESW10K-T10FDP-114-751M-751S / Stratix 5700 10-Port
11	4	2100-BK10 / Blank Unit Door - 1.0 Space Factor
12	2	2100-BK05 / Blank Unit Door - 0.5 Space Factor
13	1	2193MB-EKC-52TMM-88HN-751M / Main Circuit Breaker - 800A Frame Rating - Bottom Mounted with 600A Trip
14	1	2100-NK30-79L-79U / Empty Unit Insert - 3.0 Space Factor

Rockwell Automation

Centerline 2100 Motor Control Center

Unit Description

Project Name: CWD - Conejo Wells
 Project Item: MCC-4 - N3R
 Project ID #: 5271772/6

Salesperson: Juan Campos
 Created By: Juan Campos
 Date/Time: 10/25/21 - 21:03

General Information

Line Voltage / Frequency: 480 Volts / 60 Hertz
 Power System Configuration: Wye, 3-phase, 4-wire with solidly grounded neutral
 Class I Wiring Type: B-T Control and Power Terminal Blocks
 NEMA Enclosure Type: 3R - Outdoor Non-Walk-In
 Available Fault Current: 50,001 to 65,000 A
 Unit Nameplate Type: Acrylic - Black letters on white
 Delivery Program: ENG

Unit Information

Description	Unit Features									
Unit Loc: 01A Del Prog: SCII Unit ID: 11 DOOR - Blank Unit Door	Catalog Number: 2100-BK10 Total Space Factor = 1									
Unit Loc: 01C Del Prog: ENG Unit ID: 2 METR - Metering Unit <u>Wiring Diagram</u> 10006415275 <u>Name Plate Information</u> POWER METER <u>Ethernet Information</u> <table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2190</td><td>192.168.1.1</td><td>255.255.255.0</td></tr><tr><td>2190</td><td>192.168.1.2</td><td>255.255.255.0</td></tr></table> Cable Length : 2.12 m Power Monitor Firmware Version : LATEST	Device Type	IP Address	Subnet Mask	2190	192.168.1.1	255.255.255.0	2190	192.168.1.2	255.255.255.0	Catalog Number: 2190-CKB-56M-79U-86W54CXB-751M-751S Total Space Factor = 1.5 Metering Type: Bul 1426-M5 PM 5000 w/Ethernet Ammeter Scale 1200 <u>Features Included</u> Unit Grd Stab Unplated Cu (-79U) Mylar Device Markers (-751M) Sleeve Type Markers (-751S) <u>Engineered Spec(s)/Modification(s)</u> (1) Upgrade PM 5000 from M5 to M6, 1426-M6E (1) Engineered Modification and/or Custom Diagram
Device Type	IP Address	Subnet Mask								
2190	192.168.1.1	255.255.255.0								
2190	192.168.1.2	255.255.255.0								
Unit Loc: 01F Del Prog: PEII Unit ID: 3 SPD - Surge Protective Device Unit <u>Wiring Diagram</u> 10006415263 <u>Name Plate Information</u> SPD	Catalog Number: 2100-SPKB-3-751M-751S Total Space Factor = 0.5 Surge Protector Type: Wye w/solidly grd neut, 4-wire <u>Features Included</u> Mylar Device Markers (-751M) Sleeve Type Markers (-751S)									

<div>Unit Loc: 01GDel Prog: PEII</div> <div>Unit ID: 13</div> <div>MCB - Main Circuit Breaker</div> <div>Rating</div> <div>600A</div> <div>Wiring Diagram</div> <div>10006130039</div>	<div>Catalog Number: 2193MB-EKC-52TMM-88HN-751M</div> <div>Total Space Factor = 3</div> <div>Circuit Breaker: Electronic (LSI), 65kA at 480V (600) with Frame Rating of 800A (M6H Frame), Bottom Mounted, 600A Trip</div> <div>Lugs Supplied: Std Mech/Lug Pads, 350 kcmil Size Wire, 2 Cables per Phase</div> <div>Features Included</div> <div>INC_NEUT_BUS Half-rated (-88HN)</div>						
<div>Unit Loc: 02ADel Prog: PEII</div> <div>Unit ID: 10</div> <div>ENSW - Stratix 5700 10-Port</div> <div>Wiring Diagram</div> <div>10006415249</div> <div>Name Plate Information</div> <div>ETHERNET SWITCH</div> <div>Ethernet Information</div> <table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2100-ESW</td><td>192.168.1.3</td><td>255.255.255.0</td></tr></table> <div>No Cable Length</div> <div>Ethernet Switch Firmware Version : LATEST</div>	Device Type	IP Address	Subnet Mask	2100-ESW	192.168.1.3	255.255.255.0	<div>Catalog Number: 2100-ESW10K-T10FDP-114-751M-751S</div> <div>Total Space Factor = 1</div> <div>Full Stratix 5700 Firmware</div> <div>NAT (CIP Sync & Gigabit Ports)</div> <div>Power Adapters (w/Unit Mtg)</div> <div>Features Included</div> <div>Locking Latch Provision (-114)</div> <div>Mylar Device Markers (-751M)</div> <div>Sleeve Type Markers (-751S)</div>
Device Type	IP Address	Subnet Mask					
2100-ESW	192.168.1.3	255.255.255.0					
<div>Unit Loc: 02CDel Prog: SCII</div> <div>Unit ID: 1</div> <div>ENPS - Ethernet Power Supply Unit</div> <div>Rating</div> <div>125A</div> <div>Wiring Diagram</div> <div>10006415245</div> <div>Name Plate Information</div> <div>ETHERNET</div> <div>POWER SUPPLY</div>	<div>Catalog Number: 2100-EPS8KB-30TGM-79U-751M-751S-768C</div> <div>Total Space Factor = 1.5</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (15A Trip)</div> <div>Disconnect Type = Circuit Breaker</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div>Features Included</div> <div>Unit Grd Stab Unplated Cu (-79U)</div> <div>Mylar Device Markers (-751M)</div> <div>Sleeve Type Markers (-751S)</div> <div>Redundant ENet Power Supply (-768C)</div>						
<div>Unit Loc: 02FDel Prog: SCII</div> <div>Unit ID: 12</div> <div>DOOR - Blank Unit Door</div>	<div>Catalog Number: 2100-BK05</div> <div>Total Space Factor = 0.5</div>						

<p>Unit Loc: 02G Del Prog: SCII Unit ID: 4 FCB - Feeder Circuit Breaker</p> <p><u>Rating</u> Dual 100A/20A</p> <p><u>Wiring Diagram</u> 10006415294</p> <p><u>Name Plate Information</u> SPARE</p> <p><u>Dual Unit</u> SPARE</p> <p><u>Overload Relay(s)</u> Motor Full Load Current (FLC) = Not Available</p>	<p>Catalog Number: 2193F-AKB-79L-79U-751M-4031TGM Total Space Factor = 1 Circuit Breaker: Thermal Magnetic, 65kA at 480V (100) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 100A/20A Trip Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</p> <p><u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) Mylar Device Markers (-751M)</p>
<p>Unit Loc: 02J Del Prog: SCII Unit ID: 5 FCB - Feeder Circuit Breaker</p> <p><u>Rating</u> Dual 40A/40A</p> <p><u>Wiring Diagram</u> 10006415287</p> <p><u>Name Plate Information</u> SPARE</p> <p><u>Dual Unit</u> SPARE</p> <p><u>Overload Relay(s)</u> Motor Full Load Current (FLC) = Not Available</p>	<p>Catalog Number: 2193F-AKB-79L-79U-751M-3434TGM Total Space Factor = 1 Circuit Breaker: Thermal Magnetic, 65kA at 480V (40) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 40A/40A Trip Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</p> <p><u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) Mylar Device Markers (-751M)</p>
<p>Unit Loc: 02L Del Prog: SCII Unit ID: 4 FCB - Feeder Circuit Breaker</p> <p><u>Rating</u> Dual 100A/20A</p> <p><u>Wiring Diagram</u> 10006415294</p> <p><u>Name Plate Information</u> SPARE</p> <p><u>Dual Unit</u> SPARE</p> <p><u>Overload Relay(s)</u> Motor Full Load Current (FLC) = Not Available</p>	<p>Catalog Number: 2193F-AKB-79L-79U-751M-4031TGM Total Space Factor = 1 Circuit Breaker: Thermal Magnetic, 65kA at 480V (100) with Frame Rating of 125A (G6C Frame), Plug-In Unit, Dual 100A/20A Trip Lugs Supplied: Std Mech/Lug Pads, 1/0 AWG Size Wire, 1 Cables per Phase</p> <p><u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) Mylar Device Markers (-751M)</p>

Unit Loc: 03A **Del Prog: ENG**
Unit ID: 6
VFD - PowerFlex 755 AC Drive w/CB

Rating

125 HP
(Heavy Duty)

Wiring Diagram

10006435909

Name Plate Information

WELL NO. 3
CONEJO

Ethernet Information

Device Type	IP Address	Subnet Mask
2163V	192.168.1.4	255.255.255.0

Cable Length : 2.9 m

PowerFlex 755 Firmware Version : LATEST

Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A

Total Space Factor = 6

Wiring: NEMA Type B wiring

Output Current Rating: 156A

Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)

Human Interface Module: LCD full numeric keypad - Door Mounted

Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz

Control Wiring: #16 AWG MTW(TEW) Cu

Features Included

Selector Switch: HAND-OFF-AUTO (-3F)

Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)

(2) Drive 120VAC w/ I/O (-14DA2R3)

Thermostat Door Mounted (-14FCT)

Dualport Ethernet (for VFD) (-14GER)

Drive Line Reactor (-14RLX)

Mylar Device Markers (-751M)

Sleeve Type Markers (-751S)

1 Aux and 1 Alarm-Internal-CB (-790A)

Engineered Spec(s)/Modification(s)

(1) Customer Load Cables Exit(Bottom)

(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?

