

O&M
For
***BLUE MARBLE
PRODUCTIONS***

Date : - ÅÛ x

Customer : ADCO COMPANIES

Shop Order : 21-701-D

Equipment : 40MS-175 DUPLEX ZER-O-PAC

All questions can be sent to Erik@bfs-ind.com

Project Manager: Erik Jackola Prepared by: Erik Jackola

Section 1

Mechanical Layout : 21701D-ME

Bill of materials : 21-701-D

Electrical Schematic : 21-701-SC

Appendix A: *VESSEL ASSEMBLY*

2.....	WATERGLASS GAUGE SET
3.....	WATER PRESSURE GAUGE
4.....	STEAM PRESSURE GAUGE
5.....	SHUT-OFF COCK
6.....	WATER STORAGE THERMOMETER W/ BRASS THERMOWELL
7.....	MANUAL VENT VALVE
8.....	AUTO VENT
9.....	VACUUM BREAKER
10.....	SAFETY RELIEF VALVES SET @ 50 PSI 4,456#/HR. EACH
11.....	OVERFLOW TRAP (SHIPPED LOOSE)
12.....	ISOLATION GATE VALVES
13.....	HIGH LEVEL ALARM SWITCH
14.....	LOW LEVEL ALARM SWITCH
15.....	LOW-LOW LEVEL ALARM / LWCO SWITCH
16.....	CHEMICAL INJECTION QUILL
17.....	CHEMICAL INJECTION BALL VALVE
18.....	SAMPLE GLOBE VALVE
19.....	MAGNESIUM CORROSION ROD
20.....	VESSEL DRAIN GATE VALVE
21.....	MOTORIZED WATER INLET VALVE
22.....	ISOLATION GATE VALVE
23.....	Y-TYPE STRAINER
24.....	BY-PASS GLOBE VALVE
25.....	DP LEVEL TRANSMITTER W/ 3-VALVE MANIFOLD
26.....	PRESSURE REDUCING E-VALVE W/ D PILOT W/ FITTINGS

Appendix B: *PUMP ASSEMBLY*

30.....	CENTRIFUGAL PUMP 112 GPM @ 425' TDH (175 PSIG)
31.....	MOTOR: 460V 60HZ 3PH 3500RPM
32.....	SUCTION GATE VALVES
33.....	SUCTION Y-TYPE STRAINER
34.....	EXPANSION COUPLING
35.....	RECIRCULATION CHECK VALVE
36.....	RECIRCULATION ORIFICE
37.....	RECIRCULATION GATE VALVE
38.....	RECIRCULATION ADAPTOR
39.....	PRESSURE GAUGE - LIQUID FILLED
40.....	SHUT-OFF COCK
41.....	DISCHARGE CHECK VALVE
42.....	DISCHARGE GLOBE VALVE
43.....	DISCHARGE GATE VALVE

WARRANTIES AND CONDITIONS OF SALE

Dated 1/1/2016

PROPOSAL - The proposal contains all of the terms and conditions agreed to by the parties and is intended to provide for a complete agreement between BFS Industries, LLC (hereinafter sometimes referred to as the "Seller", the "Company", or "BFS") and the purchaser (hereinafter sometimes referred to as the "Buyer"). No supplemental or contradictory terms or conditions shall be binding unless accepted in writing by the Company. Any purchase order, contract, or letter of intent must reference the proposal as well as any subsequent modifications made by either party. All contracts arising from this proposal or taken directly from our current price list are subject to acceptance by the Company only. No contract or sale may be canceled except by the Company's written permission. All drawings, bulletins or pre-printed illustrations submitted with the proposal are intended to show general configuration and approximate dimensions only. Engineering drawings will be furnished after receipt and acceptance of purchase order.

VALIDITY - The validity of the proposal shall be as stated herein. Any extensions of or modifications to the proposal must be agreed to in writing by the Company. The quotation is subject to change, withdrawal, or correction for typographical errors without notice. The Company reserves the right to make, at any time, such changes in details of design, construction or arrangement of equipment which, in its sole judgment, is deemed to constitute an improvement over previous practice.

TAXES - The amount of any federal, state, or local tax, or similar charge, upon the production, use, sale, shipment, etc., of products sold hereunder now imposed or becoming effective during the progress or existence of the contract, shall be paid by the purchaser. The Company is not licensed to collect such taxes and will not under any circumstances be liable for their payment.

LIMITED WARRANTY

a) WARRANTY - BFS Industries, LLC (herein referred to as "Seller") warrants that at the time of shipment the products manufactured by it shall be merchantable, free from defects in material and workmanship, and shall possess the characteristics represented in writing by Seller. Seller's warranty is conditioned upon the product being properly installed, maintained, and operated in a manner that does not vary materially from that under which such product is usually tested under industry standards existing at time of sale. This warranty is made to the Original Buyer only and is in effect for a period of one (1) year from the date the product is first placed in service or eighteen (18) months from the date of original shipment from Seller's factory, whichever occurs first.

b) WARRANTY ADJUSTMENT

1. Seller agrees to replace or repair (at its sole option), but not install, any product of its manufacture or part or portion thereof which, upon test and examination by Seller, proves defective within the terms of the above warranty. Seller reserves the right to designate where, how, and by whom any such defect will be repaired. Any action taken by the Buyer to proceed with any repair or replacement work without prior written consent of the Seller shall terminate the Seller's responsibility, fiscal and otherwise, for such work.

2. Unless Buyer notifies Seller in writing of any claimed breach of this warranty within thirty (30) days of the discovery of any defect, Buyer's warranty rights hereunder shall lapse.

3. No product will be accepted for return or replacement without Seller's prior written authorization. Upon such authorization, and in accordance with instructions from Seller, the product shall be returned as instructed by the Seller, shipping charges prepaid by Buyer. Seller shall not be liable for any costs or expenses connected with warranty adjustments, except that Seller shall furnish a replacement or repair of a product or part which is proved to be defective in material or workmanship as provided in the above warranty; further, Seller shall furnish to Buyer the replacement or repaired part f.o.b. Seller's factory.

4. Warranty will not be honored by the Seller unless Buyer has made all payments then due and owing.

c) EXCLUSIONS FROM WARRANTY AND LIMITATIONS OF WARRANTY

1. THE FOREGOING WARRANTY IS LIMITED SOLELY AS SET FORTH HEREIN, AND APPLIES ONLY FOR THE PERIOD DESIGNATED ABOVE. THIS WARRANTY TAKES THE PLACE OF AND SUPERSEDES ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED IN LAW. THERE ARE NO EXPRESS WARRANTIES EXCEPT THOSE CONTAINED HEREIN, AND TO THE EXTENT PERMITTED BY LAW, IMPLIED WARRANTIES OR WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED.

2. Except for the remedies provided by this warranty, and to the extent permitted by law, Seller shall not be liable for any loss, damage, or indirect or consequential damages of any kind, whether based upon warranty, contract, or negligence, arising in connection with the sale, use, or repair of the product. In no event shall the Seller be liable for loss of profits by reason of shutdown, non-operation or increase in expense of operation of any other equipment or facilities. The Seller shall not be liable for installation costs or for any special, indirect, consequential, liquidated, or punitive damages. No agent, representative, or salesman of the Seller is authorized to assume for the Seller any liability as set forth above. In any event, the maximum liability of Seller in connection with this limited warranty shall not exceed the contract price for the product claimed to be defective.

3. This warranty does not extend to any product manufactured by Seller which has been subjected to misuse, misapplication, neglect, accident, improper installation, or any use in violation of instructions furnished by Seller. Seller shall not be responsible for any damage or malperformance of the equipment due to corrosive or erosive contaminants or abnormal operating conditions not covered in the design criteria or accepted installation and operational practices.

4. This warranty does not extend to or apply to any product which has been repaired or altered at any place other than Seller's factory, or by persons not expressly approved by Seller (including Buyer or any of Buyer's representatives); nor to any product, the serial number, model number, or any identification of which has been removed, defaced, or changed.

5. Equipment manufactured by anyone other than Seller shall bear only such warranties as are made by the manufacturer of that product, that is, such equipment is warranted only for the period, and to the extent, of original manufacturer's warranty, and is subject to all of the terms and conditions of said warranty.

DELAYS - If shipment is delayed by the Buyer after commencement of fabrication, the contract price shall become due and payable progressively as the work is completed. If storage is required, Buyer agrees to pay applicable storage charges, which may include any insurance and taxes assessed during the delay. The Seller shall not be responsible or liable for any loss or damage resulting from delays or from the Seller's inability to perform the contract as a result of conditions of force majeure such as acts of God, accidents, explosions, fire, earthquakes, war, riots, strikes, action of the elements, material and/or labor shortages, transportation delays, sub-supplier failure to perform, or any other causes or events beyond the Seller's control.

TERMS OF PAYMENT - The Seller's accepted terms of payment are net 30 days from date of shipment, except as may be modified herein by mutual agreement, or in any subsequent modification (s) made in writing by either party and agreed to by both parties.

RETAINAGES - Retainages, other than those agreed to herein or in subsequent written modification (s), will not be accepted. Any arbitrary retainage imposed upon the Seller will be subject to a finance charge not to exceed one-and-one-half (1-1/2) percent per month on the unpaid balance.

ACCEPTANCE - Any purchase order, contract, or letter of intent arising from this proposal is accepted subject to Buyer having established satisfactory credit performance. The Seller reserves the right to modify its terms of payment according to the credit rating of the Buyer.

SHIPMENT - If payment from Buyer is past due, equipment will not be shipped; shipment will be delayed until Buyer is current with payments then due and owing to the Seller.

DISPUTES - Litigation arising from the Seller's performance or failure to perform under the provisions of the purchase agreement will be subject to adjudication in the State of North Carolina.

ATTORNEY'S FEES AND COSTS - In the event legal proceedings are instituted by the Seller to enforce collection under this contract, the Buyer agrees to pay all of the Seller's costs and expenses, including reasonable attorney's fees, in connection with such action. Should any other type of legal action be instituted by either party to this contract, and in the event the Seller is the prevailing party and/or obtains a judgment against the Buyer and/or is awarded damages with respect to any part of the Seller's claim in such action, the Buyer shall be liable for and shall pay to the Seller all costs and expenses, including reasonable attorney's fees, incurred by the Seller in such action.

THE ABOVE CONSTITUTES THE ENTIRE AGREEMENT BETWEEN THE PARTIES AND MAY NOT BE CHANGED OR MODIFIED WITHOUT THE WRITTEN CONSENT OF ALL PARTIES.

***bfs* INDUSTRIES, LLC**
200 INDUSTRIAL DRIVE, BUTNER, NORTH CAROLINA

Receiving/Inspection

This equipment was packed with great care by experienced packers in accordance with Weight and Inspection Bureau specifications. Check **ALL** equipment immediately upon delivery for shortage or damages and notify carrier promptly. We are **NOT** responsible for damages which occur in transit.

INSTALLATION:

A. Accessibility:

Entire system should be positioned to permit access to operating controls, instruments and inspection openings. Additional space should be allocated for necessary platforms, ladders and any other items whose removal extends beyond the system envelope.

B. Foundations:

Deaerator foundations need not be massive as those required by rotating or reciprocating machinery. The foundation should be level and designed to support the anticipated load. Calculations should be based upon the maximum, or flooded weight of the entire system including allowances for piping, platforms, stairs or any other attachments.

C. Rigging:

Qualified riggers should be used to place the system on the foundation. Slings, blocks and all rigging equipment must be carefully placed to avoid damaging or loosening piping, nozzles and other parts of the assembly. The system should be securely bolted to the foundation and shimmed as necessary.

D. Piping:

Prior to piping, a thorough internal inspection should be made. All foreign material or debris must be removed to prevent possible damage. Care should be taken to avoid imposing any piping strain on the vessel or pumps. Provide expansion joints and suitable independently supported pipe hangers where necessary. Isolating valves should be installed to allow for cleaning or repairs. Valved by passes are recommended around water inlet and steam pressure reducing valves. Vent piping should be vertical, full size, avoiding any bends or restrictions. To insure continuous venting, a gate valve is factory installed with a pre-drilled orifice in its disc to prevent complete closure.

The piping of the steam pressure reducing valve is crucial to the proper operation of the deaerator. In service, a pressure reducing valve produces a lower pressure at its outlet than at its inlet, creating a high steam velocity across the valve seat. In most reducing valve installations, sonic velocity will occur. The extreme velocities that must exist across reducing valve seats cannot be tolerated in piping upstream or downstream of the valve. Excessive erosion and noise would result. In systems where the noise of steam flow would be a consideration it is common practice to limit velocities to between 4,000 and 6,000 feet per minute. The steam velocity chart on Page 2 lists steam capacities in pipes under various pressure and velocity conditions.

E. Water Inlet Valve:

All water inlet valve flows listed in catalog are based on the water pressure **at the valve** and a deaerator operating pressure of 5 psig. Calculate frictional line losses **before installation** to avoid excessive pressure drops and resulting reduction in flow. For deaerator operating pressures in excess of 5 psig, re-check water inlet valve flow.

E-1 Valve with Integral Float Chamber:

Install valve sub-assembly as shown on drawing with centerline of float chamber at designated operating level. On systems incorporating two valves, one should be located at the operating level, and the second approximately 2" lower. The primary valve will accommodate average flow requirements, with the secondary unit contributing additional capacity to cover peak loads.

E-2 Valve with Internal Float:

Install rotary shaft packing box in opening indicated on drawing. Gaining access to the interior of the vessel through the manhole, securely attach float rod with float to the internal portion of the

rotary shaft. Mount balancing lever on external portion of the rotary shaft and clamp securely with set screw. Connect turn buckle assembly to balancing and valve levers, and adjust counterweight so that float is half submerged. This position is established when equal force is required to lift or submerge the float.

E-3 Valve with Separate External Float Operation:

(mechanical type) – Install external float operator at operating level as shown on drawing. Connect turn buckle assembly to float operator arm and valve lever and adjust as described above.

E-4 Valve with External Float Operator:

(pneumatic type) – Install external float operating level as shown on drawing. Connect pneumatic control tubing between float operator and valve actuator as described in instructions accompanying operator and valve assemblies.

F. Overflow Trap:

This should be installed at floor level or as low as possible below the deaerator, for maximum static head, assuring the greatest flow.

G. Insulation:

The deaerator, storage tank and all equipment carrying hot water or steam should be thoroughly insulated to prevent condensation of steam and loss of heat. Sample connection, thermometer wells and manholes should be left exposed.

DEAERATOR FLOWS:

It is imperative that **all flows and temperatures in and out** of the deaerator are given us at the time of quoting **(preliminary engineering stage)**. Lack of this information or its accuracy could severely alter the operation of the deaerator and associated equipment.

A. Make-up Water:

Make-up water pressure must be sufficient to overcome the head losses caused by internal steam pressure, pipe friction, water inlet control and spray valves.

B. Low Temperature Returns:

Condensate returns 30 degrees Fahrenheit below the deaerator operating temperature, or cooler, should be piped into the opening provided (as shown on drawing) between the water inlet control valve and the spray valve. This permits the water to pass through the complete deaeration cycle; and its given preference over raw make-up.

C. Medium Temperature Returns (spray type only):

Returns having a temperature ranging from 30 degrees Fahrenheit below, up to the deaerator operating temperature enter this opening.

D. High Temperature Returns:

This opening is used for returns having a temperature higher than that of the steam within the deaerator. They enter directly into the steam entrance where they flash to steam and are utilized in the deaeration process. Care should be taken that the quantity and temperature of this flash steam does **not exceed** the deaerators ability to use it.

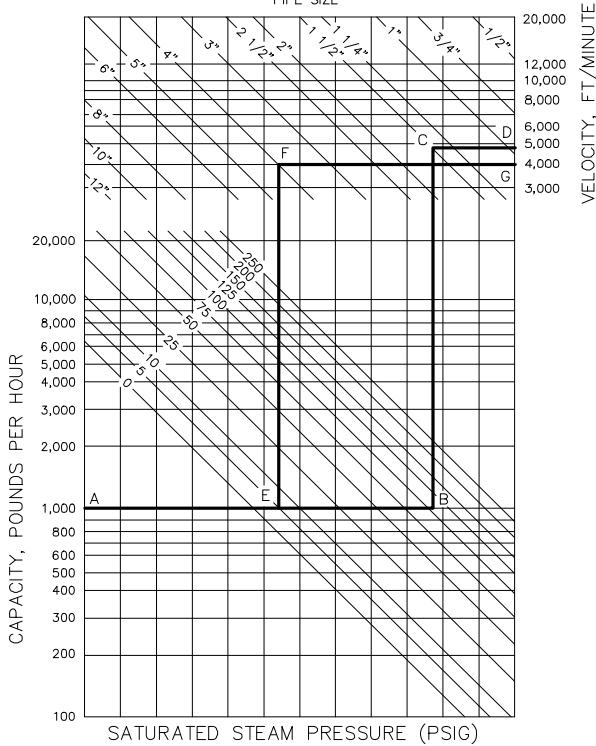
E. Oil Contaminated Returns:

If exhaust steam comes from reciprocating units such as pumps, engines or compressors, it may contain entrained oil which **must be removed** by an oil separator. The oil separator must be of adequate size for maximum steam flow. It should be preceded by a straight pipe equal in length to at least four pipe diameters, to prevent turbulence at separator inlet. Connect oil separator drain line to a trap or pipe loop seal.

F. Steam:

Steam is required to heat and deaerate water. Thermodynamic laws determine the quantity of steam necessary for deaeration. In order to accurately calculate the required steam it is necessary to set up a heat balance. The steam consumed by a deaerator consists of that needed to raise the temperature of incoming water to the saturated steam temperature within the vessel, plus carrier steam utilized in venting non-condensables. This quantity is reduced by the introduction of flash steam from high temperature returns. Heat balance calculations should be made using the lowest incoming water temperatures.

STEAM VELOCITY CHART
(SCHEDULE 40 PIPE)
PIPE SIZE



UPSTREAM PIPING: Enter the velocity chart at “A” for 1,000 pounds per hour. Move horizontally to point “B” where the 100 PSIG diagonal line intersects. Follow up vertically to “C” where an intersection with a diagonal line falls inside the 4,000 – to – 6,000 foot-per-minute velocity band. Actual velocity at “D” is about 4,800 feet per minute for 1 ½ inch upstream piping.

DOWNSTREAM PIPING: Enter the velocity chart at “A” for 1,000 pounds per hour. Follow horizontally to point “E” where the 5 PSIG diagonal line intersects. Move up vertically to “F” where an intersection with a diagonal line falls inside the 4,000 – to – 6,000 foot-per-minute velocity band. Actual velocity at “G” is 4,000 feet per minute for 4 inch downstream piping.

*Multiply chart velocity by factor below to get velocity in schedule 80 pipe.

PIPE SIZE	FACTOR
½”	1.30
¾” & 1”	1.23
1 ¼” & 1 ½”	1.17
2” to 16”	1.12

B. Initial Start-up, Cold (No Steam Available):

- B-1** Open vent valve completely, exhausting to atmosphere.
- B-2** Close valves between deaerator and feed pumps.
- B-3** Admit water to deaerator by opening gate valve in make-up water line. Fill storage section to operating level, as shown on drawing.
- B-4** Open valves in boiler feed pump suction piping.
- B-5** Start boiler feed pumps and fill boiler with cold water.
- B-6** Close valve in deaerator make-up water line.
- B-7** Spray Type Only – Open scrubber drain valve (in systems equipped with scrubber drain) and drain scrubber.
- B-8** Slowly admit steam, when available, to deaerator until normal operating pressure is obtained. Gradually open the manual valve in the make-up water line. Admitting water at a rate sufficiently slow to maintain a positive steam pressure in the vessel. This will be evidenced by a continuous escape of steam through the vent. The incoming water should be manually controlled until it reaches a point sufficient for the water inlet float valve to maintain a proper level. At this level, manual control will no longer be necessary, but the float control should be checked for proper operation. Make any adjustments which may be required to maintain specified operating levels.
- B-9** When a considerable volume of steam is discharging from the vent, throttle back the vent valve until only a plume of vapor can be seen. The water temperature at this point should rise to within three degrees of saturation temperature of the steam at the observed deaerator operating pressure. A lower temperature would indicate insulating pockets of air in the vessel. If this occurs, open the vent valve completely until this air is purged from the deaerator. Return the vent valve to its original position.
- B-10** Open steam valve fully.
- B-11** When water temperature rises to within two degrees of steam temperature, the system is ready for service. The pump suction valves may be opened and the vent valve should be adjusted in accordance with Paragraph D. During operation, stored water temperature should correspond to that of saturated steam at the deaerator operating pressure.
- B-12** Check all valves and float controls to be sure proper level is maintained.
- B-13** Some rumbling may occur with a cold tank. This should disappear as temperature levels increase. Entrapped air is another possible source of rumbling; this should be eliminated as described in Paragraph B-9. The deaerator is designed to remove **dissolved** gases from the water and will handle free air trapped in steam or return piping.
- B-14** When proper operating temperature has been achieved, recheck all piping, flange and manhole bolts, etc., for tightness.

ACCESSORIES

- A. Relief Valve:**
The relief valve furnished is a sentinel type intended to warn of over pressure in the vessel and not be adequate to fully protect the equipment from excess pressure. Since overpressure in a deaerator is a function of the entire steam system, the user must make suitable provision for sufficient total relieving capacity. The valve furnished has a hand release lever which should be operated periodically to assure freedom of movement.
- B. Vacuum Breaker:**
A vacuum breaker is furnished to protect the vessel from external pressure. An open vacuum breaker would indicate an insufficient supply of steam within the deaerator. Operation under this condition will result in oxygen contamination of the stored feed water. This unit should be checked and cleaned at regular intervals to insure proper operation.
- C. Vessel Pressure Gauges:**
Pressure gauges are provided for the steam section and water inlet line. Higher or lower pressures than normal alert the operator of a potential problem.

SYSTEM START-UP

- A. After the equipment has been completely installed, the following procedures should be followed:**
 - A-1** Inspect all pipe connections to be sure they are correctly and securely connected. Examine all controls and valves to assure that each is operating freely and properly lubricated where necessary.
 - A-2** Thoroughly flush vessel and all associated piping until there is no indication of rust or foreign material. Spray valves and vessel nozzles should be freed of all large pieces of mill scale or debris.
 - A-3** Ascertain that all instruments and gauges are operating and indicating correctly.

EXAMPLE: Given a system with 100 PSIG steam pressure entering the pressure reducing valve at a flow of 1,000 pounds of steam per hour and a reduced pressure of 5 PSIG, find the smallest size “from the steam velocity chart” of upstream and downstream piping for reasonably quiet steam velocities.

C. Start-up, Hot (Steam Available):

- C-1** Open vent valve completely, exhausting to atmosphere.
- C-2** Open steam valve slowly, gradually bring deaerator up to operating pressure. If pressure reducing valve hunts or pulsates, adjust until pressure remains steady.
- C-3** Gradually admit water to deaerator by partially opening the gate valve in the water inlet line. The rates of steam and water flow should be carefully controlled to maintain a positive steam pressure in the vessel. This will be evidenced by a continuous escape of steam through the vent. Water flow should be manually controlled until it reaches a point sufficient for the water inlet float valve to maintain a proper level. At this level, manual control will no longer be necessary, but the float control should be checked for proper operation. Make any adjustments which may be required to maintain specified operating levels.
- C-4** At this stage, follow Paragraph B-5 through 13 under "Initial Start-up cold."

D. Venting:

Vent valve is furnished with an orifice in its gate. This orifice is sized for minimum venting. Heavy concentrations of removed gases may require that the valve be opened wider to permit their release to atmosphere. Water temperature lower than that of saturated steam at the deaerator operating pressure would indicate insufficient venting. The vent valve opening should be adjusted accordingly until proper temperature is indicated.

SHUT-DOWN

A. Temporary (overnight, weekend, etc.):

Recommended procedure is to allow deaerated water to remain in storage section while maintaining steam pressure in the vessel. Close water inlet and outlet valves.

B. Long-Term Idle Periods:

The deaerator may be shut-down completely with no steam pressure in the unit. Water must be completely drained. Water inlet valve **must** be closed **before** eliminating steam pressure. Cold water entering the unit will condense the steam, causing a vacuum condition which could result in the collapse of the vessel.

START-UP AFTER SHUT DOWN

- A.** When steam pressure has been maintained in the deaerator during temporary shut-down, it is only necessary to open the water inlet valve and gradually bring flow to required capacity. Recheck adjustments to maintain proper operating levels, and open outlet valve.
- B. Spray Type Only:** When steam pressure has not been maintained, first drain scrubber completely, close valve and proceed in accordance with Paragraph B or C, (system start-up) as appropriate. **CAUTION:** The above described procedures **must** be followed to prevent oxygen contamination of stored water, water hammer and rumble in the deaerator scrubber section.

OPERATING RECORD

A per shift or per day record of deaerator steam and water pressures, and temperatures should be maintained. Inspection of all gauges and controls for proper operation should be made at the same time intervals.

MAINTENANCE

A. Vessel:

A-1 BI-Weekly

Clean gauge glasses and inspect all controls for proper operation. Lubricate all moving parts as required.

- A-2** After first month of operation check spray valves for foreign matter, which may have accumulated from new piping. Clean if necessary.

A-3 Semi-Annually

A-3-1 Inspect spray valves and preheater section for scale or dirt

(thin scale formations will not affect efficiency). Remove any accumulation of debris or scale if necessary.

A-3-2 Clean oil separator trap if employed.

A-3-3 Inspect relief valve and vacuum breaker for proper operation.

A-4 Annually

A-4-1 Drain storage section and remove manhole. Flush out all sediment in storage section and follow with manual cleaning, if necessary. Make certain pump suction openings and piping are clean.

A-4-2 Spray Type Only - Inspect scrubber section. Flush out sediment through scrubber drain.

A-4-3 Carefully inspect all steam and water control devices as well as other accessories. Replace or recondition any parts as required.

A-4-4 Tray Type Only - Check Tray Assemblies. Be sure they are in place and securely held by "Tray Hold Down Bar."

- A-5** Check deaerator gauge glasses frequently for the presence of oil. Oil is more damaging than scale in a boiler. If detected, immediate steps must be taken to find its source and eliminate it (refer to Paragraph C Troubleshooting). After the cause has been found and rectified, the deaerator should be drained and thoroughly cleaned before being returned to service.

B. Pumps:

B-1 Packed Stuffing Boxes

Check packing glands - **DO NOT** run dry. Permit a few drops of water per minute to drip from glands. This provides lubrication for the shaft, eliminating burned packing and scored shafts. When tightening gland bolts, do so **ONLY** when pump is running. Draw up evenly 1/4 turn at a time to allow gland pressure to equalize throughout stuffing box. Replace with HI-temp packing after six (6) months to one (1) year, depending upon severity of service. Remove all old packing first (do not intermix new and old packing). Insert individual rings so that splices are staggered. When stuffing box is full, adjust gland just tight enough to permit slight leakage as described above. **DO NOT RUN DRY.**

B-2 Mechanical Seals

It is not recommended that worn seals be reused. A mechanical seal is similar to a gasket in this respect. Using an old one involves too great a risk of a failure, considering the expense of removing and reinstalling a pump. Attempts to lap the seal faces are **not** recommended under any circumstances.

B-3 Bearings

These will require periodic lubrication, using the grease fittings in the pump frame. For 8 hours daily operation, this should be every thousand hours. Use ball bearing grease of high quality; lithium soda or calcium base grease is recommended for both wet and dry locations. Do not mix different brands. Avoid over lubrication, which can result in overheating and bearing failure. Adequate lubrication is assured if grease quantity is maintained at 1/3 to 1/2 the capacity of the bearing. Approximately every six (6) months, bearings should be cleaned by flushing with kerosene and re-lubricated.

TROUBLE-SHOOTING

A. Low Temperature:

The only reasons for a deaerator to operate at less than saturated steam temperature are lack of steam or improper venting:

- A-1** Insufficient steam may result from an undersized pressure reducing valve or an insufficient supply of steam due to other causes.
- A-2** Insufficient venting can be traced to the vent valve and its associated piping. This valve is furnished with an orifice in its disc sized for minimum venting. Rapid accumulation of released gases may require that the valve be opened wider to accommodate their evacuation to atmosphere. Low water temperature is an indication of insufficient venting. Adjust valve opening accordingly. Vent piping must be vertical, full size and free of bends or obstructions. No other valves should be installed in this line.

B. High Temperature:

- B-1** Pressure reducing valve set at a higher pressure. Adjust valve setting.
- B-2** Sensing line of steam pressure reducing valve water logged - pitch line down to tank.
- B-3** An excess high temperature return. **This condition must be eliminated.** Failure to do so could result in a **hazardous situation** and **destruction** of the boiler feed pumps.

C. Vibration, Rumble and Hammer:

These can be caused by low steam pressure or blockage of internal steam passages in the deaerator.

- C-1** Low steam pressure may result from an undersized pressure reducing valve, improper steam piping, malfunction of the pressure reducing valve or an insufficient supply of steam. Check size, capacity, proper operation of pressure reducing valve as well as steam supply and pressure.
- C-2** If steam piping and controls are not at fault, it will be necessary to drain the vessel and examine all internals for debris or other blockage.

D. Oil Contamination:

- D-1** Possibly from a leaking heat exchanger or steam driven equipment.
- D-2** Improper grade of oil used in steam driven equipment.
- D-3** Oil separator not draining properly. After locating and rectifying the cause of contamination, the deaerator must be drained and thoroughly cleaned before returning to service.

E. Water Level:

- E-1** Wide fluctuations in water level are to be avoided since they may cause rumbling or variations in both temperature and pressure. The following precautions should be observed:
 - E-1-1** Check water inlet valve for proper operation. Water supply pressures differing from those originally specified will result in inadequate or erratic supply. Remedy by installing a properly sized valve or adjusting water supply pressure.
 - E-1-2** Sudden slugs of water will cause variations in steam pressure. These can be the result of large volume returns from a condensate pump, or an oversized water inlet valve. Inlet water flows should be as smooth as possible to avoid sudden steam pressure drops, which will cause flashing and cavitation in the boiler feed pumps.
 - E-1-3** Make certain that total water flows (returns and make-up) do not exceed rated deaerator capacity.

F. Pumps:

- F-1** Cavitation
At any given temperature, all liquids have a definite pressure at which they will boil. It follows, therefore, that a liquid will boil at any temperature, if the pressure is reduced sufficiently. All pumps have a specific net positive suction head (NPSH) requirement. If this positive head is not available, cavitation will develop usually accompanied by a rumbling noise, resulting in severe damage to the pump. The required NPSH has been provided in this system, including additional height to overcome suction line friction losses.

Suction piping has been intentionally oversized to further reduce these losses. Any unusual restriction, such as a clogged strainer, in the suction piping will cause cavitation. The existence of such an obstruction can be best determined by a thorough visual check or by installing a compound gauge (reading in vacuum and pressure) in the pump suction line close to the pump. A thoroughly clean and unrestricted line will produce a pressure reading on the gauge, while the pump is running, equal to the operating pressure of the deaerator plus the static head available. This head is measured in feet from the water level to the pump suction

centerline and converted to PSIG by dividing by 2.31. A slight variance may be observed due to friction losses in suction piping. Any restriction must be corrected immediately or severe pump damage will result.

- F-2** Another source of noise would be a misaligned coupling between pump and motor. Check this by applying a straight edge across coupling halves at 90 degrees and 180 degrees. Straight edge should rest evenly on both coupling halves. Shim pump and/or motor, if necessary, to bring coupling into perfect alignment vertically and laterally. Check pump for free rotation by turning coupling manually.
- F-3** Be sure piping connections at pump are properly aligned and supported to eliminate any strain on pump casing. Forcing piping into place will result in misalignment of pump, causing noise and structural damage.
- F-4** Vibration can be induced by bent or broken shaft, worn bearings or binding of the impeller due to foreign matter entering the pump. Worn or damaged shafts and bearings must be replaced. Remove any contaminants in the pump and replace damaged parts. It is essential that the source of contamination be found and eliminated **BEFORE** returning the pump to service.

G. Overflow:

A continuing overflow condition may result from malfunction of the trap-or-the water inlet valve.

- G-1** Inspect trap for accumulated dirt at the valve seat and clean, if necessary. Periodically remove the drain plug and drain sediment.
- G-2** If trap is functioning properly, inspect water inlet float for possible water-logged condition. Make certain the water inlet valve control linkage is properly adjusted to maintain specified operating level in deaerator.

H. Motors:

Any number of reasons exist for motor failure. Some of the most common are as follows:

- H-1** Tripped starter overload - Reset and check motor and pump for proper operation.
- H-2** Improper power supply - Check motor nameplate data against available power supply.
- H-3** Incorrect connections - check wiring diagrams.
- H-4** Mechanical failure. Check for free rotation and examine bearings.
- H-5** Short circuited windings - indicated by blown fuse or failure to start. Motor must be replaced.
- H-6** Overload - Check pump for proper operation and free rotation.
- H-7** One phase open in three phase circuit - check power supply lines.
- H-8** Vibration.
 - H-8-1** Check alignment of pump and motor.
 - H-8-2** Defective bearing - replace.
 - H-8-3** Polyphase motor running single phase - check for open circuit.

I. Controls:

- I-1** Blown fuses
 - I-1-1** Check motor for short circuit windings
 - I-1-2** Incorrect connections - Refer to wiring diagram.
 - I-1-3** Improper power supply - check motor name plate against available power supply.
- I-2** Starter overload tripped - Reset and inspect pump and motor for proper operation.
- I-3** Motor fails to start
 - I-3-1** Make certain boiler level switch is functioning properly.
 - I-3-2** Check control circuit for continuity.
- I-4** High/low alarm system not operating.
 - I-4-1** Relays defective.
 - I-4-2** High or low alarm switch not operating properly.



BUTNER, NORTH CAROLINA
PHONE: 919-575-6711 FAX: 919-575-4275

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CLASS "S" – SPRAY TYPE

DATED 6/6/19
SUPERSEDES 1/15/03

MECHANICS OF DEAERATION

Extensive research proves that to inhibit corrosion in a steam system, the oxygen content must be limited to a maximum level of .01ppm (.0075 cc/1). A true deaerator will reduce the oxygen to the .005 cc/1 level and the carbon dioxide to zero. A further benefit of this process is the simultaneous pre-heating of the feed water. More rapid removal of gas occurs when the liquid is sprayed in a thin film and then violently scrubbed by the incoming steam.

The modern spray-type deaerator has evolved into a two stage device, the pre-heater and the scrubber where water and steam are mixed at controlled velocities. It is essential that the first stage (pre-heater) heat the feed water to a temperature approaching that of the operating steam pressure.

The effluent then enters the second stage (scrubber) where it is vigorously boiled and scrubbed with fresh steam. This forces the remaining traces of oxygen and carbon dioxide to the surface of the liquid, where they are liberated from the water.

Non-condensable gases must be evacuated from the deaerator at a rate equal to their liberation. A vent condenser is utilized to concentrate these gases and condense the carrier steam, thereby avoiding unnecessary steam venting.

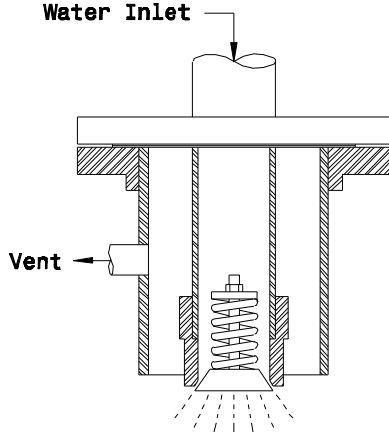
OPERATION

Incoming water first enters the deaerator through the spray valves, directed downward into the steam atmosphere in the first stage pre-heater section. There the water is heated to within two degrees of the steam temperature in the deaerator. This is accomplished by spraying water through self-adjusting spray valves designed to produce a uniform, thin, continuous film thru all load conditions. These efficient valves assure a constant temperature and uniform gas removal.

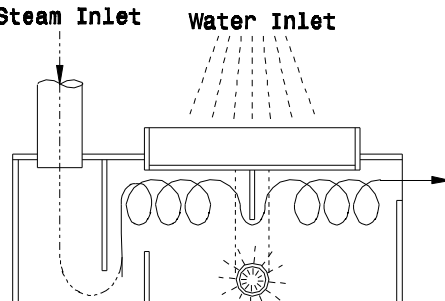
From the first stage the pre-heated water, containing traces of dissolved gasses flows into the second stage, scrubber section. Here the water is brought into direct contact with an abundance of fresh, gas-free steam. The steam enters this stage at the base of the scrubber and is vigorously mixed with the pre-heated water. This direct physical contact shakes loose the dissolved gases, separating them from the effluent. Very little steam is condensed here, as incoming pre-heated water has a temperature approaching that of the steam. The water leaving this stage, now completely deaerated and heated to the steam temperature corresponding to the pressure within the vessel, spills into the storage section where it remains ready for use.

A reduction in temperature and pressure in the vent condenser is created as the entering water condenses the steam atmosphere. This causes a steam flow toward the vent condenser, carrying with it the liberated gases. Here most of the steam is condensed, and the remainder carries the residual gases through the vent to atmosphere.