(1) Engineered Modification and/or Custom Diagram

(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included

(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17

(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA

(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C

(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch

(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)

<div>Unit Loc: 04ADel Prog: ENG</div> <div>Unit ID: 6</div> <div>VFD - PowerFlex 755 AC Drive w/CB</div> <div>Rating</div> <div>125 HP</div> <div>(Heavy Duty)</div> <div>Wiring Diagram</div> <div>10006435909</div> <div>Name Plate Information</div> <div>WELL NO. 8</div> <div>SANTA ROSA</div> <div>Ethernet Information</div> <table><tr><td>Device Type</td><td>IP Address</td><td>Subnet Mask</td></tr><tr><td>2163V</td><td>192.168.1.5</td><td>255.255.255.0</td></tr></table> <div>Cable Length : 3.66 m</div> <div>PowerFlex 755 Firmware Version : LATEST</div>	Device Type	IP Address	Subnet Mask	2163V	192.168.1.5	255.255.255.0	<div>Catalog Number: 2163VB-186HKB-3F-5LRG-14DA2R3-14FCT-14GER-14HBA6-14RLX-51TJM-751M-751S-790A</div> <div>Total Space Factor = 6</div> <div>Wiring: NEMA Type B wiring</div> <div>Output Current Rating: 156A</div> <div>Circuit Breaker: Thermal Magnetic, 65kA at 480V (J6F Frame) (250A Trip)</div> <div>Human Interface Module: LCD full numeric keypad - Door Mounted</div> <div>Control: Transformer with Secondary Fuse, Standard Capacity, Primary Fusing, 120V/60Hz</div> <div>Control Wiring: #16 AWG MTW(TEW) Cu</div> <div>Features Included</div> <div>Selector Switch: HAND-OFF-AUTO (-3F)</div> <div>Pilot Light(s): RUN-AT SPEED Type: LED Push To Test, Color(s): Red, Green (-5LRG)</div> <div>(2) Drive 120VAC w/ I/O (-14DA2R3)</div> <div>Thermostat Door Mounted (-14FCT)</div> <div>Dualport Ethernet (for VFD) (-14GER)</div> <div>Drive Line Reactor (-14RLX)</div> <div>Mylar Device Markers (-751M)</div> <div>Sleeve Type Markers (-751S)</div> <div>1 Aux and 1 Alarm-Internal-CB (-790A)</div> <div>Engineered Spec(s)/Modification(s)</div> <div>(1) Customer Load Cables Exit(Bottom)</div> <div>(1) Bulletin 700-HA Tube Base Relay, 3PDT, 3-pole, 3 Form C, Single AgNi Contact,700-HA33?</div> <div>(1) Engineered Modification and/or Custom Diagram</div> <div>(1) 200 watt extra capacity to Standard Control Transformer Fusing/Fuse Block Included</div> <div>(1) Hobbs Elapsed Time Meter, 2.08"w x 1.02"h, 6 digit, 99999.9, non-reset (Option -85T),20001U-17</div> <div>(1) Bulletin 800T/H, Contact block, addition to standard number of contacts,800T-XA</div> <div>(1) Change 3% to 5% 160 amp reactor (125 HP),1321-3R160-C</div> <div>(3) Convert (1) 800F Pilot Light or Selector Switch to (1) 800H Pilot Light or Selector Switch</div> <div>(1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</div>
Device Type	IP Address	Subnet Mask					
2163V	192.168.1.5	255.255.255.0					
<div>Unit Loc: 05ADel Prog: SCII</div> <div>Unit ID: 11</div> <div>DOOR - Blank Unit Door</div>	<div>Catalog Number: 2100-BK10</div> <div>Total Space Factor = 1</div>						
<div>Unit Loc: 05CDel Prog: SCII</div> <div>Unit ID: 11</div> <div>DOOR - Blank Unit Door</div>	<div>Catalog Number: 2100-BK10</div> <div>Total Space Factor = 1</div>						
<div>Unit Loc: 05EDel Prog: SCII</div> <div>Unit ID: 11</div> <div>DOOR - Blank Unit Door</div>	<div>Catalog Number: 2100-BK10</div> <div>Total Space Factor = 1</div>						

Unit Loc: 05G Del Prog: ENG Unit ID: 14 INSR - Empty Unit Insert <u>Name Plate Information</u> WELL 8 DV/DT FILTER	Catalog Number: 2100-NK30-79L-79U Total Space Factor = 3 Without disconnecting means. Disconnect Type = No Disconnect Means <u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) <u>Engineered Spec(s)/Modification(s)</u> (1) Power Interwiring - 225A, Max Wire Size: #3/0 AWG (Max 1 per phase) (1) Engineered Modification and/or Custom Diagram (1) Filter,dv/dt,200A,480-600V,60Hz,Open (Nema 1 & 1G Only),V1K200A00 (1) Venting on 3.0 to 6.0 space factor single NEMA type 1 unit door.
Unit Loc: 06A Del Prog: SCII Unit ID: 12 DOOR - Blank Unit Door	Catalog Number: 2100-BK05 Total Space Factor = 0.5
Unit Loc: 06B Del Prog: ENG Unit ID: 8 LPAN - Lighting Panel Unit <u>Wiring Diagram</u> 10005989973 <u>Name Plate Information</u> LP4	Catalog Number: 2193LE-AKB327-40WT-31A27-111-751M Total Space Factor = 2.5 Panel Type & Rating: Three Phase, 4-Wire, 120/208V, 100A, 27 total circuits Bolt-On Branch Breakers: None <u>Features Included</u> (27) 20A 1-P CB (-31A27) <u>Engineered Spec(s)/Modification(s)</u> (1) 2193LE, Lighting Panel - Copper bus, unplated (Aluminum is standard), 100A (30 circuit maximum, 1or 3 phase) (1) Engineered Modification and/or Custom Diagram (1) 2193LE, Lighting Panel - Wire panel to transformer, 100A
Unit Loc: 06G Del Prog: SCII Unit ID: 7 XFMR - Control & Lighting Transformer w/CB <u>Wiring Diagram</u> 10006415299 <u>Name Plate Information</u> TX-LP4	Catalog Number: 2197-WKBH-37TGM-79L-79U-751M-790A Total Space Factor = 3 Secondary Wiring Fusing & Rating: 3-Phase, 120/208V, 3 Fuse, 45.0 kVA Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (70A Trip) <u>Features Included</u> Unit Ground Load Connector Unplated Cu (-79L) Unit Grd Stab Unplated Cu (-79U) 1 Aux and 1 Alarm-Internal-CB (-790A)

<p>Unit Loc: 07A Del Prog: ENG</p> <p>Unit ID: 9 PLAT - Full Sect Blank Mtg Plate w/ or w/o Disc</p> <p><u>Rating</u> 20A</p> <p><u>Wiring Diagram</u> 10006415257</p>	<p>Catalog Number: 2100-GKC2X3B-31TGM-120-751M Total Space Factor = 6</p> <p>Rating: 20A Circuit Breaker: Thermal Magnetic, 65kA at 480V (G6C Frame) (20A Trip) Disconnect Type = Circuit Breaker Required Section Width 30" Wide Working Depth 14" Deep</p> <p><u>Features Included</u> Omit horizontal power bus (-120)</p> <p><u>Engineered Spec(s)/Modification(s)</u> (1) Customer Load Cables Exit(Bottom) (1) Compact Logix 2MB Motion Controller,1769-L33ERM (1) Engineered Modification and/or Custom Diagram (2) 120V AC INPUT MODULE,1769-IA16 (1) 8 ANALOG INPUTS,1769-IF8 (1) POWER SUPPLY,1769-PA4 (2) Power Supply, 120W, 24VDC, 5A output, 120-240VAC input,1606-XLS120E Note - 1606-XLE240E (1) END CAP RIGHT,1769-ECR (2) 1000VA Control Transformer-Fusing/Fuse Block Included ,1497-K-BASX-0-N Note - 1.6KVA XFMR (30) IEC Terminal Blocks,1492-JG4,6,10? (200) I/O Wiring to terminal blocks within a PLC, SLC or ControlLogix unit (per wire) (200) Finger-Safe High Density Terminal Blocks,1492-H1,2,4,5,6,7? (2) Receptacle, Duplex, GFI, 120V, 15A maximum, mounted on door behind 3R door (for 3R only enclosures) or inside unit behind door Nema 1/1g or 12 , power source not included (4) Pduit Wiring Duct and Covers (White, 6 ft length) (Width, Height determined by adding PCB Note) (1) 8 CURRENT ANALOG OUTPUTS,1769-OF8C (1) 120/240V AC OUTPUT MODULE,1769-OA16 (1) Control Wire Color, Non-Standard, Standard Colors: Red-AC, Blue-DC, Red-neutral, Green/Yellow-ground (per unit)</p>
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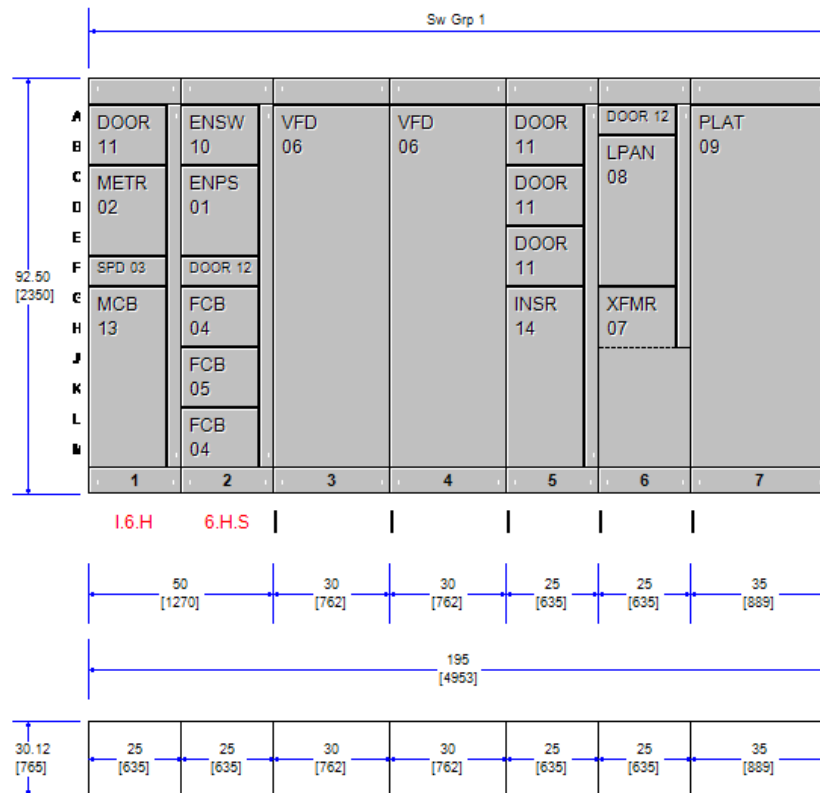
Rockwell Automation

Centerline 2100 Motor Control Center Front Elevation

Project Name: CWD - Conejo Wells
Project Item: MCC-4 - N3R
Project ID #: 5271772/6

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:04

Rockwell Automation/Allen-Bradley
PowerControl Builder Lineup



NOTE: Dimensions are subject to change after design review.

ENCLOSURE: NEMA Type 3R (Outdoor Non-Walk-In: the external width of each NEMA Type 3R cabinet is 5" wider and 10" deeper than its internal section)

Estimated Heat Loss: 6593 watts

BTU/hr Required: 22497

Air Conditioning Tons: 1.88

Estimated Weight: 5250 lb (2381 kg)

Heat loss values are for estimating purposes only.

Rockwell Automation

Centerline 2100 Motor Control Center

Unit Nameplate Report

Project Name: CWD - Conejo Wells
Project Item: MCC-4 - N3R
Project ID #: 5271772/6

Salesperson: Juan Campos
Created By: Juan Campos
Date/Time: 10/25/21 - 21:04

Master Nameplate Type - No Master Nameplate Supplied

Unit Nameplate Type - Acrylic - Black letters on white (3 lines)
(Maximum characters per line is 17 / 15 / 17)

IP Address - IP Address Not Included on Nameplate

Section 1

Location: 01A DOOR Space Factor: 1 Wiring Diagram Number: 10002277148

Location: 01F SPD Space Factor: 0.5 Wiring Diagram Number: 10006415263
SPD

Location: 01C METR Space Factor: 1.5 Wiring Diagram Number: 10006415275
POWER
METER

Location: 01G MCB Space Factor: 3 Wiring Diagram Number: 10006130039

Section 2

Location: 02A ENSW Space Factor: 1 Wiring Diagram Number: 10006415249
ETHERNET SWITCH

Location: 02C ENPS Space Factor: 1.5 Wiring Diagram Number: 10006415245
ETHERNET
POWER SUPPLY

Location: 02F DOOR Space Factor: 0.5 Wiring Diagram Number: 10002277146

Location: 02J FCB Right Space Factor: 1 Wiring Diagram Number: 10006415287
SPARE

Location: 02G FCB Left Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02L FCB Left Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02G FCB Right Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02L FCB Right Space Factor: 1 Wiring Diagram Number: 10006415294
SPARE

Location: 02J FCB Left Space Factor: 1 Wiring Diagram Number: 10006415287
SPARE

Section 3

Location: 03A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
WELL NO. 3
CONEJO

Section 4

Location: 04A VFD (125 HP) Space Factor: 6 Wiring Diagram Number: 10006435909
WELL NO. 8
SANTA ROSA

Section 5

Location: 05A DOOR Space Factor: 1 Wiring Diagram Number: 10002277148

Location: 05E DOOR Space Factor: 1 Wiring Diagram Number: 10002277148

Location: 05C DOOR Space Factor: 1 Wiring Diagram Number: 10002277148

Location: 05G INSR Space Factor: 3 Wiring Diagram Number: 10003296377
WELL 8
DV/DT FILTER

Section 6

Location: 06A DOOR Space Factor: 0.5 Wiring Diagram Number: 10002277146

Location: 06G XFMR Space Factor: 3 Wiring Diagram Number: 10006415299
TX-LP4

Location: 06B LPAN Space Factor: 2.5 Wiring Diagram Number: 10005989973
LP4

Section 7

Location: 07A PLAT Space Factor: 6 Wiring Diagram Number: 10006415257

2A	ENSW	0	0	0	ETHERNET SWITCH				2A-R	192.168.1.3 255.255.255.0			
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Ethernet Switch Port Capacity

Uplink	Switch group	Section	Consumed Switch Ports		Available Switch Ports
1	1	1	2	4	4
		2	0		
		3	1		
		4	1		
		5	0		
		6	0		
		7	0		

NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIER

ENGINEERING DEPARTMENT

CAMROSA WATER DISTRICT

NOTICE TO BIDDERS, SUBCONTRACTORS, AND SUPPLIERS

Complete digital bidding documents are available at Camrosa.com. You may download the digital documents from the District website.

If you discover any error or omission in the plans, specifications, or proposal, or have any question concerning the bidding documents, please contact:

Becca Bugielski, Project Manager
MKN and Associates
bbugielski@mknassociates.us
Telephone (805) 947-4971

Advise the person answering the phone that you have a "Bidding Question." Please do not call other staff members or consultants.

All bids must be sealed and submitted at or before 2:00 p.m., November 9, 2021, to the following:

Ian Prichard, Assistant General Manager
Camrosa Water District
7385 Santa Rosa Road
Camarillo, CA 93012

There will be a mandatory pre-bid meeting on October 28, 2021, at 9:00 AM. Contractors shall meet at the site.

After the bid opening, bid results may be posted online.

After a Notice to Proceed is issued to the successful bidder, all contacts should be through Becca Bugielski at (805) 947-4971.

NOTE: The District office is currently closed for renovation. When delivering bids, please call (805) 388-0226 upon arriving. District personnel will meet you outside and register your bid.

NOTE: Please mark the outside of the envelope (and express shipment envelope, if applicable):

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS
SPECIFICATION NO. PW 21-04

Bids to be opened November 9, 2021, 2:00 p.m.

PROPOSAL

ENGINEERING DEPARTMENT

PROPOSAL

FOR

1, 2, 3- TCP REMOVAL PROJECT FOR CONEJO WELLS
SPECIFICATION NO. PW 21-04

Specification No.: PW 21-04

Bids to be Received on: November 9, 2021, at or before 2:00 p.m.

Completion Time: 330 Calendar Days **from Notice to Proceed to Completion of Project, exclusive of scope relating to the generator and appurtenances**
360 Calendar Days **from Notice to Proceed to Completion of Project, to project's entirety inclusive of generator and appurtenances**

Liquidated Damages: \$1000 Per Calendar Day

Number of Pages in Proposal: 19

CONTRACTOR

Name _____

Street Address _____

City _____ State _____ Zip Code _____

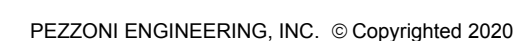
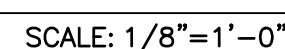
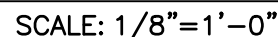
Telephone Number _____

Fax Number _____ (Optional)

The bid shall be balanced so that each bid item is priced to carry its share of the cost of the work and also its share of the contractor's overhead and profit. Work not specifically listed in the bid schedule as a line item will be distributed by the contractor in the line items as they seem fit. The District reserves the right to delete any bid item to the extent that the bid is qualified by specific limitation. An unbalanced bid shall be considered as grounds for rejecting the entire bid.