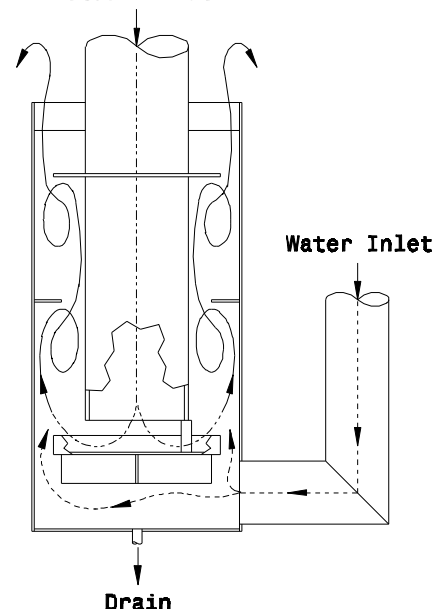
**SPRAY VALVE AND INTERNAL
VENT CONDENSER ASSEMBLY**
Capacities over 30,000 lbs./hr.
will have multiple spray valves
Water Inlet



HORIZONTAL SCRUBBER
Capacities up to 11,000 lbs./hr.
Steam Inlet Water Inlet



VERTICAL SCRUBBER
Capacities 14,000 lbs./hr.-up
Steam Inlet



bfs INDUSTRIES, LLC
BUTNER, NORTH CAROLINA

Section 1

Section 1

Mechanical Layout : 21701D-ME

Bill of materials : 21-701-D

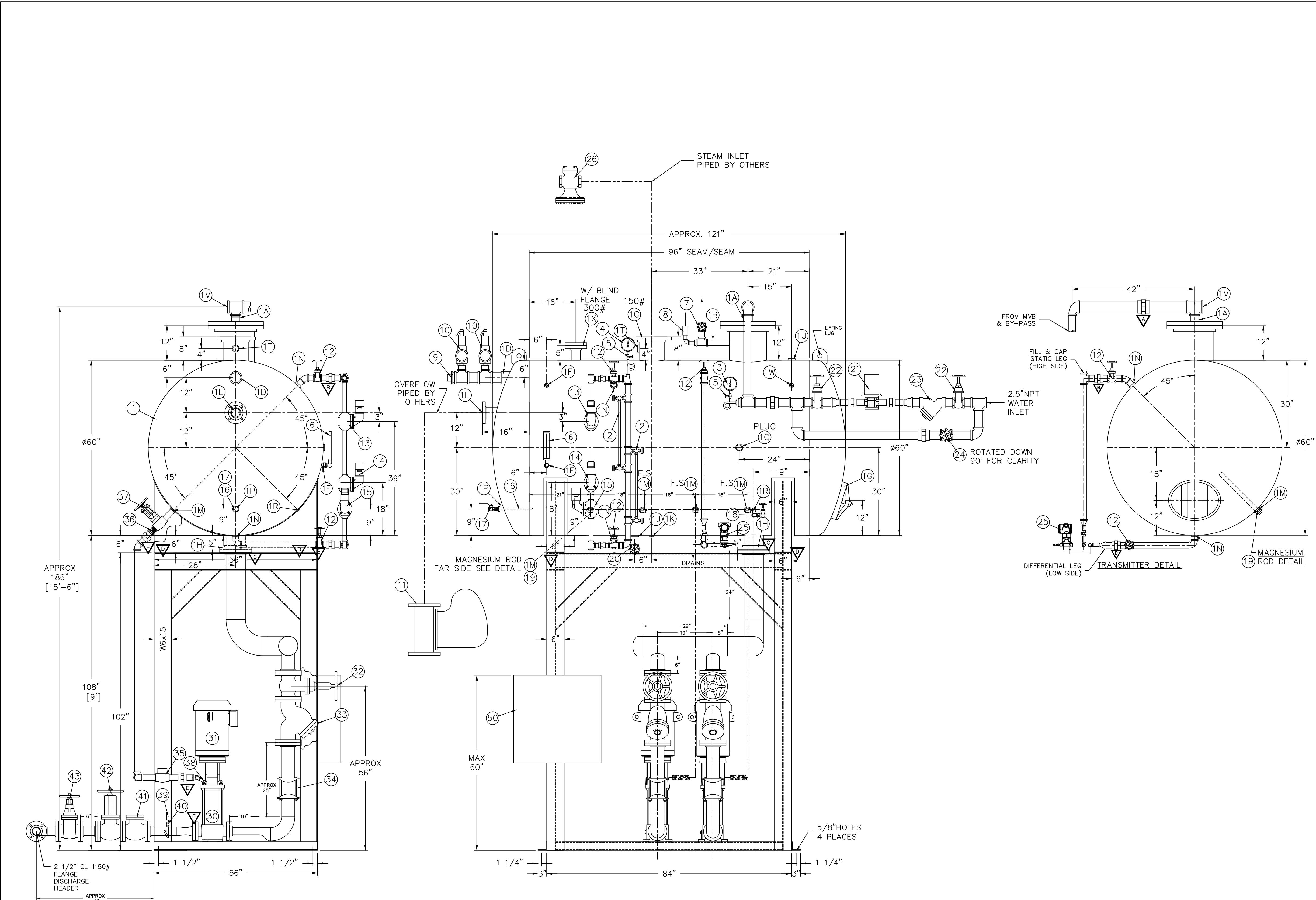
Electrical Schematic : 21-701-SC



BFS INDUSTRIES, LLC
200 INDUSTRIAL DRIVE, BUTNER, NORTH CAROLINA

Your complete line of BOILER ROOM AUXILARY EQUIPMENT Needs

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BILL OF MATERIAL			
DEAERATOR VESSEL MODEL NUMBER	40MS	VESSEL DESIGNED,	
RATED OUTPUT CAPACITY (#/HR.)	40,000	CONSTRUCTED & STAMPED	
STORAGE CAPACITY TO OVERFLOW (GALLONS / MINUTES)	1024 / 12	IN ACCORDANCE WITH	
VESSEL DESIGN PRESSURE / TEMPERATURE (PSIG / °F)	50 / 400	A.S.M.E. CODE	
OPERATING PRESSURE / TEMPERATURE (PSIG / °F)	5 / 227	SECTION VIII	
100% MAKE-UP WATER @ (°F)	50	DIVISION 1	
0% LOW TEMPERATURE RETURNS @ (<196°F)	-		
0% MEDIUM TEMPERATURE RETURNS @ (197-226°F)	-	O2 REMOVAL TO .005 cc/liter	
0% HIGH TEMPERATURE RETURNS @ (227+°F)	-	CO2 REMOVAL TO 0	
AVAILABLE STEAM PRESSURE (PSIG)	135		

ITEM	QTY.	CONNECTION DESCRIPTION	MATERIAL	TYPE	SIZE	NOTES
1A	1	MAKE UP WATER INLET	SA312-TP304L	PIPE T.O.E.	2.5"	SCH. STD
1B	1	VENT	SA312-TP304L	PIPE T.O.E.	1.5"	SCH. STD
1C	1	STEAM INLET	SA105	FLANGE	8"	150# RFSSO
1D	1	VACUUM BREAKER	SA53-B	PIPE	8"	SCH. STD
1E	1	THERMOMETER	SA105	FULL CPLG	3"	3000#
1F	1	STEAM THERMOMETER	SA105	HALF CPLG	3/4"	3000#
1G	1	MAINTENANCE HOLE	SA675-70	ELLIPTICAL	12" x 16"	W/ COVER
1H	1	SUCTION	SA105	FLANGE	6"	150# RFSSO
1I	1	DRAIN	SA53-B	PIPE	6"	SCH. STD
1J	1	SCRUBBER DRAIN	SA105	HALF CPLG	2"	3000#
1K	1	OVERFLOW	SA105	FULL CPLG	3/4"	3000#
1L	1	OVERFLOW	SA105	FLANGE	3"	150# RFSSO
1M	4	RECIRCULATION / MAGNESIUM ROD	SA53-B	PIPE	3"	SCH. STD
1N	4	RECIRCULATION CONNECTION	SA105	FULL CPLG	1.5"	3000#
1P	1	CHEMICAL INJECTION	SA105	HALF CPLG	1.5"	3000#
1Q	1	SPARE	SA105	FULL CPLG	1.25"	3000#
1R	1	SAMPLE	SA105	HALF CPLG	3/4"	3000#
1T	1	HIGH TEMPERATURE RETURNS	SA105	HALF CPLG	1.5"	3000#
1U	1	MEDIUM TEMPERATURE RETURNS	SA105	FULL CPLG	1.5"	3000#
1V	1	LOW TEMPERATURE RETURNS	C.I.	TEE	2.5"	3000#
1W	1	PRV SENSING	SA105	HALF CPLG	3/4"	3000#
1X	1	RELIEF VALVE	SA105	FLANGE	2.5"	300# RFSSO
			SA53-B	PIPE	2.5"	SCH. STD

ITEM	QTY.	DESCRIPTION	MFR.	MOD.	SIZE	NOTES
1	1	SPRAY DEAERATOR - CARBON STEEL	BFS	40MS	1024 GALLONS	ASME-CODE
2	2	WATERGLASS GAUGE SET	CONBRACO	22-208-10	24"	
3	1	WATER PRESSURE GAUGE	WEISS	TL40-030-4L	4" DIAL, 1/4"NPT	0-30 PSIG
4	1	STEAM PRESSURE GAUGE	WEISS	TL40-030-4L	4" DIAL, 1/4"NPT	0-30 PSIG
5	2	SHUT-OFF COCK	TRERICE	735-2	1/4"NPT	BRASS
6	1	WATER STORAGE THERMOMETER	WEISS	9V6	30-300°F	
7	1	MANUAL VENT VALVE	ENG-75BS	507	3/4"NPT	6" STEM
8	1	AUTO VENT	POWELL	507	1 1/2" NPT	With 1/4"HOLE
9	1	VACUUM BREAKER	AV-2003-13-N	507	3/4"NPT	5/16"ORIFICE
10	2	SAFETY RELIEF VALVES SET @ 50 PSI 4,456#/HR. EACH	DURABLA	0FT8036-57	2.5"NPT	316 S.S., (EPDM)
11	1	OVERFLOW TRAP (SHIPPED LOOSE)	KUNKLE	6283-JH	2"NPT INLET	BRONZE
12	4	ISOLATION GATE VALVES	3"NPT OUTLET			
13	1	HIGH LEVEL ALARM SWITCH	BRYAN	MT-3	3"FLG	150#
14	1	LOW LEVEL ALARM SWITCH	POWELL	507	1.5"NPT	125# BZ
15	1	LOW-LOW LEVEL ALARM / LWCO SWITCH	MCDON. & MILLER	63-B	1"NPT	WIRED
16	1	CHEMICAL INJECTION QUILL	MCDON. & MILLER	63-B	1"NPT	WIRED
17	1	CHEMICAL INJECTION BALL VALVE	MCDON. & MILLER	63-B	1"NPT	WIRED
18	1	SAMPLE GLOBE VALVE	NEPTUNE	QC-316-50-SP-12	1/2"NPT x 12"LG	W/ INTEGRAL CHECK
19	1	MAGNESIUM CORROSION ROD	APOLLO	76-103-01A	1/2"NPT	2000# 316SS
20	1	VESSEL DRAIN GATE VALVE	POWELL	650	1.25"NPT	125# BZ
21	1	MOTORIZED WATER INLET VALVE	POWELL	507	3/4"NPT	125# CI
22	2	ISOLATION GATE VALVE	MUELLER	11M	2.5"NPT	250# CI
23	1	Y-TYPE STRAINER	POWELL	650	2.5"NPT	125# BRONZE
24	1	BY-PASS GLOBE VALVE	POWELL	650	2.5"NPT	125# BRONZE
25	1	DP LEVEL TRANSMITTER	ROSEMOUNT	2051CD2A02A1A	1/2"NPT	CALIBRATED
26	1	W/ 3-VALVE MANIFOLD PRESSURE REDUCING E-VALVE	SPENCE	0305RC32B11	4-20 mA	0 TO 72 IN H2O
		W/ D PILOT				FULL PORT
		W/ FITTINGS				3-20 PSIG
						(LOOSE)

ITEM	QTY.	DESCRIPTION	MFR.	MOD.	SIZE	NOTES
30	2	CENTRIFUGAL PUMP	GRUNDFOS	CR 20-7k	2" FLANGED	LOW NPSH
31	2	MOTOR: 460V 60HZ 3PH 3500RPM	TEFC, NEMA P.E.	#99968316	CL-250#	
32	2	SUCTION GATE VALVES	BY PUMP MFR	1793A	20 HP	FAC. WIRED
33	2	SUCTION Y-TYPE STRAINER	POWELL	788	4" FLANGED	125# CI
34	2	EXPANSION COUPLING	MUELLER	38	4" FLANGED	125# CI
35	2	RECIRCULATION CHECK VALVE	DRESSER	38	4" FLANGED	EPDM SEALS
36	2	RECIRCULATION ORIFICE	POWELL	SW08TA58GBJ	1.5"NPT	800# F.S.
37	2	RECIRCULATION GATE VALVE	POWELL	1155SN	1.5"NPT	With 5/16" HOLE
38	2	RECIRCULATION ADAPTOR	POWELL	GA08TA58GBJ	1.5"NPT	800# F.S.
39	2	PRESSURE GAUGE - LIQUID FILLED	BFS	G1/2-NPT	1/2"NPT TO FNPT	W/ O-RING
40	2	SHUT-OFF COCK	WIKKA	233.53	2.5" DIAL, 1/4"NPT	0-300 PSIG
41	2	DISCHARGE CHECK VALVE	TRERICE	735-2	1/4"NPT	BRASS
42	2	DISCHARGE GLOBE VALVE	POWELL	1561F	2.5" FLANGED	150# CS
43	2	DISCHARGE GATE VALVE	POWELL	1531F	2.5" FLANGED	150# CS
			POWELL	1503F	2.5" FLANGED	150# CS

ITEM	QTY.	DESCRIPTION	MFR.	MOD.	NOTES
50	1	CONTROL PANEL	BFS	D-32-460	SEE WIRE DIAGRAMS

RECOMMENDED STEAM PIPING DETAIL:

1) STEAM PIPING SHOWN IS NOT FURNISHED.
2) SUPPLY PIPING TO PRV TO BE SIZED FOR REQUIRED INLET PRESSURE AT REGULATOR.
3) DISCHARGE PIPING FROM PRV MUST BE SAME SIZE AS STEAM INLET ON VESSEL.
4) SENSING LINE MUST BE SLOPED DOWNWARD IN A STRAIGHT RUN WITH A MINIMUM OF ELBOWS AND PIPED TO TANK CONNECTION.

SPECIAL FAB NOTES:

PUMP RECIRCULATION TO HAVE SCHEDULE 80 PIPE WITH 150# BMT THREADED FITTINGS

PUMP DISCHARGE & SUCTION TO HAVE SCHEDULE 40 PIPE WITH BUTT-WELD FITTINGS

SPECIFICATIONS:

- * POST WELD HEAT TREAT: NONE
- * DESIGN PRESSURE: 80 PSIG
- * DESIGN TEMPERATURE: -20°F TO 400°F
- * TEST PRESSURE: 65 PSIG
- * CORROSION ALLOWANCE: .0000 INCH
- * ADDITIONAL NDE: NONE
- * APPROX. EMPTY WEIGHT: 7,300 (lbs)
- * VESSEL CONSTRUCTED & STAMPED IN ACCORDANCE WITH A.S.M.E. CODE, SECTION VIII DIVISION 1, LATEST EDITION AND NATIONAL BOARD REGISTRATION.

SHIPMENT BREAK POINTS:

- WATER INLET PIPING
- WATER COLUMN
- PUMP SUCTION
- TANK STAND
- RECIRC. PIPING
- DISCHARGE PIPING

NOTES:

1) DUE TO SHIPPING CLEARANCES, TANK WILL BE REMOVED AFTER ASSEMBLY. ANY WATER COLUMNS WILL BE REMOVED AND MATCH-MARKED FOR EASY FIELD RE-ASSEMBLY. OPEN TEES/CONNECTIONS ON WATER COLUMNS WILL BE PLUGGED.

2) ALL PIPING & WIRING IS FACTORY INSPECTED FOR TIGHTNESS. HANDLING DURING SHIPMENT MAY LOOSEN & MISALIGN COMPONENTS. THE FACTORY ASSUMES NO RESPONSIBILITY FOR LEAKS, MISALIGNMENT OR ANY OTHER CONSEQUENTIAL LIABILITY ARISING FROM SITUATIONS BEYOND ITS CONTROL. IT IS STRONGLY RECOMMENDED THAT ALL JOINTS, UNIONS & COUPLINGS BE CHECKED FOR TIGHTNESS AND ALIGNMENT AFTER INSTALLATION TO INSURE PROPER PERFORMANCE.

3) STEAM PRESSURE REDUCING VALVE PIPING TO BE BY OTHERS, IN THE FIELD, IN ACCORDANCE WITH MFR'S INSTRUCTION.

REVISIONS:

1			
2			
3			
4			
5			

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Scale: 1/8" = 1'-0"

Drawn: SL

Check: 12/27/2021

DRAWING No. 21701D-ME

Rev. 0

BFS INDUSTRIES, LLC
BURNER, NORTH CAROLINA

MODEL 40MS-175 DUPLEX ZER-O-PAC

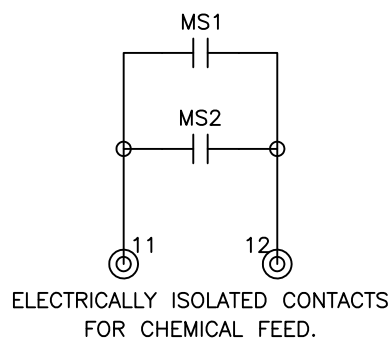
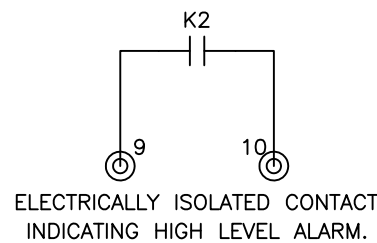
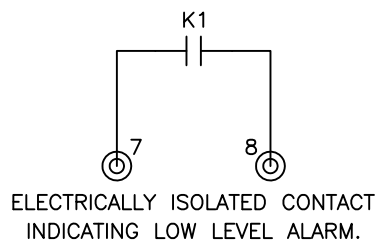
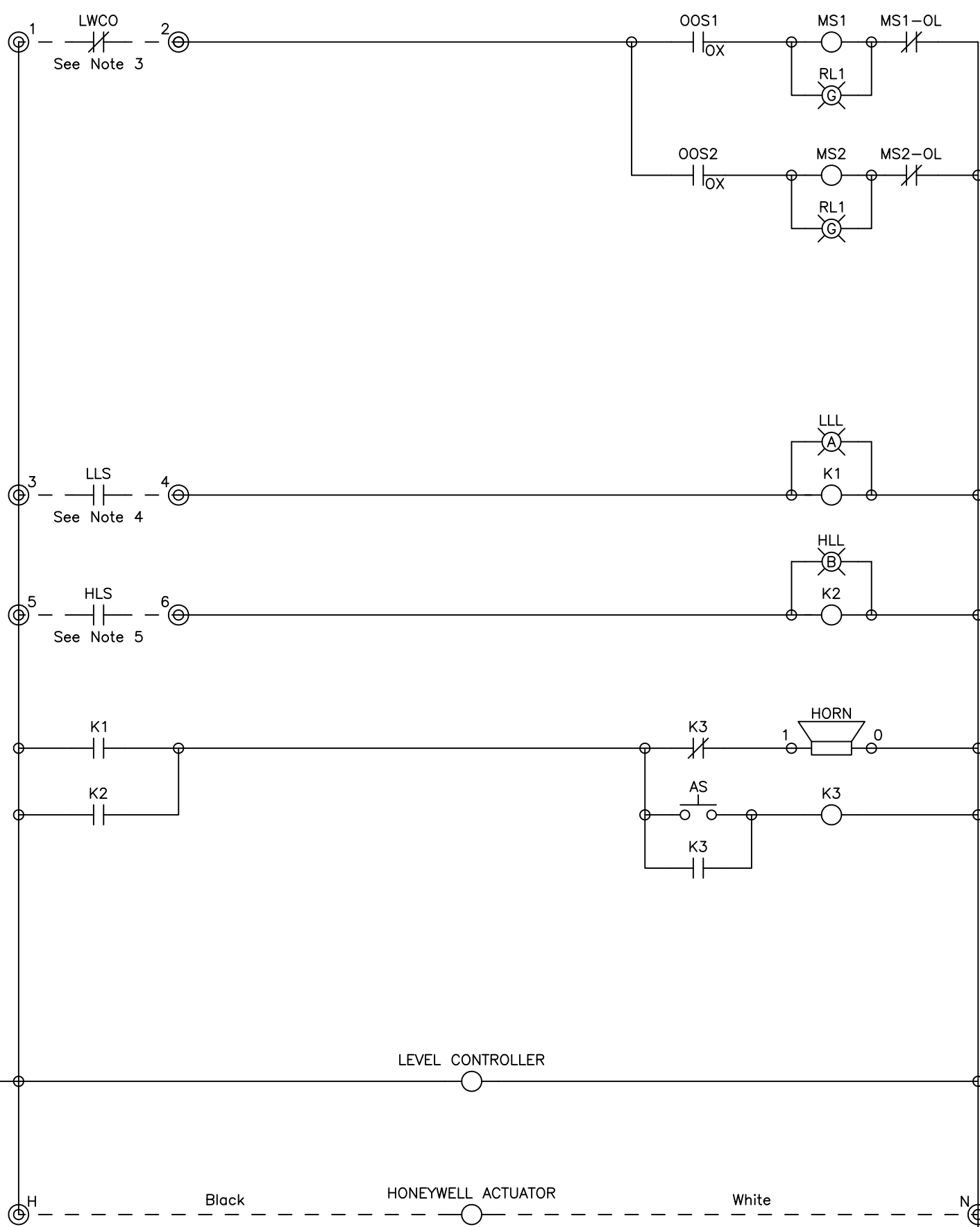
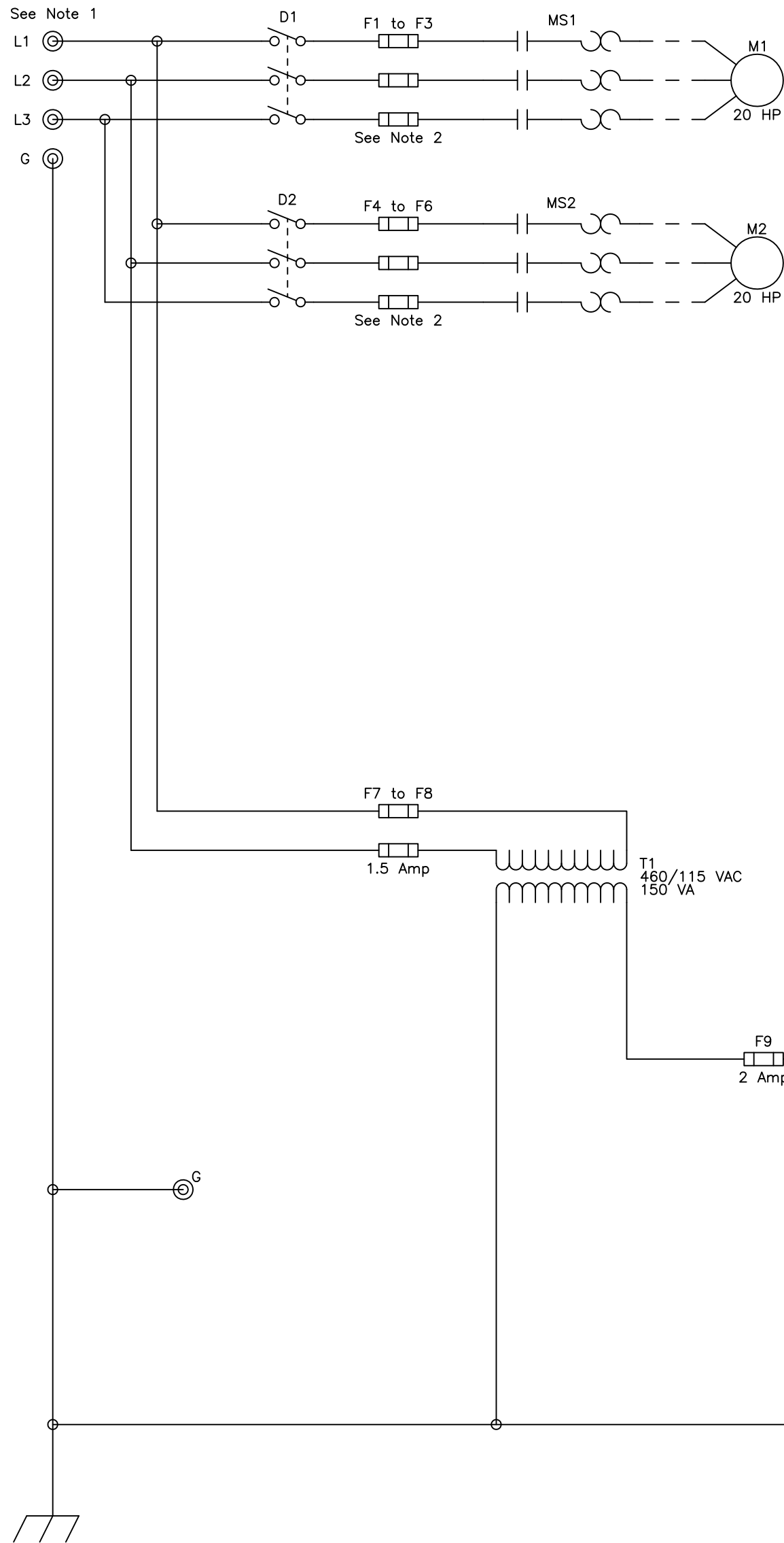
S.O.# 21-701-D

JOB BLUE MARBLE PRODUCTIONS

CUSTOMER ADCO COMPANIES

WORKSHEET	MODEL: 40MS-175 DUPLEX ZER-O-PAC				S.O. # : 21-701-D	
PURCHASING	CUSTOMER: ADCO COMPANIES				SHIPPING DATE:	
PACKING LIST	JOB: BLUE MARBLE PRODUCTIONS				REVISION: 0	
	P.O. # : 65143E90-1				BY: SL	
	SERIAL #:					
	SPRAY VALVES: (QTY. 2 / SIZE 2.5")					
BILL OF MATERIAL						
VESSEL ASSEMBLY						
	ITEM	QTY.	DESCRIPTION	MFR.	MOD.	SIZE
	1	1	SPRAY DEAERATOR - CARBON STEEL	BFS	40MS	1024 GALLONS
	2	2	WATERGLASS GAUGE SET	CONBRACO	22-208-10	24"
	3	1	WATER PRESSURE GAUGE	WEISS	TL40-030-4L	4" DIAL, 1/4"NPT
	4	1	STEAM PRESSURE GAUGE	WEISS	TL40-030-4L	4" DIAL, 1/4"NPT
	5	2	SHUT-OFF COCK	TRERICE	735-2	1/4"NPT
	6	1	WATER STORAGE THERMOMETER W/ BRASS THERMOWELL	WEISS	9V6 EN6-75BS	30-300°F 3/4"NPT
	7	1	MANUAL VENT VALVE	POWELL	507	1 1/2" NPT
	8	1	AUTO VENT	WATSON McDANIEL	AV-2003-13-N	3/4"NPT
	9	1	VACUUM BREAKER	DURABLA	DFT8036-57	2.5"NPT
	10	2	SAFETY RELIEF VALVES SET @ 50 PSI 4,456#/HR. EACH	KUNKLE	6283-JH	2"NPT INLET 3"NPT OUTLET
	11	1	OVERFLOW TRAP (SHIPPED LOOSE)	BRYAN	HT-3	3"FLG
	12	4	ISOLATION GATE VALVES	POWELL	507	1.5"NPT
	13	1	HIGH LEVEL ALARM SWITCH	McDON. & MILLER	63-B	1"NPT
	14	1	LOW LEVEL ALARM SWITCH	McDON. & MILLER	63-B	1"NPT
	15	1	LOW-LOW LEVEL ALARM / LWCO SWITCH	McDON. & MILLER	63-B	1"NPT
	16	1	CHEMICAL INJECTION QUILL	NEPTUNE	QC-316-50-SP-12	1/2"MNPT x 12"LG
	17	1	CHEMICAL INJECTION BALL VALVE	APOLLO	76-103-01A	1/2"NPT
	18	1	SAMPLE GLOBE VALVE	POWELL	650	3/4"NPT
	19	1	MAGNESIUM CORROSION ROD	BFS	MR-12518	1.25"NPT 3/4"NPT PLUG
	20	1	VESSEL DRAIN GATE VALVE	POWELL	507	2"NPT
	21	1	MOTORIZED WATER INLET VALVE	ACCU-FLOW \ BFS	MBV-G-0420	1"NPT (4-20 Ma)
	22	2	ISOLATION GATE VALVE	POWELL	507	2.5"NPT
	23	1	Y-TYPE STRAINER	MUELLER	11M	2.5"NPT
	24	1	BY-PASS GLOBE VALVE	POWELL	650	2.5"NPT
	25	1	DP LEVEL TRANSMITTER W/ 3-VALVE MANIFOLD	ROSEMOUNT	2051CD2A02A1AS 5E5M4 0305RC32B11	1/2"NPT 4-20 mA CALIBRATED 0 TO 72 IN H ₂ O WIRED
	26	1	PRESSURE REDUCING E-VALVE W/ D PILOT W/ FITTINGS	SPENCE	E-C1H9A1 P-D-C1A1HS FIT-E-B1H1A1A	2"NPT C.I. FULL PORT 3-20 PSIG (LOOSE)

WORKSHEET	MODEL: 40MS-175 DUPLEX ZER-O-PAC					S.O. # : 21-701-D	
PURCHASING	CUSTOMER: ADCO COMPANIES					SHIPPING DATE:	
PACKING LIST	JOB: BLUE MARBLE PRODUCTIONS					REVISION: 0	
	P.O. # : 65143E90-1					BY: SL	
	PUMP ASSEMBLY						
	ITEM	QTY.	DESCRIPTION	MFR.	MOD.	SIZE	NOTES
	30	2	CENTRIFUGAL PUMP 112 GPM @ 425'TDH (175 PSIG)	GRUNDFOS	CR 20-7k #99968316	2" FLANGED CL-250#	LOW NPSH
	31	2	MOTOR: 460V 60HZ 3PH 3500RPM	BY PUMP MFR	TEFC, NEMA P.E.	20 HP	FAC. WIRED
	32	2	SUCTION GATE VALVES	POWELL	1793A	4" FLANGED	125# CI
	33	2	SUCTION Y-TYPE STRAINER	MUELLER	758	4" FLANGED	125# CI
	34	2	EXPANSION COUPLING	DRESSER	38	4"	EPDM SEALS
	35	2	RECIRCULATION CHECK VALVE	POWELL	SW08TA58GBJ	1.5"NPT	800# F.S.
	36	2	RECIRCULATION ORIFICE	BFS	115SSN	1.5"NPT	With 5/16" HOLE
	37	2	RECIRCULATION GATE VALVE	POWELL	GA08TA58GBJ	1.5"NPT	800# F.S.
	38	2	RECIRCULATION ADAPTOR	BFS	G1/2-NPT	1/2"MNPT TO FNPT	W/ O-RING
	39	2	PRESSURE GAUGE - LIQUID FILLED	WIKA	233.53	2.5" DIAL, 1/4"NPT	0-300 PSIG
	40	2	SHUT-OFF COCK	TRERICE	735-2	1/4"NPT	BRASS
	41	2	DISCHARGE CHECK VALVE	POWELL	1561F	2.5" FLANGED	150# CS
	42	2	DISCHARGE GLOBE VALVE	POWELL	1531F	2.5" FLANGED	150# CS
	43	2	DISCHARGE GATE VALVE	POWELL	1503F	2.5" FLANGED	150# CS
	PANEL ASSEMBLY						
	ITEM	QTY.	DESCRIPTION	MFR.	MOD.	NOTES	
	50	1	CONTROL PANEL	BFS	D-32-460	SEE WIRE DIAGRAMS	



LEGEND:

AS = ALARM SILENCE
BLK = BLACK
CLR = CLEAR
D = DISCONNECT
F = FUSE
G = GROUND
H = HOT
HLL = HIGH LEVEL LIGHT
HLS = HIGH LEVEL SWITCH
HP = HORSEPOWER
K = CONTROL RELAY
L = LINE

LLL = LOW LEVEL LIGHT
LLS = LOW LEVEL SWITCH
LWCO = LOW WATER CUTOFF
M = MOTOR
MS = MOTOR STARTER
N = NEUTRAL
OL = OVERLOAD
OOS = OFF-ON SWITCH
RL = RUN LIGHT
S = SHIELD
T = TRANSFORMER
WICV = WATER INLET CONTROL VALVE

INTERNAL CONDUCTOR

EXTERNAL CONDUCTOR

○ ELECTRICAL
CONNECTION

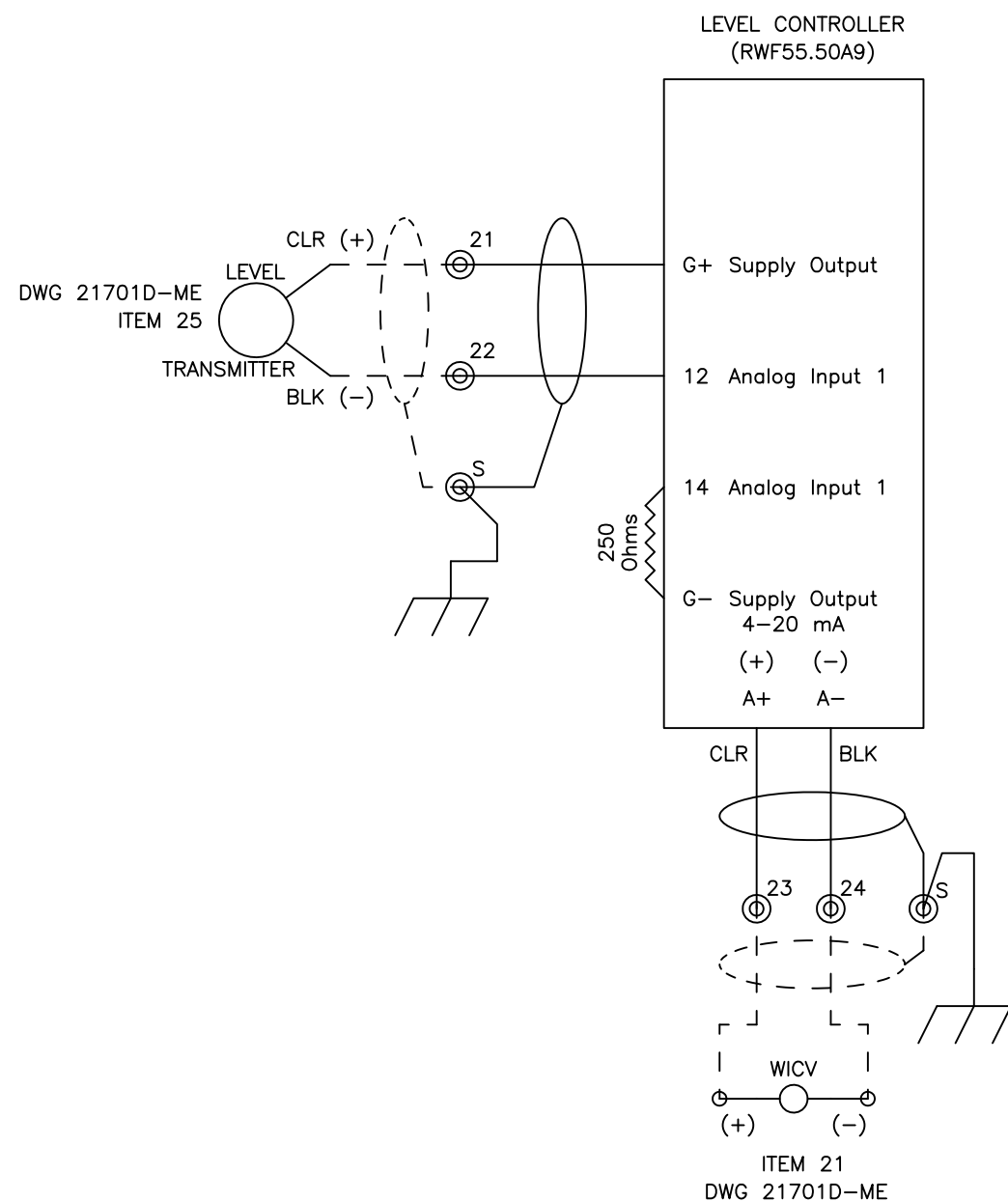
⊙ TERMINAL BLOCK
CONNECTION

GENERAL NOTES:

1. TYPE 12 ENCLOSURE, 30" x 30" x 9".
2. SHORT CIRCUIT CURRENT RATING:
5,000 AMPS RMS SYMMETRICAL.
3. THIS PRODUCT HAS EARNED THE
UL LISTING MARK.

NOTES:

1. 460 VAC, 3 ϕ , 60 HZ SERVICE.
USE COPPER CONDUCTORS ONLY, 75° C.
FIELD TO INSTALL DISCONNECTING MEANS
AND FUSE/BREAKER PROTECTION.
2. 50-AMP, CLASS J, TIME-DELAY FUSES.
3. LWCO CONTACT (C&NC) IS FACTORY SUPPLIED.
CONTACT OPENING STOPS PUMP.
CONTACT IS ELECTRICALLY NORMALLY OPEN,
CLOSED BY WATER ABOVE SWITCH LEVEL.
4. LLS CONTACT (C&NO) IS FACTORY SUPPLIED.
CONTACT CLOSURE CAUSES ALARM.
CONTACT IS ELECTRICALLY NORMALLY CLOSED,
OPENED BY WATER ABOVE SWITCH LEVEL.
5. HLS CONTACT (C&NC) IS FACTORY SUPPLIED.
CONTACT CLOSURE CAUSES ALARM.
CONTACT IS ELECTRICALLY NORMALLY OPEN,
CLOSED BY WATER ABOVE SWITCH LEVEL.



Revisions:		
1	03/03/22	Test Correction for LWCO.
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

bfs INDUSTRIES, LLC
BUTNER, NORTH CAROLINA

DESCRIPTION 40MS-175 DUPLEX ZER-O-PAC

S.O.# 21-701-D

JOB BLUE MARBLE PRODUCTIONS

CUSTOMER ADCO COMPANIES, LTD.

Scale: NONE
Drawn: HDW
Apprvd: J. Sambersky

Date: 12/2/21

Drawing no: 21701D-SC

Rev. 1

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Appendix: A

Appendix A: VESSEL ASSEMBLY

Item

- 
- 2.....WATERGLASS GAUGE SET
 - 3.....WATER PRESSURE GAUGE
 - 4.....STEAM PRESSURE GAUGE
 - 5.....SHUT-OFF COCK
 - 6.....WATER STORAGE THERMOMETER W/ BRASS THERMOWELL
 - 7.....MANUAL VENT VALVE
 - 8.....AUTO VENT
 - 9.....VACUUM BREAKER
 - 10.....SAFETY RELIEF VALVES SET @ 50 PSI 4,456#/HR. EACH
 - 11.....OVERFLOW TRAP (SHIPPED LOOSE)
 - 12.....ISOLATION GATE VALVES
 - 13.....HIGH LEVEL ALARM SWITCH
 - 14.....LOW LEVEL ALARM SWITCH
 - 15.....LOW-LOW LEVEL ALARM / LWCO SWITCH
 - 16.....CHEMICAL INJECTION QUILL
 - 17.....CHEMICAL INJECTION BALL VALVE
 - 18.....SAMPLE GLOBE VALVE
 - 19.....MAGNESIUM CORROSION ROD
 - 20.....VESSEL DRAIN GATE VALVE
 - 21.....MOTORIZED WATER INLET VALVE
 - 22.....ISOLATION GATE VALVE
 - 23.....Y-TYPE STRAINER
 - 24.....BY-PASS GLOBE VALVE
 - 25.....DP LEVEL TRANSMITTER W/ 3-VALVE MANIFOLD
 - 26.....PRESSURE REDUCING E-VALVE W/ D PILOT W/ FITTINGS

****ALL ITEMS ARE BOOK MARKED TO REFLECT THE BILL OF MATERIALS****



Your complete line of BOILER ROOM AUXILARY EQUIPMENT Needs

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WATER GAUGES AND LIQUID LEVEL GAUGES

Water Gauge Dos and Don'ts

DO NOT'S

- **DO NOT** use glass if it contains any scratches, chips, or any other visible signs of damage.
- **DO NOT** reuse any tubular glass or glass packings.
- **DO NOT** subject gauge glass to bending or torsional stresses.
- **DO NOT** over tighten glass packing nuts.
- **DO NOT** allow glass to touch any metal parts.
- **DO NOT** exceed the recommended pressure of the gauge or gauge glass.
- **DO NOT** clean the gauge or gauge glass while pressurized or in operation.

DO'S

- **DO** verify proper gauge has been supplied.
- **DO** examine gauge glass and packings carefully for damage before installation.
- **DO** install protective guards and utilize automatic ball checks where necessary to help prevent injury in case of glass breakage.
- **DO** inspect the gauge glass daily, keep maintenance records, and conduct routine replacements.
- **DO** protect glass from sudden changes in temperatures such as drafts, water spray, etc.

MAINTENANCE

Examine the gauge glass regularly for any signs of clouding, scratching, erosion, or corrosion. The glass should be inspected daily until the need for replacement becomes apparent. This will help establish the routine inspection and routine replacement schedules.

CLEANING

Use commercial non-abrasive glass cleaners to keep glass clean. Use diluted acids such as Hydrochloric (muriatic) acid when regular cleaners do not seem to work. Do not use wire brushes or any other abrasive materials which could scratch the glass.

INSPECTION

Examine the surface of the glass for scratches, corrosion, chips, cracks, surface flaws, or nicks. To do this, aim a very bright concentrated light at an angle of about 45 degrees. A defective glass will glisten as the light strikes imperfections. Glass which appears cloudy or roughened, and will not respond to cleaning, should be replaced.

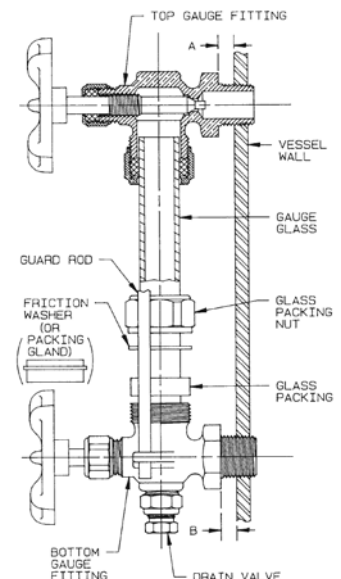
STORING

Keep gauge glass in original packaging until ready to install.

Installation

Only properly trained personnel should install and maintain water gauge glass and connections. Remember to wear safety gloves and glasses during installation. Before installing, make sure all parts are free of chips and debris.

- 1 Apply Teflon® tape or pipe dope to pipe threads. Install top gauge fitting (fitting without a drain valve) into the upper most tapping. Wrench tighten the fitting until it is snug and the glass outlet is pointing at five o'clock (about 1/8 turn from its final, downward vertical, position).
- 2 Install the bottom gauge fitting (the fitting with a drain valve) until it is snug and the glass outlet is pointing directly upward. Verify top and bottom fittings are threaded into the tappings the same number of turns (distance A= distance B).
- 3 Remove glass packing nut, friction washer (or packing gland and retaining ring, depending upon the model), and glass packing from the fittings, and place them, in the same order, on to both ends of the gauge glass. Push both packings about an inch up the gauge glass.
- 4 Gently insert one end of the glass into the top gauge fitting. Keeping the glass inside the top fitting, gently rotate the top gauge fitting clockwise, using wrench on valve wrench flats, until vertically aligned with the bottom gauge fitting, then insert glass into bottom fitting until glass bottoms out on the shoulder inside the bottom fitting.
- 5 Carefully raise glass about 1/16" and slide lower glass packing down until the glass packing contacts the lower gauge fitting. **DO NOT** allow the glass to remain in contact with any metal!
- 6 Carefully slide upper glass packing up as far as possible.
- 7 Hand tighten both glass packing nuts, then tighten 1/2 turn more by wrench. Tighten only enough to prevent leakage. **DO NOT OVER TIGHTEN!** If any leakage should occur, tighten slightly, a quarter turn at a time, checking for leakage after each turn.



WATER GAUGES AND LIQUID LEVEL GAUGES

Repair Kits

SELECTION INSTRUCTIONS

It is helpful to determine the following information when ordering a repair kit.

- Model number (if not available describe gauge, i.e. material, # guard rods, NPT size, etc.)
- Glass O.D. and type
- Handle type
- Service media, temperature, and pressure

If you know the model number just examine the "Repair Kit Applications" chart to select kit number for your valve. To order the standard kit, or Viton®, or graphite gaskets, assemble the ordering matrix for the desired kit number.

If you are unable to determine model number please determine the above information and call customer service for assistance.