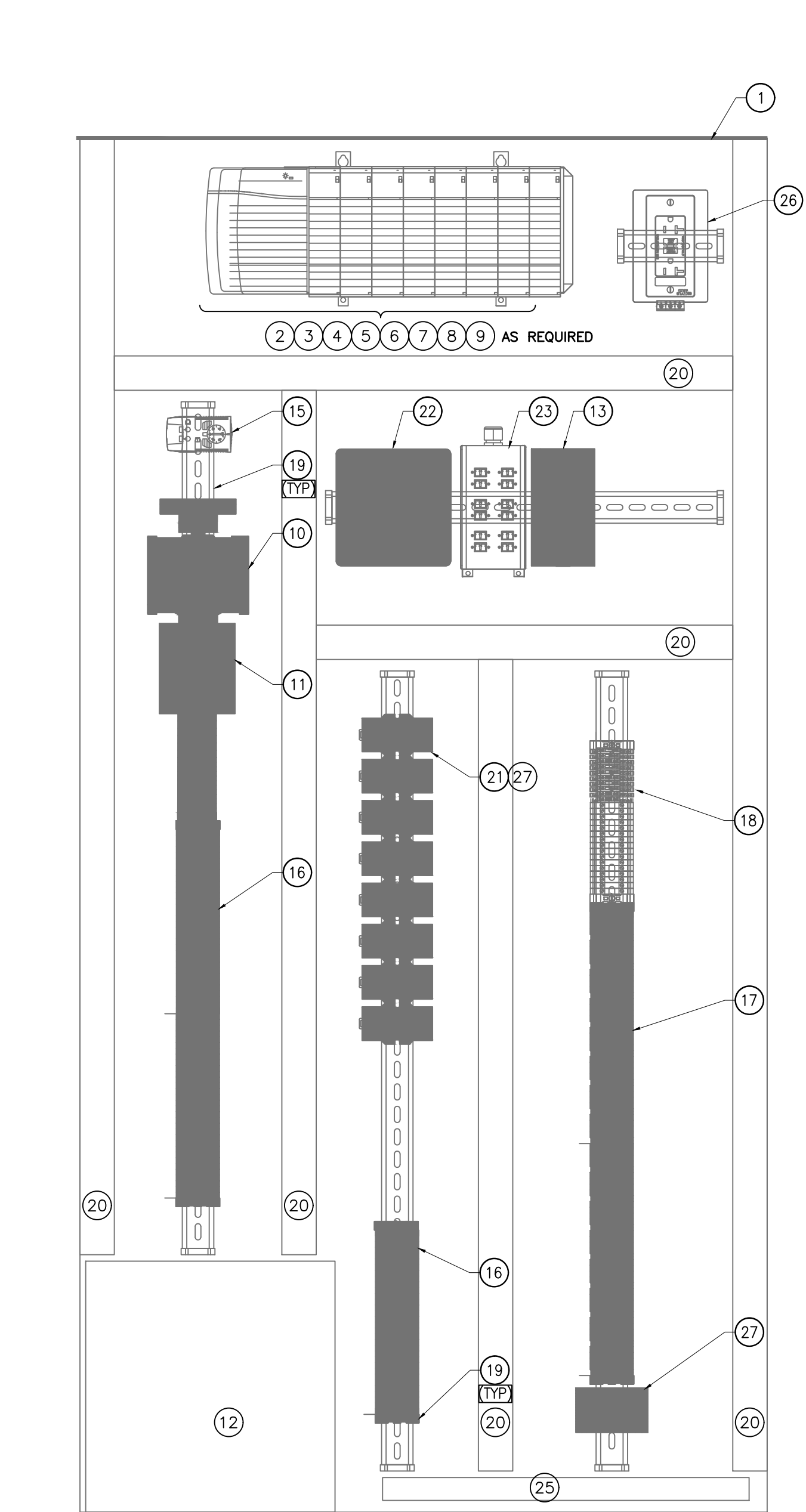
SUBMIT PAGES 13 THROUGH 29 FULLY EXECUTED WITH THIS PROPOSAL

ELECTRICAL SHEETS

46 OF 54

598 Camrossa Conduit & Cable Schedule

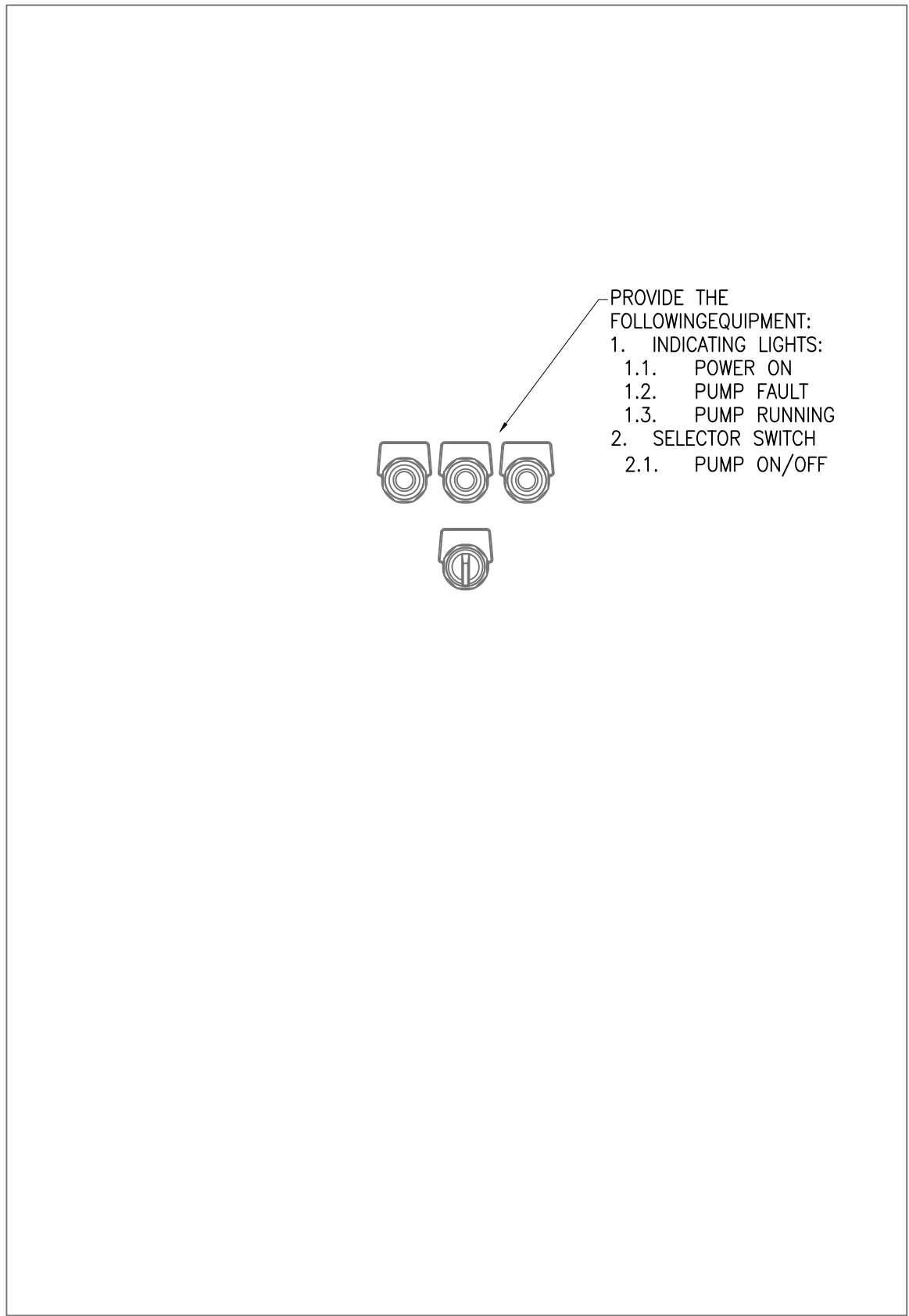
CONDUIT ID#	FROM	TO	QNTY	SIZE	TYPE	QNTY	SIZE	QND	QNTY	TYPE	NOTES
P 001	(E) S.C.E. UTILITY POLE	(N) S.C.E. XFMR	1	4"	PVC40						PRIMARY PER S.C.E.
H 001	(N) S.C.E. XFMR	UGPS	7	5"	PVC40	4	#400MCM	250			[1] SECONDARY PER S.C.E.
H 002	UGPS	M/M SECTION				24	#400MCM	250			2000A
H 003	M/M SECTION	ATS-1				24	#400MCM	250			2000A
H 004	ATS-1	MSB				24	#400MCM	250			2000A VIA WIREWAY
H 005	ATS-1	EG-1	5	4"	RMC	3	#400MCM	#1/6			[1][2][3] 1000A VIA WIREWAY
H 006	MSB	P1 3/4" VAULT POWER	1	1"	PVC40	3	#4	#10			
H 006	B	P1 3/4" VAULT POWER	1	1"	PVC40	3	#4	#10			DEM INTEGRATED POWER CENTER
H 007	A	MSB	1	1"	PVC40	3	#10	#10			
H 007	B	BSTR-PMP-CNPL	1	1"	CRMC	3	#10	#10			[2] CO2 SYSTEM 480V-3PH-20A
H 008	MSB	P1 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 008	B	P2 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 008	C	P2 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 009	A	MSB	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 009	B	P1 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 009	C	P2 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 009	D	P3 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 009	E	P4 3/4" VAULT POWER	3	4"	PVC40	3	#500MCM	#3/6			[1] 1200A MCC2 FEEDER
H 010	A	MSB	2	4"	PVC40	3	#400MCM	#1			[2] 800A MCC4 FEEDER
H 010	B	P1 3/4" VAULT POWER	2	4"	PVC40	3	#400MCM	#1			[2] 800A MCC4 FEEDER
H 010	C	P2 3/4" VAULT POWER	2	4"	PVC40	3	#400MCM	#1			[2] 800A MCC4 FEEDER
H 010	D	P3 3/4" VAULT POWER	2	4"	PVC40	3	#400MCM	#1			[2] 800A MCC4 FEEDER
H 010	E	P4 3/4" VAULT POWER	2	4"	PVC40	3	#400MCM	#1			[2] 800A MCC4 FEEDER
H 011	MSB	EG-FPM-1	1	1"	CRMC	3	#12	#12			[1] DUPLICER FUEL PUMP 480V-3PH-20A
H 012	MSB	GATE OPERATOR #1/CONTROLLER	1	1"	CRMC	3	#12	#12			[1]HP MOTORIZED GATE
H 201	MCC2	40-PMP-01	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (N) BOOSTER PUMP 100HP-156A
H 202	MCC2	40-PMP-02	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (N) BOOSTER PUMP 100HP-156A
H 203	MCC2	(E) 22-PMP-01	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) PUMP 100HP-156A
H 204	MCC2	(E) 22-PMP-02	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) PUMP 100HP-156A
H 205	MCC2	(E) WELL-PMP-CA	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) WELL PUMP 100HP-156A
H 301	MCC3	(E) 100A PANEL CHEM FEED BLDG.	1	1 1/2"	CRMC	3	#2	#8			[2][3] (N) 100A FEEDER TO (E) PANEL
H 302	MCC3	(E) WELL-PMP-C2	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) WELL-PMP-C2 -100HP-156A
H 303	MCC3	(E) BSTR-PMP-P4	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) BSTR-PMP-P4 100HP-156A
H 304	MCC3	(E) BSTR-PMP-P5	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) BSTR-PMP-P5 100HP-156A
H 305	MCC3	(E) BSTR-PMP-P6	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) BSTR-PMP-P6 100HP-156A
H 306	MCC3	(E) BSTR-PMP-P7	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) BSTR-PMP-P7 100HP-156A
H 400	MCC4	TX-SRB	1	2"	CRMC	3	#10	#10			[2]
H 401	MCC4	(N) SUB AT (E) WELL-PMP-C3	1	2 1/2"	CRMC	3	#250MCM	#4			[2][3] (E) WELL-PMP-C3 -100HP-156A
H 402	A	MCC4	1	2 1/2"	PVC 40	3	#250MCM	#4			(N) FEEDER WELL-PMP-SRB
H 402	B	P5 3/4" VAULT POWER	1	2 1/2"	PVC 40	3	#250MCM	#4			(N) FEEDER WELL-PMP-SRB
H 402	C	P6 3/4" VAULT POWER	1	2 1/2"	PVC 40	3	#250MCM	#4			(N) FEEDER LB INTO BLDG/(N) DISC
H 402	D	(N) 400A/3P DISCONNECT SW	1	2 1/2"	CRMC	3	#250MCM	#4			[3] (E) WELL-PMP-SRB -100HP-156A
H 402	E	P5 3/4" VAULT POWER	1	2"	CRMC	2	#10	#10			(N) FEEDER (E) SINGLE PHASE 30A DISC/PANEL SRB
H 403	B	P5 3/4" VAULT POWER	1	2"	CRMC	2	#10	#10			
H 403	C	P6 3/4" VAULT POWER	1	2"	CRMC	2	#10	#10			2"CRMC RISER LB INTO (E) 30A/2P DISC.
L 000	A	MCC2-LP2	1	1"	PVC 40	2	#10	#10			LP2-1,3,5-7
L 000	B	P2 3/4" VAULT POWER	1	1"	RMC	2	#12	#12			[2] LP2-1,3,5-7
L 101	LP1	LP1-FMC	1	1"	RMC	2	#12	#12			[2] LP1-1
L 102	NOT USED										
L 103	A	LP1	1	1"	CRMC	8	#12	#12			[2] LP1-3,5,7,9
L 103	B	RECP WP/GFCI	1	1"	CRMC	6	#12	#12			LP1-5,7,9
L 103	C	RECP WP/GFCI	1	1"	CRMC	4	#12	#12			LP1-7,9
L 103	D	RECP WP/GFCI	1	1"	CRMC	2	#12	#12			LP1-9
L 103	E	RECP WP/GFCI	1	1"	CRMC	2	#12	#12			LP1-3
L 104	LP1	CHM-MTR-PMP-01	1	1"	CRMC	2	#12	#12			[3] LP1-11
L 105	LP1	CHM-MTR-PMP-02	1	1"	CRMC	2	#12	#12			[3] LP1-13
L 106	LP1	HEAT TRACE SODIUM HYDROXIDE ENCL	1	1"	CRMC	2	#12	#12			[2][3] LP1-15
L 107	A	LP1	1	1"	CRMC	4	#12	#12			[2][3] LP1-24
L 107	B	J BOX GAC FIT/FE-01A	1	1"	CRMC	4	#12	#12			[2][3] LP1-34
L 107	C	J BOX GAC FIT/FE-02A	1	1"	CRMC	4	#12	#12			[2][3] LP1-24
L 107	D	J BOX GAC FIT/FE-03A	1	1"	CRMC	2	#12	#12			[2][3] LP1-24
L 107	E	J BOX GAC FIT/FE-04A	1	1"	CRMC	2	#12	#12			[2][3] LP1-4
L 108	A	LP1	1	1"	CRMC	10	#12	#12			[2][3] LP1-6,8,10,12,14
L 108	B	J BOX GAC ACTU-01A	1	1"	CRMC	8	#12	#12			[2][3] LP1-6,8,10,12,14
L 108	C	J BOX GAC ACTU-02A	1	1"	CRMC	6	#12	#12			[2][3] LP1-10,12,14
L 108	D	J BOX GAC ACTU-03A	1	1"	CRMC	4	#12	#12			[2][3] LP1-12,14
L 108	E	J BOX GAC ACTU-04A	1	1"	CRMC	2	#12	#12			[2][3] LP1-14
L 109	A	LP1	1	1"	CRMC	10	#12	#12			[2][3] LP1-16,18,20,22,24
L 109	B	J BOX GAC ACTU-01B	1	1"	CRMC	8	#12	#12			[2][3] LP1-18,20,22,24
L 109	C	J BOX GAC ACTU-02B	1	1"	CRMC	6	#12	#12			[2][3] LP1-20,22,24
L 109	D	J BOX GAC ACTU-03B	1	1"	CRMC	4	#12	#12			[2][3] LP1-22,24
L 109	E	(F) J BOX MTR-ACTU-VLV-4B	1	1"	CRMC	2	#12	#12			[2][3] LP1-24
L 110	LP1	J BOX RECP WP/GFCI	1	1"	CRMC	2	#12	#12			[2] LP1-26
L 111	A	LP1	1	1"	CRMC	6	#12	#12			[2] LP1-17,18,21
L 111	B	J BOX RECP WP/GFCI	1	1"	CRMC	4	#12	#12			[2][3] LP1-18,21
L 111	C	J BOX (F) GAC FIT/FE-01B	1	1"	CRMC	4	#12	#12			[2][3] LP1-18,21
L 111	D	J BOX (F) GAC FIT/FE-02B	1	1"	CRMC	2	#12	#12			[2][3] LP1-19
L 111	E	J BOX GAC FIT/FE-03B	1	1"	CRMC	4	#12	#12			[2][3] LP1-19,21
L 111	F	J BOX GAC FIT/FE-04B	1	1"	CRMC	2	#12	#12			[2][3] LP1-21
L 111	G	J BOX (F) GAC FIT/FE-01-4B	1	1"	CRMC	2	#12	#12			[2][3] LP1-21
L 201	A	LP2	1	1"	CRMC	4	#12	#12			[2][3] LP2-24
L 201	B	J BOX GAC 40-FIT/FE-01/02	1	1"	FLEX	2	#12	#12			[2][3] LP2-24
L 201	C	J BOX GAC 40-FIT/FE-01/02	1	1"	CRMC	2	#12	#12			[2][3] LP2-4
L 202	A	J BOX GAC 22-PMP-ACT-01	1	1"	CRMC	10	#12	#12			[2][3] LP2-4
L 202	B	J BOX GAC 22-PMP-ACT-02	1	1"	CRMC	2	#12	#12			[2][3] LP2-11,13,15,17
L 202	C	J BOX GAC 22-PMP-ACT-01	1	1"	CRMC	6	#12	#12			[2][3] LP2-11
L 202	D	J BOX GAC 22-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP2-13
L 202	E	J BOX GAC 22-FIT-01	1	1"	CRMC	2	#12	#12			[2][3] LP2-13
L 202	F	J BOX GAC 22-FIT-01	1	1"	CRMC	4	#12	#12			[2][3] LP2-15,17
L 202	G	J BOX GAC 22-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP2-17 FLEX TO C4-ACT-01
L 203	LP2	J BOX GAC 22-FIT-00	1	1"	CRMC	2	#12	#12			[2][3] LP2-6 FLEX TO 22-FIT-00
L 301	A	LP3	1	1"	CRMC	4	#12	#12			[2][3] LP3-1,3
L 301	B	J BOX (E) BSTR-FIT-01	1	1"	CRMC	2	#12	#12			[2][3] LP3-3
L 302	A	LP3	1	1"	CRMC	4	#12	#12			[2][3] LP3-5,7
L 302	B	J BOX (E) C2-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP3-5
L 302	C	J BOX (E) C2-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP3-7
L 302	D	J BOX (E) C2-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP3-7
L 303	LP3	J BOX (E) BSTR-FIT-02	1	1"	CRMC	2	#12	#12			[2][3] LP3-2
L 400	TX-LP4	MCC4-LP4				4	#2	#8			SECONDARY 100A PANEL LP4
L 401	A	MCC4-LP4	1	1"	CRMC	4	#12	#12			[2][3] LP4-1,3
L 401	B	(N) J BOX AT (E) C3-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP4-1
L 401	C	(N) J BOX AT (E) C3-FIT-01	1	1"	FLEX	2	#12	#12			[2][3] LP4-3
L 402	MCC4-LP4	(N) RECP WP/GFCI	1	1"	CRMC	2	#12	#12			[2][3] LP4-5
C 000	A	MCC2-PCM	1	1"	RMC	12	#14	#14			[2][3]
C 000	B	C1 3/4" VAULT COMM	1	1"	RMC	12	#14	#14			[2][3]
C 000	C	C1 3/4" VAULT COMM	1	1"	RMC	12	#14	#14			[2][3]
C 001	LP1-FMC	C1 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO LP1-PCM
C 002	A	C1 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC2-PCM
C 002	B	C2 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC3-PCM
C 003	A	C1 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 003	B	C2 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 003	C	C3 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 003	D	C4 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 004	A	C1 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 004	B	C2 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 004	C	C3 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 004	D	C4 3/4" VAULT COMM	1	2"	PVC 40						[1] FOMB-OSP COMM TO MCC4-PCM
C 005	EG-1	EG-FPM-1	1	1"	RMC	10	#14	#14			[2][3]
C 005	ATS-1	EG-1	1	1"	RMC	4	#14	#14			[2][3]
C 007	MCC2-PCM	C2 3/4" VAULT COMM	1	1"	RMC						[1] FOMB-OSP COMM TO LP1-PCM
C 007	C1 3/4" VAULT COMM	EG-FPM-1	1	1"	RMC						[1] FOMB-OSP COMM TO MCC2-PCM
C 008	MCC2-PCM	C2 3/4" VAULT COMM	1	1"	RMC						[1] FOMB-OSP COMM TO MCC2-PCM
C 008	C1 3/4" VAULT COMM	MSB-DIST.	1	1"	PVC 40						[1] STPE-OSP
C 009	A	MCC2-PCM	1	1"	RMC						[1] FOMB-OSP COMM TO MCC4-PCM
C 009	B	C2 3/4" VAULT COMM	1	1"	RMC						[1] FOMB-OSP COMM TO MCC4-PCM
C 010	A	GATE OPERATOR #1/CONTROLLER	1	1"	RMC						[1] FOMB-OSP COMM TO MCC4-PCM
C 010	B	GATE OPERATOR #1/CONTROLLER	1	1"	RMC						[1] FOMB-OSP COMM TO MCC4-PCM
C 010	C	GATE OPERATOR #1/CONTROLLER	1	1"	RMC		</				