For replacement glass please determine the above information in addition to the "L" dimension and call customer service. "L" dimension (center to center height of water gauge inlets).

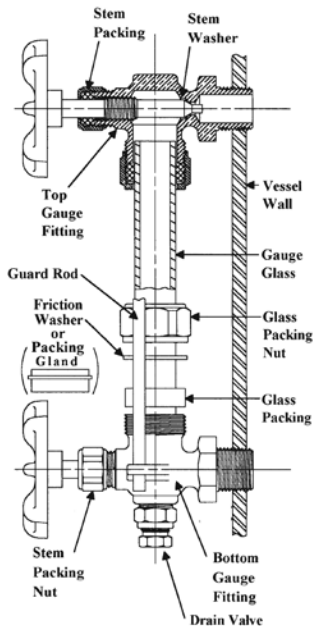
WATER GAUGE & GAUGE GLASS REPAIR KIT INSTRUCTIONS

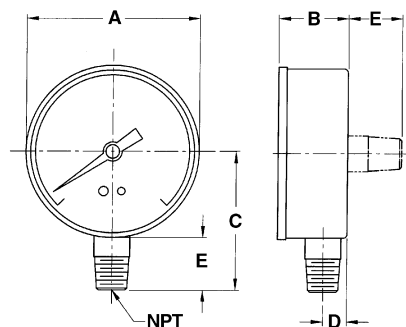
Only properly trained personnel should install, maintain and repair water gauge glass and connections. Remember to wear safety gloves and glasses during installation/repair. Before installing, make sure all parts are free of chips and debris.

DISASSEMBLY/ASSEMBLY

- 1 Close water gauge valves. If necessary drain vessel to eliminate leakage during repair. Drain gauge glass using drain valve or plug.
- 2 Completely loosen both glass packing nuts.
- 3 Gently raise gauge glass until bottom of gauge glass clears lower fitting.
- 4 Using a wrench attached to the hex flats on the upper fitting, lift glass and packing nut then rotate the fitting and glass 1/8 turn counterclockwise.
- 5 Carefully remove the gauge glass from the upper fitting. Remove all glass packing, packing nuts, washers and packing glands, noting their positions on the glass.
- 6 Clean and inspect gauge glass and fittings for any wear, erosion, cracks or debris. Any damaged components must be replaced.

- 7 If it is desired, the stem packing can be replaced by removing the handle(s) then the stem packing nut. Remove old packing and stem packing washer if applicable. Install new packing in stem packing nut and reuse stem packing washer as applicable.
- 8 To replace seat washers (where applicable) the system must be drained. After removing the stem packing nut reinstall handle and remove stem by opening valve. Cut off old seat washer and install new seat washer using appropriate size tube driver.
- 9 Install stem until it seats. Remove handle and install stem packing nut with packing inside. Tighten stem packing nut until snug using wrench.
- 10 Place glass packing nut, friction washer (or packing gland and retaining ring, depending upon the model), and new glass packing, in the same order as found, on to both ends of the gauge glass. Push both packings about an inch up the gauge glass.
- 11 Gently insert one end of the glass into the top gauge fitting. Keeping the glass inside the top fitting, gently rotate the top gauge fitting clockwise, using wrench on valve hex flats, until vertically aligned with the bottom gauge fitting. Insert glass into bottom fitting until glass bottoms out on the shoulder inside the bottom fitting.
- 12 Carefully raise glass about 1/16" and slide lower glass packing down until the glass packing bottoms out. **DO NOT** allow the glass to remain in contact with any metal!
- 13 Carefully slide upper glass packing up as far as possible.
- 14 Hand tighten both glass packing nuts, then tighten 1/2 turn more by wrench. Tighten only enough to prevent leakage. **DO NOT OVER TIGHTEN!** If any leakage should occur, tighten slightly, a quarter turn at a time, checking for leakage after each turn.





LOWER AND CENTER BACK CONNECTION

DIAL SIZE	CAT NO	A	B	C	D	E	NPT
1 1/2"	TL15	1.58	1.08	1.40	.34	.70	1/8"
2"	TL20	1.93	1.10	1.75	.40	.78	1/8 or 1/4"
2 1/2"	TL25	2.44	1.18	2.08	.40	.90	1/8 or 1/4"
4"	TL40	3.90	1.26	2.80	.40	—	1/4"

CASE - Drawn steel, with push-in Lexan window.

TUBE & SOCKET - Phosphor bronze. Brass socket and 1/4" male NPT lower or center back connection. Soft soldered connection.

DIAL - White coated metal lithographed with black graduations lines and numerals. 2", 2 1/2", 3 1/2" or 4".

MOVEMENT - All brass construction, precision gear and pinion.

ACCURACY - 2% ANSI-ASME B40.1 Grade B.

PRESSURE (psi) - Series TL

Range	Figure interval	Minor graduation
0-15	1	0.2
0-30	5	0.5
0-60	5	1.0
0-100	10	1.0
0-160	20	2.0
0-200	20	2.0
0-300	50	5.0
0-400	50	5.0
0-600	50	10.0

COMPOUND

Range	Figure interval		Minor graduation	
	in Hg	psi	in Hg	psi
30"Hg-15psi	10	5	1	0.5
30"Hg-30psi	10	5	1	1
30"Hg-60psi	10	10	2	2
30"Hg-100psi	15	10	5	2
30"Hg-150psi	30	20	2	2

VACUUM

Range	Figure interval	Minor graduation
0-30"Hg	5"Hg	0.5"Hg

Note: All dial ranges dual scale - psi & Kpa.



WEISS INSTRUMENTS, INC.
HOLTSVILLE, NEW YORK 11742

DESCRIPTION:

Utility Pressure Gauge - Series TL

DRAWN BY:

DATE:

DRAWING:

Accessories

PRESSURE GAUGES

Coil Syphons

885 Series Coil Syphons are designed for use on steam service to form a pocket of water between the pressure gauge and the process steam, thereby preventing the steam from reaching the bourdon tube of the pressure gauge. Trerice Coil Syphons are constructed of steel, brass, or 304 stainless steel with a 180° coil for use on a variety of requirements. Other materials and coil styles are available; consult factory.



885 Series Coil Syphons

Item No.	Material	Style	Connection Size (NPT)	Maximum Pressure (psig)	Maximum Temperature	Approximate Shipping Weight
885-1	Welded steel, schedule 40	180° coil	1/4	600	750°F	0.4 lbs [0.18 kg]
885-1.1	Welded steel, schedule 40	180° coil	1/2	800	650°F	1.4 lbs [0.64 kg]
885-2	Seamless brass, schedule 40	180° coil	1/4	250	406°F	0.4 lbs [0.18 kg]
885-3	Chrome plated brass, schedule 40	180° coil	1/4	250	406°F	0.4 lbs [0.18 kg]
885-4	Welded 304SS, schedule 40	180° coil	1/4	1300	650°F	0.4 lbs [0.18 kg]
885-4.1	Welded 304SS, schedule 40	180° coil	1/2	1000	650°F	1.4 lbs [0.64 kg]
885-6	Welded 316SS, schedule 40	180° coil	1/4	1300	650°F	0.4 lbs [0.18 kg]
885-6.1	Welded 316SS, schedule 40	180° coil	1/2	1000	650°F	1.4 lbs [0.64 kg]

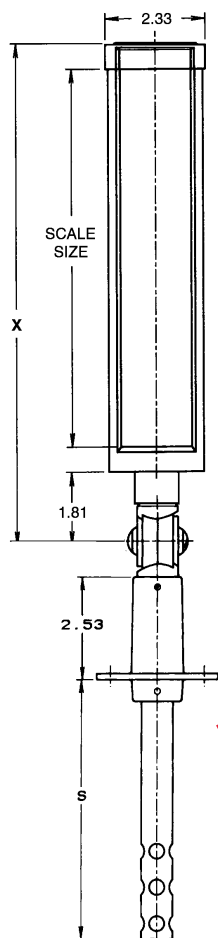
Needle Valves

735/740 Series Needle Valves are of the rising stem type and are designed to shut off the flow of the process media to the pressure instrument, thereby allowing the instrument to be isolated from the pressure media or removed from service. Needle valves may also be used to throttle flow and aid in dampening pulsations. Trerice Needle Valves are constructed from brass, carbon steel and stainless steel for use on a variety of pressure media. **It is recommended to place a needle valve, ball valve or gauge cock in line before every pressure gauge installation.**



735/740 Series Needle Valves

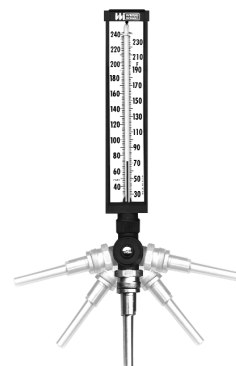
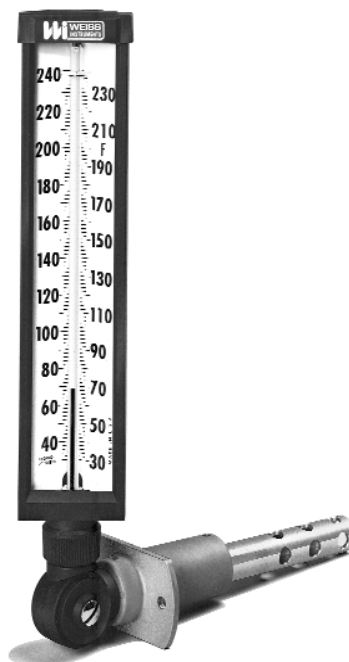
Item No.	Type	Connection Size (NPT)	Body	Seat	Stem	Packing	Maximum Pressure (psig)	Maximum Temperature	Approximate Shipping Weight
735-2	F X F	1/4	Brass	Brass	Brass	Teflon	2000	300°F	0.3 lbs [0.14 kg]
735-4	F X F	1/4	Carbon steel	Teflon	316SS	Teflon	4000	500°F	0.3 lbs [0.14 kg]
735-8	F X F	1/4	316SS	316SS	316SS	Teflon	6000	500°F	0.3 lbs [0.14 kg]
735-9	M X F	1/4	316SS	316SS	316SS	Teflon	6000	500°F	0.3 lbs [0.14 kg]
740-3	F X F	1/2	Carbon steel	Carbon steel	316SS	Teflon	10,000	200°F	1.0 lbs [0.45 kg]
740-4	M X F	1/2	Carbon steel	Carbon steel	316SS	Teflon	10,000	200°F	1.3 lbs [0.59 kg]
740-9	M X F	1/2	316SS	Delrin	316SS	Teflon	6000	200°F	1.3 lbs [0.59 kg]
740-11	F X F	1/2	316SS	316SS	316SS	Teflon	10,000	200°F	1.0 lbs [0.45 kg]



CASE: Modern V-shape design with parts molded of GE Valox® polyester in black textured finish. Heavy glass protected front firmly secured against rat-tles by spring action. **STEM:** Perforated Aluminum. **LOCKING DEVICE:** A hand rotatable friction lock with the angle adjusting screw work independently to provide a full 360° positioning of thermometer case and stem. **ADJUSTABLE JOINT:** GE Valox finished to match case. **ACCURACY:** Within 1% of scale range. Silicone shock mounted for lasting durability. **SCALE:** White coated aluminum with permanently baked bold black markings. **FILL:** Blue liquid.

9" SCALE	CAT NO.
3 1/2" STEM	9VU35
6" STEM	9VU6
9" STEM	9VU9
12" STEM	9VU12

°F RANGES	SCALE DIV.	RANGE CODE
40-0-110°F	2°	110
0-120°F	1°	120
0-160°F	2°	160
30-180°F	2°	180
30-240°F	2°	240
30-300°F	5°	300
50-400°F	5°	400
50-550°F	5°	550
50-750°F	5°	750



VARI-ANGLE INDUSTRIAL THERMOMETERS					
QTY.	CAT. NO.	SCALE LGTH.	STEM LGTH	RANGE	TAG
1	9VD6	9"	6"	30-300°F	

THERMOWELLS AND ACCESSORIES

STEM LENGTH	BRASS CAT NO.	304SS CAT NO.	316SS CAT NO.	NPT	INSERTION (U)	LAG EXTENSION (L)
3 1/2	E35-75BS	E35-75SS	E35-75316SS	3/4	2 1/2	—
6	ER6-75BS	ER6-75SS	ER6-75316SS	3/4	5	—
9	ER9-75BS	ER9-75SS	ER9-75316SS	3/4	8	—
12	ER12-75BS	ER12-75SS	ER12-75316SS	3/4	11	—
3 1/2	ESS35-50BS	ESS35-50SS	ESS35-50316SS	1/2	2	1
3 1/2	ESS35-75BS	ESS35-75SS	ESS35-75316SS	3/4	2	1
6	EN6-75BS	EN6-75SS	EN6-75316SS	3/4	2 1/2	2 1/2
9	ENS9-75SS	ENS9-75SS	ENS9-75316SS	3/4	5 1/2	2 1/2
12	ENS12-75BS	ENS12-75SS	ENS12-75316SS	3/4	8 1/2	2 1/2

Catalog No. ECC - Brass Cap and Chain Assembly for Test Well



WEISS INSTRUMENTS, INC.
HOLTSVILLE, NEW YORK 11742

Vari-angle® Industrial Glass Thermometer

Manual Vent Valve : 1/4" Hole

Powell Valves
2503 Spring Grove Ave.
Cincinnati, OH 45214
Phone: 513-852-2000
Fax: 513-852-2997



MSS SP-80 GATE VALVE
THREADED BONNET, THREADED ENDS
GATE ¼ TO 3" (6 TO 75mm) CLASSES 125 AND 150
BRONZE NON-RISING STEM

STANDARD MATERIALS

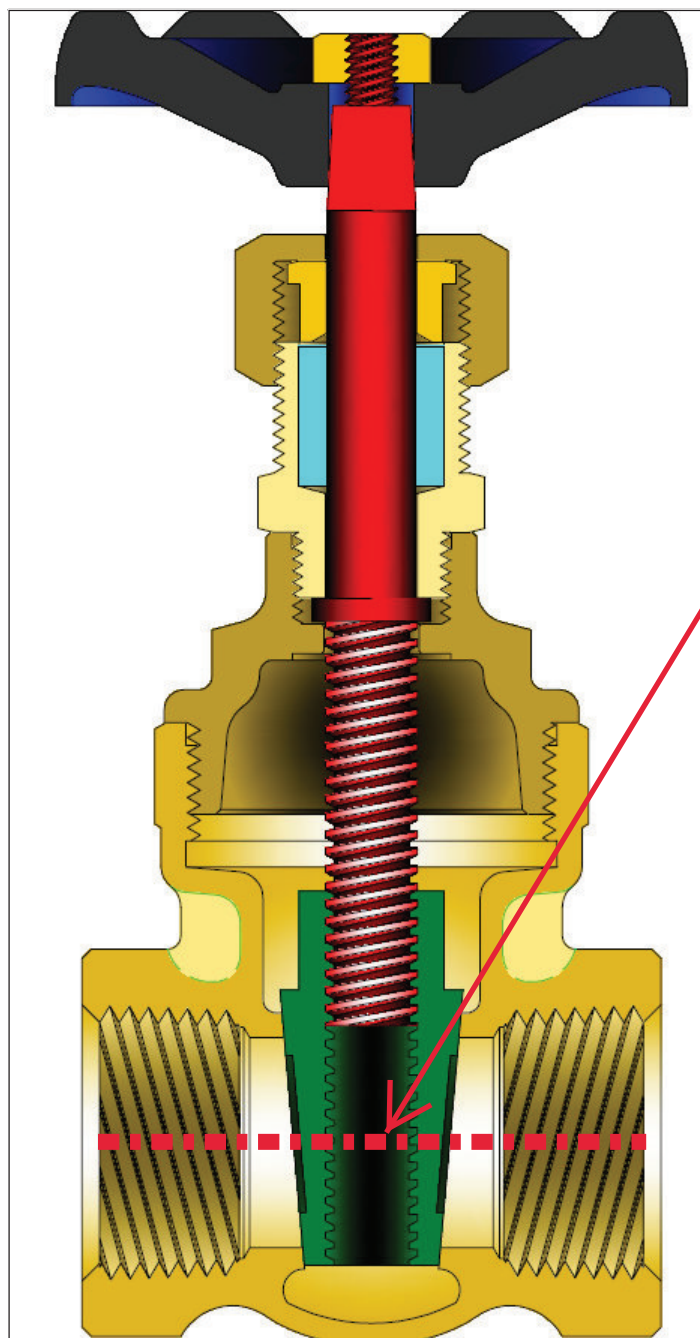
PART	MATERIALS
Body	B62
Bonnet	B62
Wedge	B62
Stem	B371 C69400
Packing Nut	B62 or B16
Gland	B16
Packing	Graphite
Hand Wheel	Ductile Iron
Hand Wheel Nut	Brass
Stuffing Box	B371 C69400
Wheel Plate	Aluminum

Design Specifications

Item	Applicable Specification
Pressure - temperature ratings	MSS SP-80
General valve design	MSS SP-80
Thread design	ASME B1.20.1
Materials	ASTM

DESIGN FEATURES:

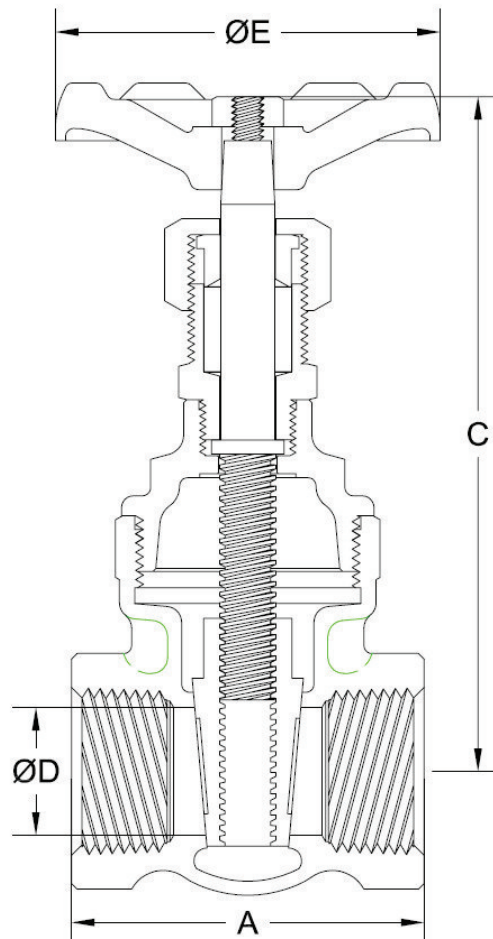
- **Renewable** solid wedges.
- **Integral** seats.
- **High-Tensile** bronze alloy stems.
- **Each** valve is shell and seat pressure tested per industry standard MSS SP-80.
- **Stems** are rotating, non-rising design.



Class	Fig. No.
125	507
150	512 / 2712

GATE VALVE DIMENSIONS (CLASSES 125 & 150).

SIZE	FIG 507, 512, & 2712					
in	A	C	D	E	WT	lb
mm						kg
¼	1.75	3.5	0.25	2.1	0.7	3.2
6	44	89	6	54	0.3	
⅜	2.00	3.5	0.38	2.1	0.9	7.1
10	51	89	10	54	0.4	
½	2.38	3.9	0.50	2.5	1.0	12.6
13	60	99	13	64	0.5	
¾	2.44	4.6	0.75	2.8	1.7	30
20	62	117	19	70	0.8	
1	2.75	5.4	1.00	3.0	2.8	55
25	70	137	25	76	1.3	
1¼	3.00	6.2	1.25	3.3	4.0	87
32	76	157	32	83	1.8	
1½	3.38	6.8	1.50	3.6	5.0	129
40	86	173	38	92	2.3	
2	3.50	7.8	2.00	4.1	7.2	240
50	89	198	51	103	3.3	
2½	4.50	9.4	2.50	5.1	16.0	350
65	114	239	64	130	7.3	
3	5.00	10.5	3.00	5.7	22.5	510
75	127	267	76	144	10.2	



C = Center to top open / closed

WT = Weight

C_v = Flow Coefficient

Thermostatic Air Vent

Model	AV2000 Series
Sizes	1/2", 3/4"
Connections	NPT
Body Material	Stainless Steel
PMO Max. Operating Pressure	650 PSIG
TMO Max. Operating Temperature	Saturated Steam Temp.
PMA Max. Allowable Pressure	1032 PSIG @ 100°F
TMA Max. Allowable Temperature	750°F @ 800 PSIG



Air Vents are used for Removing Air from Steam Systems

Typical Applications

The **AV2000** air vent is used on industrial steam applications up to 650 PSIG for the removal of air and non-condensable gases from process equipment, vessels and piping. The air vent should be located at a high point in the system or vessel and can be installed in any orientation.

How It Works

The thermostatic air vent contains a welded stainless steel thermal element that expands when heated and contracts when cooled. When air and non-condensable gases are present, the valve is in the open discharge position. When steam reaches the air vent, the element expands and closes the valve off tightly.

Features

- Welded stainless steel thermal element
- Hardened stainless steel seat and valve plugs for extended service life
- Integral strainer to protect from contamination
- Steam pressures up to 650 PSIG
- Special Subcool Options Available

Sample Specification

Air vent shall have a thermal element with a seal-welded tamper-proof stainless steel construction. All internals shall be stainless steel, featuring an integral strainer and hardened seat and disc.

Installation

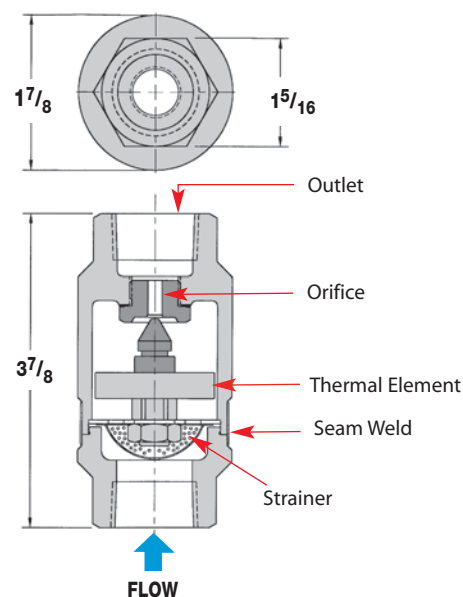
The air vent should be located at a high point in the system or vessel and can be installed in any orientation. An isolation valve should be installed to facilitate removal and replacement without system shut-down. Unit is seal-welded and non-repairable.

MATERIALS

Housing	Stainless Steel, ASTM A351-CF3
Thermal Element	Stainless Steel
Valve & Seat	Hardened Stainless Steel, 40 Rc
Strainer Screen .033" perf.	Stainless Steel

Size/Connection NPT	Model Code	Orifice Size	PMO PSI	Weight lbs
1/2"	AV2001-12-N	3/16"	650	1.25
1/2"	AV2003-12-N	5/16"	650	1.25
3/4"	AV2001-13-N	3/16"	650	1.25
3/4"	AV2003-13-N	5/16"	650	1.25

DIMENSIONS – inches



CAPACITIES – Air (SCFM)

Model	Orifice Size	PMO (PSIG)	Inlet Pressure (PSIG)																	
			2	5	10	25	50	100	125	150	200	250	300	350	400	450	500	550	600	650
AV2001	3/16"	650	5.2	6.2	7.7	12.4	20.2	35.9	43.9	51.5	67.2	82.8	98.5	114	130	145	161	177	192	208
AV2003	5/16"	650	10.7	12.6	15.8	25.4	41.4	73.3	89.4	105	137	169	201	233	265	297	329	361	393	425

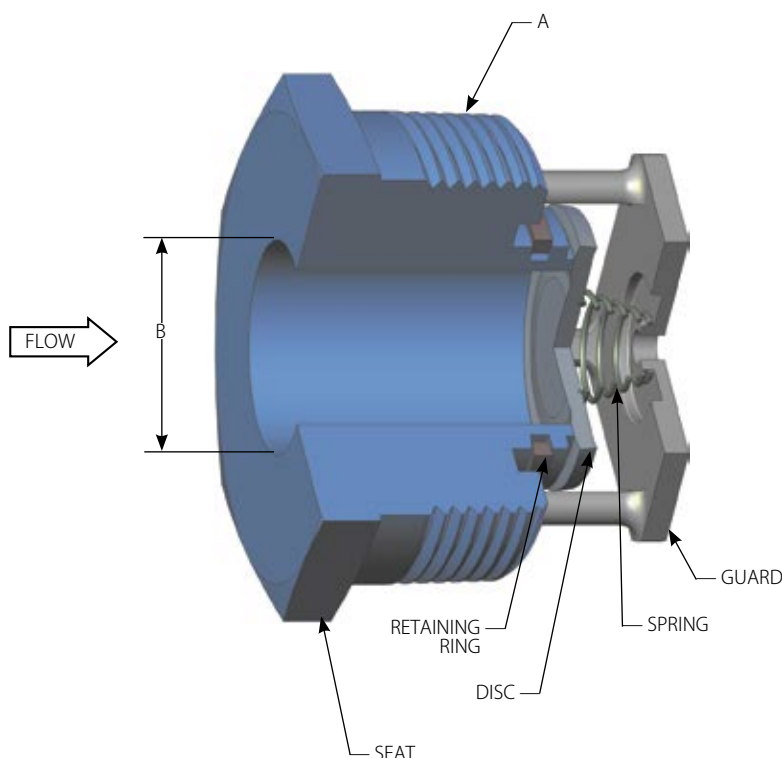
Vacuum Breaker

DFT® Vacuum Breakers provide effective protection against collapse of pressure vessels, tanks and rolls. They prevent condensate “back-up” when equipment is shut down or inlet steam is reduced by modulating control valves. In piping systems, DFT Vacuum Breakers are used to break siphons, prevent pipe collapse during transient pressure drops, and to provide addition of air on the downstream side of check valves to dampen water hammer.



FEATURES:

- 1" to 4" size (Outside diameter)
- 450 to 6000 CWP
- Threaded O.D. (MNPT)
- Unthreaded inlet bore
- Stainless steel construction
- Spring-assisted silent closing
- Horizontal or vertical installation
- Tight shutoff - lapped disc & seat
- Easy to no maintenance
- Versatile
- Options:
 - Inconel® X-750 spring
 - Soft seat



Vacuum Breaker

Vacuum Breaker				Cracking Pressure	
A Nominal Size (MNPT)	B Unthreaded Inlet Bore	Weight	Cv	PSI	Inches of Water
1	0.56	0.38	5.8	0.60 (1)	16.7
1 1/2	0.88	0.88	13.2	0.45	12.5
2	1.09	1.25	23.1	0.38	10.5
2 1/2	1.50	2.25	36	0.20	5.5
3	1.72	3.75	57.4	0.14	3.9
4	2.22	7.00	90	0.15	4.3

*Cracking pressure for vertical flow will be slightly different: upward flow, slightly higher; downward flow, slightly less.

COLD, NON-SHOCK PRESSURE RATING (PSIG) (2)

	1"	1 1/2"	2"	2 1/2"	3"	4"
Vacuum Breaker BSSV	2500	2000	1500	850	700	450
Vacuum Breaker BSSV6	6000	5500	3000	1100	900	450

MATERIALS OF CONSTRUCTION

COMPONENT	Vacuum Breaker BSSV	High Pressure Vacuum Breaker BSSV6
Seat	303 SS	316 SS
Disc	316 SS	316 SS
Guard	CF8M	CF8M
Spring	316 SS	316 SS
Retaining Ring	316 SS	316 SS

Sat. Steam Pressure (PSIG) Ref. (3)	Temperature (°F)	Adjusted Rating as Percent of Cold Rating
-3	200	86%
15	250	82%
52	300	78%
232	400	71%
407	450	69%
665	500	66%
1526	600	62%
3075	700	60%

All stainless steel construction is suitable for cryogenic service. For pressure rating at elevated temperatures for standard metal-seated valves, reduce above rating per chart above.
Maximum valve temperature rating is limited by soft seal (if any) and spring materials in chart above.

Notes: 1. Light spring available: Cracking Pressure = .24 PSI (6.5 inches of water)
2. Contingent on service ratings of matching pipe and fittings.
3. Saturated steam pressure is given for reference only; pressure limit of valve is the adjusted rating at the given temperature.

All dimensions are in inches. Weights are in pounds. For metric measurements, visit www.dft-valves.com. CP: Cracking Pressure (psig)

KUNKLE SERIES 6000 SAFETY VALVES

SAFETY AND RELIEF PRODUCTS

Bronze safety valves to ASME section I and VIII, steam, 'V' and 'UV'; section VIII, air/gas, 'UV' National Board certified including models to ASME section IV, steam 'HV'. PED certified for non-hazardous gas



MODEL 6010

FEATURES

- O-ring seats available for exceptional leak-free performance, reduced maintenance cost, multiple cycles with tight shutoff and improved seating integrity.
- Heavy duty casting.
- Wide hex on valve nozzle provides clearance for easy installation.
- Seats lapped to optical flatness.
- Dual control rings offer easy adjustability for precise opening with minimum pre-open or simmer and exact blowdown control.
- Pivot between disc and spring corrects misalignment and compensates for spring side thrust.
- Grooved piston type disc reduces sliding area and friction.
- Heavy duty lift lever assembly.
- Each valve tested and inspected for pressure setting and leakage.

GENERAL APPLICATION

These valves are suitable for use on steam boilers and generators, reciprocating or rotary, portable or stationary air/gas compressors, intercoolers and aftercoolers. Also for pressure vessels containing steam, air or non-hazardous gas and on pressure reducing stations.

TECHNICAL DATA

Connections: Threaded NPT
 Temperature range¹: -60° to 425°F (-51° to 219°C)
 Pressure range¹: 3 to 300 psig (0.2 to 20.7 barg)
 Code: ASME I, IV, VIII and PED



NOTE

1. See page 2 for more temperature and pressure range information.

Before installation these instructions must be fully read and understood

Pre-Installation Handling

This pressure relief valve is designed to protect equipment from overpressure. The valve should be handled with care, not subjected to heavy shock loads, and protected to prevent dirt from getting inside. It should be installed correctly. Failure to do so could result in property damage or serious injury to personnel. When hoisting the valve into position for installation, care should be exercised so that lifting straps do not contact the valve lift lever. Service life may vary upon condition of service. Check unit at least once per 8000 hours or longer intervals based upon site experience.

Installation

1. Mount the valve in a vertical position so that the valve body is self draining. If a body drain port is provided, make sure it is open when required by the ASME code. Do not plug any bonnet vent openings. The inlet piping should be as short as possible, with no elbows, and equal to or greater than the size of the pressure relief valve inlet connection. This will help to limit the inlet pressure drop to 3% or less when the valve is relieving.
2. When discharge piping is connected to valve outlet, make sure it is self draining if a body drain port is not used. The valve should not be connected to any discharge pipe that contains pressure before the valve opens or to any pipe where the pressure build-up is greater than 10% of the set pressure when the valve is open and relieving.
Discharge piping, other than a short tailpipe, must be supported. For steam service, a drip pan elbow or flexible connection between the valve and the pipe should be used to prevent excessive pipe stress, due to thermal expansion, from being imposed on the valve body.
3. For threaded valves, to prevent sealing compound from entering and damaging the valve, apply a small amount of pipe thread sealing compound to external threads only. Do not put any sealing compound on the first thread or on any internal threads. To do so may cause the sealing compound to enter the valve and cause seat leakage.
Do not use the valve body or bonnet for installing the valve in threaded connections. Use the wrench flats provided to tighten the valve to the connecting pipe, and do not overtighten. To do so may cause valve leakage.
4. For flanged valves, use new gaskets and tighten the mounting studs evenly.

Operation

1. Maintain a system operating pressure at least 5 psig or 10% below the set pressure of the valve, whichever is greater. Operating too close to the valve set pressure will cause seat leakage and will shorten the time between valve maintenance.
2. Do not use the safety valve as a control valve to regulate system operating pressure. Excessive operation will cause the seat to leak and will require more frequent valve maintenance.
3. ASME Section I and VIII valves equipped with lift levers are designed to be operated only when the system pressure is 75% of set pressure or greater. ASME Section IV valves may be operated at any set pressure. When hand operating the valve, hold it open long enough to purge any foreign matter from the seat area. If a cable or wire is attached to the lift lever for remote actuation, make sure the direction of pull is the same as it would be if the lever were pulled directly by hand.

Contacts

Kunkle

An Anderson, Greenwood Company
Phone: 828-669-5515
1281 Old US 70, Black Mountain, NC 28711
Fax: 828-669-0586

Maintenance

Maintenance should be performed on a regular basis. An initial inspection interval of 12 months is recommended. Depending on the service conditions and the condition of the valve, the inspection interval may be decreased or increased. Use only Kunkle parts for repair. Depending on the local jurisdictional requirements where the valve is installed, repairs may have to be made by a repair facility holding a VR stamp.



WARNING

Removal of the seal wire or any attempt to adjust, repair, or modify this product by non-qualified or non-authorized persons voids the product guarantee and may cause serious damage to equipment, personal injury, and death. Kunkle Valve is not liable for any damages resulting from misuse or misapplication of its products.



Overflow Traps

Size ranges from 2" - 6"



The most reliable overflow trap on the market.

100-year proven design.

John J. Hoppes created his first overflow trap over 100 years ago. Today, Bryan Steam builds units based on this original design concept which has proven so efficient in thousands of installations through the years.

Quality products.

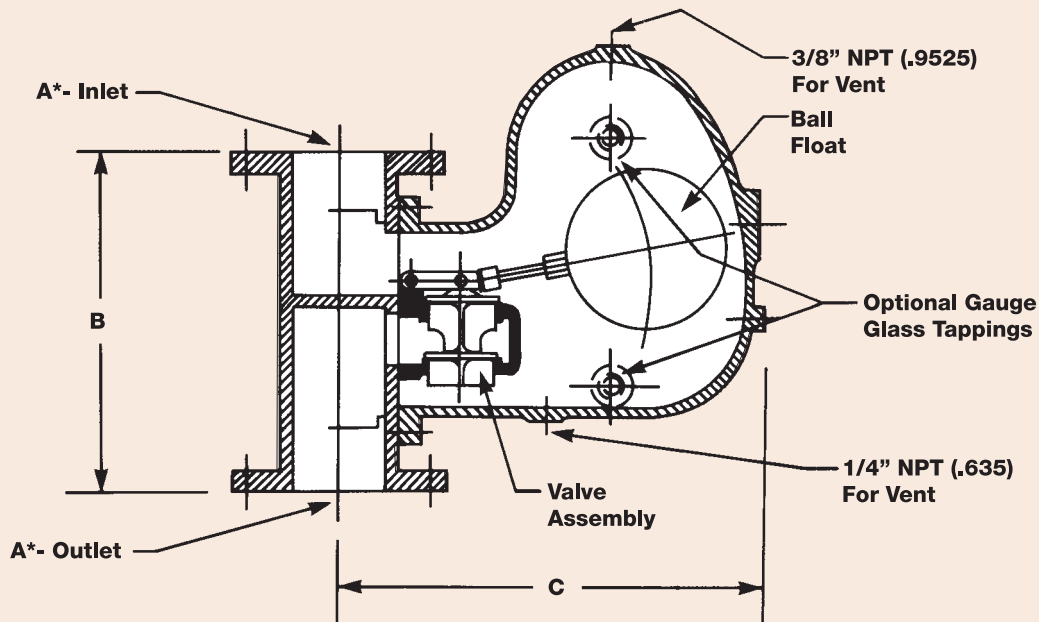
Bryan overflow trap bodies are constructed of cast iron. Inside the body, a double-sealed

brass valve is automatically operated by a stainless steel ball float. As you can see, only the highest quality materials are used.

Many sizes.

Our mechanical float-controlled overflow traps come in a range of sizes from 2" through 6". And they're in stock for immediate shipment.

Bryan Steam Overflow Traps



MODEL NO.	DEAERATOR RATED CAPACITY IN LBS/HR	DIMENSIONS IN INCHES (CM)			APPROX. SHIP WT. LBS. (KG)
		A	B	C	
HT-2	10,000 thru 15,000	2 (5.08)	6 ³ / ₄ (17.15)	12 ⁵ / ₈ (32.07)	50 (22.7)
HT-3	20,000 thru 100,000	3 (7.62)	14 ³ / ₄ (37.47)	17 ³ / ₄ (45.09)	155 (70.3)
HT-4	45,000 thru 171,000	4 (10.16)	14 ¹ / ₂ (36.83)	17 ³ / ₄ (45.09)	165 (74.8)
HT-6	175,000 thru 385,000	6 (15.24)	14 ³ / ₄ (37.47)	26 ¹ / ₄ (66.68)	310 (140.6)

**NOTE: HT-2 has NPT connection. HT-3 to HT-6 has flanged connection.
Specifications subject to change without notice.*

BTM BRYAN STEAM
Bryan Steam LLC—Leaders Since 1916
 783 N. Chili Ave., Peru, Indiana 46970 U.S.A.
 Phone: 765-473-6651 • Internet: www.bryanboilers.com
 Fax: 765-473-3074 • E-mail: bryanboilers@iquest.net



MSS SP-80 GATE VALVE
 THREADED BONNET, THREADED ENDS
 GATE ¼ TO 3" (6 TO 75mm) CLASSES 125 AND 150
 BRONZE NON-RISING STEM

STANDARD MATERIALS

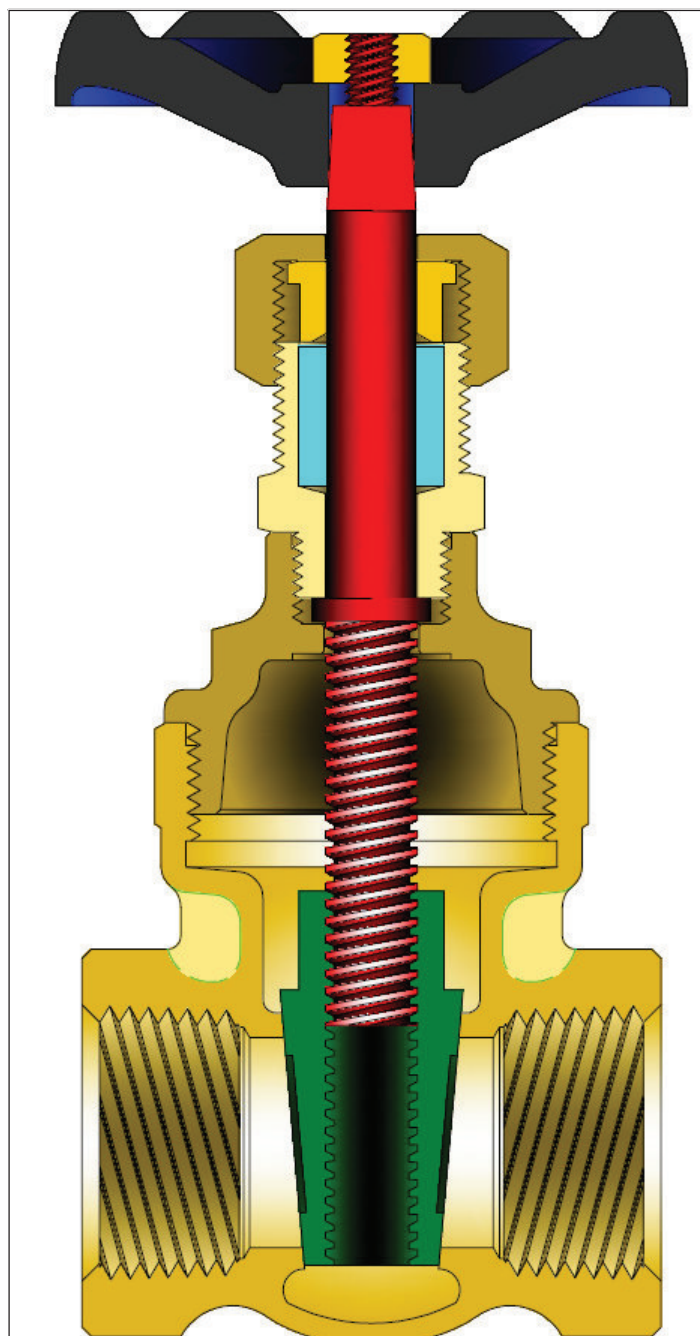
PART	MATERIALS
Body	B62
Bonnet	B62
Wedge	B62
Stem	B371 C69400
Packing Nut	B62 or B16
Gland	B16
Packing	Graphite
Hand Wheel	Ductile Iron
Hand Wheel Nut	Brass
Stuffing Box	B371 C69400
Wheel Plate	Aluminum

Design Specifications

Item	Applicable Specification
Pressure - temperature ratings	MSS SP-80
General valve design	MSS SP-80
Thread design	ASME B1.20.1
Materials	ASTM

DESIGN FEATURES:

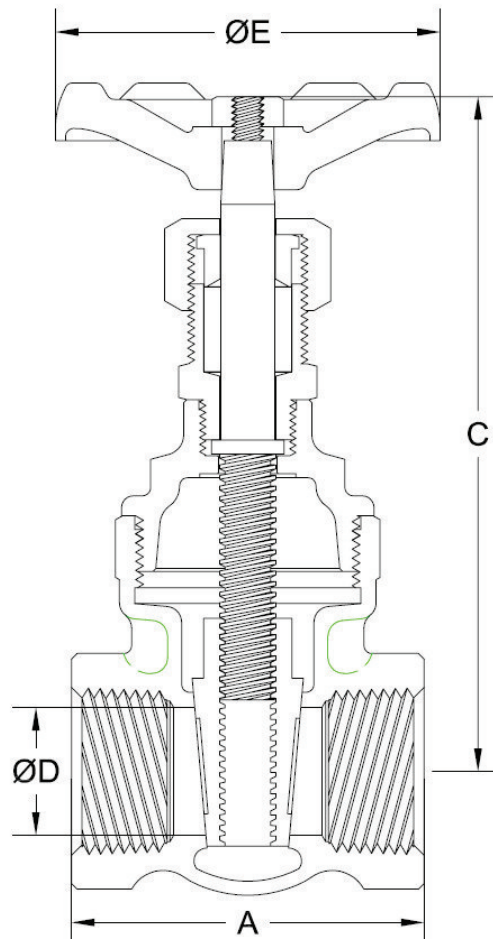
- **Renewable** solid wedges.
- **Integral** seats.
- **High-Tensile** bronze alloy stems.
- **Each** valve is shell and seat pressure tested per industry standard MSS SP-80.
- **Stems** are rotating, non-rising design.