1
SCALE: N.T.S.

BACKPAN ELEVATION

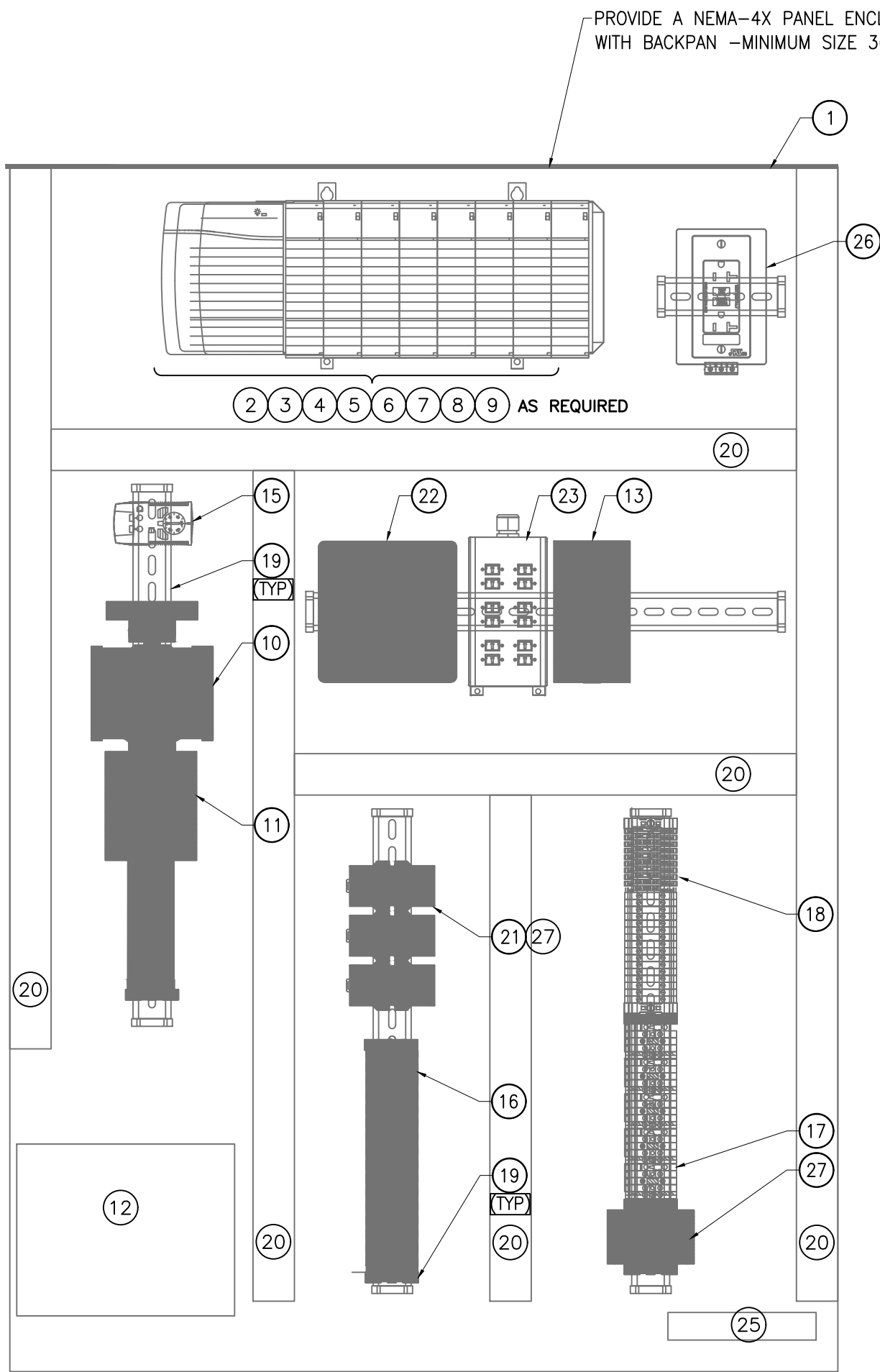
TYPICAL PANEL CONFIGURATION
–PCM, MCC2, MCC3, & MCC4



2
SCALE: N.T.S.

OUTER DOOR

TYPICAL PANEL CONFIGURATION
–RIO–SR8

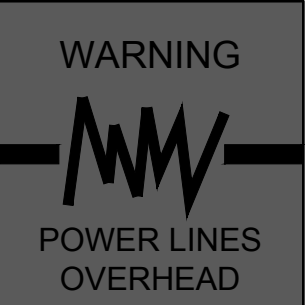


BACKPAN ELEVATION

SHEET NOTES:

1. ENCLOSURE DRAWING REPRESENTS DESIGN INTENT. CONTRACTOR TO SUPPLY AS-BUILT DRAWINGS SHOWING FINAL LAYOUT CONFIGURATION WITH ALL EQUIPMENT.
2. CONSTRUCT PANEL TO MEET CEC 409 REQUIREMENTS.
3. COMPLY WITH UL 508 & 508A REQUIREMENTS.
4. QUANTITY OF COMPONENTS VARY AS REQUIRED FOR EACH CABINET.
5. REFER TO SPECIFICATION SECTIONS 405000 AND 405150 FOR ADDITIONAL CABINET REQUIREMENTS.