Class	Fig. No.
125	507
150	512 / 2712

GATE VALVE DIMENSIONS (CLASSES 125 & 150).

SIZE	FIG 507, 512, & 2712					
in	A	C	D	E	WT	lb
mm						kg
¼	1.75	3.5	0.25	2.1	0.7	3.2
6	44	89	6	54	0.3	
⅜	2.00	3.5	0.38	2.1	0.9	7.1
10	51	89	10	54	0.4	
½	2.38	3.9	0.50	2.5	1.0	12.6
13	60	99	13	64	0.5	
¾	2.44	4.6	0.75	2.8	1.7	30
20	62	117	19	70	0.8	
1	2.75	5.4	1.00	3.0	2.8	55
25	70	137	25	76	1.3	
1¼	3.00	6.2	1.25	3.3	4.0	87
32	76	157	32	83	1.8	
1½	3.38	6.8	1.50	3.6	5.0	129
40	86	173	38	92	2.3	
2	3.50	7.8	2.00	4.1	7.2	240
50	89	198	51	103	3.3	
2½	4.50	9.4	2.50	5.1	16.0	350
65	114	239	64	130	7.3	
3	5.00	10.5	3.00	5.7	22.5	510
75	127	267	76	144	10.2	



C = Center to top open / closed

WT = Weight

C_v = Flow Coefficient

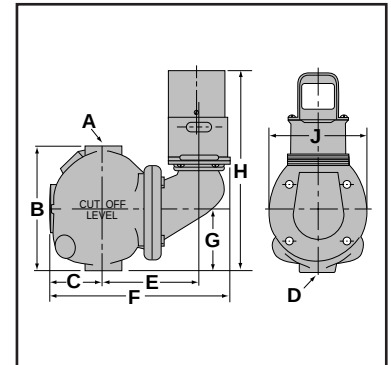
Low Water Cut-Offs – Mechanical For Steam and Hot Water Boilers

Series 63



Low Water Cut-Offs

- For residential, commercial, and industrial applications
- Heavy duty
- Includes No. 2 switch
- Optional manual reset available
- Maximum boiler pressure 50 psi (3.5 kg/cm²)
- Use with TC-4 on hot water systems



Electrical Ratings

Voltage	Motor Switch Rating (Amperes) 120 VDC .5 Amp		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

Dimensions, in. (mm)

A NPT	B	C	D NPT	E	F	G	H	J
1	6½ (165)	2 ⁹ / ₁₆ (65)	1	5 ⁵ / ₃₂ (131)	9 ³ / ₈ (238)	3 ¹ / ₈ (79)	10½ (267)	5 ¹ / ₈ (130)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
63	142400	Low water cut-off	13.5 (6.1)
63-B	142700	63 w/ float block	15.0 (6.8)
63-BM	143300	63 w/float block & manual reset	15.0 (6.8)
63-E	142500	63 w/BSPT threads	14.0 (6.4)
63-EM	142800	63-E w/manual reset	14.0 (6.4)
63-EP	142850	63-E w/1" NPT plug	14.0 (6.4)
63-M	143100	63 w/manual reset	14.0 (6.4)
E-28	142900	63 w/DPDT switch	14.3 (6.5)



McDonnell & Miller

Installation & Maintenance
Instructions
MM-206(D)

Series 63   

Low Water Cut-Off

Typical Applications:

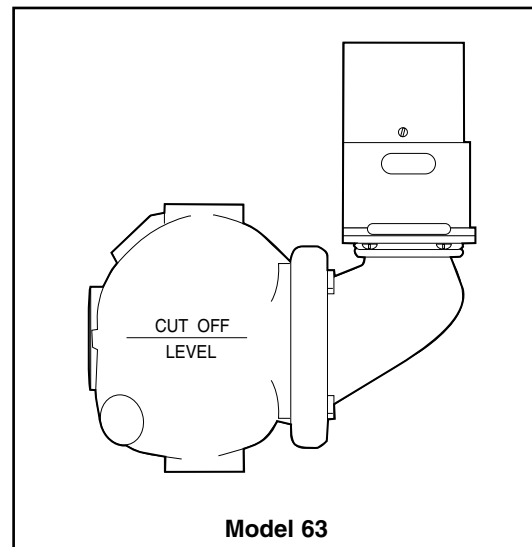
- Primary or secondary low water cut-off for hot water and steam boilers.
- Low water cut-off
- High water cut-off
- Alarm actuator

OPERATION

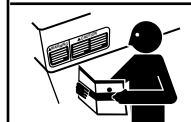
Maximum Boiler Pressure: 50 psi (3.5 kg/cm²)

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at
240 VAC	5.1	30.6	120 or 240 VAC



WARNING



- Before using this product read and understand instructions.
 - Save these instructions for future reference.
 - All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.
 - To prevent serious burns, the boiler must be cooled to 80°F (27°C) and the pressure must be 0 psi (0 bar) before servicing.
 - To prevent electrical shock, turn off the electrical power before making electrical connections.
 - This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.
 - We recommend that secondary (redundant) Low Water Cut-Off controls be installed on all steam boilers with heat input greater than 400,000 BTU/hour or operating above 15 psi of steam pressure. At least two controls should be connected in series with the burner control circuit to provide safety redundancy protection should the boiler experience a low water condition. Moreover, at each annual outage, the low water cut-offs should be dismantled, inspected, cleaned, and checked for proper calibration and performance.
 - To prevent serious personal injury from steam blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.
 - To prevent a fire, do not use this low water cut-off to switch currents over 10.2A, 1/2 Hp at 120 VAC or 5.1A, 1/2 Hp at 240 VAC, unless a starter or relay is used in conjunction with it.
- Failure to follow this warning could cause property damage, personal injury or death.

INSTALLATION –

Model 63 – For Steam Boilers with 1” (25mm) Equalizing Lines

TOOLS NEEDED:

One (1) flathead screwdriver and two (2) pipe wrenches.

STEP 1 - Determine the Location of the Low Water Cut-Off

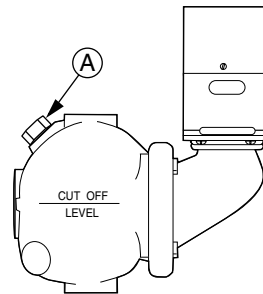
- a. Whether the gauge glass is mounted directly into the boiler or on an independent water column, the cut-off line on the 63 body casting should be mounted 1/2” (15mm) above the lowest visible point of the gauge glass.

STEP 2 - Installation of the Model 63

For 63 models with float block

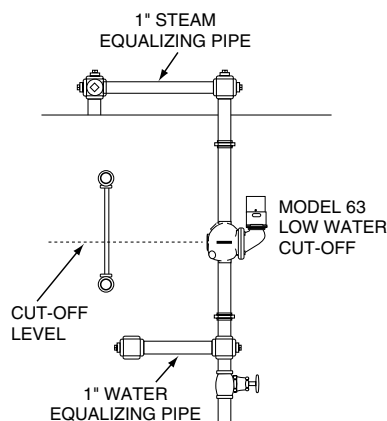
Using pipe wrench

- Remove float blocking plug (A) from low water cut-off body tapping.
- Screw 3/4” NPT steel plug (provided) in tapping.

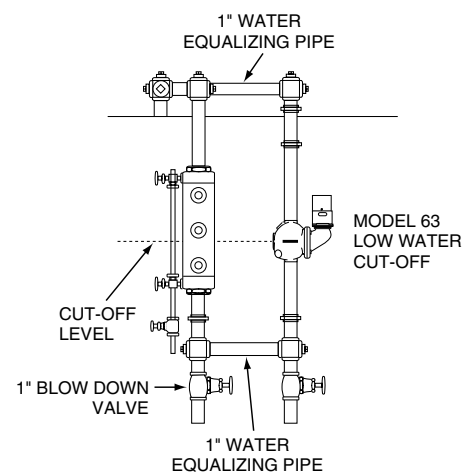


- a. Locate the gauge glass and determine the level that the 63 has to be mounted at in order to achieve the criteria in Step 1.
- b. Pipe the 63 following the diagrams shown to the right. Follow the diagram that represents your boiler.
- c. Crosses should be used at each right angle connection for inspection and cleaning.
- d. Make sure the blow-down valves are full port.
- e. While the burner is operating, open the blow-down valve, causing the water level to drop in the float chamber while burner is operating. As the float drops the alarm circuit (if used) closes first; then on further drop the cut-off circuit will open, shutting the burner off.
- f. Test the Model 63 before leaving the site.

Gauge Glass Mounted Directly into Boiler



For Boilers with Independent Water Columns



INSTALLATION –

Model 63 – For Hot Water Boilers with 1” (25mm) Equalizing Lines

TOOLS NEEDED: One (1) flathead screwdriver and two (2) pipe wrenches.

STEP 1 - Determine the Location of the Low Water Cut-Off

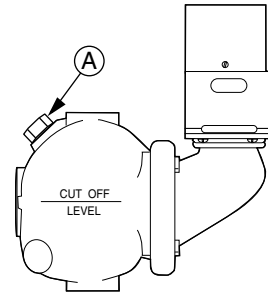
- a. The line on the casting of the model 63 must be installed above the lowest permissible water level determined by the boiler manufacturer.

STEP 2 - Installation of the Model 63

For 63 models with float block

Using pipe wrench

- Remove float blocking plug (A) from low water cut-off body tapping.
- Screw 3/4” NPT steel plug (provided) in tapping (A).



For float type controls it is recommended that Test-N-Check® (TC-4) valves be used in the upper and lower equalizing lines. They offer a functional means for testing the 63 control, and conform to the ASME CSD-1 code.

- a. Study the figures to the right and determine which figure shows how the 63 control will be attached to the boiler.

Figure 1. Connect the upper equalizing pipe to the riser going to the radiation or to the compression tank. Connect the lower equalizing pipe to any available opening in the side of the boiler. **NOTE:** If no opening is available in the side of the boiler, connect the lower equalizing pipe into the drain connection.

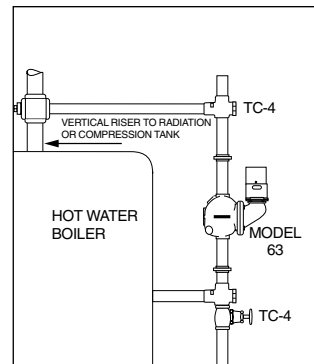


Figure 1

Figure 2. If there is a tapping available on the top of the boiler, connect the upper equalizing pipe to it. **NOTE:** During initial filling or after blow-down the upper equalizing pipe and possibly the 63 control will have an air pocket. Connect a vent or bleed valve on the top of the vertical equalizing pipe. If the Test-N-Check (TC-4) valve is used the vacuum breaker can be used to bleed the air pocket.

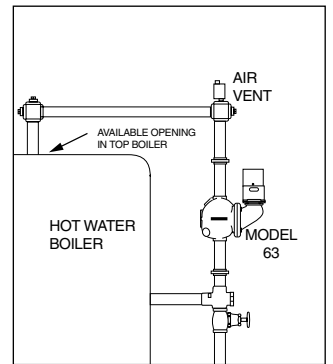


Figure 2

CAUTION: When bleeding an air pocket manually, protect yourself from being burned with hot water.

Figure 3. If there is no tapping available on the boiler, connect both the upper and lower equalizing pipe into the vertical riser going to the radiation or to the compression tank. **IMPORTANT:** The horizontal equalizing pipe should be below the horizontal run going to the radiation. If it is not, an air pocket will be created and a vent or bleed will have to be installed.

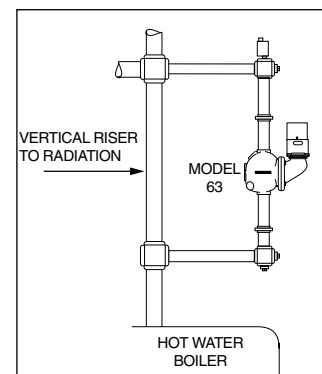


Figure 3

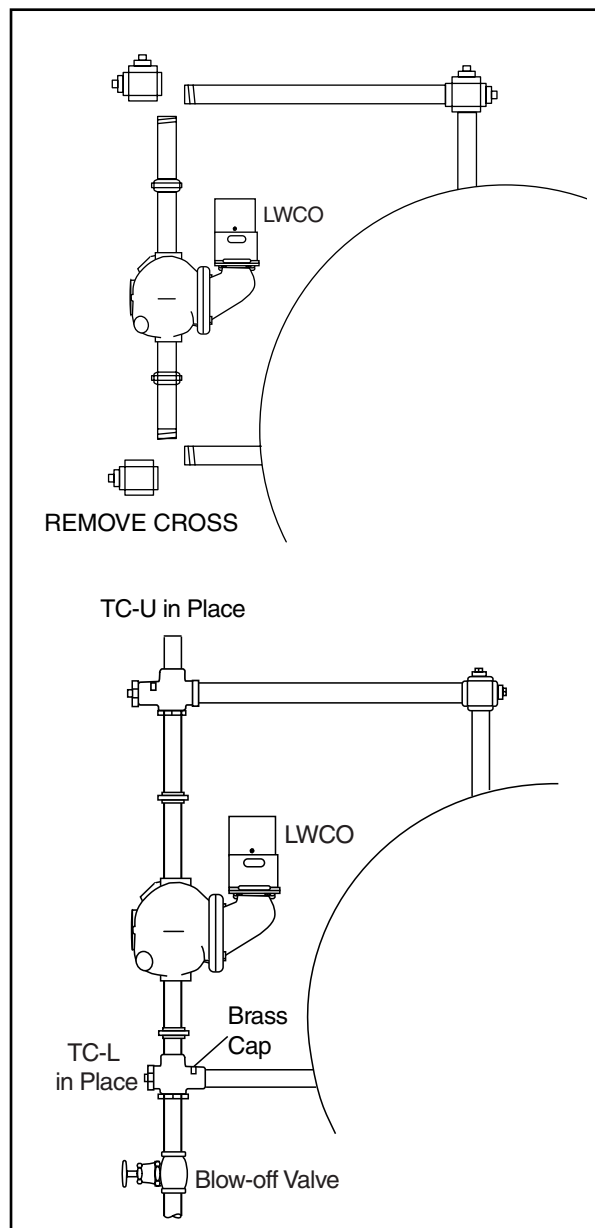
- b. While the burner is operating open the blow-down valve, causing the water level to drop in the float chamber. As the float drops the alarm circuit (if used) closes first; then on further drop the cut-off circuit will open, shutting the burner off.
- c. Test the Model 63 before leaving the site.

TEST-N-CHECK® VALVES

Simplify Testing of Low Water Cut-offs on Hot Water Boilers

Installation of the TC-4 Test-N-Check valves with a New Low Water Cut-off

1. Assemble the TC-U (the upper Test-N-Check valves, with the vacuum breaker) into the upper equalizing line in place of the cross described in the low water cut-off installation instructions. **NOTE:** The vacuum breaker must be on the top and the long leg must face the boiler. **NOTE:** Make sure low water cut-off position is located in accordance with the boiler manufacturer's recommended cut-off level.
2. Assemble the TC-L (the lower Test-N-Check valve, without the vacuum breaker) into the lower equalizing line in place of the cross described in the low water cut-off installation instructions. **NOTE:** The brass cap must be located above the center of the lower equalizing line, and the long leg must face the boiler.
3. Assemble the blow-off valve into the bottom port of the TC-L.
4. Assemble 1" NPT pipe plugs into the remaining open port in both the TC-U and TC-L.
5. Complete the installation as described in the low water cut-off installation instructions.
6. After all piping assembly has been completed, refill the system with water, turn on all electrical supply and bring system to operating conditions. After system reaches operating pressure, inspect to make sure no leaks exist at the threaded connections. Test valves by opening blow-off valve while burner is on, to make sure valves operate correctly and low water cut-off shuts burner off.



IMPORTANT:

- Installation should be performed by qualified personnel only, in accordance with all applicable codes.
- If vacuum breaker stem is accidentally depressed, hot water could be discharged causing burns.
- Blow-off valve drain piping should be piped to a suitable drain to handle hot water and steam discharge, and should be the same size as the equalizing pipe.

ELECTRICAL WIRING

TOOLS NEEDED:

One (1) flathead screwdriver.

WARNING



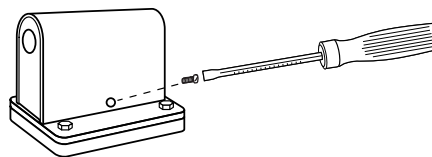
- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.



Failure to follow this warning could cause electrical shock, an explosion and/or a fire, which could result in property damage, personal injury or death.

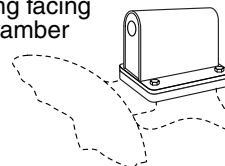
Cover Removal and Installation Procedure

- Using a flathead screwdriver, remove the one (1) screw that secures the switch cover.
- Place the cover on the switch housing and, using a flathead screwdriver, tighten the one (1) screw to approximately 2 ft•lb (2.6 N•m).

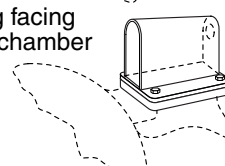


- The No. 2 switch can be positioned with the conduit opening facing toward or away from the float chamber. These are the only positions in which the switch will function properly. See drawing at right.
- On initial fill-up, push the 2M manual reset button after the proper water level is reached to energize the burner. If a low water condition occurs and the water level has been restored, push the reset button to energize the burner.
- Follow the wiring diagrams below to wire the No. 2 Switch. Terminals C and NC are the low water cut-off switch. Terminals C and NO are alarm switch. If the electrical load exceeds the rating of the switch, use an auxiliary relay or motor starter.

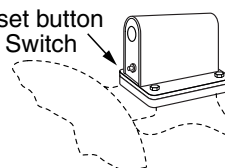
Conduit opening facing toward float chamber



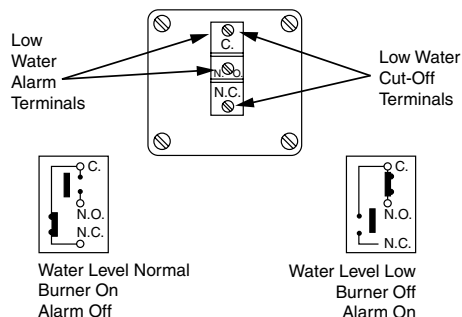
Conduit opening facing away from float chamber



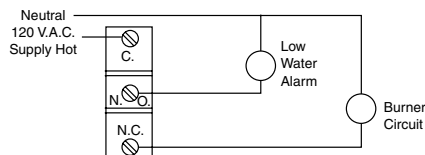
Manual reset button on No. 2m Switch



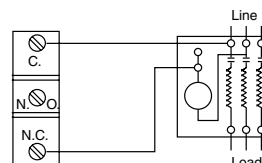
SCHEMATIC OF SWITCH OPERATION



USED AS A MAIN LINE SWITCH AND/OR LOW WATER ALARM



USED AS A PILOT SWITCH TO COIL OF RELAY OR MOTOR STARTER



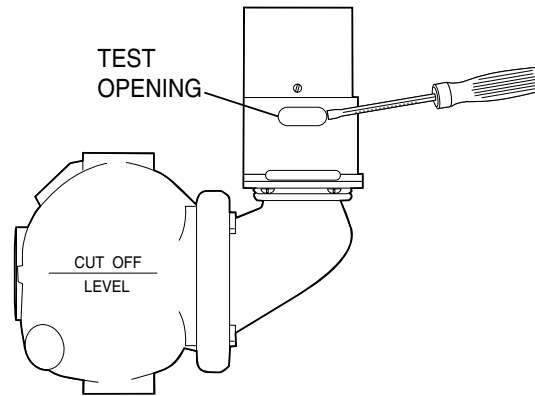
WARNING

Do not use automatic water feeders with manual reset LWCO's.

Failure to follow this warning could cause flooding, property damage, personal injury or death.

TESTING

- Control can be tested on a hot water boiler by gently inserting a screwdriver in the test opening below the switch (see drawing) and lifting linkage to cause float to drop, thereby simulating a low water condition.



TROUBLESHOOTING

Problem:

1. Burner does not shut off on low water.

- a. **Cause:** Float chamber is loaded with mud or sediment.

Test: With water level below the control check if terminals C and N.C. are open. If not, remove switch and manually test if terminals C and N.C. can be opened.

Solution: Open float chamber and clean. At this time, check for a build-up of scale or sediment between corrugations of the bellows.

- b. **Cause:** Contacts are fused together.

Test: Remove switch and operate manually to verify proper switch operation.

Solution: Replace switch. Check electrical load and make sure it is within the ratings of the switch.

MAINTENANCE

SCHEDULE:

- Blow down control as follows when boiler is in operation:

Steam:

- Daily if operating pressure is above 15 psi.
- Weekly if operating pressure is below 15 psi.

Hot Water:

- Quarterly

NOTE

More frequent blow-down may be necessary due to dirty water and/or local codes.

- **Disassemble and inspect annually. Replace the low water cut-off if it is worn, corroded, or if components no longer operate properly.**
- **Inspect the float chamber and equalizing piping annually. Remove all sediment and debris.**
- **Replace head mechanism every 5 years.**
More frequent replacement may be required when severe conditions exist such as rapid switch cycling, surging water levels, and use of water treatment chemicals.
- **We recommend head mechanism replacement when the switch(es) no longer operate properly.**
If you choose to replace the switch(es), order the proper McDonnell & Miller replacement switch or switch assembly and follow the Repair Procedure provided.

PROCEDURE:



CAUTION



To prevent serious personal injury from steam pipe blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.

Failure to follow this caution could cause personal injury.

1. Blow down the low water cut-off when the water level is at its normal level and the burner is on. **Slowly** open the blow down valve until it is fully open and observe the water level fall in the gauge glass. Close the valve after verifying that the pump contacts have closed and the burner shuts off. If this does not happen, immediately shut off the boiler and correct the problem.

Neptune
 A DOVER COMPANY

INJECTION QUILLS



MODEL QC-316-50

High Pressure Injection Quills

High Pressure Injection Quills are used to inject chemicals pumped by metering pumps into the turbulent flow zone of high pressure water or steam lines.

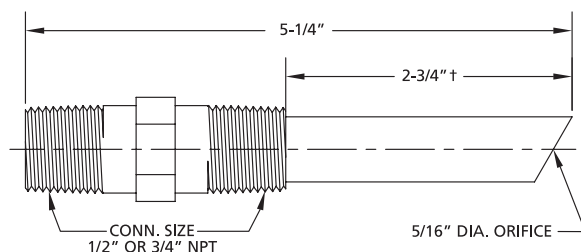
- Use to 3,000 psi
- Spring loaded check valve
- Available in PVC, Kynar, 316SS and C-20

Features

- Built-in Spring Loaded Check on all models
- High pressure to 3,000 psi
- Available in PVC, Kynar, 316 stainless steel and Carpenter 20-Cb3

MODEL	MATERIAL OF BODY	MATERIAL OF CHECK	MATERIAL OF SPRING	PRESS. (MAX.)	MAXIMUM TEMP.	CONN. SIZE NPT
QC-PVC-50	PVC	Ceramic	HAST C	150 psi	100°F (37°C)	1/2"
QC-PVC-75	PVC	Ceramic	HAST C	150 psi	100°F (37°C)	3/4"
QC-316-50	316SS	316SS	HAST C	3000 psi	750°F (400°C)	1/2"
QC-316-75	316SS	316SS	HAST C	3000 psi	750°F (400°C)	3/4"
QC-316-HPSE*	316SS	316SS	HAST C	3000 psi	750°F (400°C)	1/2"
QC-C20-50	C-20	C-20	HAST C	3000 psi	750°F (400°C)	1/2"
QC-KY-50	Kynar	Ceramic	HAST C	150 psi	200°F (93°C)	1/2"
QC-KY-75	Kynar	Ceramic	HAST C	150 psi	200°F (93°C)	3/4"

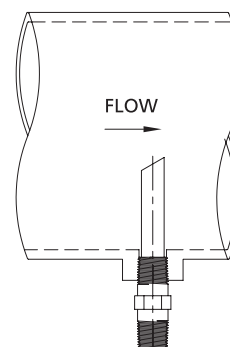
*Has slotted end.



†Special lengths are available up to 24".

Recommendations

- For lines smaller than 4" diameter, trim quill so chemical is released near center of line. Use as is for lines over 4" diameter.
- Install with "Telltale" V-notch facing upstream so flow strikes angled face at end of quill for most rapid dispersal of injected chemical.
- For maintenance ease, installation of an isolation valve, rated above line operating pressure, immediately behind the quill is recommended.


Neptune
 A DOVER COMPANY

P.O. Box 247 • Lansdale, PA 19446-0247
 Tel: 215-699-8700 • Fax: 215-699-0370
 Toll-Free Tel: 1-888-3NEPTUNE (1-888-363-7886)
 Toll-Free Fax: 1-800-255-4017
 Web Site: <http://www.neptune1.com>
 E-mail: pump@neptune1.com

SOLD BY:

NEPTUNE
 MEMBER OF
PSG
 PUMP SOLUTIONS GROUP
 A DOVER COMPANY

76-100 SERIES

STAINLESS STEEL BALL VALVE W/ MOUNTING PAD
1/4" - 1"



Female NPT Thread, 2000 CWP (psig). Cold Non-Shock. (See referenced P/T chart)
150 psig Saturated Steam.
Vacuum Service to 29 inches Hg.
MSS SP-110 Compliant.

FEATURES

- Investment cast components
- Reinforced seats
- Mounting pad for easy actuator mounting
- Blowout-proof stem design
- Adjustable packing gland
- Stainless steel lever and nut

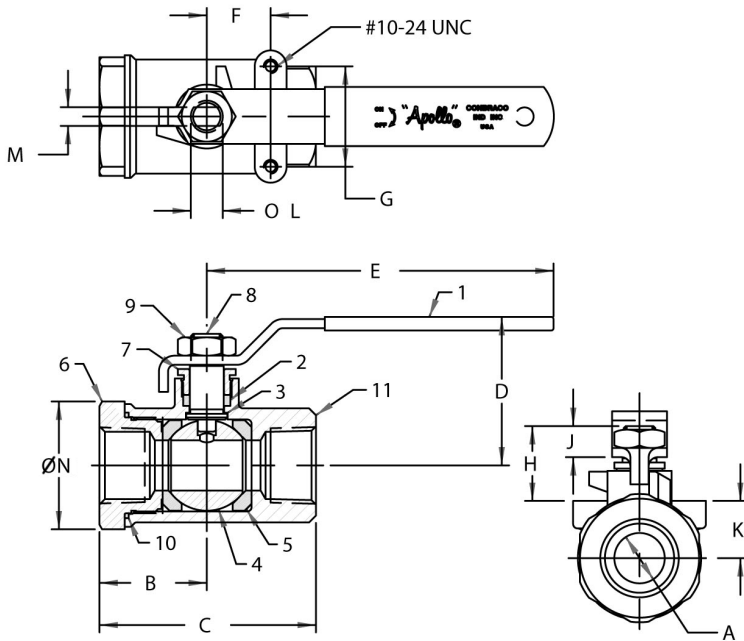
- Fire safe to API 607 (requires -24 suffix)
- Meets NACE MR0175 (2000) & MR0103 (2012)
- CSA CGA 3.16-M88 (Requires "GS" suffix)
- NSF/ANSI/CAN 61 Section 8, Annex G
- NSF/ANSI 372 - Drinking Water System Components - Lead Content

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	All
-T -01-	BSPT (Tapered) Thread Connection	All
-02-	Stem Grounded	All
-04-	2-1/4" Stem Extension (Carbon Steel, Zinc Plated)	All
-07-	Steel Tee Handle	All
-08-	90° Reversed Stem	All
-14-	Side Vented Ball (Uni-Directional)	All
-15-	Wheel Handle, Steel	All
-16-	Chain Lever - Vertical	3/4" to 2"
-19-	Lock Plate	All
-21-	UHMWPE Trim (Non-PTFE)	All
-24-	Graphite Packing, PTFE Body Seal, RPTFE Bearing (API 607, 6th Edition, ISO 10497:2010)	All
-27-	SS Latch-Lock Lever & Nut	All
-30-	Cam-Lock and Grounded	All
-32-	SS Tee Handle & Nut	All
-35-	PTFE Trim	All
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	All
-40-	Cyl-Loc and Grounded	All
-44-	Seal Welded	All
-45-	Less Lever & Nut	All
-46-	Latch Lock Lever - Lock in Closed Position Only	All
-47-	SS Latch Lock Oval Handle	All
-48-	SS Oval Handle (No Latch) & Nut	All
-49-	No Lubrication. Assembled Dry.	All
-50-	2-1/4" CS Locking Stem Extension	All
-57-	Oxygen Cleaned	All
-58-	Chain Lever - Horizontal	3/4" to 2"
-60-	Static Grounded Ball & Stem	All
-64-	250# Steam Trim (MPTFE Seats & Packing)	All
-GS-	CSA CGA 3.16	All
-UA-	AIS (American Iron & Steel) Compliant	All



STANDARD MATERIAL LIST

PART	MATERIAL
1 Lever and grip	304 SS w/vinyl
2 Stem packing	MPTFE
3 Stem bearing	RPTFE
4 Ball	A276-316 Stainless Steel
5 Seat (2)	RPTFE
6 Retainer	A351-CF8M SS or A276-316 SS
7 Gland nut	A276-316 Stainless Steel
8 Stem	A276-316 Stainless Steel
9 Lever nut	18-8 Stainless Steel
10 Body seal	PTFE
11 Body	A351-CF8M Stainless Steel

DIMENSIONS

PART NO.	SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	WT.
76-101-01A	1/4"	0.37	1.02	2.05	1.71	3.85	0.50	1.12	0.88	0.34	0.53	0.375	0.234	1.16	0.58
76-102-01A	3/8"	0.37	1.02	2.05	1.71	3.85	0.50	1.12	0.88	0.34	0.53	0.375	0.234	1.16	0.55
76-103-01A	1/2"	0.50	1.12	2.23	1.79	3.85	0.50	1.12	0.90	0.34	0.59	0.375	0.234	1.38	0.63
76-104-01A	3/4"	0.68	1.47	2.96	2.03	4.75	0.87	1.37	1.02	0.42	0.78	0.437	0.256	1.75	1.30
76-105-01A	1"	0.87	1.67	3.34	2.16	4.75	0.87	1.37	1.02	0.42	0.91	0.437	0.256	1.94	1.60

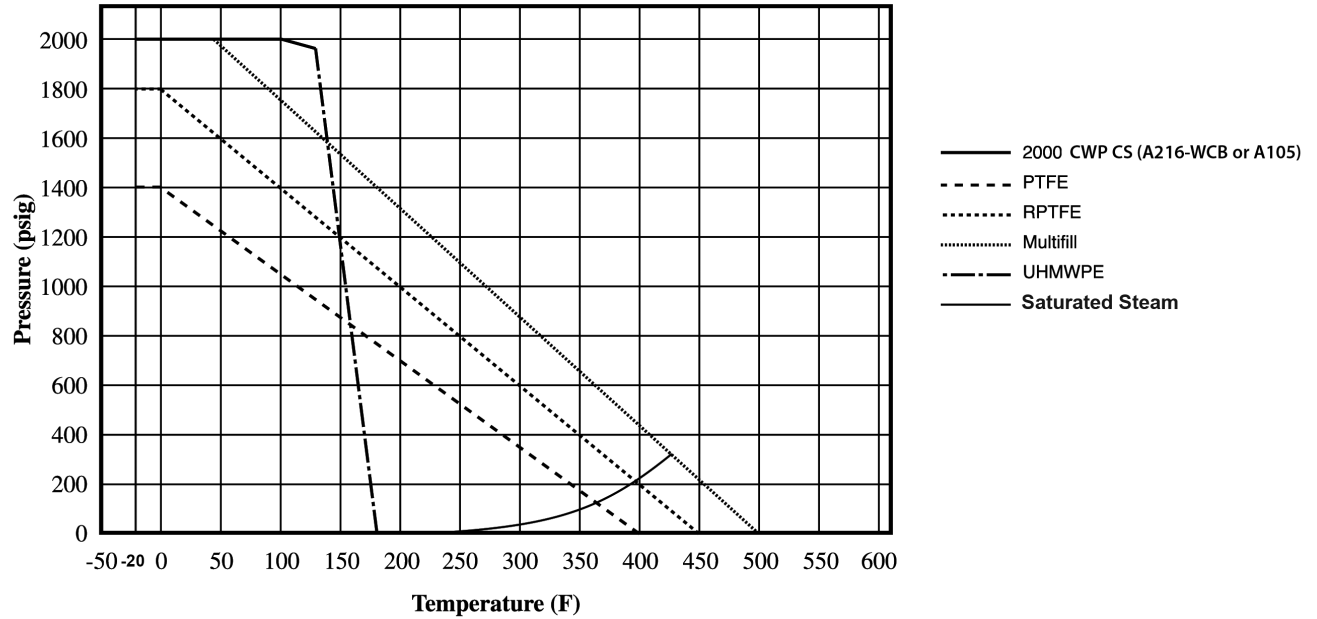
Pressure/Temperature Ratings - Page M-14, Graph No. 14

*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. 18JUL19

2000 CWP

(CS) ASTM A216-WCB OR ASTM A105

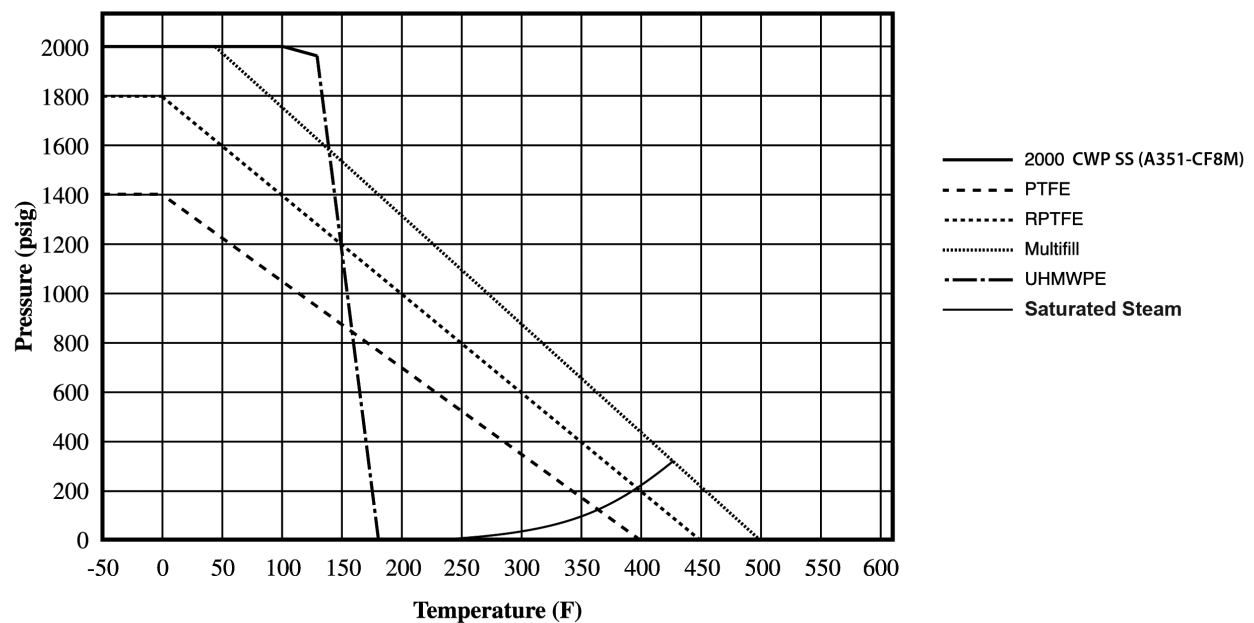
GRAPH 13



2000 CWP

(SS) ASTM A351-CF8M

GRAPH 14





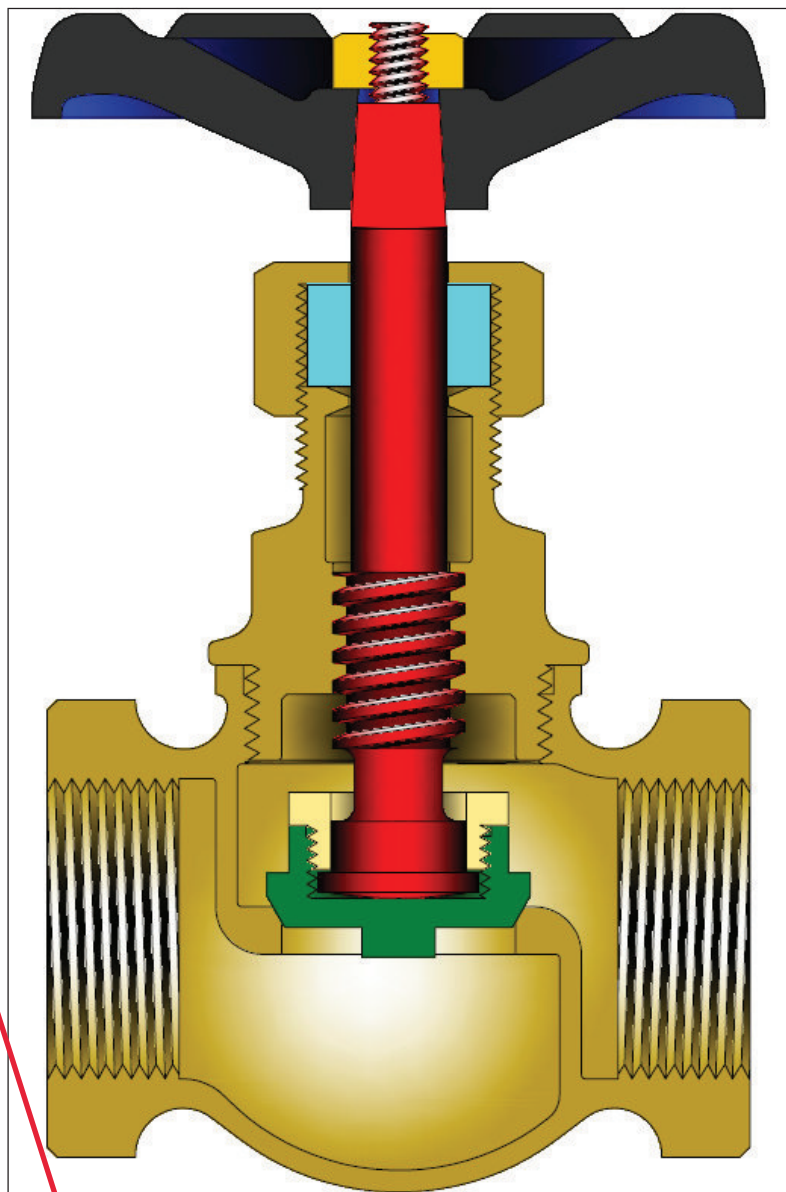
MSS SP-80 GLOBE VALVE
THREADED BONNET, THREADED ENDS
¼ TO 3" (6 TO 75mm) CLASS 125
BRONZE

STANDARD MATERIALS

PART	MATERIALS
Body	B62
Bonnet	B62*
Disc	B62**
Stem	B371 C69400
Packing Nut	B62 or B16
Disc Locknut	B371 C69400
Packing	Graphite
Hand Wheel	A47 Gr. 32510
Hand Wheel Nut	Brass
Horseshoe Ring	SS 303 or SS 304
Wheel Plate	Aluminum

* B16 for sizes ¼" through ¾"

** For ½" and smaller sizes, disc and stem are integral and disc material is same as stem.



Class	Fig. No.
125	650

DESIGN FEATURES:

- **High-Tensile** bronze alloy stem.
- **Integral** seats.
- **Discs** in ¾" and larger valves are attached to stem by disc locknut. The ½" and smaller valves have stem and disc integral.
- **Each** valve is shell and seat pressure tested per industry standard MSS SP-80.

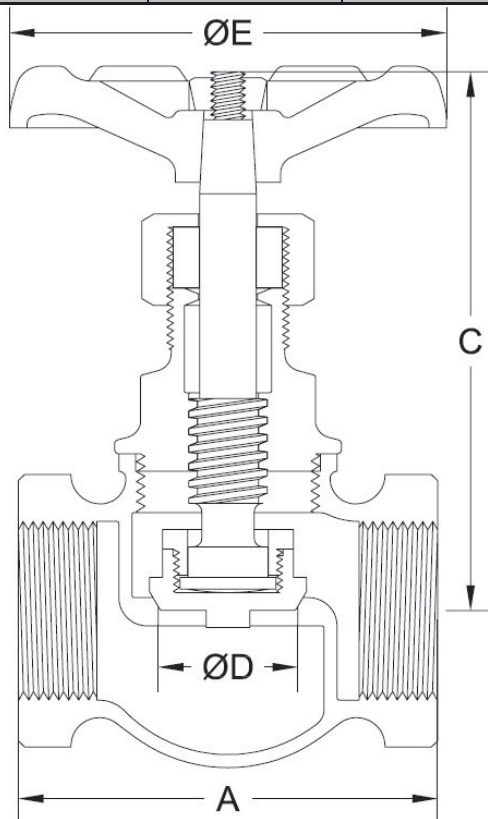
Design Specifications

Item	Applicable Specification
Pressure - temperature ratings	MSS SP-80
General valve design	MSS SP-80
Thread design	ASME B1.20.1
Materials	ASTM

GLOBE VALVE DIMENSIONS (CLASS 125).

SIZE	FIG 650					
in	A	C	D	E	WT	lb
mm						kg
¼	1.63	2.7	0.25	2.1	0.4	0.6
6	41	68	6	54	0.2	
⅜	1.94	3.0	0.38	2.5	0.6	1.4
10	49	76	10	64	0.3	
½	2.13	3.4	0.50	2.8	0.8	2.5
13	54	86	13	70	0.4	
¾	2.50	3.9	0.75	3.0	1.3	5.8
20	64	100	19	76	0.6	
1	3.00	4.4	1.00	3.3	1.9	10.7
25	76	111	25	83	0.9	
1¼	3.44	5.1	1.25	3.6	2.7	17.1
32	87	129	32	92	1.2	
1½	3.81	5.4	1.50	4.1	4.4	25
40	97	137	38	105	2.0	
2	4.75	6.5	2.00	4.8	5.9	50
50	121	165	51	121	2.7	
2½	5.69	7.3	2.50	5.1	10.1	75
65	144	186	64	130	4.6	
3	6.56	8.3	3.00	5.8	15.4	110
75	167	210	76	146	7.0	

C = Center to top open
WT = Weight
C_v = Flow Coefficient





MSS SP-80 GATE VALVE
 THREADED BONNET, THREADED ENDS
 GATE ¼ TO 3" (6 TO 75mm) CLASSES 125 AND 150
 BRONZE NON-RISING STEM

STANDARD MATERIALS

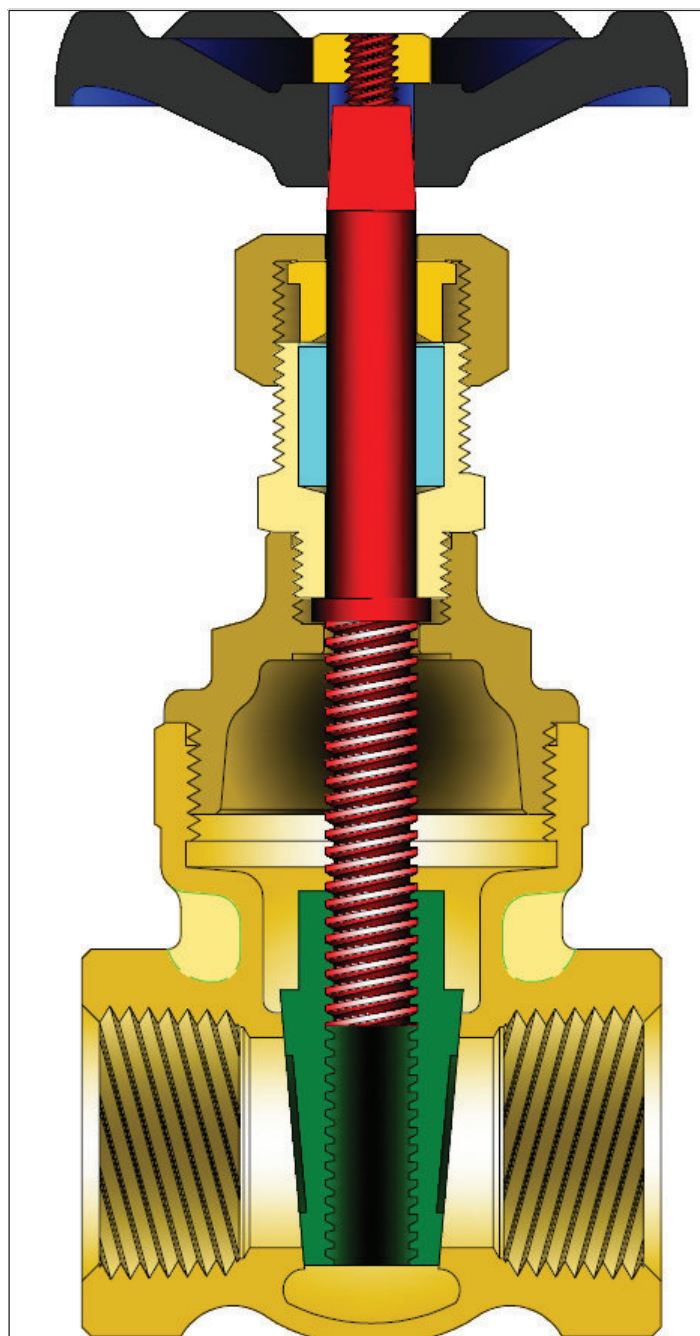
PART	MATERIALS
Body	B62
Bonnet	B62
Wedge	B62
Stem	B371 C69400
Packing Nut	B62 or B16
Gland	B16
Packing	Graphite
Hand Wheel	Ductile Iron
Hand Wheel Nut	Brass
Stuffing Box	B371 C69400
Wheel Plate	Aluminum

Design Specifications

Item	Applicable Specification
Pressure - temperature ratings	MSS SP-80
General valve design	MSS SP-80
Thread design	ASME B1.20.1
Materials	ASTM

DESIGN FEATURES:

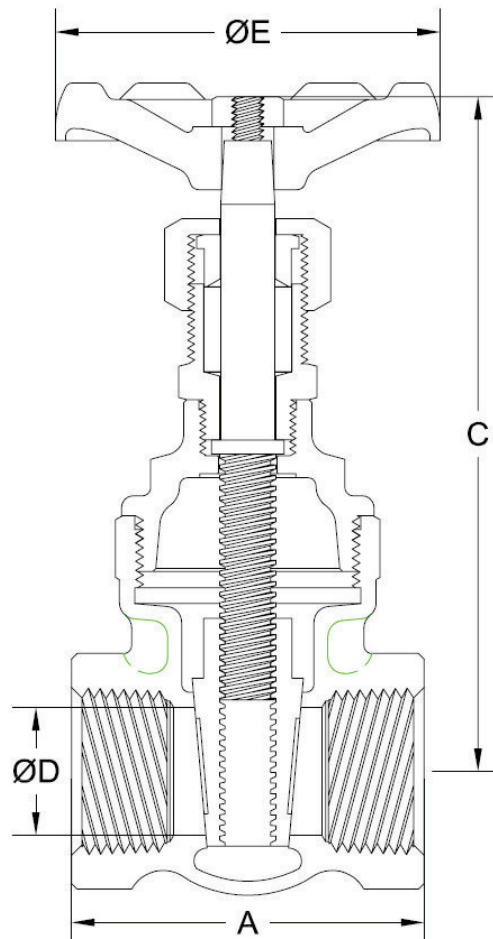
- **Renewable** solid wedges.
- **Integral** seats.
- **High-Tensile** bronze alloy stems.
- **Each** valve is shell and seat pressure tested per industry standard MSS SP-80.
- **Stems** are rotating, non-rising design.



Class	Fig. No.
125	507
150	512 / 2712

GATE VALVE DIMENSIONS (CLASSES 125 & 150).

SIZE	FIG 507, 512, & 2712					
	A	C	D	E	WT	C _v
in						
mm						
¼	1.75	3.5	0.25	2.1	0.7	3.2
6	44	89	6	54	0.3	
⅜	2.00	3.5	0.38	2.1	0.9	7.1
10	51	89	10	54	0.4	
½	2.38	3.9	0.50	2.5	1.0	12.6
13	60	99	13	64	0.5	
¾	2.44	4.6	0.75	2.8	1.7	30
20	62	117	19	70	0.8	
1	2.75	5.4	1.00	3.0	2.8	55
25	70	137	25	76	1.3	
1¼	3.00	6.2	1.25	3.3	4.0	87
32	76	157	32	83	1.8	
1½	3.38	6.8	1.50	3.6	5.0	129
40	86	173	38	92	2.3	
2	3.50	7.8	2.00	4.1	7.2	240
50	89	198	51	103	3.3	
2½	4.50	9.4	2.50	5.1	16.0	350
65	114	239	64	130	7.3	
3	5.00	10.5	3.00	5.7	22.5	510
75	127	267	76	144	10.2	



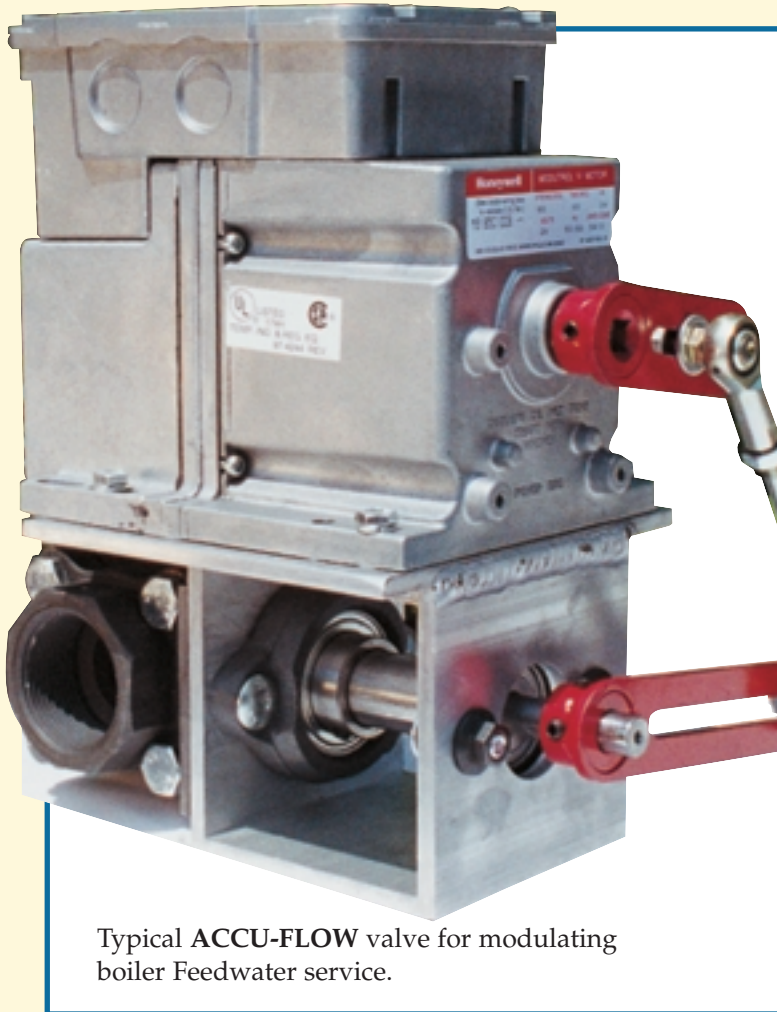
C = Center to top open / closed

WT = Weight

C_v = Flow Coefficient

ACCU-FLOW

by BFS Industries, LLC



Typical **ACCU-FLOW** valve for modulating boiler Feedwater service.

- **Reliable** ball valve with - #316 S.S. ball & stem—3 piece C.S. body—virgin Teflon seat & seal—bubble tight shut off
- **Optional** 0-135Ω or 4-20 mA input signal
- **Rugged**, unitized, light-weight, aluminum frame
- **Stainless Steel** shaft
- **High End** adjustable linkage system including—self lubricating molded race, rod with lock nuts
- **Durable**, self adjusting **ball bearings**, supporting **both** ends of shaft
- **Quality** motor assembled to frame and adjustable linkage
- **Transformer** integral within motor connection box

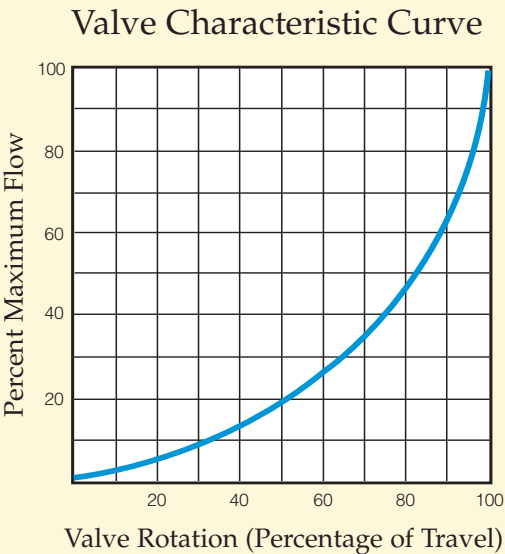
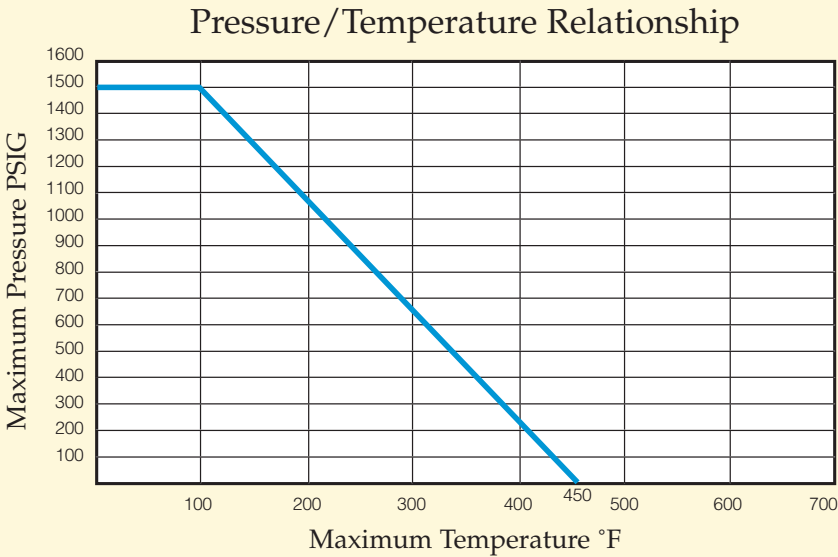
This versatile motorized valve can be utilized in the boiler room as well as with any automated service

- Electric modulating Boiler Feedwater Valve
- Electric modulating Deaerator Level Control
- Electric modulating Surge Tank Level Control
- Electric modulating Boiler Feed Tank Level Control
- Automated flow control of Stand-by-Pump on Primary Pump failure

QUALITY
EXPERIENCE VALUE

BFS Industries is proud to be the most trusted name in Boiler Room Equipment. Established in 1946, we have earned this trust, not only by our engineering competence, but by a compelling “Pride In Our Products”. We urge comparison of our **ACCU-FLOW** valve with all others with confidence. Remember...

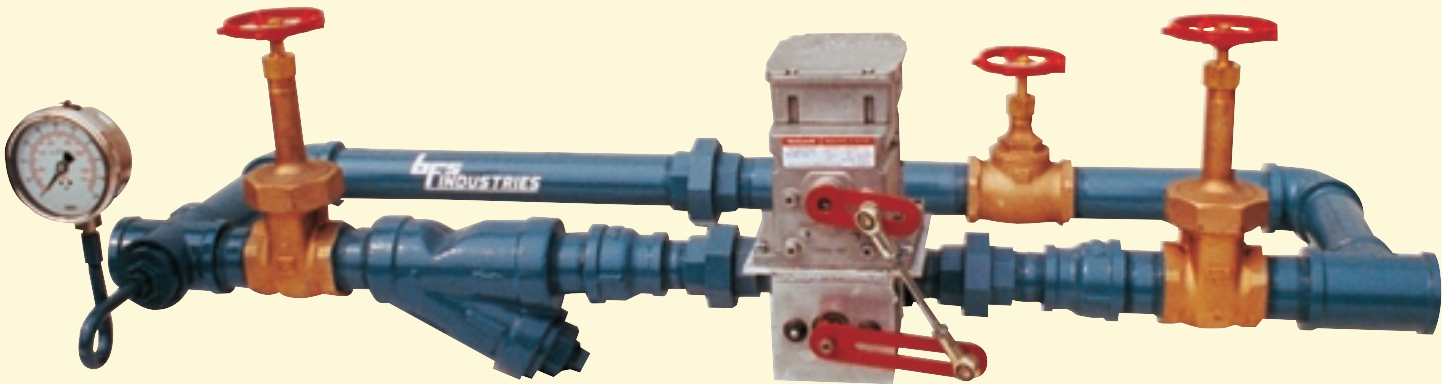
“A quality product is only the beginning at BFS Industries”.



Performance Data

Valve Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Flow Coeff. Cv	8	12	32	57	80	104

Note: For valve capacities at specific operating pressures, see selection flow chart.



Accu-Flow Valve With Optional (3) Valve By-Pass And Strainer

bfs INDUSTRIES, LLC

200 Industrial Drive, Butner, NC 27509
 www.bfsindustries.com

Distributed by:

ACCU-FLOW

SELECTION FLOW CHART

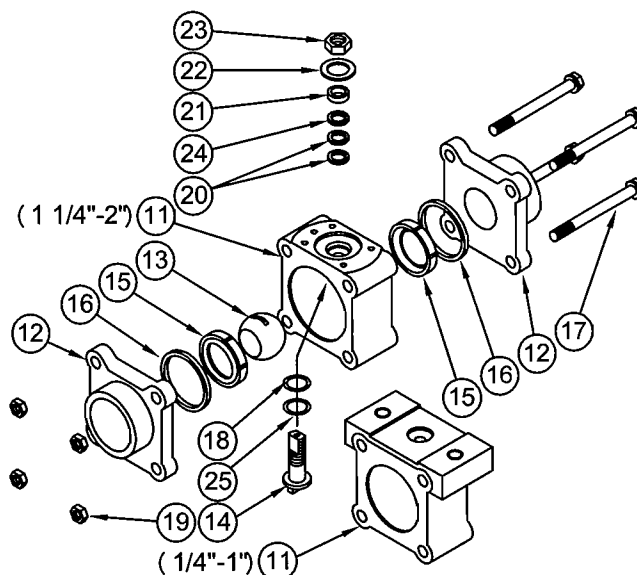
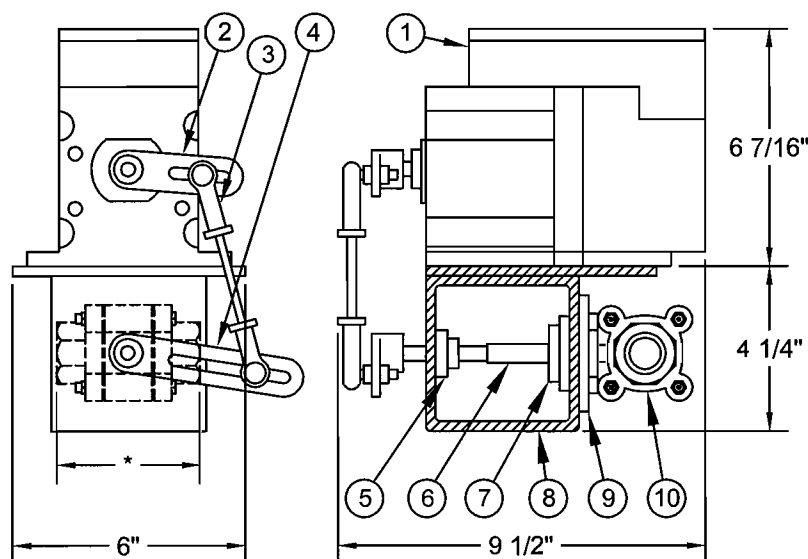
PRESSURE DROP ACROSS VALVE										
Valve Size	5	10	15	20	25	30	35	40	45	50
1/2"	8	18	31	36	40	44	47	51	54	57
3/4"	27	38	46	54	60	66	71	76	80	85
1"	72	101	124	143	160	175	189	202	215	226
1 1/4"	127	180	221	255	285	312	337	360	382	403
1 1/2"	179	253	310	358	400	438	473	506	537	566
2"	233	329	403	465	520	570	615	658	698	735

- NOTES:** 1. Valve flows shown are in G.P.M and based on water at ambient temperature.
2. Minimum size piping to and from valve. Long runs may require larger sizes.

GPM	Up To 13	27	41	72	132	212
PIPING SIZE	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"

3. For flows not listed obtain the Cv from page 2 of bulletin # BF8 and apply following formula:

$$GPM = Cv \times \sqrt{\Delta P}$$



VALVE

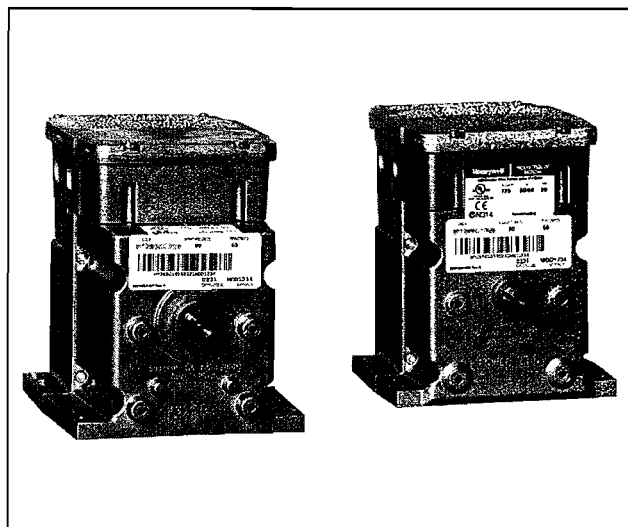
SIZE	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
* FACE TO FACE VALVE DIMENSION	2.54"	2.76"	3.66"	4.16"	4.50"	4.94"

Item#	Description	Material
1	Motor	-----
2	Short Arm	Carbon Steel
3	Linkage	Carbon Steel
4	Long Arm	Carbon Steel
5	Small Bore B.B.	Carbon Steel
6	Shaft	Stainless Steel
7	Large Bore B.B.	Carbon Steel
8	Unitized Frame	Aluminum
9	Valve Adaptor Plate	Carbon Steel
10	Valve	C.S./S.S. Fitted

Item#	Description	Material
11	Body	Carbon Steel
12	Pipe Ends	Carbon Steel
13	Ball	316 Stainless
14	Stem	316 Stainless
15	Valve Seats	Polyfill
16	Body Conn. Seal	Polyfill
17	Body Conn. Bolts	C.S. Zinc PL
18	Thrust Bearing	Polyfill
19	Body Conn. Nuts	C.S. Zinc PL
20	Stem Seal	Polyfill
21	Stem Seal Follower	Stainless
22	Belleville Washers	C.S. Zinc PL
23	Retaining Nut	C.S. Zinc PL
24	Seal Protector	PEEK
25	Thrust Bearing Protector	PEEK

Series 90 Modutrol IV™ Motors

PRODUCT DATA



APPLICATION

The Series 90 Modutrol IV™ Motors are spring return and non-spring return modulating proportional control motors. Use these motors with controllers that provide a Series 90 output to operate dampers or valves.

FEATURES

- Replaces M934A,D, M941, M944A,C,D, M945A,D,F, M954, M965, and M975 motors.
- Integral junction box provides NEMA 3 weather protection.
- Integral spring return returns motor to normal position when power is interrupted.
- Motor and circuitry operate from 24 Vac. Models available with factory installed transformer, or a field added internal transformer.
- Quick-connect terminals are standard—screw terminal adapter is available.
- Adapter bracket for matching shaft height of older motors is available.
- Motors have field adjustable stroke (90° to 160°).
- Die-cast aluminum housing.
- Integral auxiliary switches are available factory mounted, or can be field added.
- Nominal timing standard of 30 seconds (90° stroke), and 60 seconds (160° stroke). Other timings available.
- Spring return motors can operate valve linkages from power end or auxiliary end shafts for normally closed or normally open valve applications.
- All models have dual shafts (slotted and tapped on both ends).
- All models have auxiliary switch cams.
- Fixed torque throughout the entire voltage range.
- Motors are designed for either normally open or normally closed valves and dampers.
- Field addable interface modules can be mounted in the junction box to upgrade the motor to Series 70 (electronic) control.

Contents

Application	1
Features	1
Specifications	2
Ordering Information	2
Wiring	7
Settings and Adjustments	7
Operation	10
Checkout	12
Replacement	12



SPECIFICATIONS

TRADELINE Models: Selected and packaged to provide ease of stocking, ease of handling and maximum replacement value. Specifications are the same as those of standard models unless specified otherwise.

NOTE: Auxiliary switches can only be added to motors that include auxiliary switch cams. (These cams cannot be field-added.)

Modutrol IV Order Number Guide: See Table 1.

Table 1. Modutrol IV Series 3 Version Order Number Guide.

M	Motor					
	91	Proportioning Series 90 Control				
	94	Flame Safeguard Firing Rate Motor				
		6	60 lb-in. Spring Return		35 lb-in. Non-Spring Return	
		7			75 lb-in. Non-Spring Return	
		8			150 lb-in. Non-Spring Return	
		9			300 lb-in. Non-Spring Return	
		1	Dual-ended shaft		Non-Spring Return	
		2			Normally Closed (NC) Spring Return	
		4			Non-Spring Return	
		5			Normally Closed (NC) Spring Return	
			A	0 Auxiliary Switches	Adjustable Stroke	Normally Closed
			B	1 Auxiliary Switch		
			C	2 Auxiliary Switches		
			D	0 Auxiliary Switches		
			E	1 Auxiliary Switch		
M	91	8	4	A	XXXX	See Catalog for Complete O.S. Number

NOTE: Torque designation corresponds to torque rating at standard timing (nominally 60 sec for 160° and 30 sec for 90° *except* for 300 lb-in. motors which have timings of 2 or 4 min).

Dimensions: Refer to Fig. 2.

NOTE: 25% *duty cycle* indicates that the motor operates for 6 out of every 24 hours.

Electrical Ratings: Refer to Table 2.

Control Inputs: Proportional, Series 90.

Dead Weight Load On Shaft:

Power or Auxiliary End: 200 lb (90.8 kg) maximum.
Maximum Combined Load: 300 lb (136 kg). (Dual shaft motors only.)

NOTE: Motor Series 90 control can be either Electronic, or Mechanical (135 ohm).

Auxiliary Switch Ratings: Refer to Table 3.

Crankshaft: 3/8 in. (9.5 mm) square. (Some models have double-ended shafts.)

Ambient Temperature Ratings:

Maximum: 150° F (66° C) at 25% duty cycle.
Minimum: -40° F (-40° C).

Stroke: Models available with field adjustable stroke from 90° to 160° (See Settings and Adjustments on page 8).

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Toronto, Ontario M1V 4Z9.

International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

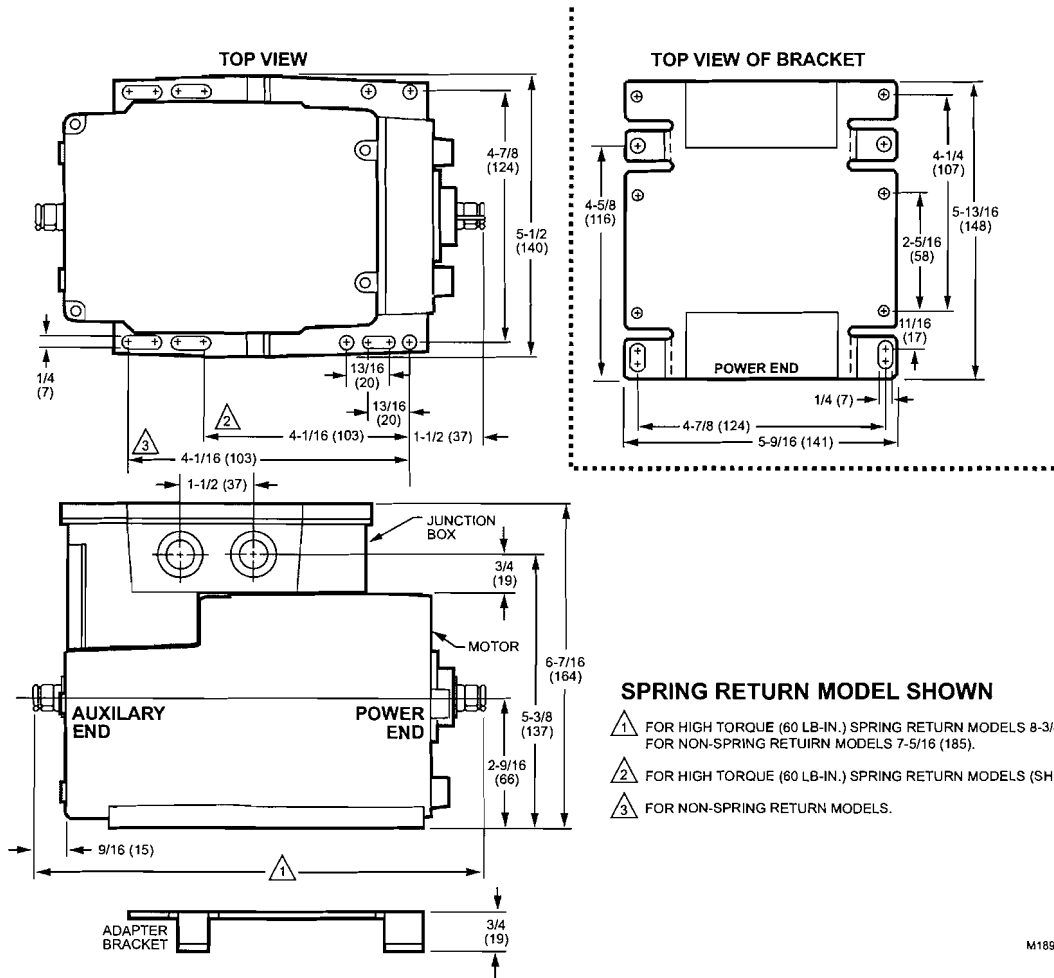


Fig. 1. Modutrol IV Motor mounting dimensions in inches (mm).

Table 2. Series 90 Modutrol Motor Power Consumption Ratings.

Internal Transformer	Power Consumption					
	Non-Spring Return Motors				Spring Return Motors	
	75, 150 and 300 lb-in. Torque		35 lb-in. Torque		60 lb-in. Torque	
	(VA)	(W)	(VA)	(W)	(VA)	(W)
No	14	12			18	16
Yes	16	14			20	18

Table 3. Auxiliary Switch Ratings (in Amps).

Single Contact Rating ^a	120 V	240 V
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

^a 40 VA pilot duty, 120/240 Vac on opposite contact.

Timing And Torque: Refer to Table 4.

Approvals:

Underwriters Laboratories Inc. Listed: File No. E4436, Guide No. XAPX.

Canadian Standards Association Certified: General Listed File No. LR1620, Guide 400-E.

U.S. Patents: pending

Table 4. Series 90 Modutrol Motor Timing and Torque Ratings.

Nominal Timing ^a in sec		Rated Torque in lb-in. (N·m) ^b			
		Normal Running Torque		Breakaway Torque ^c	
90°	160°	Spring Return	Non-Spring Return	Spring Return	Non-Spring Return
30	60	—	35 (4)	—	70 (8)
15 ^d /30	30 ^d /60	60 (6.8)	75 (8.5)	120 (13.6)	150 (17)
30	60	—	150 (17)	—	300 (34)
60	120	—	300 (34)	—	600 (68)

^a Timings apply to all TRADELINE models. Some OEM models are available with non-standard timing/torque.

^b The torque rating for dual-ended shaft motors is the sum of the shaft torques (power-end torque plus auxiliary-end torque).

^c Breakaway torque is maximum torque available to overcome occasional large loads such as a seized damper or valve.

^d Low timing is for M9184D1005 only.

NOTE: Some 150 lb-in. and 300 lb-in. torque adjustable stroke motors have timings that are twice that of the nominal timing.

IMPORTANT

Never use a Modutrol Motor continuously at the Breakaway Torque rating.

Accessories:

220736 Internal Auxiliary Switch Kit can be field-installed.

One- (220736A) and Two- (220736B) switch kits available.

220738A Adapter Bracket raises motor shaft height by 19 mm to match that of previous Modutrol Motor models.

220741A Screw Terminal Adapter converts the standard quick-connect terminals to screw terminals.

221455A Infinitely Adjustable Crank Arm approximately 0.75 inch shorter than the 4074ELY Crank Arm, can rotate through downward position and clear base of motor without requiring use of adapter bracket.

221508A Resistor Board plugs onto Series 90 Motor quick-connect wire terminals. Provides same functionality as 4074BYK, 4074EAU, 4074EDC, or 4074EED Resistor Kits.

4074BYK Series 90 Resistor Kit provides for unison control of up to six Series 90 Motors.

4074EAU W973 Resistor Kit provides for control of two or three Series 90 Motors from a W973 Single-zone Logic Panel or W7100 Discharge Air Controller.

4074EDC 4-20 mA Resistor Kit drives one Series 90 Motor from a 4-20 mA controller.

4074EED Unison Control 4-20 mA Resistor Kit provides for control of up to four Series 90 Motors from one 4-20 mA controller.

4074ERU Weatherproofing Kit provides NEMA 3 rating for Modutrol IV Motors mounted in position other than upright.

50017460-001 Internal Transformer; 24/120/230 Vac 50/60 Hz primary, 24 Vac secondary, quick connect terminals.

50017460-003 Internal Transformer; 120 Vac 50/60 Hz primary, 24 Vac secondary, quick connect terminals.

7617ADW Crank Arm approximately 0.75 inch shorter than 7616BR Crank Arm. Can rotate through downward position and clear base of motor without requiring use of adapter bracket.

Q100 Linkage connects Modutrol Motor to V51 Butterfly Valve. Requires the 220738A adapter bracket (packed with TRADELINE Modutrol IV Motors).

Q181 Auxiliary Potentiometer for sequence or unison control of 1 to 4 additional modulating (Series 90) motors.

Q209E,F Potentiometer limits motor minimum position.

Q5001 Bracket and Linkage Assembly connects Modutrol Motor to a water or steam globe valve.

Q605 Damper Linkage connects motor to damper. Includes motor crank arm.

Q607 External Auxiliary Switch controls auxiliary equipment as a function of motor position.

Q7130A Interface Module with selectable voltage ranges (4-7 Vdc, 6-9 Vdc, and 10.5-13.5 Vdc) adapts motor to M71XX function.

Q7230A Interface Module with selectable control (2-10 Vdc or 4-20 mA) and adjustable zero and span adapts motor to M72XX function.

Q7330A Interface Module for W936 Economizer applications adapts motor to M73XX function.

Q7630A Interface Module for 14-17 Vdc control with minimum position capability adapts motor to M76XX function.

ES650-117 Explosion-Proof Housing encloses motor for use in explosive atmospheres. Not for use with Q5001 (or any other valve linkages). Order separately from EGS Enclosures. To order, contact: EGS Enclosures, (281) 774-3763; or write to: EGS Enclosures in Houston, TX
Karen Barfield 281-774-3763
Karen.barfield@egseq.com
<http://appleonelec.com/>
part number ES-650-117

You a 7617DM coupling assembly from Honeywell to use with the cover.

Table 5. Modutrol Motor Cross-Reference.

Original Motor	Replacements
M944A,C,D, M954	M9181, M9194, M9191, M9194
M965, M975	M9172, M9175
M934D	M9161, M9164, M9171, M9174
M945A,D,F, M955	M9182, M9185, M9183, M9186
M941	M9481, M9484, M9491, M9494

INSTALLATION

When Installing this Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.



CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
 Disconnect all power supplies before installation.
 Motors with auxiliary switches can have more than one disconnect.



CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.
 Never turn the motor shaft by hand or with a wrench.
 Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

IMPORTANT

Always conduct a thorough checkout when installation is complete.

Location

Allow enough clearance for installing accessories and motor servicing when selecting a location (See Fig. 2). If located outdoors, use liquid-tight conduit connectors with the junction box to provide NEMA 3 weather protection. If mounted outdoors in a position other than upright, install a 4074ERU Weatherproofing Kit and liquid-tight connectors to provide NEMA 3 protection.



CAUTION

Motor Damage Hazard.
Deteriorating vapors and acid fumes can damage metal parts.
 Install motor in areas free of acid fumes and other deteriorating vapors.

In excessive salt environments, mounting base and screws should be zinc or cadmium plated, not stainless steel or brass. Use the 220738A Adapter Bracket for mounting on these surfaces.

Mounting



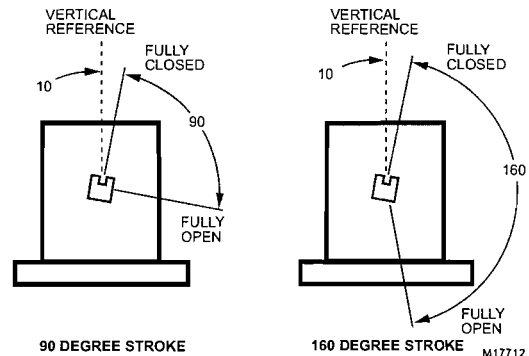
CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.
 Always install motors with the crankshaft horizontal.
 Improper motor mounting can result in inadequate motor gear train lubrication.

Use the following guidelines for proper motor mounting:

- Always install motors with the crankshaft horizontal.
- Mounting flanges extending from motor housing base are drilled for 1/4 inch (6.4 mm) machine screws or bolts.
- Non-Spring Return Motors are shipped from the factory in the closed position (at the limit of counterclockwise rotation, as viewed from the power end of the motor).
- Spring Return Motors are shipped from the factory in their normal position:
 - Normally closed models: shipped at limit of counterclockwise rotation, as viewed from the power end of the motor.

NOTE: See to Fig. 2 for graphical representation of full open and full closed.



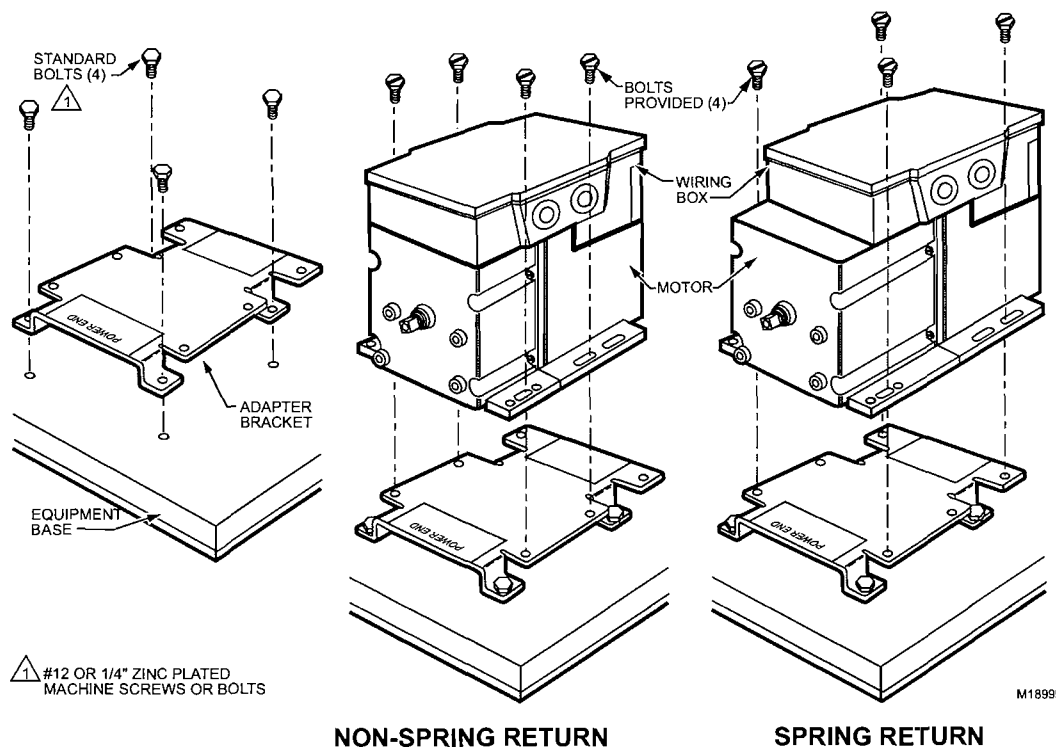
**Fig. 2. Motor Shaft Positions at Stroke Limits
 (Viewed from Power End of Motor).**

Adapter Bracket

The 220738A Adapter Bracket, positioned between the motor and the equipment, raises motor shaft height by 0.75 in. (19 mm) to match that of the former Modutrol Motor.

The following applications require this bracket:

- Q607 External Auxiliary Switch.
- Damper linkage applications require added clearance to allow:
 - crank arm rotation through the downward position.
 - sufficient damper linkage to reach the motor shaft.
- All valve linkages except the Q5001.