GENERIC EQUIPMENT SCHEDULE	
ITEM	DESCRIPTION
1	BACK PANEL
2	PLC BACKPLANE
3	PLC PROCESSOR/RIO
4	PLC POWER SUPPLY
5	PLC ETHERNET COMM MODULE
6	PLC DI MODULES
7	PLC DO MODULES
8	PLC AI MODULES
9	PLC AO MODULES
10	120VAC SURGE PROTECTOR DEVICE
11	CIRCUIT BREAKERS
12	UPS
13	24VDC POWER SUPPLY
14	REDUNDANCY MODULE
15	ENCLOSURE T-STAT
16	DISCRETE TERMINAL BLOCKS
17	ANALOG TERMINAL BLOCKS
18	120VAC FUSED TERMINAL BLOCKS
19	DIN RAIL
20	WIRE DUCT
21	CONTROL RELAYS
22	ETHERNET SWITCH
23	PATCH PANEL
24	(NOT USED)
25	GROUND BAR
26	DIN RAIL RECEPTACLE
27	SIGNAL ISOLATORS



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BID ISSUE
10-12-2021



1,2,3–TCP REMOVAL PROJECT FOR
CONEJO WELLS
CAMROSA WATER DISTRICT
CAMARILLO, CA
ELECTRICAL
ELECTRICAL DETAILS

EST. 1965
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
200 WEST CORNELL AVENUE
FRESNO, CALIFORNIA 93711-6162
559/448-2700 FAX 559/448-2715
www.peng.com

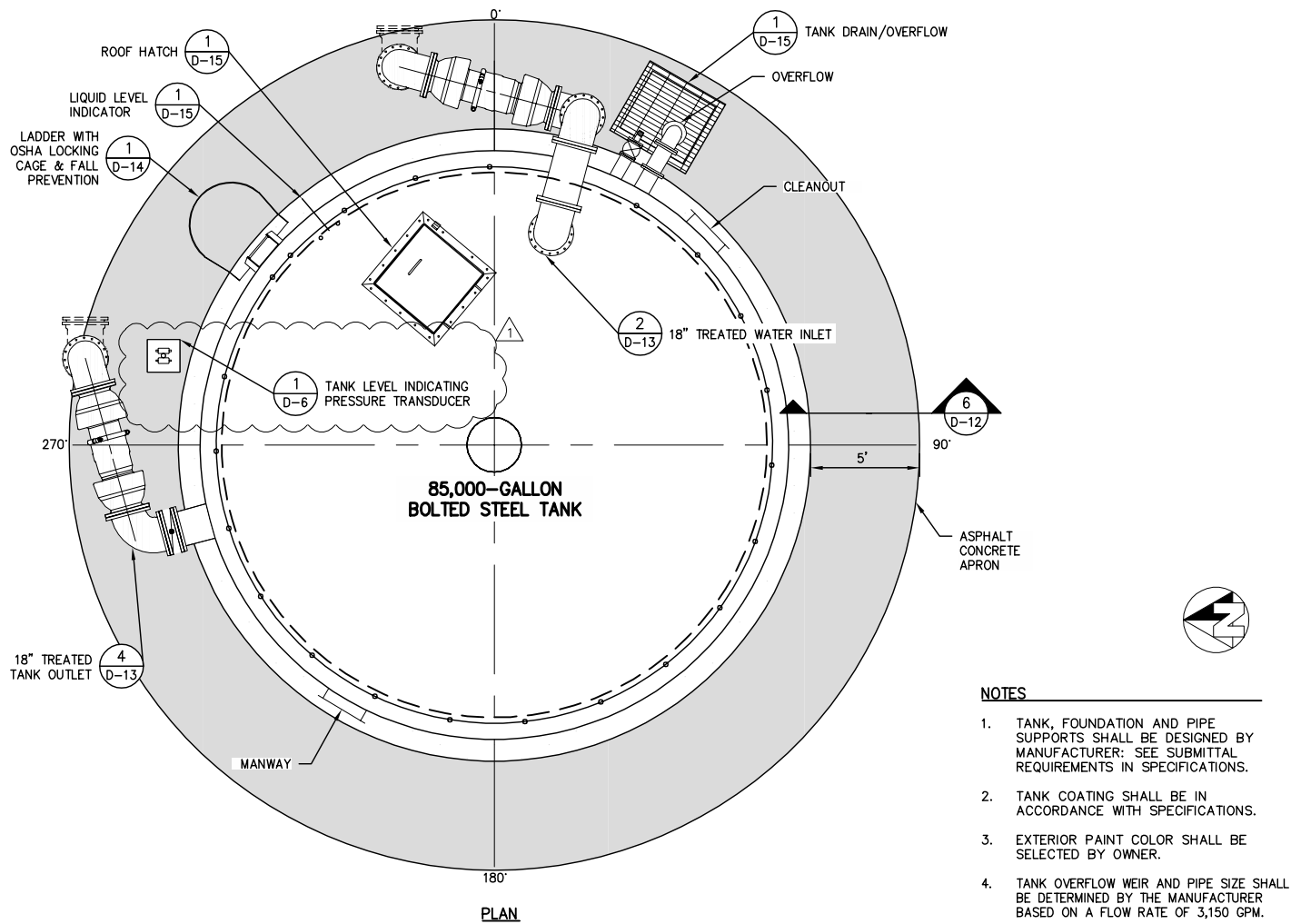
DESIGN ENGINEER:
KLP
LICENSE NO:
16269
DRAFTED BY: FR
CHECKED BY: KLP
DATE: 5-03-2021
JOB NO: 21-598

PHASE: -
0 1"
ORIGINAL SCALE SHOWN IS
ONE INCH. ADJUST SCALE FOR
REDUCED OR ENLARGED PLANS.