NOTE: When no bracket is used in replacement applications, damper linkages require adjustment for the new shaft position.

Fig. 3. Mounting the Motor with an Adapter Bracket.

To mount the motor with the bracket (See Fig. 3):

1. Mount the bracket to the equipment with existing or standard bolts.
2. Using the provided bolts, mount the motor to the bracket threaded holes.

For valve linkage applications (other than the Q5001):

1. Mount the bracket to the linkage.
2. Position the motor on the bracket to align the motor shaft with the linkage.
3. Attach the motor to the bracket with the four bolts provided (See Fig. 4).

Damper Linkages

The motor does not include a crank arm. Order the crank arm, included in the Q605 Linkage, separately (refer to Accessories in the Specifications section). For detailed instructions on the assembly of specific linkages, refer to the instruction sheet packed with the linkage.



CAUTION

Equipment Damage Hazard.

Stalling a motor can damage the drive shaft.

Ensure installation of motors and linkages allows the motor to drive through full stroke without obstruction.

Valve Linkages

The Q100 Linkage requires the 220738A Adapter Bracket for all valve applications. Applications with the Q5001 Valve Linkage do not require the 220738A Adapter Bracket (Refer to Fig. 4).

Junction Box

When used with liquid-tight conduit connectors, the junction box provides NEMA 3 weather protection for the motor. The junction box, standard with replacement motors, encloses the terminals and provides knockouts for wiring conduits. Housing an internal transformer or internal auxiliary switches requires use of the junction box.

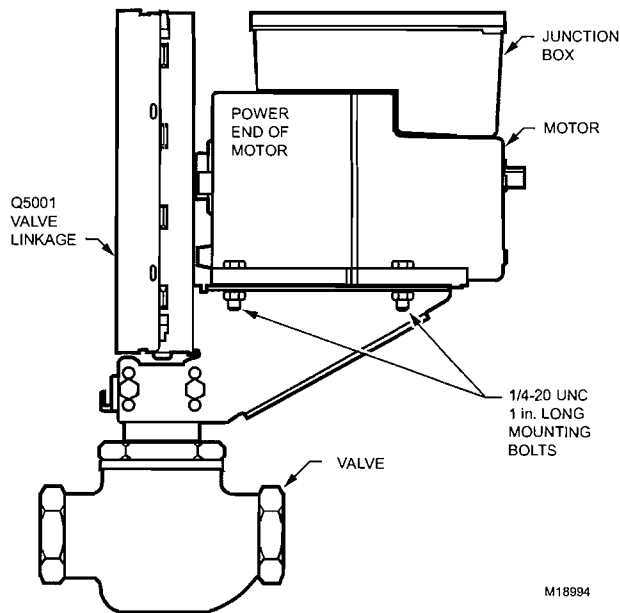


Fig. 4. Mounting the Motor on a Q5001 Valve Linkage.

WIRING



CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.

Disconnect power supply before installation.

IMPORTANT

All wiring must agree with applicable codes, ordinances and regulations.

1. Ensure that the voltage and frequency stamped on the motor correspond to the power supply characteristics.
2. When connecting several motors in parallel, ensure that the power supply VA rating is large enough to provide power to all motors used without overloading.
3. Fig. 11 shows that the motor terminals are quick-connects located on top of the printed circuit board.
4. To access the wiring compartment:
 - a. Remove the four screws from the junction box top.
 - b. Lift off the cover.
5. Refer to Fig. 5 for typical wiring, and Fig. 7 for internal auxiliary switch connections.

NOTE: Reverse motor rotation by switching wires at either the motor or the panel. Reverse rotation on the Series 90 models by reversing the wires at terminals W and B.

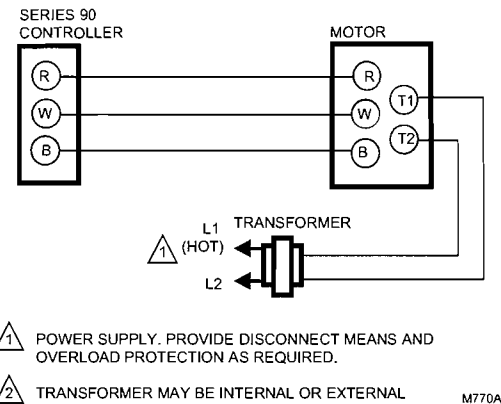


Fig. 5. Typical Series 90 Wiring.

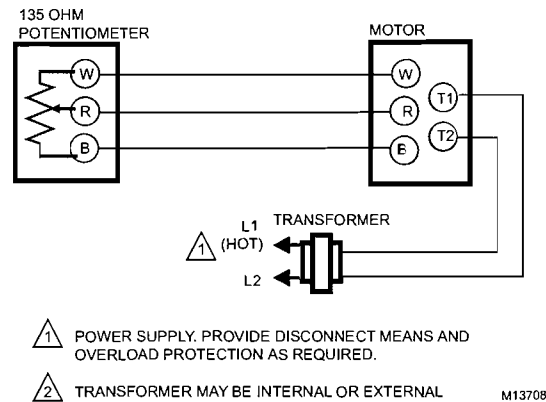


Fig. 6. Wiring for Potentiometer Control.

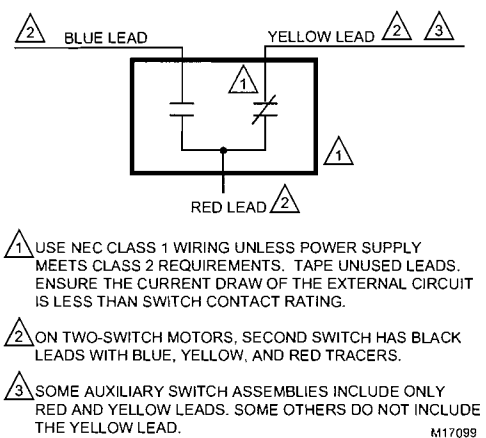


Fig. 7. Auxiliary Switch Schematic.

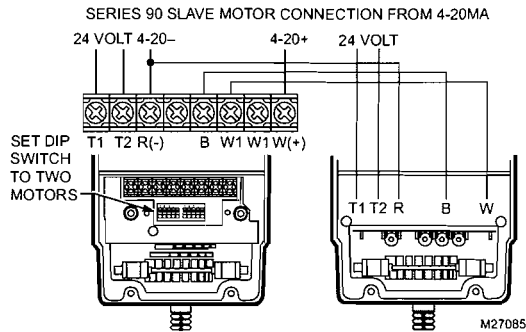


Fig. 8. Series 90 Slave Motor Connection.

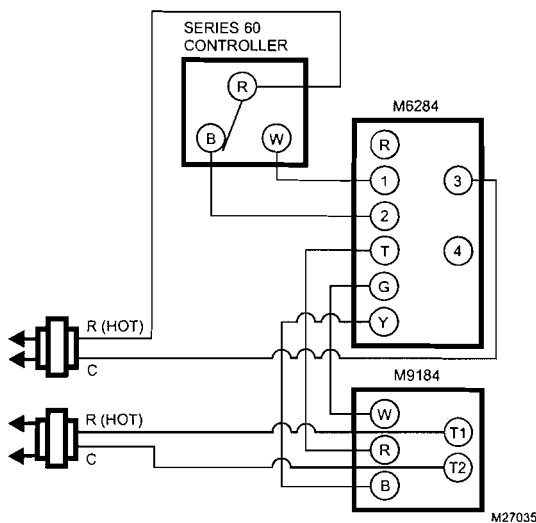


Fig. 9. Series 60 Controller.

SETTINGS AND ADJUSTMENTS

Before Setting Stroke

1. Remove the top cover from the motor.
2. Disconnect the controller from the motor.
3. Connect a remote potentiometer to the motor as shown in Fig. 6 (R-W-B).

The stroke adjustment on the series 2 and series 3 motors is made using the **stroke and sensitivity** potentiometers located under the cove inside the motor. The stroke adjustment on a series 1 motor was made by adjusting the CAMS.

For Series 2 and Series 3 Motors:

To set the stroke to 160 degrees (maximum position) turn both stroke and sensitivity potentiometers fully clockwise ↻, using a 1/8 inch straight-blade screwdriver.

To set the stroke to 90 degrees (minimum position) turn both stroke and sensitivity potentiometers fully counter-clockwise ↺, using a 1/8 inch straight-blade screwdriver.

To set the stroke between 90 and 160 degrees:

1. Turn the **stroke and sensitivity** potentiometers fully clockwise, using a 1/8 inch straight-blade screwdriver.
2. Turn the **remote** potentiometer (previously installed on R-W-B terminals) to maximum position.
3. Turn the sensitivity potentiometer to the selected stroke (between 90 and 160 degrees) **OR** until the motor stops.
4. **IF** the motor stops before the selected stroke is reached, turn the **stroke** potentiometer until the selected stroke is reached **OR**
5. **IF** the selected stroke is reached using the sensitivity potentiometer, turn the **stroke** potentiometer counter-clockwise ↺ until the motor begins to move. Then turn the **stroke** potentiometer clockwise ↻ slightly to have the position correspond to the sensitivity potentiometer.
6. Make sure the minimum position is correct.

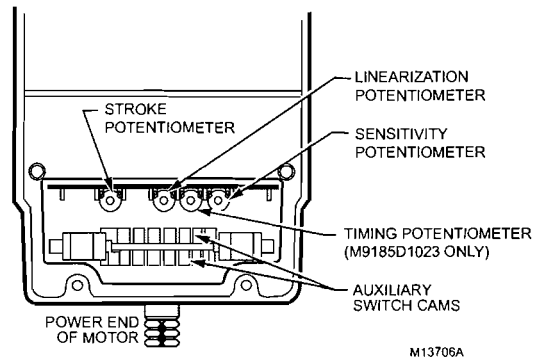


Fig. 10. Potentiometer Location and Stroke Adjustment Setup for Non-Spring Return Series 90 Motors.

Linearization Potentiometer

The linearization potentiometer is set in the mid-position at the factory. Do not change the position unless you are using an interface module with the motor. The linearization potentiometer is used with the modules to convert a control signal to a series 90 signal to drive the motor or to slave series 90 motors. Set the linearization potentiometer according to the setting shown in Table 6.

Turn the potentiometer fully CW ↻ for driving the motor CW ↻ and turn the potentiometer fully CCW ↺ to drive the motor CCW ↺.

Table 6. Position of Linearization Potentiometer.

Interface Module	Control signal	Linearization Potentiometer	Notes
Q7130	4-7V; 6-9V; 10.5-13.5V; CW or CCW	CW or CCW according to the CW/CCW switch on the module	
Q7230	Voltage/current could be adjust by Span and Zero potentiometer on module CW or CCW	CW or CCW according to the CW/CCW switch on the module	Customer is able to adjust the range of input signal the same way Series 70 units with adjustable span and zero.
Q7630	14-17V; CW or CCW	CW or CCW according to the CW/CCW switch on the module	
221508A with shunt resistor	Series 90 controller; more Series 90 units as slaves CW or CCW	Middle point (no linearization)	Customer is able to select the number of slave units to connect together
221508A used as a converter to Series 70 with no slaves	4-20mA	Just CW	Only one unit (no slaves)
221508A used as a converter to Series 70 with 1 or more slaves	4-20mA	Middle point (no linearization)	Customer is able to select the number of slave units to connect in parallel
Q7330A1004	W936 controller	Only CW	Voltage range is approximately 0.7 (fully closed) to 1.9 Vdc (fully open)

Adjustable timing for M9185D1023

The timing potentiometer (the second from the right, (Refer to Fig. 10) sets the timing to 1minute, if turned fully CCW , 2 minutes if turned to its middle point and 4 minutes if turned fully CW .



CAUTION

Careless Installation Hazard.

Use of excessive force while adjusting cams damages the motor.

To avoid damaging motor end switches, set cams by moving only the top of the screwdriver.



CAUTION

Careless Installation Hazard.

Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

Never turn motor shaft manually (by hand or with a wrench).

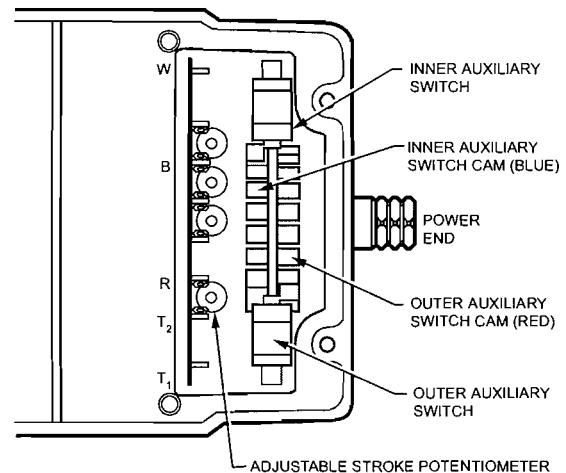


CAUTION

Equipment Damage Hazard.

Can damage the motor beyond repair.

Set cams by moving the top of the screwdriver only. Pressing screwdriver against cam slot sides or use of excessive force can damage motor end switches.



NOTE: NOT ALL FEATURES AVAILABLE ON ALL MODELS.

M13707

Fig. 11. Terminals and Adjustments.

Auxiliary Switches

Adjustable cams actuate the auxiliary switches. These cams can be set to actuate the switches at any angle within the stroke of the motor. Select switch differential of 1° or 10°.

Motors with factory-added auxiliary switches are shipped in the closed position (fully counterclockwise, as viewed from the power end). Auxiliary cam default actuates the switches 30° from full open with a 1° differential. With the motor in the closed (fully counterclockwise) position, the auxiliary switch breaks contacts R-B. Refer to Fig. 7 (or the auxiliary switch Instruction Sheet) for auxiliary switch wiring.

NOTE: Auxiliary switches can only be added to motors that include auxiliary switch cams. (These cams cannot be field-added.)

NOTE: Series 3 Motors are shipped with auxiliary switch cams that permit acceptance of 220736A,B Internal Auxiliary Switch Kits. Refer to Form no. 63-2228 for 220736A,B Installation Instructions.

Auxiliary Switch Adjustment

1. Remove the top cover from the motor to gain access to the motor terminals and auxiliary cams.
2. Disconnect the controller from the motor.
3. Connect a potentiometer to the motor as shown in Fig. 6.
4. Using the potentiometer, drive the motor to the position where the auxiliary equipment is to be switched.
5. For a 1° switch differential, check continuity of the auxiliary switch contacts R-B and rotate the cam as follows:
 - a. If the contacts are open, rotate the cam clockwise until the R-B contacts close.
 - b. If the contacts are closed, rotate the cam counterclockwise until the R-B contacts open.
6. For a 10° switch differential:
 - a. Spring return models: rotate the cam approximately 180° so that the slow-rise portion of the cam actuates the switch. Then check continuity of the auxiliary switch contacts R-B
 - b. Non-spring return models: check continuity of the auxiliary switch contacts R-B.
7. Rotate the cam as follows:
 - a. If the contacts are open, rotate the cam counterclockwise until the R-B contacts close.
 - b. If the contacts are closed, rotate the cam clockwise until the R-B contacts open.
8. Check for proper auxiliary equipment differential and switching by driving the motor through the full stroke in both directions.
9. Disconnect the potentiometer, reconnect the controller, and replace the motor top cover.

NOTE: Changing the differential from 1° to 10° reverses the switching action. For example, with a 10° differential, switch contacts R-B make and R-W break on a counterclockwise (closed) rotation. With a 1° differential, switch contacts R-W make and R-B break on a counterclockwise (closed) rotation.

OPERATION

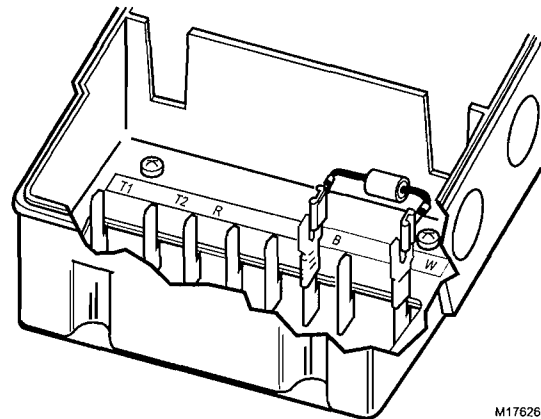
Use Series 90 Modutrol IV Motors for standard Series 90 operation (See Table 7):

1. Two potentiometers, one in the controller and one in the motor, along with the motor resistor network, form a bridge circuit. As long as the value of the controlled medium remains at the setpoint, the circuit remains balanced and the motor does not run.
2. When the controlled medium value changes, the controller potentiometer wiper moves, unbalancing the bridge circuit.

3. The imbalance is amplified and the microcontroller then drives the motor in the direction necessary to correct the controlled medium change.
4. As the motor shaft rotates, it turns the feedback potentiometer, rebalancing the bridge circuit, stopping the motor.

Table 7. Modutrol IV Motor Operation.

Motor Type	Signal	Resulting Action
Non-Spring Return or Spring Return	Open W and short R to B	drives open
	Open B and short R to W	drives closed
	Jumper R-W-B	drives to midstroke
	None	drives closed
Non-Spring Return	Power Loss	stops (none)
Spring Return	Power Loss	spring returns (closed)



M17626

Fig. 12. Attaching a Shunt Resistor to TRADELINE Motors.

Table 8. Cam Arrangements.

Motor	Inner Cam	Outer Cam
M9164D1009, M9174D1007	Red	Blue
M9175D1014		
M9172W1004	Red	Red
ALL OTHER M9164, M9172, M9175	Blue	Red
M9161, M9171		
M9184, M9194		
M9185, M9186		
M9484, M9494		
All Other M9174	Blue	Blue

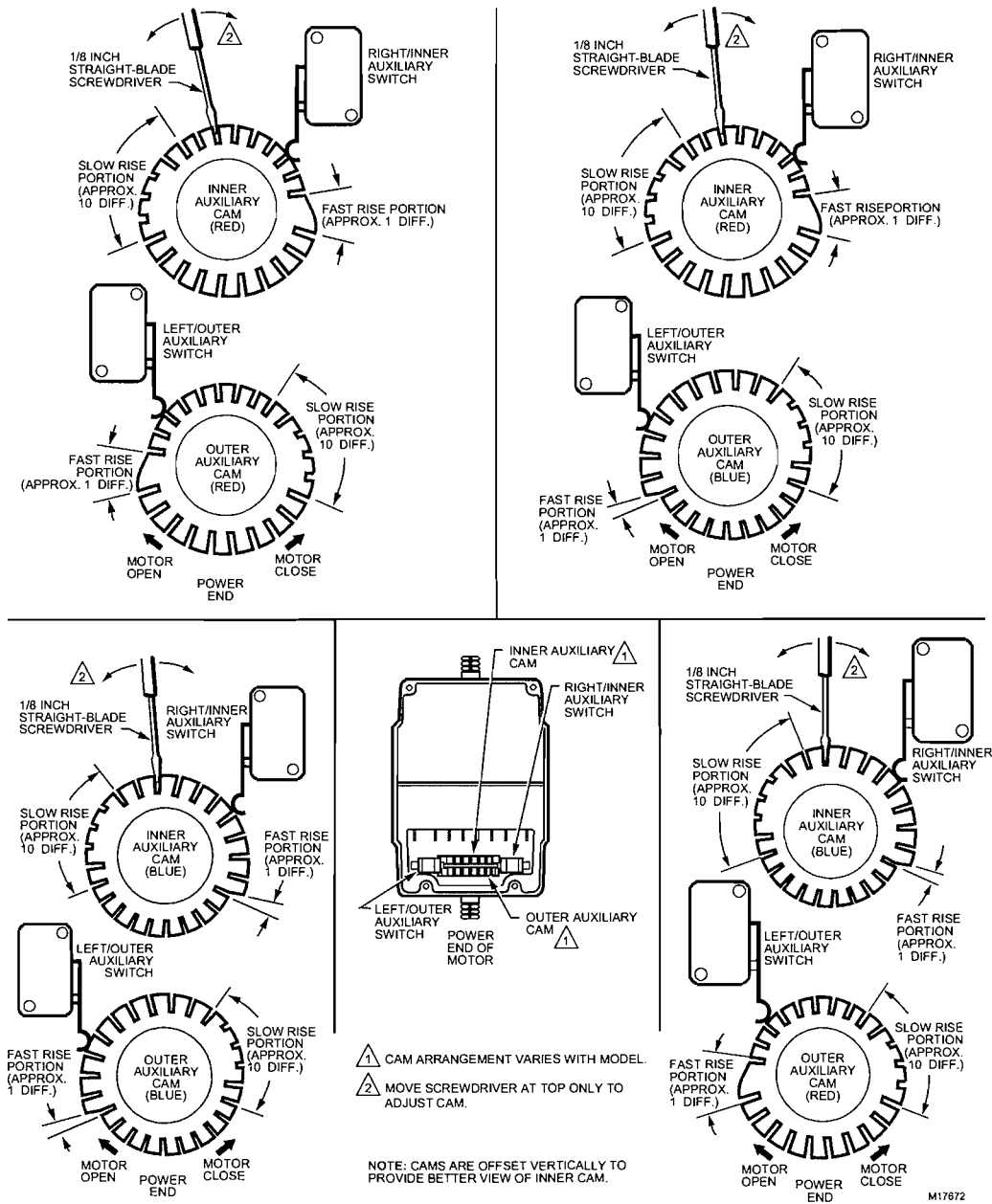


Fig. 13. Auxiliary Switch Adjustment.

CHECKOUT

After the installation and linkage adjustment, check the entire motor and control hookup. Proper checkout ensures that:

- The motor operates the load (damper or valve) properly.
 - The motor responds properly to the controller as the input varies (See Table 7).
 - The auxiliary switch, if used, operates at the desired point of motor rotation.
1. Inspect motor, linkage, and valve or damper to ensure all mechanical connections are correct and secure.

NOTE: In damper installations, the pushrod should not extend more than a few inches past the ball joints.

2. Ensure that there is adequate clearance for the linkage throughout the entire motor stroke without binding or striking other objects.
3. Ensure the motor transformer is properly sized.

NOTE: If a common transformer is used to power multiple motors, ensure the power input is in phase with all motors.

4. Drive the motor fully open and fully closed (See Table 7).

NOTE: Refer to controller or system instructions for additional checkout procedures.

5. For spring return motors, ensure that the valve or damper returns to normal position upon power interruption.
6. Return the controller to the desired setting before leaving the job.

REPLACEMENT

Damper Application

1. Turn off power and remove wiring from the old motor.
2. Remove the crank arm from shaft of old motor and remove the old motor.
3. Determine necessity of the mounting bracket. If the linkage can reach the new motor shaft position and the crank arm has clearance for the necessary rotation, the bracket is not required. Use the 220738A Adapter Bracket or the 221455A Crank Arm if the crank arm must rotate through the bottom plane of the motor.
 - a. If no bracket is required, mount the new motor directly to the equipment and refer to the Installation, Settings and Adjustments, and the Operation and Checkout sections of these instructions.
 - b. If the bracket is required, refer to the Adapter Bracket section and Fig. 3 in addition to the Installation, Settings and Adjustments, and the Operation and Checkout sections of these instructions.
4. Use No. 12 or 1/4 inch machine screws or bolts to mount the new motor.
5. Mount damper crank arm and linkage to the new motor shaft.
6. Use the Checkout procedures to test the crank arm and linkage adjustment.

Valve Application

When replacing a motor in a valve application, the linkage determines the necessity of the 220738A Adapter Bracket. With Q100, Q601 or Q618 Linkages, it is necessary to use the 220738A to raise the motor shaft to the appropriate height. Valve applications with a Q5001 Linkage do not require the 220738A Adapter Bracket. To operate Honeywell V5011 two-way or V5013 three-way valves through full stroke, use a 160° stroke motor.

Automation and Control Solutions

Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Toronto, Ontario M1V 4Z9

Honeywell





MSS SP-80 GATE VALVE
 THREADED BONNET, THREADED ENDS
 GATE ¼ TO 3" (6 TO 75mm) CLASSES 125 AND 150
 BRONZE NON-RISING STEM

STANDARD MATERIALS

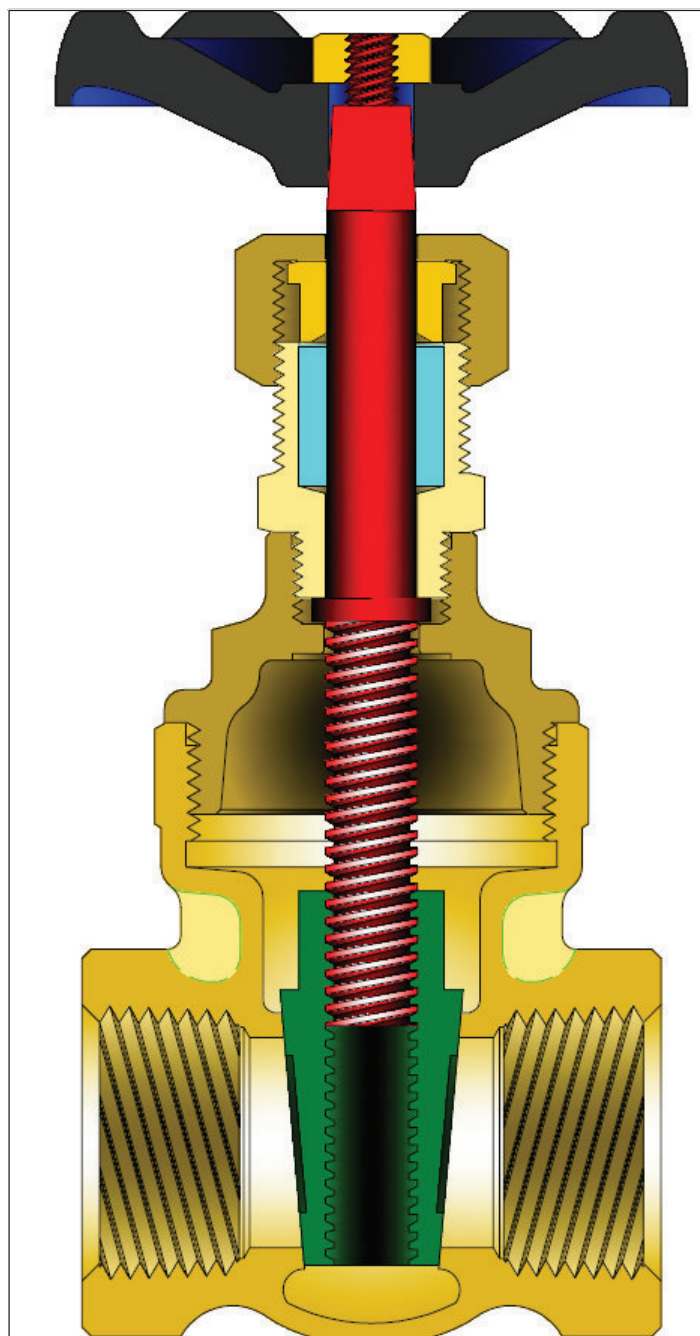
PART	MATERIALS
Body	B62
Bonnet	B62
Wedge	B62
Stem	B371 C69400
Packing Nut	B62 or B16
Gland	B16
Packing	Graphite
Hand Wheel	Ductile Iron
Hand Wheel Nut	Brass
Stuffing Box	B371 C69400
Wheel Plate	Aluminum

Design Specifications

Item	Applicable Specification
Pressure - temperature ratings	MSS SP-80
General valve design	MSS SP-80
Thread design	ASME B1.20.1
Materials	ASTM

DESIGN FEATURES:

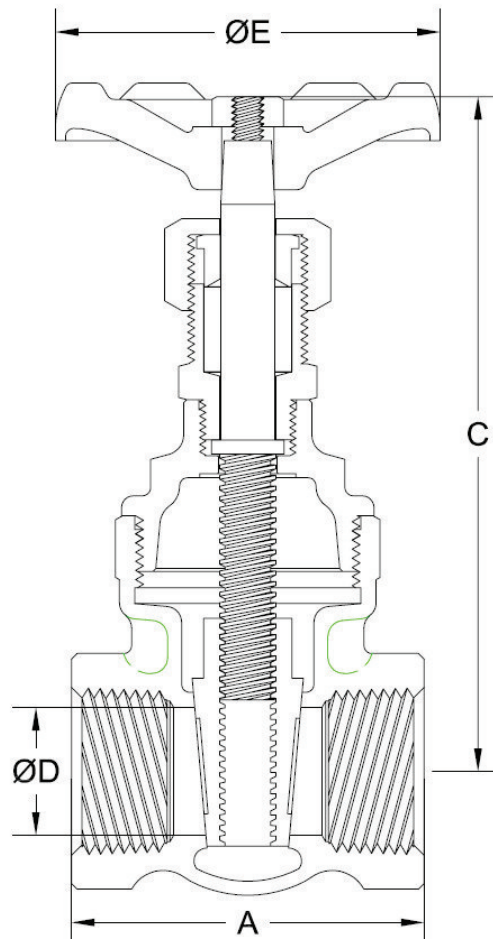
- **Renewable** solid wedges.
- **Integral** seats.
- **High-Tensile** bronze alloy stems.
- **Each** valve is shell and seat pressure tested per industry standard MSS SP-80.
- **Stems** are rotating, non-rising design.



Class	Fig. No.
125	507
150	512 / 2712

GATE VALVE DIMENSIONS (CLASSES 125 & 150).

SIZE	FIG 507, 512, & 2712					
in	A	C	D	E	WT	lb
mm						kg
¼	1.75	3.5	0.25	2.1	0.7	3.2
6	44	89	6	54	0.3	
⅜	2.00	3.5	0.38	2.1	0.9	7.1
10	51	89	10	54	0.4	
½	2.38	3.9	0.50	2.5	1.0	12.6
13	60	99	13	64	0.5	
¾	2.44	4.6	0.75	2.8	1.7	30
20	62	117	19	70	0.8	
1	2.75	5.4	1.00	3.0	2.8	55
25	70	137	25	76	1.3	
1¼	3.00	6.2	1.25	3.3	4.0	87
32	76	157	32	83	1.8	
1½	3.38	6.8	1.50	3.6	5.0	129
40	86	173	38	92	2.3	
2	3.50	7.8	2.00	4.1	7.2	240
50	89	198	51	103	3.3	
2½	4.50	9.4	2.50	5.1	16.0	350
65	114	239	64	130	7.3	
3	5.00	10.5	3.00	5.7	22.5	510
75	127	267	76	144	10.2	



C = Center to top open / closed

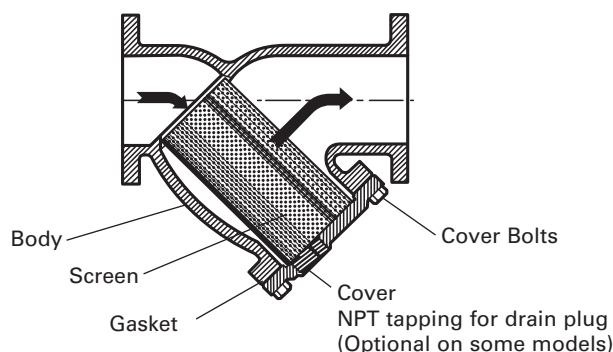
WT = Weight

C_v = Flow Coefficient

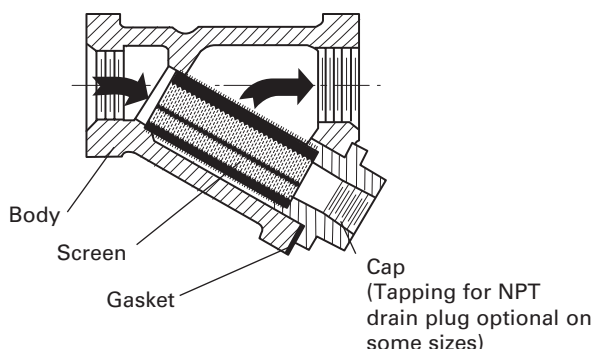
Installation, Operation and Maintenance

"Y" Strainers

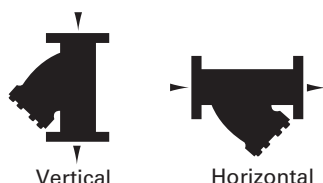
Typical flanged end "Y" strainer



Typical threaded "Y" strainer



Mounting Positions



The cover of the "Y" side should face down

Before installing the "Y" strainer, be sure its pressure rating is correct for the system. If the end connections are threaded or designed for soldering or brazing, be sure the piping is straight and not at an angle or offset. If the strainer has flanged ends, be sure the flanges of the connecting piping are square with the pipe so that no undue stresses are put on the strainer or piping when tightening flange bolts. Tighten in sequence, crossing to opposites.

For maximum efficiency, a differential pressure gauge installed across the inlet and outlet will indicate pressure loss due to clogging and may be used as a guide to determine when cleaning is required. Normally, when differential pressure reaches 5–10psi, screen must be cleaned. If the strainer is equipped with a blow-down valve, open and flush out until any sediment is removed. If the strainer is not fitted for blow-down cleaning, (strainer must be off line), remove the cover or cap and clean the screen. Reinstall the screen in the strainer in the same position as before and tighten cover or cap. Replace the gasket if necessary.

Keeping a spare, clean screen will minimize shut down time.

Warning

Individuals performing removal and disassembly should be provided with suitable protection from possibly hazardous liquids.

Note: Large size "Y" strainers are supplied with Breech-Lok screens. To remove screen, rotate screen 45°, Breech-lok will disengage.

Spare Parts

To order replacement screens or gaskets, which are the only items normally required, you should specify the following:

- A. Size and model number of strainer or casting number as it appears on the body of the strainer
- B. Specify the type of service. For example: water, steam, gas, oil, air. The working pressure and temperature of the system and the particle size to be strained out should also be specified.

CALIFORNIA PROPOSITION 65 WARNING

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. (California law requires this warning to be given to customers in the State of California.)

For more information: www.watts.com/prop65

Limited Warranty: Mueller Steam Specialty warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. This shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** Any implied warranties that are imposed by law are limited in duration to one year.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights.



USA: 1491 NC Hwy 20 West, St. Pauls, NC 28384; www.muellersteam.com
Tel: 910-865-8241 Fax: 910-865-6220
Toll Free Phone 1-800-334-6259 Toll Free Fax: 1-800-421-6772

A Watts Water Technologies Company



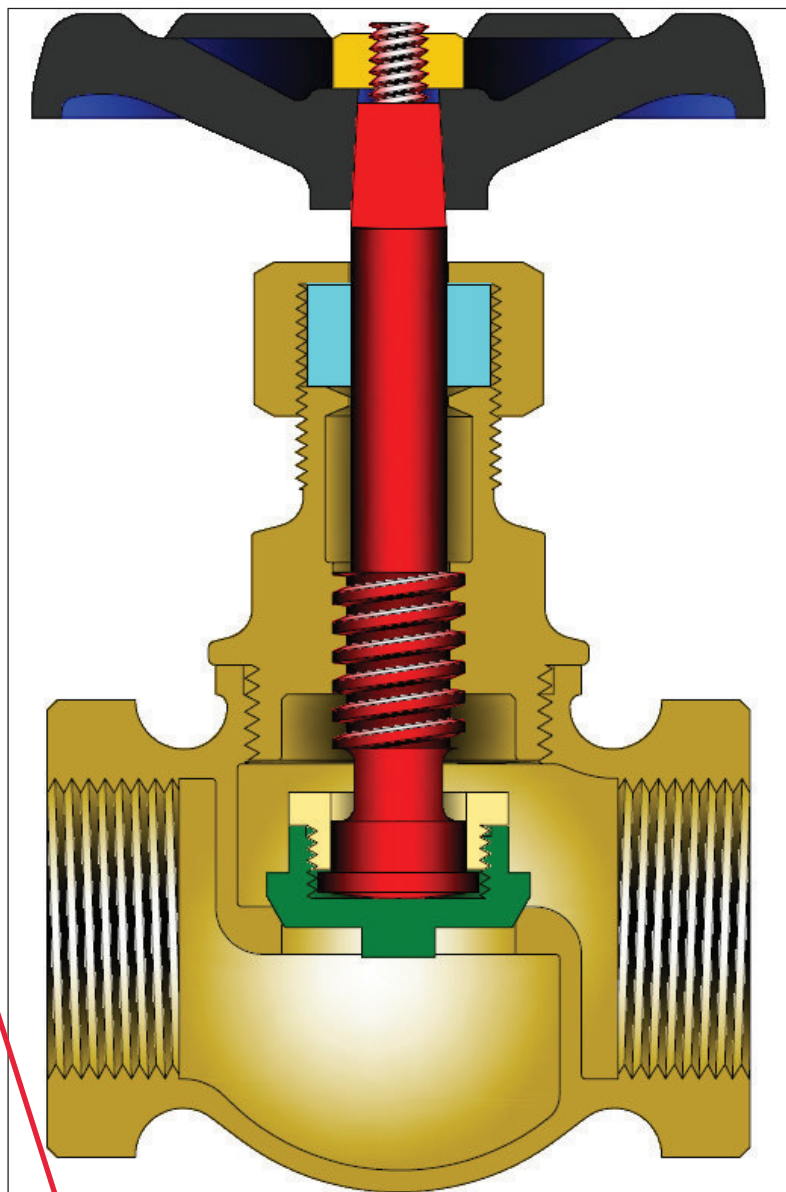
MSS SP-80 GLOBE VALVE
THREADED BONNET, THREADED ENDS
¼ TO 3" (6 TO 75mm) CLASS 125
BRONZE

STANDARD MATERIALS

PART	MATERIALS
Body	B62
Bonnet	B62*
Disc	B62**
Stem	B371 C69400
Packing Nut	B62 or B16
Disc Locknut	B371 C69400
Packing	Graphite
Hand Wheel	A47 Gr. 32510
Hand Wheel Nut	Brass
Horseshoe Ring	SS 303 or SS 304
Wheel Plate	Aluminum

* B16 for sizes ¼" through ¾"

** For ½" and smaller sizes, disc and stem are integral and disc material is same as stem.



Class	Fig. No.
125	650

DESIGN FEATURES:

- **High-Tensile** bronze alloy stem.
- **Integral** seats.
- **Discs** in ¾" and larger valves are attached to stem by disc locknut. The ½" and smaller valves have stem and disc integral.
- **Each** valve is shell and seat pressure tested per industry standard MSS SP-80.

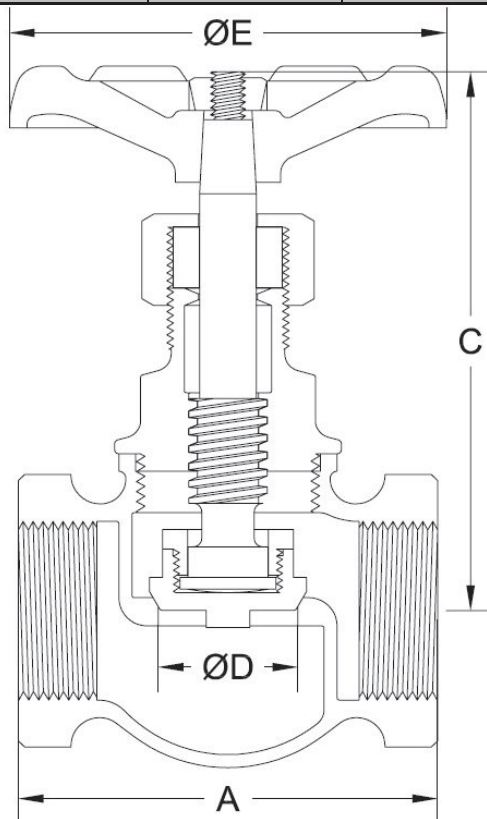
Design Specifications

Item	Applicable Specification
Pressure - temperature ratings	MSS SP-80
General valve design	MSS SP-80
Thread design	ASME B1.20.1
Materials	ASTM

GLOBE VALVE DIMENSIONS (CLASS 125).

SIZE	FIG 650					
in	A	C	D	E	WT	lb
mm						kg
¼	1.63	2.7	0.25	2.1	0.4	0.6
6	41	68	6	54	0.2	
⅜	1.94	3.0	0.38	2.5	0.6	1.4
10	49	76	10	64	0.3	
½	2.13	3.4	0.50	2.8	0.8	2.5
13	54	86	13	70	0.4	
¾	2.50	3.9	0.75	3.0	1.3	5.8
20	64	100	19	76	0.6	
1	3.00	4.4	1.00	3.3	1.9	10.7
25	76	111	25	83	0.9	
1¼	3.44	5.1	1.25	3.6	2.7	17.1
32	87	129	32	92	1.2	
1½	3.81	5.4	1.50	4.1	4.4	25
40	97	137	38	105	2.0	
2	4.75	6.5	2.00	4.8	5.9	50
50	121	165	51	121	2.7	
2½	5.69	7.3	2.50	5.1	10.1	75
65	144	186	64	130	4.6	
3	6.56	8.3	3.00	5.8	15.4	110
75	167	210	76	146	7.0	

C = Center to top open
WT = Weight
C_v = Flow Coefficient



Rosemount 2051C Transmitter



2051C Coplanar
Pressure Transmitter

Configuration	Transmitter Output Code
4-20 mA HART® 2051 2051 with Selectable HART ⁽¹⁾	A
Lower Power 2051 2051 with Selectable HART ⁽¹⁾	M
FOUNDATION Fieldbus	F
Profibus	W
Wireless	X

(1) The 4-20mA with Selectable HART device can be ordered with Transmitter Output option code A plus any of the following options codes: M4, QT, DZ, CR, CS, CT, HR5, HR7.

Additional Information

Specifications: [page 50](#)

Certifications: [page 60](#)

Dimensional Drawings: [page 68](#)

Table 1. Rosemount 2051C Transmitters Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.

The Expanded offering is subject to additional delivery lead time.

Model	Transmitter type		
2051C	Coplanar Pressure Transmitter		
Measurement Type			
Standard			Standard
D	Differential		★
G	Gage		★
Pressure Range			
Standard			Standard
	2051CD	2051CG	
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)	★

Table 1. Rosemount 2051C Transmitters Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.

The Expanded offering is subject to additional delivery lead time.

Transmitter Output				
Standard				Standard
A ⁽¹⁾	4–20 mA with Digital Signal Based on HART Protocol			★
F	FOUNDATION fieldbus Protocol			★
W	PROFIBUS PA Protocol			★
X	Wireless			★
Expanded				
M	Low-Power, 1–5 Vdc with Digital Signal Based on HART Protocol			
Materials of Construction				
	Process Flange Type	Flange Material	Drain/Vent	
Standard				Standard
2	Coplanar	SST	SST	★
3 ⁽²⁾	Coplanar	Cast C-276	Alloy C-276	★
5	Coplanar	Plated CS	SST	★
7 ⁽²⁾	Coplanar	SST	Alloy C-276	★
8 ⁽²⁾	Coplanar	Plated CS	Alloy C-276	★
0	Alternate Process Connection			★
Isolating Diaphragm				
Standard				Standard
2 ⁽²⁾	316L SST			★
3 ⁽²⁾	Alloy C-276			★
Expanded				
5 ⁽³⁾⁽⁴⁾	Tantalum			
O-ring				
Standard				Standard
A	Glass-filled PTFE			★
B	Graphite-filled PTFE			★
Sensor Fill Fluid				
Standard				Standard
1	Silicone			★
2 ⁽⁴⁾	Inert			★

Table 1. Rosemount 2051C Transmitters Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.

The Expanded offering is subject to additional delivery lead time.

Housing Material		Conduit Entry Size	
Standard			Standard
A	Aluminum	½–14 NPT	★
B	Aluminum	M20 × 1.5	★
J	SST	½–14 NPT	★
K ⁽⁵⁾	SST	M20 × 1.5	★
P ⁽⁶⁾	Engineered Polymer	No Conduit Entries	★
Expanded			
D	Aluminum	G½	
M ⁽⁵⁾	SST	G½	

Wireless options (Requires Wireless output code X and Engineered Polymer housing code P)

Wireless Transmit Rate, Operating Frequency and Protocol		
Standard		Standard
WA3	User Configurable Transmit Rate, 2.4GHz WirelessHART	★
Antenna and SmartPower		
Standard		Standard
WP5	Internal Antenna, Compatible with Green Power Module (I.S. Power Module Sold Separately)	★

Options (Include with selected model number)

PlantWeb Control Functionality		
Standard		Standard
A01	FOUNDATION fieldbus Advanced Control Function Block Suite	★
Alternate Flange⁽⁷⁾		
Standard		Standard
H2	Traditional Flange, 316 SST, SST Drain/Vent	★
H3 ⁽²⁾	Traditional Flange, Cast C-276, Alloy C-276 Drain/Vent	★
H7 ⁽²⁾	Traditional Flange, 316 SST, Alloy C-276 Drain/Vent	★
HJ	DIN Compliant Traditional Flange, SST, 7/16 in. Adapter/Manifold Bolting	★
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount	★
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount	★
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount	★
FD	Level Flange, SST, 3 in., 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	★

Table 1. Rosemount 2051C Transmitters Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.

The Expanded offering is subject to additional delivery lead time.

Expanded		
HK ⁽⁸⁾	DIN Compliant Traditional Flange, SST, 10 mm Adapter/Manifold Bolting	
HL	DIN Compliant Traditional Flange, SST, 12 mm Adapter/Manifold Bolting	
Manifold Assembly⁽⁸⁾⁽⁹⁾		
Standard		Standard
S5	Assemble to Rosemount 305 Integral Manifold	★
S6	Assemble to Rosemount 304 Manifold or Connection System	★
Integral Mount Primary Element⁽⁸⁾⁽⁹⁾		
Standard		Standard
S4 ⁽¹⁰⁾	Assemble to Rosemount Annubar® Flowmeter or Rosemount 1195 Integral Orifice	★
S3	Assemble to Rosemount 405 Primary Element	★
Seal Assemblies⁽⁹⁾		
Standard		Standard
S1 ⁽¹¹⁾	Assemble to one Rosemount 1199 diaphragm seal	★
S2 ⁽¹²⁾	Assemble to two Rosemount 1199 diaphragm seals	★
Mounting Brackets		
Standard		Standard
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	★
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	★

Table 1. Rosemount 2051C Transmitters Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.

The Expanded offering is subject to additional delivery lead time.

Product Certifications		
Standard		Standard
E1 ⁽⁵⁾	ATEX Flameproof	★
E2 ⁽⁵⁾	INMETRO Flameproof	★
E3 ⁽⁵⁾	China Flameproof	★
E4 ⁽⁵⁾	TIIS Flameproof	★
E5	FM Explosion-proof, Dust Ignition-proof	★
E6	CSA Explosion-proof, Dust Ignition-proof, Division 2	★
E7 ⁽⁵⁾	IECEx Flameproof	★
EW	India (CCOE) Flameproof Approval	★
I1 ⁽⁵⁾	ATEX Intrinsic Safety	★
I2 ⁽⁵⁾	INMETRO Intrinsically Safe	★
I3 ⁽⁵⁾	China Intrinsic Safety	★
I4 ⁽⁵⁾⁽⁶⁾	TIIS Intrinsic Safety	★
I5	FM Intrinsically Safe, Division 2	★
I6	CSA Intrinsically Safe	★
I7 ⁽⁵⁾	IECEx Intrinsic Safety	★
IA ⁽¹³⁾	ATEX FISCO Intrinsic Safety	★
IE ⁽¹⁴⁾	FM FISCO Intrinsically Safe	★
IF ⁽¹⁴⁾	CSA FISCO Intrinsically Safe	★
IG ⁽¹⁴⁾	IECEx FISCO Intrinsically Safe	★
IW ⁽⁵⁾	India (CCOE) Intrinsically Safe	★
K1 ⁽⁵⁾	ATEX Flameproof, Intrinsic Safety, Type n, Dust	★
K2	INMETRO Flameproof and Intrinsic Safety	★
K5	FM Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K6	CSA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
K7 ⁽⁵⁾	IECEx Flameproof, Intrinsic Safety, Type n and Dust	★
KA ⁽⁵⁾	ATEX and CSA Flameproof, Intrinsically Safe, Division 2	★
KB	FM and CSA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Division 2	★
KC ⁽⁵⁾	FM and ATEX Explosion-proof, Intrinsically Safe, Division 2	★
KD ⁽⁵⁾	FM, CSA, and ATEX Explosion-proof, Intrinsically Safe	★
N1 ⁽⁵⁾	ATEX Type n	★
N7 ⁽⁵⁾	IECEx Type n	★
ND ⁽⁵⁾	ATEX Dust	★
Drinking Water Approval		
Standard		Standard
DW ⁽¹⁵⁾	NSF Drinking Water Approval	★

Table 1. Rosemount 2051C Transmitters Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.

The Expanded offering is subject to additional delivery lead time.

Shipboard Approvals		
Standard		Standard
SBS ⁽⁴⁾	American Bureau of Shipping (ABS) Type Approval	★
SBV ⁽⁴⁾	Bureau Veritas (BV) Type Approval	★
SDN ⁽⁴⁾	Det Norske Veritas (DNV) Type Approval	★
SLL ⁽⁴⁾	Lloyds Register (LR) Type Approval	★
Bolting Materials		
Standard		Standard
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		
Standard		Standard
M4 ⁽¹⁴⁾	LCD Display with Local Operator Interface	★
M5	LCD display	★
Hardware Adjustments		
Standard		Standard
D4 ⁽¹⁶⁾	Zero and Span Configuration Buttons	★
DZ ⁽¹⁷⁾	Digital Zero Trim	★
Flange Adapters		
Standard		Standard
DF ⁽¹⁸⁾	1/2-14 NPT Flange Adapters	★
Conduit Plug		
Standard		Standard
DO ⁽⁴⁾⁽¹⁹⁾	316 SST Conduit Plug	★
RC 1/4 RC 1/2 Process Connection		
Expanded		
D9 ⁽²⁰⁾	RC 1/4 Flange with RC 1/2 Flange Adapter - SST	
Ground Screw		
Standard		Standard
V5 ⁽⁴⁾⁽²¹⁾	External Ground Screw Assembly	★
Performance		
Standard		Standard
P8 ⁽²²⁾	High Performance Option	★

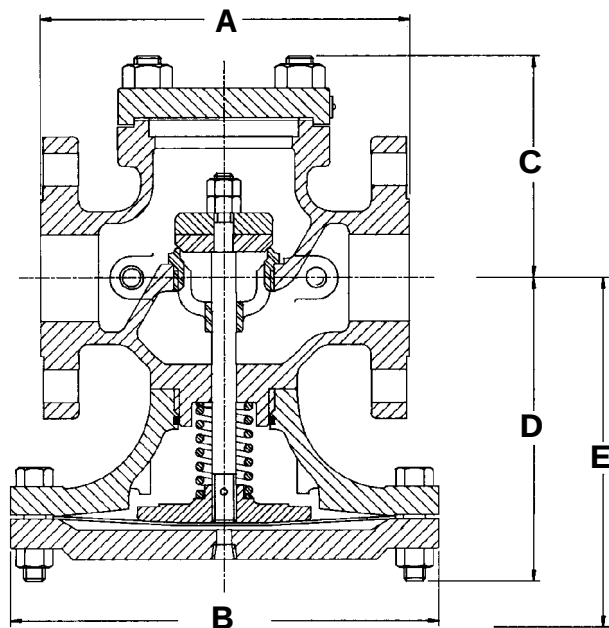


A division of CIRCOR International, Inc.

Technical Data

SD 3001E

SPENCE ENGINEERING COMPANY, INC. 150 COLDENHAM ROAD, WALDEN, NY 12586-2035



TYPE E MAIN VALVE

TYPE E Main Valve Sizes 3/8" through 12"

The Spence Type E Main Valve is of normally closed, single seat design featuring packless construction, balanced metal diaphragms and protected main spring.

When controlled by one or more of the various types of Spence Pilots, this valve will accomplish most functions required of a regulator.

CAST IRON RATINGS (Maximum Inlet Conditions)

Valve Ends Pressure (Temperature)

- ANSI NPT Screwed250 PSIG(450°F)
- ANSI 125 Flanged125 PSIG(450°F)
- ANSI 250 Flanged250 PSIG(450°F)

CAST STEEL RATINGS (Maximum Inlet Conditions)

Valve Ends Pressure (Temperature)

- ANSI NPT Screwed300 PSIG.....(600°F)[†]
- ANSI 150 Flanged150 PSIG(600°F)
- ANSI 300 Flanged300 PSIG.....(600°F)[†]
- ANSI 600 Flanged600 PSIG.....(600°F)[†]

[†]750°F construction available on request.

DIMENSIONS (inches) AND WEIGHTS (pounds)

SIZE	FACE TO FACE DIMENSIONS					OTHER DIMENSIONS					APPROX. WT.					
	A					B	C		D	E	ANSI NPT	ANSI 125	ANSI 150	ANSI 250	ANSI 300	ANSI 600
	ANSI NPT	ANSI 125,150	ANSI 250	ANSI 300	ANSI 600			ANSI 600								
3/8	4 3/8	—	—	—	—	5 7/8	2 3/4	—	5 1/4	7 3/8	14	—	—	—	—	—
1/2	4 3/8	—	—	—	6	5 7/8	2 3/4	2 3/4	5 1/4	7 3/8	14	—	—	—	—	20
3/4	4 3/8	—	—	—	6 3/8	6 1/2	2 7/8	3 7/8	5 1/2	7 7/8	18	—	—	—	—	28
1	5 3/8	5 1/2	6	6 1/2	6 1/2	7	3 5/8	4 1/4	6 1/4	8 7/8	23	24	26	27	31	32
1 1/4	6 1/2	6 3/4	7 1/4	7 7/8	7 7/8	7 7/8	4 1/8	4 5/8	6 1/2	9 1/8	33	36	37	40	41	45
1 1/2	7 1/4	6 7/8	7 3/8	8	8	8 3/4	4 3/8	5 1/8	7 1/8	9 3/4	43	45	47	51	55	58
2	7 1/2	8 1/2	9	10 1/4	10 1/4	9 7/8	5 1/4	5 3/4	7 5/8	11 1/4	62	67	73	72	78	83
2 1/2	—	9 3/8	10	11 1/4	11 1/4	10 7/8	5 3/4	7 7/8	8 3/8	12 1/8	—	82	95	100	100	130
3	—	10	10 3/4	12 1/4	12 1/4	11 3/4	6 5/8	9 1/8	9 1/4	14 5/8	—	110	125	130	140	175
4	—	11 7/8	12 1/2	12 1/2	14 1/2	14 3/4	7 5/8	10 5/8	11 7/8	18 1/4	—	200	210	235	230	310
5	—	13 5/8	14 1/2	14 1/2	16 1/2	16 7/8	8 1/2	12 1/2	12 1/2	20 1/8	—	280	295	315	310	490
6	—	15 1/8	16	16	17 3/8	19 3/4	10	13 3/4	14 1/8	22 3/8	—	385	420	455	470	655
8	—	19	20	20	21 5/8	22 1/2	11 1/2	15 3/8	17 1/4	27 3/4	—	657	700	735	710	1070
10	—	23 5/8	25	25	—	28	13 3/4	—	23 3/8	36 1/4	—	1260	1240	1430	1300	—
12	—	26 1/2	28	28	—	33	15 7/8	—	25 1/4	41 1/2	—	2070	2060	2145	2140	—

RATED FLOW COEFFICIENTS (Cv)

SEAT FACTOR	REGULATOR SIZE															
	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12	
Full	1.5	2.8	5.4	8.8	14.1	19.8	31	44	74	109	169	248	444	706	1113	
Full 75 %	—	2.1	4.0	6.6	10.6	14.8	23.3	33	56	82	127	186	333	530	835	
Full 50 %	—	1.4	2.7	4.4	7.0	9.9	15.5	22	37	55	85	124	222	353	557	
Normal	.65	1.5	4.8	7.5	10.4	14.6	17.6	24	43	78	115	151	249	377	631	
Normal 75 %	—	—	—	—	—	—	—	18	33	59	87	114	187	283	474	
Normal 50 %	—	—	—	—	—	—	—	12	22	39	58	76	125	189	316	

OPERATING PRINCIPLE

The regulator is operated by initial steam or fluid pressure. It is normally closed, being held so by initial pressure on the disc and by an internal main spring. When the pilot is opened (see pilot instructions), initial pressure flows through the pilot to the 8B tee. Bleedport 4A restricts the flow and pressure builds under the diaphragm and opens the main valve. The 5A steadies the operation of the regulator.

Delivery pressure feeds back through the control pipe to the pilot diaphragm. As this pressure approaches a balance with the thrust of the adjusting spring, the pilot throttles the loading pressure. In turn, the main valve takes a position established by the loading pressure where just enough steam flows to maintain the set delivery pressure.

RECOMMENDED INSTALLATION

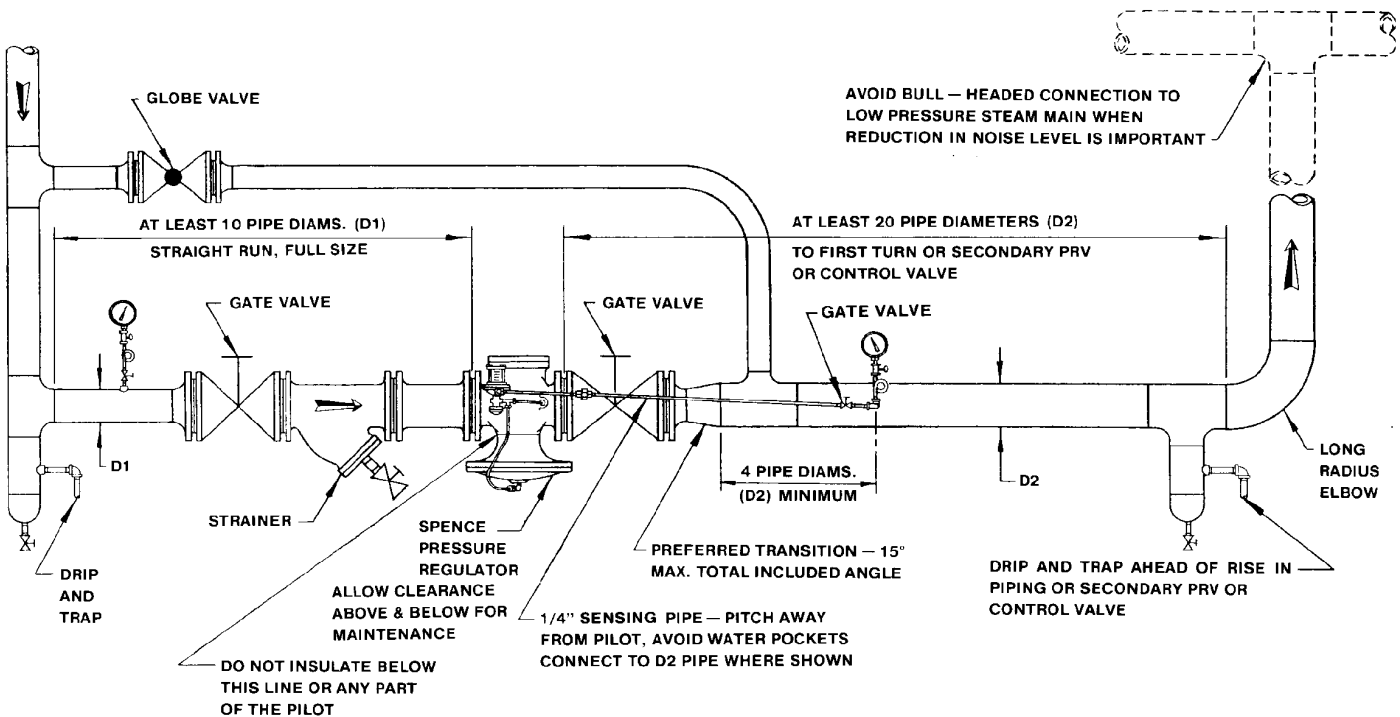


FIGURE 1A - Typical Installation

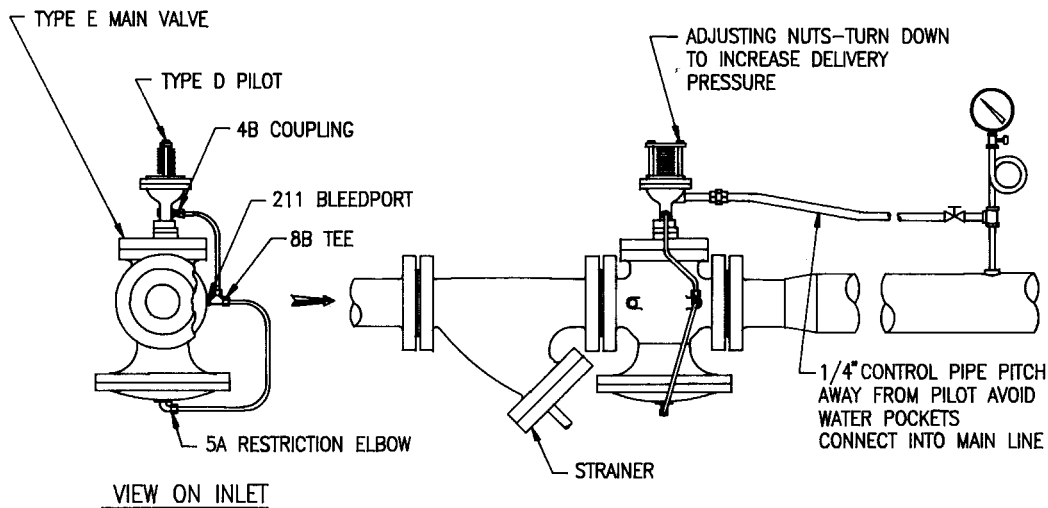


FIGURE 1B - Installation of Integrally Mounted Pilot

INSTALLATION

PLANNING

Locate the valve in a straight run of horizontal pipe. Allow headroom above the valve for access through the blind flange. Provide clearance for stem withdrawal underneath. Prevent water hammer and erratic operation by installing traps to provide proper drainage before and after the valve and before secondary PRV or control valve. Avoid damaging effects of scale and dirt in pipe lines by using a strainer as shown in Figure 1. Provide a 3-valve by-pass to facilitate inspection without interrupting service.

To eliminate excessive noise and erratic regulation with steam and other compressible fluids, enlarge the delivery pipe size to effect a reasonable flow velocity at the reduced pressure. A tapered transition is recommended. If possible, avoid a sharp turn close to the regulator outlet and a bull-headed tee connection to the low pressure main.

Install initial and delivery pressure gages to indicate performance. If the pressure rating of the delivery system or connected equipment is less than the initial steam pressure, provide a safety valve.

MAIN VALVE

Flush the piping system thoroughly to clear it of welding beads, scale, sand, etc. Mount the main valve with diaphragm chamber down and arrow on body pointing in the direction of flow. Screwed end valves should be mounted in unions.

PILOT

Mount the pilot on either side of the main valve by means of 1/4" nipple and union provided. Make this connection the the 1/4" pipe tap at the inlet of the main valve as shown in Figure 2.

Screw No. 4A bleedport fitting into the 1/8" pipe tap at the outlet of the main valve body. Note bleed orifice in this fitting – vital to operation of regulator.

Screw No. 8B tee into 1/8" pipe tap in pilot. Select tap facing downstream.

Screw No. 5A elbow containing restriction orifice into 1/8" pipe tap on underside of main valve diaphragm chamber. If the initial pressure or pressure drop is less than 15 psi, a No. 5B open elbow is used.

Connect tubing bends as illustrated in Fig. 2. Valves with condensation chamber are fitted up according to Figure 2.

CONTROL PIPE (if required)

Use 1/4" pipe for this line which connects the pilot diaphragm chamber to the desired point of pressure control. Take the control at a point of minimum turbulence. Avoid control immediately at the valve outlet or after a turn. When the delivery pipe expands in size, select a spot at least 4 pipe diameters beyond the point of enlargement. Pitch away from pilot to avoid erratic operation and excessive fouling. Eliminate water pockets. Locate delivery pressure gage in control pipe to show pressure actually reaching pilot diaphragm.

START-UP AND SETTING

On pressure reducing valves like the ED, use by-pass to fill the delivery system and raise pressure to slightly below normal required. Close pilot by releasing compression on adjusting spring. See Figure 2. Open 1/4" control pipe valve. Crack outlet stop valve. Crack inlet stop valve. Blow down strainer. **Caution: Never open a reducing valve without positive indication that the high side is clear of condensate.**

Open inlet stop valve and gradually compress adjusting spring until the valve opens and takes control at desired pressure. Alternately choke down on the by-pass and open outlet stop valve until the regulator is on the line. See individual instructions for other pilots.

HYDROSTATIC TEST PROCEDURE

Install pilot according to instructions. Fully compress pilot spring and open inlet and outlet stop valves before filling system. **SLOWLY** fill system from inlet or high pressure side of regulator. Bleed off trapped air. **SLOWLY** develop test pressure up to **300 PSIG MAXIMUM**. If a higher pressure is required **CONTACT FACTORY FIRST**. Test pressures may cause normally acceptable leakage at the diaphragm joint. Consult factory for hydrostatic test for other types of regulators.

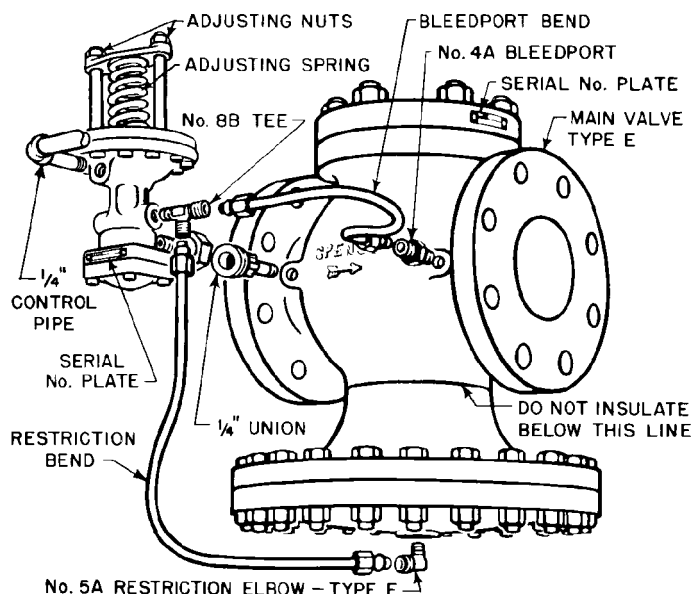


FIGURE 2

TROUBLE SHOOTING

FAILURE TO OPEN OR SAGGING DELIVERY PRESSURE

1. Adjusting spring on pilot may have been tampered with.
2. Initial pressure may be down due to partially closed supply valve, clogged strainer or other obstruction.
3. Orifice in No. 5A restriction elbow may be plugged. No. 4A bleedport fitting may have been omitted and an open coupling substituted.
4. Control pipe may be plugged. Most likely points of obstruction are at shutoff valve and entrance to delivery main.
5. Main diaphragm may be broken. Test with air or water before dismantling.

FAILURE TO CLOSE OR OVER-RIDING DELIVERY PRESSURE

1. Adjusting spring on pilot may have been tampered with.
2. Orifice in bleedport No. 4A may be plugged.
3. By-pass valve may be leaking.
4. On pressure regulators like the ED, the main valve or pilot may be held open by foreign matter in seat. To determine which valve leaks, first close stop valve and 1/4" control pipe valve. Then remove bleedport bend so pilot will exhaust to atmosphere. Crack inlet stop valve. Steam will issue from No. 8B tee. Release compression on adjusting spring to see if pilot closes tight. Open and close several times to wash seat. Steam blowing back from bleedport means main valve disc is held open by foreign matter. Steam may wash the obstruction from the seat if the valve is made to open wide. This can be accomplished, even at light loads, if the control point is beyond the outlet stop valve. Reassemble bleedport bend and place regulator in operation. Then, slowly open and close outlet stop valve.

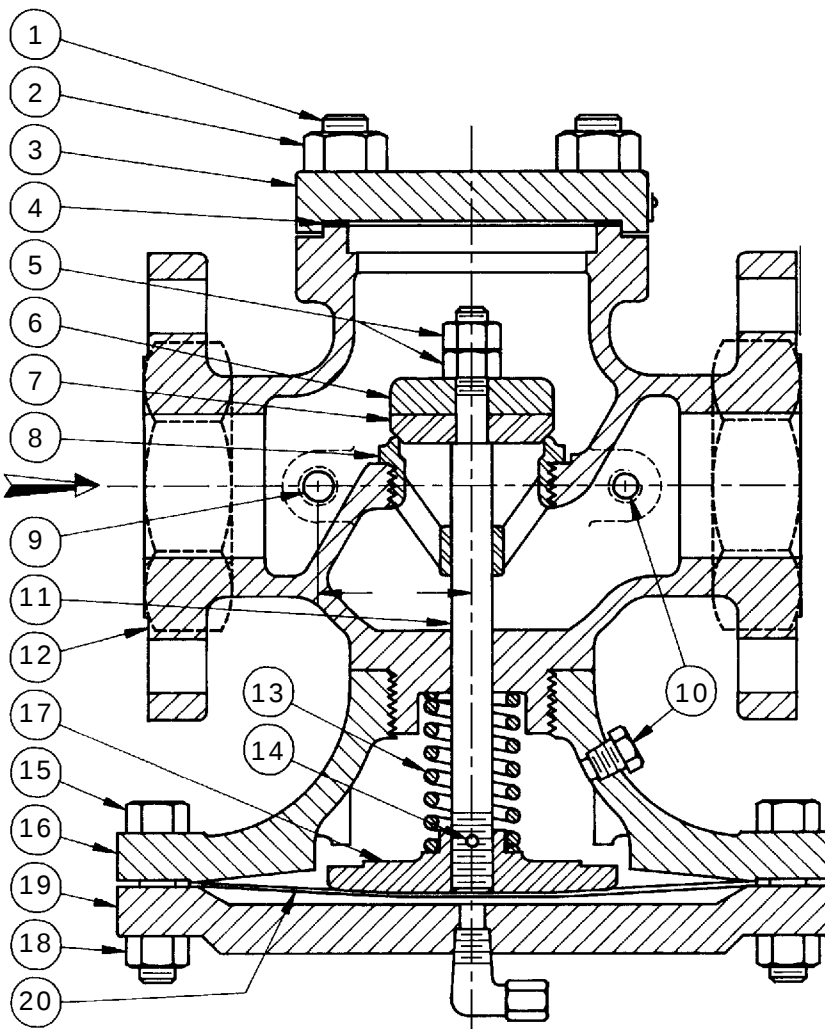
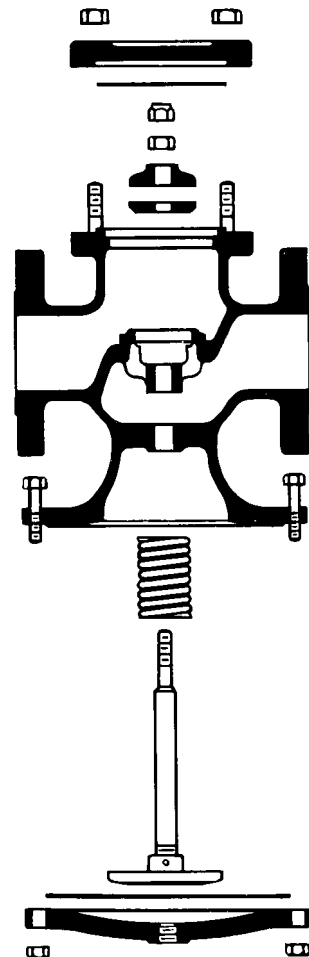


FIGURE 3



MAINTENANCE

INSPECTION

Under normal conditions, complete dismantling at regular intervals is not recommended. A valve kept relatively free of dirt will function for years with minimum attention.

After the first few days of operation and twice a year, the following should be checked.

1. Inspect for dirt collected at bleedport No. 4A and restriction elbow No. 5A.
2. Inspect all joints for leakage. Keep bolts tight. Never allow a leak to persist.

DISMANTLING MAIN VALVE

Connect a source of air or water pressure which can be adjusted by hand to the No. 5A restriction elbow. Apply pressure to jack valve open and prevent stem from turning while removing stem nuts. Usually 50 to 60 psi will suffice. Use penetrating oil on the threads.

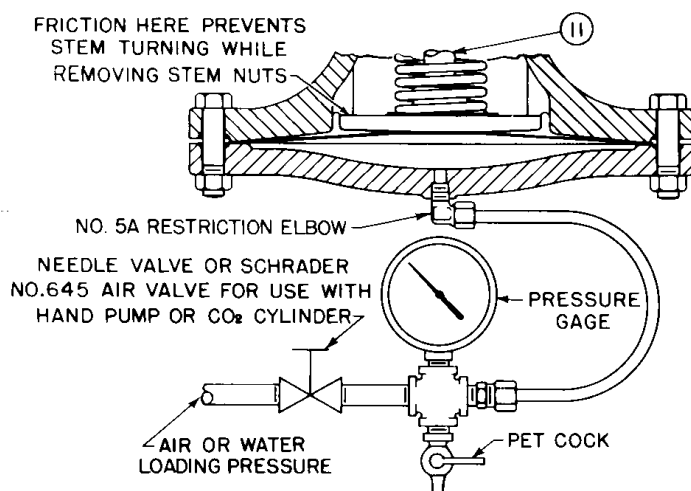


FIGURE 4

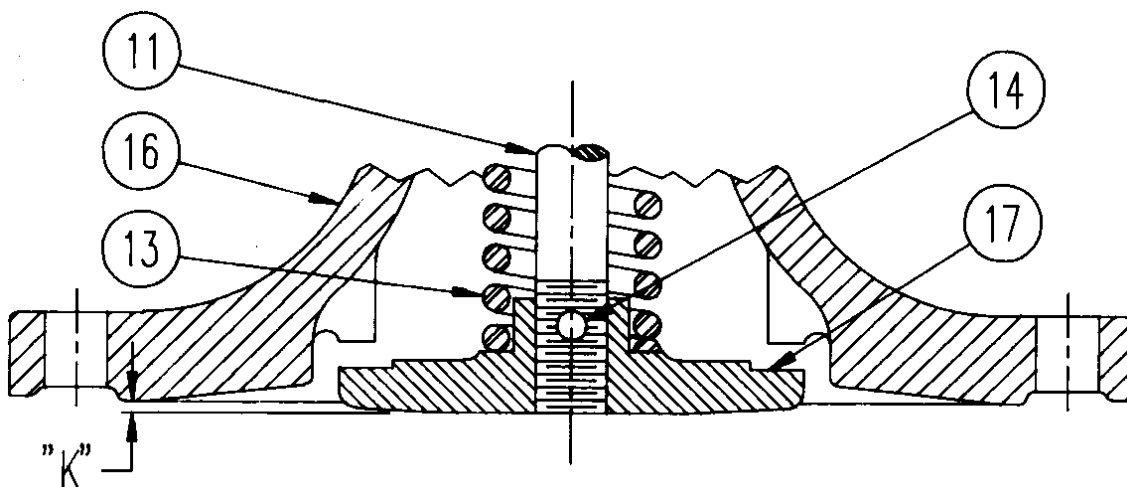


FIGURE 5

REPLACING SEAT RINGS

These joints should be made up with Copaltite, Permatex or equal high temperature gasket compound. Remove old compound from body and seat ring with a wire brush. Apply new compound sparingly to both parts, threads and shoulders. Let stand until tacky before assembling.

GRINDING IN

Seats and discs should never require more than the lightest touch up with very fine (400 grit) grinding compound. Heavy grinding will produce galling, wider seating surface and a groove in the disc, all of which tend to cause leakage. Reface a damaged surface before attempting to grind it in. Grind sparingly.

Main stem (11) is slotted for rotation with a screwdriver. Valve spring (13) is omitted from the assembly during grinding. Slip the stem into its normal position. Apply compound to the disc, place it on the stem and tighten with one stem nut.

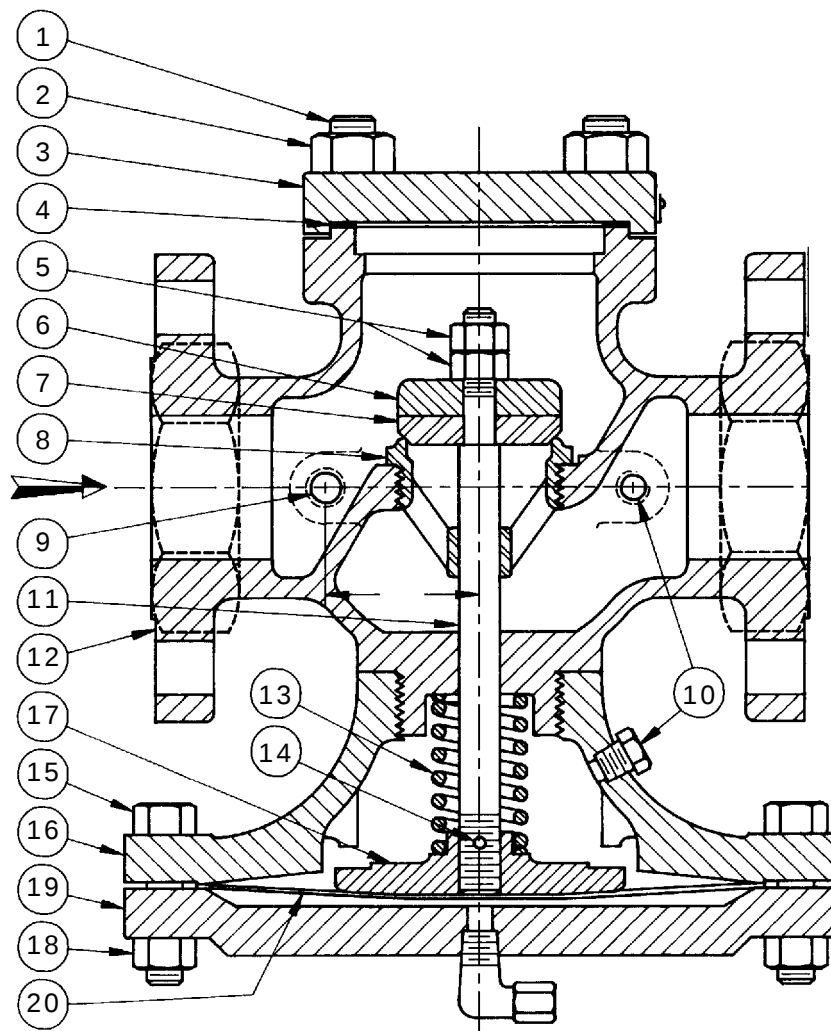
After grinding, disassemble and clean all parts.

VALVE SETTING

Valve setting is gaged at K to establish correct stem length and diaphragm position. Dimension K is supplied with each replacement stem. For metal diaphragm valves, K is cast on the upper face of pressure plate (17) (Fig. 3).

To install new stem (11), fasten disc (7) firmly on stem with stem nut. Insert stem and disc assembly in valve and screw on pressure plate (17). Omit spring (13) for this operation. Hold disc on seat and adjust position of pressure plate until valve setting K is reached. Push pressure plate against stops in base (16). Remove disc, drop out pressure plate and stem, drill and insert dowel pin (14) to lock the joint. Grind off stem projection flush with face of pressure plate.

VALVE SIZE	TYPE E	
	HOOD (K)	TOTAL
3/8	1/32	3/32
1/2	3/64	7/64
3/4	3/64	1/8
1	1/16	5/32
1-1/4	5/64	3/16
1-1/2	3/32	7/32
2	7/64	1/4
2-1/2	1/8	9/32
3	9/64	3/8
3-1/2	5/32	11/32
4	3/16	13/32
5	7/32	1/2
6	9/32	19/32
8	11/32	3/4
10	7/16	31/32
12	9/16	1-1/4



When ordering parts, it is essential that the valve type, size, service and serial number be stated.

Select part by item number, but order by part number.

Specify complete part number when ordering.