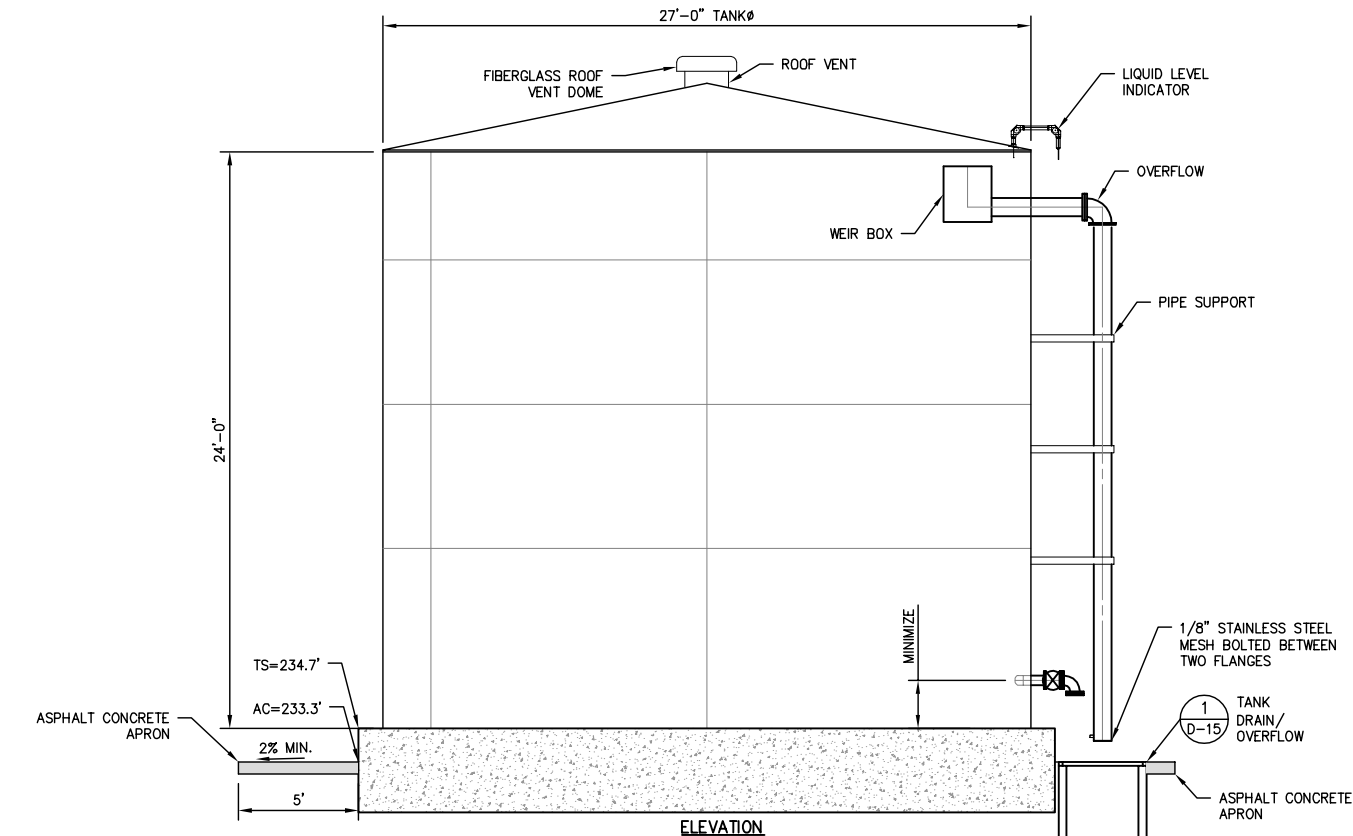
SHEET
E4.2

54 OF 54

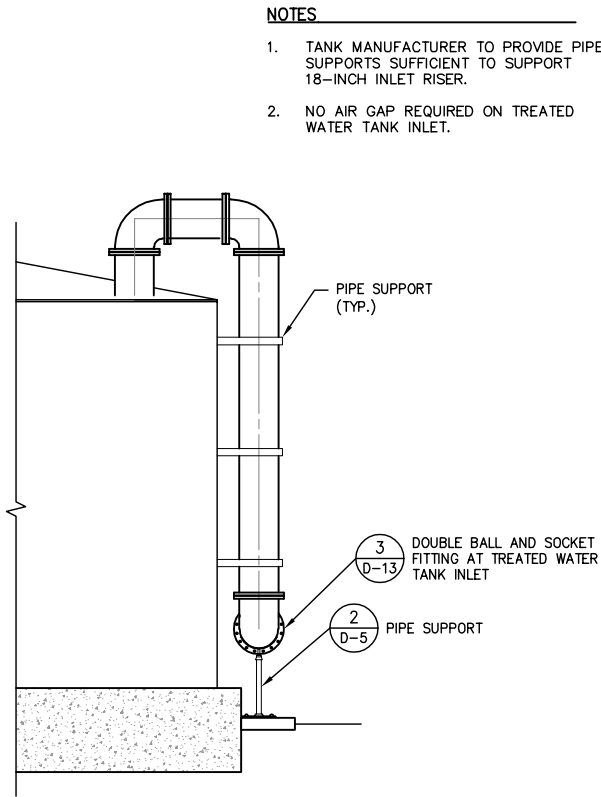
PROCESS SHEETS



- NOTES**
1. TANK, FOUNDATION AND PIPE SUPPORTS SHALL BE DESIGNED BY MANUFACTURER: SEE SUBMITTAL REQUIREMENTS IN SPECIFICATIONS.
 2. TANK COATING SHALL BE IN ACCORDANCE WITH SPECIFICATIONS.
 3. EXTERIOR PAINT COLOR SHALL BE SELECTED BY OWNER.
 4. TANK OVERFLOW WEIR AND PIPE SIZE SHALL BE DETERMINED BY THE MANUFACTURER BASED ON A FLOW RATE OF 3,150 GPM.



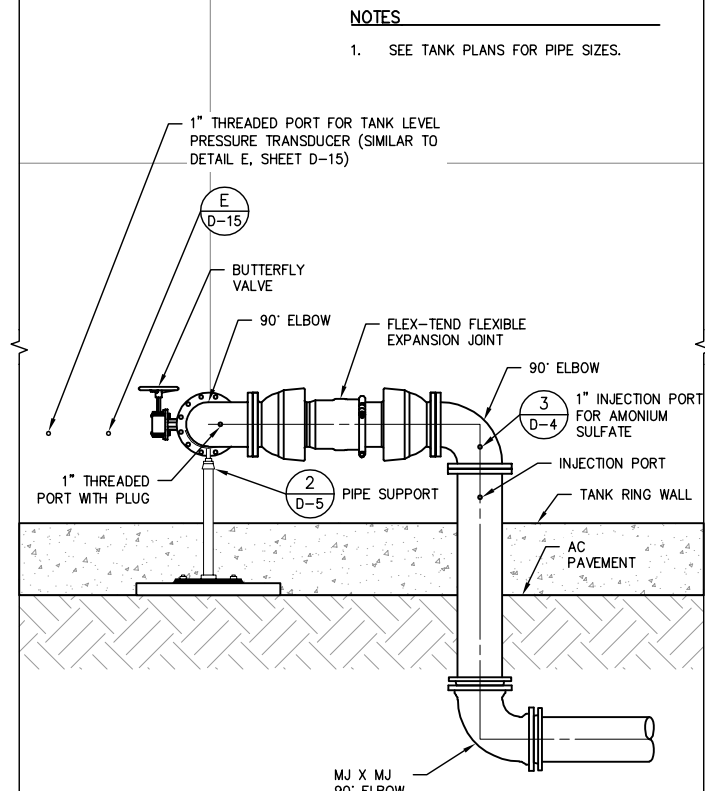
1 D-13 NOT TO SCALE



- NOTES**
1. TANK MANUFACTURER TO PROVIDE PIPE SUPPORTS SUFFICIENT TO SUPPORT 18-INCH INLET RISER.
 2. NO AIR GAP REQUIRED ON TREATED WATER TANK INLET.

2 D-13

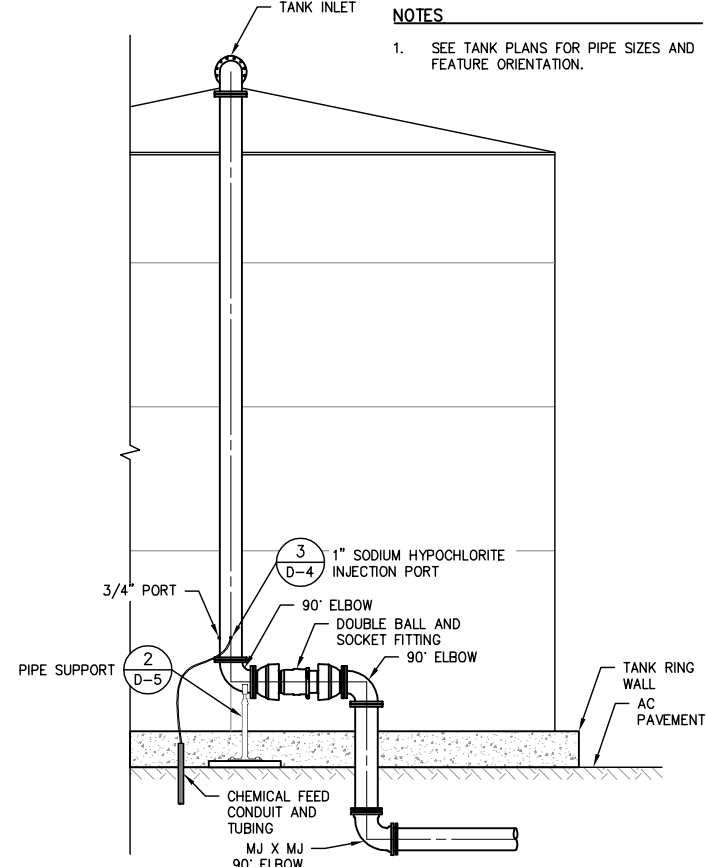
NOT TO SCALE



- NOTES**
1. SEE TANK PLANS FOR PIPE SIZES.

4 D-13

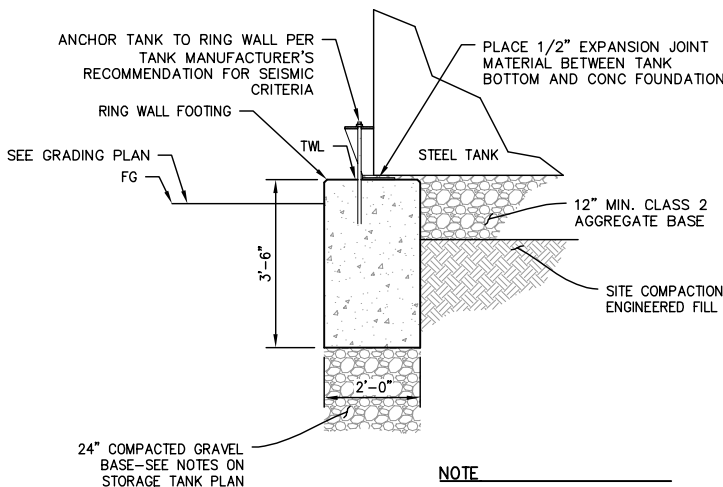
NOT TO SCALE



- NOTES**
1. SEE TANK PLANS FOR PIPE SIZES AND FEATURE ORIENTATION.

3 D-13

NOT TO SCALE



- NOTE**
1. FINAL FOUNDATION DESIGN SHALL BE DETERMINED BY TANK MANUFACTURER.

5 D-13

NOT TO SCALE

BID ISSUE
10-12-2021

1,2,3-TCP REMOVAL PROJECT FOR CONEJO WELLS
CAMROSA WATER DISTRICT
CAMARILLO, CA

TREATED WATER TANK DETAILS

PROVOST & PRITCHARD CONSULTING GROUP
EST. 1988
An Employee Owned Company
KEVIN BERRYHILL
DESIGN ENGINEER
LICENSE NO: 70415
DRAFTED BY: JB
CHECKED BY: RKB
DATE: 10/11/2021
JOB NO: 295820002
PROJECT NO: 295820002
PHASE:
ORIGINAL SCALE SHOWN IS ONE INCH. ADJUST SCALE FOR REDUCED OR ENLARGED PLANS.
SHEET **D-13**
29 OF 54

REVISIONS

No.	REVISION	BY	DATE
1	ADDED LOCATION OF LEVEL INDICATING TRANSDUCER	JB	10-29-2021

DATE SIGNED: 10/29/2021
JENNIFER BONITA