CAST IRON PARTS LIST - 3/8" to 2"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE						
			3/8	1/2	3/4	1	1 1/4	1 1/2	2
1	Stud	Steel	04-05516-00	04-05516-00	04-05516-00	04-10118-00	04-05442-00	04-05443-00	04-10119-00
2	Nut	Steel	05-02847-00	05-02847-00	05-02847-00	05-02851-00	05-02854-00	05-02856-00	05-02860-00
3	Blind Flange	Cast Iron	04-02213-00	04-02213-00	04-02171-00	04-02173-00	04-02176-00	04-02178-00	04-02180-00
4	*Gasket	Non-Asbestos	05-16167-00	05-16167-00	05-16168-00	05-16169-00	05-16170-00	05-16171-00	05-16172-00
5	*Stem Nut	Steel	05-02968-00	05-02968-00	05-02969-00	05-02970-00	05-02970-00	05-02971-00	05-02971-00
6	Muffling Plate	Cast Iron	—	—	—	—	—	—	04-03550-01
7	*Disc	Stainless Steel	04-01790-02	04-01800-02	04-01813-02	04-01832-02	04-01850-02	04-01870-02	04-01888-02
8	*Seat Ring	Stainless Steel	04-04109-01	04-04066-01	04-04075-01	04-04084-01	04-04092-01	04-04496-01	04-11544-00
9	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
10	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
11	*Stem	Stainless Steel	04-05306-01	04-05306-01	04-05233-01	04-05237-02	04-05248-01	04-05251-02	04-05262-01
12	NPT Body	Cast Iron	04-00638-00	04-00634-00	04-00639-00	04-00640-00	04-00643-00	04-00646-00	04-00649-00
	125 Body	Cast Iron	—	—	—	04-00641-00	04-00644-00	04-00647-00	04-00650-00
	250 Body	Cast Iron	—	—	—	04-00642-00	04-00645-00	04-00648-00	04-00651-00
13	*HP Spring	Steel	05-09106-00	05-09106-00	05-09107-00	05-09108-01	05-09110-00	05-09110-00	05-09368-02
	LP Spring	Steel	05-05000-01	05-05000-01	05-04987-01	05-04979-01	05-05010-01	05-05010-01	05-04989-01
14	*Dowel Pin	Steel	05-03244-00	05-03244-00	05-03245-00	05-03245-00	05-03248-00	05-03248-00	05-03248-00
15	Diaphragm Bolt	Steel	05-04771-00	05-04771-00	05-04774-00	05-04774-00	05-04774-00	05-04775-00	05-04780-00
16	Base	Cast Iron	04-00475-00	04-00475-00	04-00467-00	04-00476-00	04-00468-00	04-00472-00	04-00469-00
17	*Pressure Plate	Cast Iron	04-03695-00	04-03695-00	04-03579-00	04-03580-00	04-03582-00	04-03581-00	04-03584-01
18	Diaphragm Nut	Steel	04-02872-00	04-02872-00	05-02874-00	05-02874-00	05-02874-00	05-02874-00	05-02877-00
19	Hood	Cast Iron	04-02569-00	04-02569-00	04-02572-00	04-02573-00	04-02576-00	04-02577-00	04-02580-01
20	*Diaphragm	Stainless Steel	04-01629-01	04-01629-01	04-01662-00	04-01632-00	04-01664-00	04-01635-00	04-01638-00
	Repair Kit - High Pressure		07-07746-00	07-07747-00	07-07748-00	07-07749-00	07-07750-00	07-07751-00	07-07752-00
	Repair Kit - Low Pressure		—	—	20112	08-11978-00	08-11979-00	08-09124-00	08-11981-00

*These parts furnished in Repair Kit

CAST IRON PARTS LIST – 2-1/2" to 8"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE					
			2 1/2	3	4	5	6	8
1	Stud 125	Steel	04-10119-00	04-05443-00	04-10119-00	04-10120-00	04-10120-00	04-10120-00
	Stud 250	Steel	04-05448-00	04-10119-00	04-05448-00	04-05449-00	04-05449-00	04-05455-0
2	Nut 125	Steel	04-02860-00	05-02856-00	05-02860-00	05-02877-00	05-02860-00	05-02860-00
	Nut 250	Steel	05-02862-00	05-02860-00	05-02862-00	05-02862-00	05-02862-00	05-02862-00
3	Blind Flange 125	Cast Iron	04-02185-00	04-02157-00	04-02158-00	04-02160-00	04-02165-00	04-02167-00
	Blind Flange 250	Cast Iron	04-02183-00	04-02186-00	04-02159-00	04-02161-00	04-02163-00	05-02166-00
4	*Gasket	Non-Asbestos	05-16173-00	05-16174-00	05-16175-00	05-16176-00	05-16178-00	05-16179-00
5	*Stem Nut	Steel	05-02972-00	05-02973-00	05-02974-00	05-02975-00	04-02976-00	04-02977-00
6	Muffling Plate	Cast Iron	04-03515-00	04-03516-00	04-03518-00	04-03519-00	04-03520-00	05-03524-00
7	*Disc	Stainless Steel	04-01906-01	04-01918-00	04-01931-00	04-01938-00	04-01995-00	04-01691-00
8	*Seat Ring	Stainless Steel	04-11539-00	04-11484-00	04-11565-00	04-11700-01	04-15142-00	07-40483-00
9	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
10	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
11	*Stem	Stainless Steel	04-05260-02	04-05279-01	04-05282-02	04-05285-01	04-05288-01	04-05292-01
12	125 Body	Cast Iron	04-00653-00	04-00655-00	04-00659-01	04-00661-01	04-00662-00	04-00665-00
	250 Body	Cast Iron	04-00652-00	04-00654-00	04-00658-01	04-00660-01	04-00663-00	04-00664-00
13	*HP Spring	Steel	05-08257-02	05-09112-02	05-09114-02	05-09115-02	05-09116-01	05-09118-01
	LP Spring	Stainless Steel	05-05021-01	05-05057-01	05-12267-00	05-12268-00	05-12269-00	05-12270-00
14	*Dowel Pin	Steel	05-03252-00	05-03254-00	05-03254-00	05-03258-00	05-03258-00	05-03261-00
15	Diaphragm Bolt	Steel	04-04779-00	05-04780-00	05-04782-00	05-04782-00	05-04786-00	05-04788-00
16	Base	Cast Iron	04-00471-00	04-00470-00	04-00473-01	04-00478-00	04-00479-00	04-00474-00
17	*Pressure Plate	Cast Iron	04-03583-00	04-03585-01	04-03587-00	04-03588-01	04-03589-02	04-03591-00
18	Diaphragm Nut	Steel	05-02877-00	05-02877-00	05-02877-00	05-02877-00	05-02881-00	05-02881-00
19	Hood	Cast Iron	04-02581-00	04-02584-00	04-02588-01	04-02591-00	04-02593-00	04-02595-00
20	*Diaphragm	Stainless Steel	04-01641-00	05-02038-00	05-01647-00	05-01649-00	05-01651-00	05-01653-00
Repair Kit - High Pressure			08-08148-01	08-08567-01	08-08568-01	08-09738-01	08-09720-00	22800
Repair Kit - Low Pressure			—	20113	20114	—	—	—

CAST STEEL PARTS LIST – 3/8" to 2"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE						
			3/8	1/2	3/4	1	1 1/4	1 1/2	2
1	Stud NPT, 150, 300	Steel	05-05518-00	05-05518-00	05-05518-00	05-05506-00	05-05507-00	05-05509-00	05-05510-00
	Stud 600	Steel	—	—	05-05507-00	05-05507-00	05-05464-00	05-05501-00	05-05513-00
2	Nut NPT, 150, 300	Steel	05-02848-00	05-02848-00	05-02848-00	05-02852-00	05-02855-00	05-02857-00	05-02857-00
	Nut 600	Steel	—	—	05-02855-00	05-02855-01	05-02859-00	05-02859-00	05-02863-00
3	Blind Flange NPT, 150, 300	Steel	04-02188-00	04-02188-00	04-02190-00	04-02192-00	04-02194-00	04-02196-00	04-02198-00
	Blind Flange 600	Steel	—	—	04-02191-00	04-02193-00	05-02195-00	04-02196-00	04-02199-00
4	*Gasket	Non-Asbestos	05-16167-00	05-16167-00	05-16168-00	05-16169-00	05-16170-00	05-16171-00	05-16172-00
5	*Stem Nut	Steel	05-02968-00	05-02968-00	0502969-00	05-02970-00	05-02970-00	05-02971-00	05-02971-00
6	Muffler Plate	Cast Iron	—	—	—	—	—	—	04-03550-01
7	*Disc	Stainless Steel	04-01790-02	04-01800-02	04-01813-02	04-01832-00	04-01850-02	04-01870-02	04-01888-02
8	*Seat Ring	Stainless Steel	04-04109-01	04-04066-01	04-04075-01	04-04084-01	04-04092-01	04-04496-01	04-11544-00
9	Pipe Plug 1/4	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
10	Pipe Plug 1/8	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
11	*Stem	Stainless Steel	04-05306-01	04-05306-01	04-05233-01	04-05237-02	04-05248-01	04-05251-02	04-05262-01
12	Body/Base NPT	Steel	07-46419-00	07-46017-00	07-46421-00	07-44654-00	07-44655-00	07-46436-00	07-46444-00
	Body/Base 150	Steel	—	—	—	0@-06427-00	0@-06431-00	0@-06438-00	0@-06447-00
	Body/Base 300	Steel	—	—	—	0@-06428-00	0@-06432-00	0@-04895-00	0@-06450-00
	BodyBase 600	Steel	—	0@-05717-00	0@-06424-00	0@-04617-00	0@-06434-00	0@-06441-00	0@-06455-00
13	*Spring	Steel	05-09106-00	05-09106-00	05-09107-00	05-09108-01	05-09110-00	05-09110-00	05-09368-02
14	*Dowel Pin	Stainless Steel	05-03244-00	05-03244-00	05-03245-00	05-03245-00	05-03248-00	05-03248-00	05-03248-00
15	Diaphragm Stud	Steel	05-05480-00	05-05480-00	05-05481-00	05-05481-00	05-05481-00	05-05481-00	05-05486-00
16	Base	Steel	(w/Body)	(w/Body)	(w/Body)	(w/Body)	(w/Body)	(w/Body)	(w/Body)
17	*Pressure Plate	Cast Iron	04-03695-00	04-03695-00	04-03579-00	04-03580-00	04-03582-00	04-03581-00	05-03584-01
18	Diaphragm Nut	Steel	05-02848-00	05-02848-00	05-02852-00	05-02852-00	05-02852-00	05-02852-00	05-02857-00
19	Hood	Steel	04-02570-00	04-02570-00	04-02574-00	04-02575-00	04-02578-00	04-02579-00	04-02582-00
20	*Diaphragm	Stainless Steel	04-01629-01	04-01629-01	04-01662-00	04-01632-00	04-01664-00	04-01635-00	04-01638-00
	Repair Kit		24140	24141	24142	24144	24146	24148	24150

CAST STEEL PARTS LIST – 2-1/2" to 8"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE					
			2 1/2	3	4	5	6	8
1	Stud NPT, 150, 300	Steel	05-05510-00	05-05509-00	05-05509-00	05-05511-00	05-05519-00	05-05519-00
	Stud 600	Steel	05-05478-00	05-05478-00	05-05485-00	05-05475-00	05-05475-00	05-05476-00
2	Nut NPT, 150, 300	Steel	05-02861-00	05-02857-00	05-02857-00	05-02861-00	05-02861-00	05-02861-00
	Nut 600	Steel	05-02861-00	05-02861-00	05-02863-00	05-02865-00	05-02865-00	05-02865-00
3	Blind Flange NPT, 150, 300	Steel	04-02184-00	04-02201-00	04-02204-00	04-02207-00	04-02209-00	04-02211-00
	Blind Flange 600	Steel	04-02200-00	04-02202-00	04-02205-00	04-02208-00	04-02210-00	04-02212-00
4	*Gasket NPT,150,300	Non-Asbestos	05-16173-00	05-16174-00	05-16175-00	05-16176-00	05-16178-00	05-16179-00
	*Gasket 600	Non-Asbestos	05-14952-00	05-14953-00	05-14954-00	05-14955-00	05-14956-00	05-14957-00
5	*Stem Nut	Steel	05-02972-00	05-02973-00	05-02974-00	05-02975-00	05-02976-00	05-02977-00
6	Muffler Plate	Cast Iron	04-03515-00	04-03516-00	04-03518-00	04-03519-00	04-03520-00	04-03524-00
7	*Disc	Stainless Steel	04-01906-01	04-01918-00	05-01931-00	04-01938-00	04-01995-00	04-01691-00
8	*Seat Ring	Stainless Steel	04-11539-00	04-11484-00	04-11565-00	04-11700-01	04-15142-00	04-15144-00
9	Pipe Plug 1/4	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
10	Pipe Plug 1/8	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
11	*Stem	Stainless Steel	04-05260-01	04-05279-01	04-05282-02	04-05285-01	04-05288-01	04-05292-01
12	Body 150	Steel	04-00695-00	04-00698-00	04-00704-00	04-00708-01	04-00712-00	04-00715-00
	Body 300	Steel	04-00696-00	04-00699-00	04-00705-00	04-00709-01	04-00713-00	04-00716-00
	Body 600	Steel	04-00697-00	04-00700-00	04-00706-00	04-00711-01	04-00735-00	04-00718-00
13	*Spring	Steel	05-08257-02	05-09112-02	05-09114-02	05-09115-02	05-09116-01	05-09118-01
14	*Dowel Pin	Stainless Steel	05-03252-00	05-03254-00	05-03254-00	05-03258-00	05-03258-00	05-03261-00
15	Diaphragm Stud	Steel	05-05486-00	05-05486-00	05-05487-00	05-05487-00	05-05483-00	05-05483-00
16	Base	Steel	04-00488-00	04-00487-00	04-00490-00	04-00495-00	04-00496-00	04-00491-00
17	*Pressure Plate	Cast Iron	04-03583-00	04-03585-01	04-03587-00	05-03588-01	04-03589-02	04-03591-00
18	Diaphragm Nut	Steel	05-02857-00	05-02857-00	05-02857-00	05-02857-00	05-02861-00	05-02861-00
19	Hood	Steel	04-02646-00	04-02586-00	04-02589-00	04-02592-00	04-02594-00	04-02596-00
20	*Diaphragm	Stainless Steel	04-01641-00	05-02038-00	05-01647-00	05-01649-00	05-01651-00	05-01653-00
	Repair Kit		24152	24158	24155	—	24157	—

DIAPHRAGM TABLE

Initial Pressure PSIG	Number of Diaphragms per Set
10 – 250	2
251 – 400	3
401 – 600	4



SPENCE ENGINEERING COMPANY, INC.

Technical Data

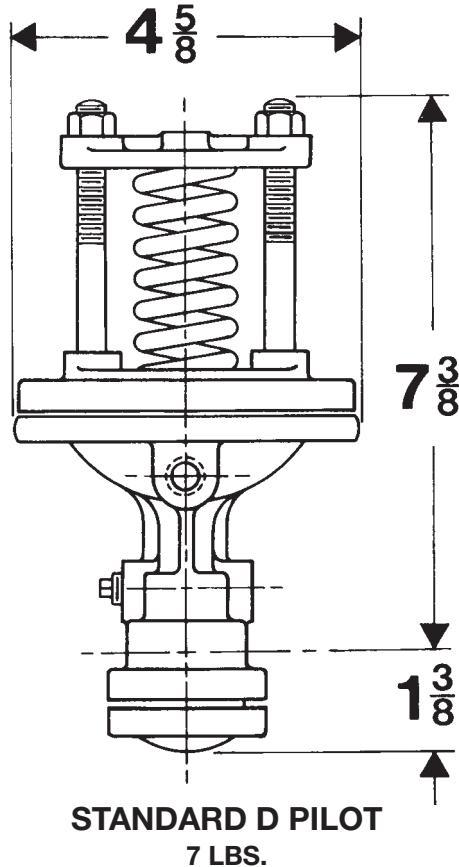
SD 4111C

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150 Coldenham Road, Walden, New York 12586-2035 • Phone (845) 778-5566 • Fax: (845) 778-7123 • www.spenceengineering.com

TYPE D PRESSURE REDUCING PILOT

DIMENSIONS: Inches



The combination of a Type D pilot and a Spence Type E or Type C main valve produces a Spence Pressure Regulator. This regulator will reduce a steady or varying initial pressure to a constant, adjustable delivery pressure.

The Type D pilot is spring loaded. Normal accuracy of regulation is ± 1 psi. The adjustable range of delivery pressure is governed by the choice of adjusting spring as shown in Table 1.

PRESSURE RANGE (PSIG)	ADJUSTING SPRING - Item 4		
	PART NUMBER	WIRE DIA. (Inch)	COLOR
3 - 20*	05-05007-00	3/16	Aluminum
5 - 50*	05-05003-00	1/4	Orange
10 - 100	05-05005-00	5/16	Green
20 - 150	05-05012-00	11/32	Black

*With Vacuum Spring Assembly, minimum range is 30 inches Hg; maximum is reduced by 15 PSIG.

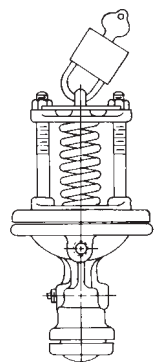
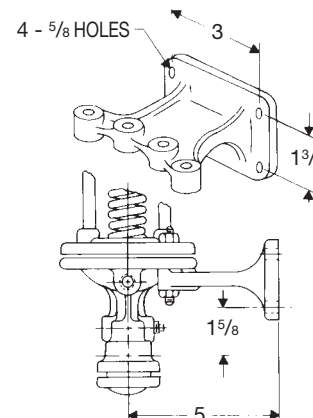
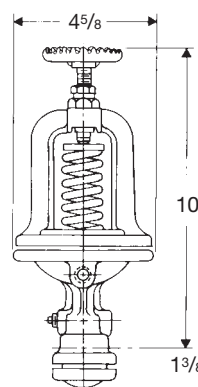
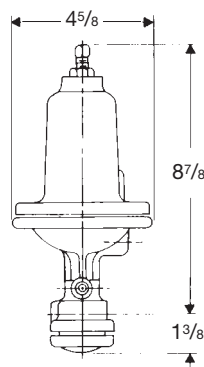
TABLE 1

RATINGS (Maximum Inlet Conditions)

Construction	Pressure	(Temperature)
☐ Cast Iron	250 PSIG	(450°F)
☐ Cast Steel	600 PSIG	(750°F)

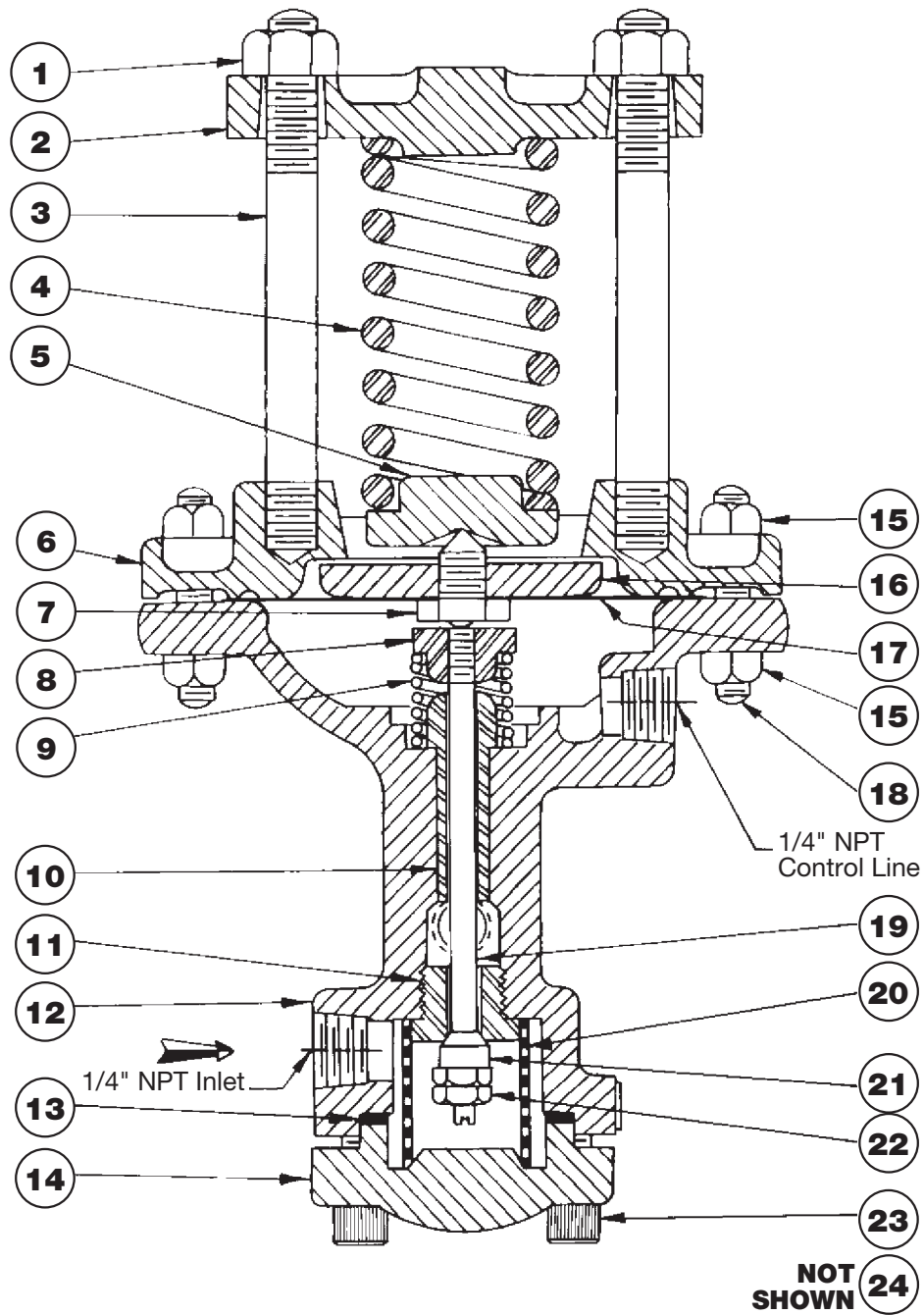
OPTIONS

- ☐ Spring Chamber
- ☐ Adjusting Handwheel
- ☐ Wall Bracket
- ☐ Locking Device
- ☐ Composition Disc
- ☐ Integral Mount Body
- ☐ Vacuum Spring Assembly

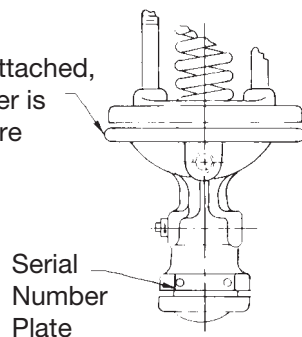


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If no plate attached,
serial number is
stamped here



When ordering parts, it is essential that the pilot type, service and serial number be stated.

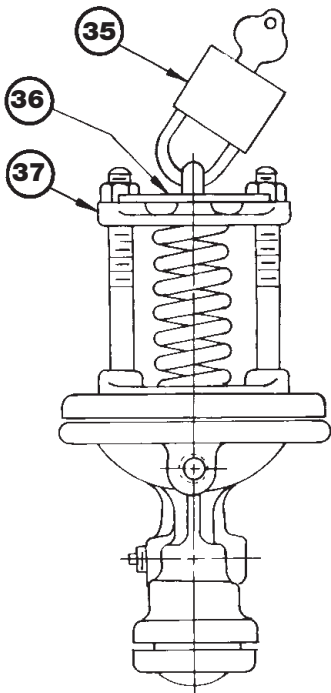
Part numbers listed apply to pilots with serial numbers later than AA 001. For earlier models, part numbers will be furnished on request.

Select part by item number, but order by part number. Specify complete part number when ordering.

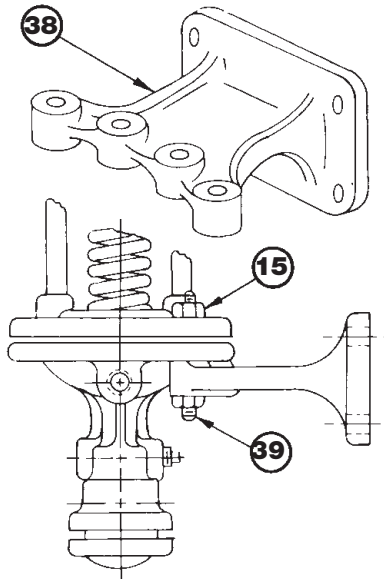
TABLE 2

ITEM NO.	PART NAME	MATERIAL	PART NO.	QTY.	REMARKS
1	Adjusting Nut	Steel	05-02874-00	2	
2	Spring Yoke	Iron	05-06183-00	1	
3	Standard	Steel	04-05219-00	2	
4	Adjusting Spring	Steel	See Table 1	1	
5	Spring Button	Steel	04-01040-00	1	
6	Cowl	Cast Iron	04-01508-00	1	Cast Iron Body
	Cowl	Steel	04-01592-00	1	Steel Body
7	Diaphragm Screw ¹	Steel	04-04822-00	1	
8	Pusher Plate ¹	Steel	04-03718-00	1	
9	Valve Spring ¹	Inconel	05-04985-00	1	
10	Bushing	St. Steel	04-01080-00	1	
11	Seat Ring ¹	Seco Metal	04-04057-90	1	
12	Body, Bushing, Plug	Cast Iron	07-03514-00	1	
	Body, Bushing, Plug	Steel	07-04267-02	1	
13	Gasket ¹	Blugard	05-02378-01	1	Cast Iron Body, Non-Asbestos
	Gasket ¹	Flexitalic	05-11718-00	1	Steel Body, Non-Asbestos
14	Blind Flange	Cast Iron	04-02151-00	1	
	Blind Flange	Steel	04-11678-00	1	
15	Diaphragm Nut	Steel	05-02871-00	12	Cast Iron Body
	Diaphragm Nut	Steel	05-02845-00	24	Steel Body
16	Pressure Plate ¹	Steel	04-03679-00	1	
17	Diaphragm ¹	St. Steel	04-01623-00	3	
18	Diaphragm Bolt	Steel	05-04764-00	12	Cast Iron Body
	Diaphragm Stud	Steel	05-05490-00	12	Steel Body
19	Stem ¹	St. Steel	04-05229-00	1	
20	Screen ¹	St. Steel	04-04700-00	1	Steam Service
	Screen ¹	St. Steel	04-04701-00	1	Water Service
21	Disc ¹	Seco Metal	04-01772-90	1	
22	Stem Nut ¹	Steel	05-02888-00	2	Steam Service
	Stem Nut ¹	Brass	05-02886-00	2	Water Service
23	Blind Flange Bolt	Steel	05-04803-00	4	Cast Iron Body
	Blind Flange Bolt	Steel	05-11719-00	4	Steel Body
	Repair Kit - Hard	Cast Iron Pilot	07-04164-00		
	Repair Kit - Hard	Steel Pilot	08-10375-00		
	Repair Kit - Soft	Cast Iron Pilot	08-08556-00		
	Repair Kit - Soft	Steel Pilot	08-10379-00		

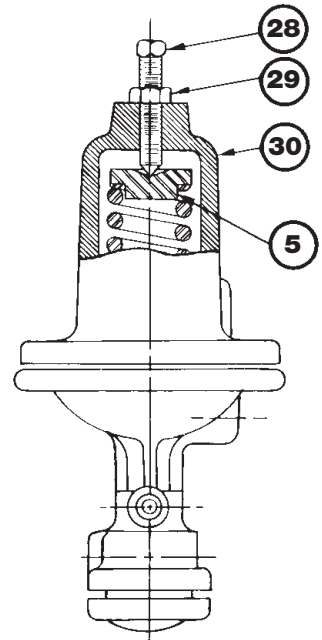
1. These parts furnished in Repair Kit



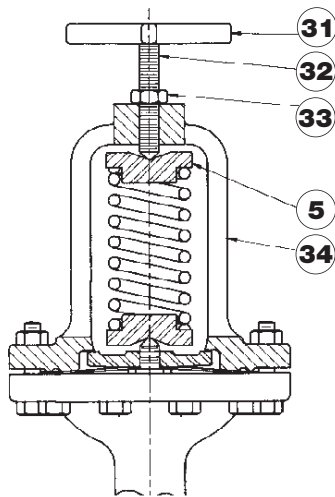
Locking Device



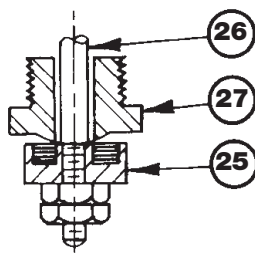
Wall Bracket



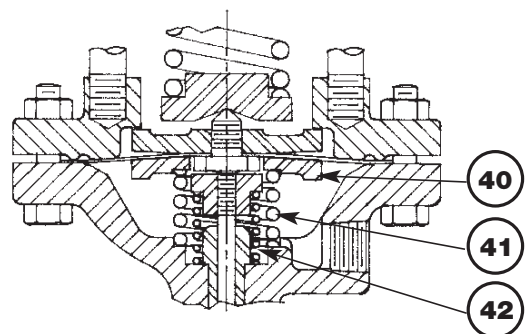
Enclosed Spring Chamber



Adjusting Handwheel



Composition Disc



Vacuum Spring Assembly

TABLE 3 - OPTIONS

ITEM NO.	PART NAME	MATERIAL	PART NO.	QUANTITY	REMARKS
----------	-----------	----------	----------	----------	---------

LOCKING DEVICE

35	Padlock	Brass	05-03204-00	1	
36	Lock Bar	Steel	04-00436-00	1	
37	Spring Yoke Ass'y	Iron	07-43507-00	1	

WALL BRACKET

15	Diaphragm Nut	Steel	05-02871-00	1	Iron Body
	Diaphragm Nut	Steel	05-02845-00	4	Steel Body
38	Wall Bracket	Cast Iron	04-01029-00	4	
39	Diaphragm Bolt	Steel	05-04766-00	4	Iron Body
	Diaphragm Stud	Steel	05-05462-00	8	Steel Body

COMPOSITION DISC

25	Disc Assembly ¹	Brass	07-53512-00	1	
26	Stem ¹	St. Steel	04-05381-00	1	
27	Seat Ring ¹	St. Steel	04-04060-00	1	

ENCLOSED SPRING CHAMBER

28	Adjusting Screw	Steel	05-04860-00	1	
29	Locknut	Steel	05-02942-00	1	
30	Spring Chamber	Iron	04-01393-00	1	
	Spring Chamber	Bronze	04-01395-00	1	
	Spring Chamber	Steel	04-01394-00	1	
	Enclosed Spring Chamber Kit	Cast Iron	08-01868-00		

ADJUSTING HANDWHEEL

31	Handwheel	Aluminum	04-12985-01	1	
32	Adjusting Screw	Steel	04-04752-02	1	
33	Locknut	Steel	05-02942-00	1	
34	Yoke	Cast Iron	04-06170-00	1	Iron Body
	Yoke	Ductile Iron	04-06167-02	1	Steel Body
	Handwheel Kit	Cast Iron	08-01867-00		

VACUUM SPRING ASSEMBLY

40	Floating Plate	Iron	04-03710-00	1	
41	Vacuum Spring	302 St. Steel	05-05055-00	1	
42	Valve Spring	Inconel	05-09353-00	1	

1. These parts furnished in Repair Kit

MAINTENANCE

(Parentheses refer to item number)

REQUIRED TOOLS

2 Socket Wrenches
Adjustable Wrench
3/16" Allen Wrench
Wire Brush
Prick Punch
Grinder
Crocus Cloth
Solvent
Travel Gage (Included in Repair Kit)
Lapping Compound (500grit)
Deep Sockets: 3/8", 7/16", 9/16", 11/16"
Sealing Compound (Copaltite or Equivalent)

DISMANTLING

- 1 – Release adjusting spring (4) compression by loosening adjusting nuts (1). Remove nuts, yoke (2), adjusting spring, and spring button (5).
- 2 – Remove diaphragm nuts (15) and lift off cowl (6). Lift out diaphragm assembly (7, 16 & 17).
- 3 – Disassemble diaphragm assembly by removing diaphragm screw (7) from pressure plate (16). This step is not necessary if installing a new diaphragm assembly (included in repair kit).
- 4 – Remove blind flange bolts (23) and take off blind flange (14). Remove screen (20) and gasket (13).
- 5 – Hold the pusher plate (8) and remove stem nuts (22). Lift out stem assembly (8 & 19) and valve spring (9). The disc (21) will drop off. If the disc is not easily removed from the stem (19), or the stem does not easily move in the the bushing (10) or is difficult to remove, inspect stem, seat ring (11), and disc carefully for notches, scratches or bending.
- 6 – Remove the seat ring from the pilot body (12) using a socket wrench. Do not remove the seat ring unless replacing the stem assembly and disc.

INSPECTION

- 1 – Examine the seat ring (11) and disc (21) sealing surfaces for nicks or other signs of damage by pipeline debris. Slight imperfections may be removed by lapping the surfaces. Otherwise, the seat ring and disc must be replaced.
- 2 – Examine the stem (19) for a build-up of pipeline contaminants or erosion. Remove any build-up with a wire brush and polish with a very fine crocus cloth. Work carefully to avoid bending the stem.
- 3 – Inspect the pilot body (12) and its ports for corrosion. Some rust is normal, but if corrosion debris is readily separated from the body, clean body with wire brush and remove debris.

LAPPING OPERATIONS

Lap sparingly using 500 grit lapping compound and light pressure. Heavy grinding may cause galling, wide sealing surfaces and a grooved disc, all of which tend to produce leakage.

Lapping may be done using a socket wrench to rotate the stem and disc assembly back and forth against the seat for 30 seconds or so. After the sealing surfaces are lapped in, disassemble and clean all parts.

SEAT, DISC AND STEM REPLACEMENT

- 1 – Clean the body threads of old sealing compound using a wire brush. Apply new sealing compound (Copaltite or equal) to the shoulder of the seat ring (11). Let stand until tacky before installing in pilot body (12).
- 2 – Secure disc (21) to stem (19) with a stem nut (22). Apply lapping compound to the disc and insert this assembly into the pilot body (omit the valve spring (9)).
- 3 – Use a socket and extender to lap in the disc to seat joint. See Lapping Operations for more information.
- 4 – Screw pusher plate (8) onto the stem. Holding the disc firmly against its seat, adjust the pusher plate so that dimension C = 11/64" (See Figure 1). A gage (part number 05-02416-00) is supplied with each repair kit. Being careful not to disturb the pusher plate adjustment, use a prick punch to notch the stem threads above the pusher plate so that the pusher plate can no longer rotate freely. Work carefully to avoid bending the stem. The valve travel is now set.
- 5 – Remove the stem nut and lift the stem assembly (19 & 8) out of the top of the pilot. Grind off the stem Projection B flush with the upper surface of the pusher plate. This can be done at the bench without removing the stem from the body as long as the grinder doesn't make contact with the mating surfaces of the pilot body.
- 6 – Reinsert the stem into the pilot body. Install disc and a stem nut.
- 7 – Check that the valve travel A = 3/64". This need not be exact. Stem should move smoothly. Binding indicates a bent stem.
- 8 – Remove the stem nut and disc; withdraw stem. Install stem with valve spring, disc and both stem nuts.

ASSEMBLY

- 1 – If the seat ring (11), disc (21), and stem (19) were not replaced, reinstall the seat ring first, then slide the valve spring (9) over the bushing (10) and slide the stem back into place. If they were replaced, skip to step 3.
- 2 – While holding the pusher plate (8) with a socket, install the seat ring (11) and stem nuts (22) one at a time.

3 – Install the screen (20) and gasket (13), and, using the blind flange bolts (23), reinstall blind flange (14). When replacing gaskets, be sure that any serrated sealing surfaces are cleaned of old gasket material.

Be sure to apply sealing compound (Copaltite or equal) to the shoulder of the diaphragm screw. For steel body pilots only, apply sealing compound to the diaphragm flange of the pilot body as well.

4 – Assemble the diaphragm assembly (7, 16 & 17) by sandwiching the diaphragms (17) between the pressure plate (16) (flat side against diaphragm) and the diaphragm screw (7). The number of diaphragm discs depends on the adjusting spring range.

5 – Drop the diaphragm assembly into place (pressure plate up). Center the assembly and install the cowl (6). Install four diaphragm bolts or studs (18) and diaphragm nuts (15) equally around the cowl to ensure the diaphragm assembly is centered. Install the rest of the diaphragm nuts, bolts and/or studs and tighten in an opposing pattern.

0 – 8 psig	1 Diaphragm Disc
3 – 20 psig	2 Diaphragm Discs
5 – 50 psig	2 Diaphragm Discs
10 – 100 psig	2 Diaphragm Discs
20 – 150 psig	3 Diaphragm Discs

6 – Install the spring button (5), adjusting spring (4), spring yoke (2) and adjusting nuts (1).

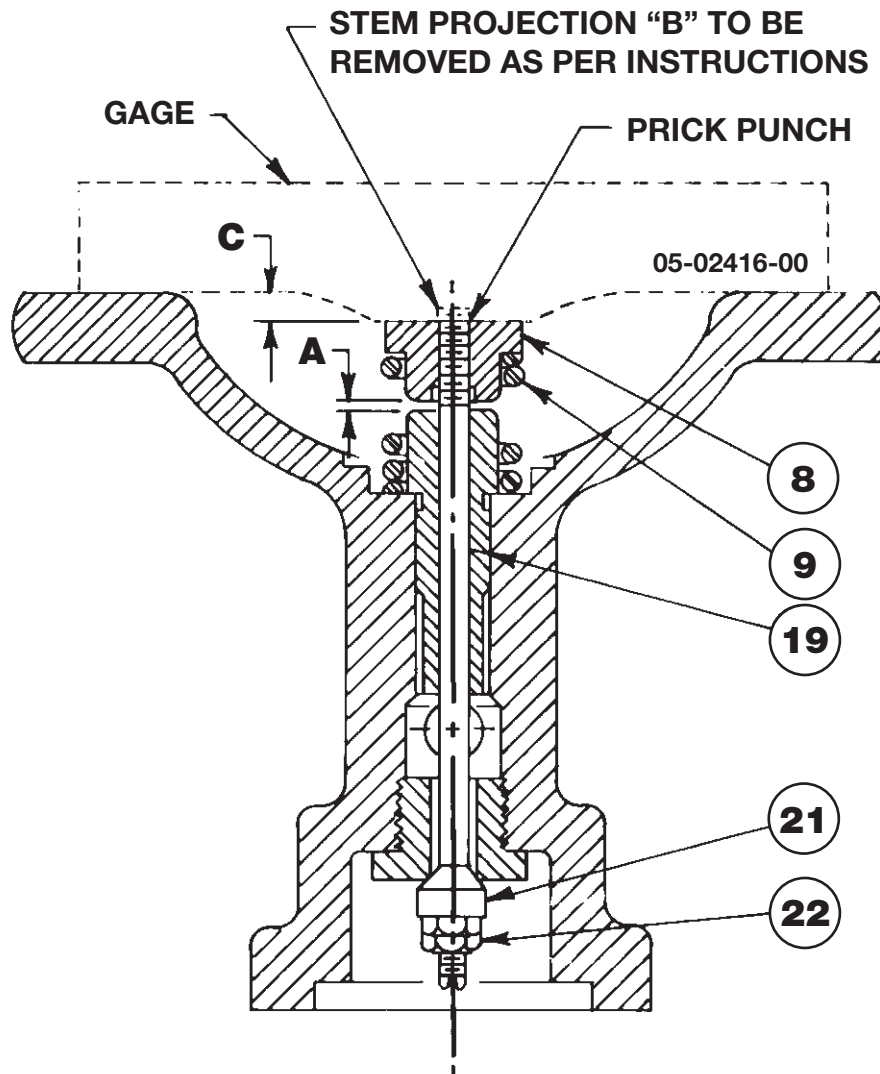
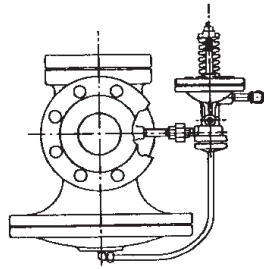
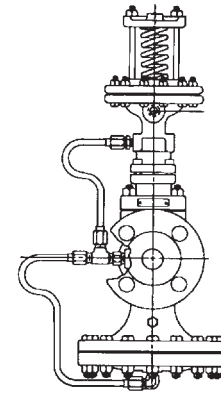
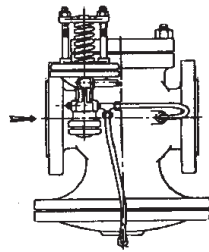


FIGURE 1 - TRAVEL SETTING

TYPICAL ED CONFIGURATIONS

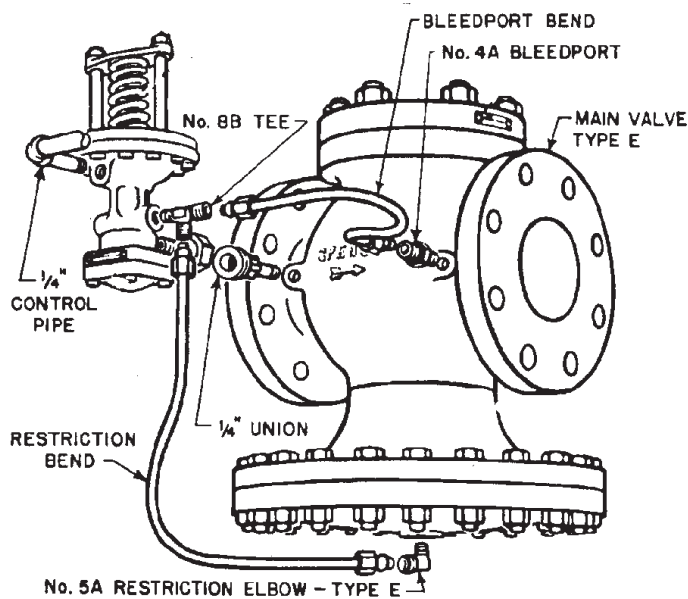
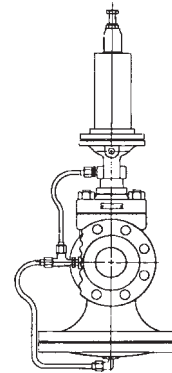


SIDE MOUNTED



INTEGRALLY MOUNTED

Valve is tapped so that
Pilot may be mounted
on either side.



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Appendix: B

Appendix B: PUMP ASSEMBLY

Item

- 30.....CENTRIFUGAL PUMP 112 GPM @ 425'TDH (175 PSIG)
- 31.....MOTOR: 460V 60HZ 3PH 3500RPM
- 32.....SUCTION GATE VALVES
- 33.....SUCTION Y-TYPE STRAINER
- 34.....EXPANSION COUPLING
- 35.....RECIRCULATION CHECK VALVE
- 36.....RECIRCULATION ORIFICE
- 37.....RECIRCULATION GATE VALVE
- 38.....RECIRCULATION ADAPTOR
- 39.....PRESSURE GAUGE - LIQUID FILLED
- 40.....SHUT-OFF COCK
- 41.....DISCHARGE CHECK VALVE
- 42.....DISCHARGE GLOBE VALVE
- 43.....DISCHARGE GATE VALVE

ALL ITEMS ARE BOOK MARKED TO REFLECT THE BILL OF MATERIALS



Your complete line of BOILER ROOM AUXILIARY EQUIPMENT Needs

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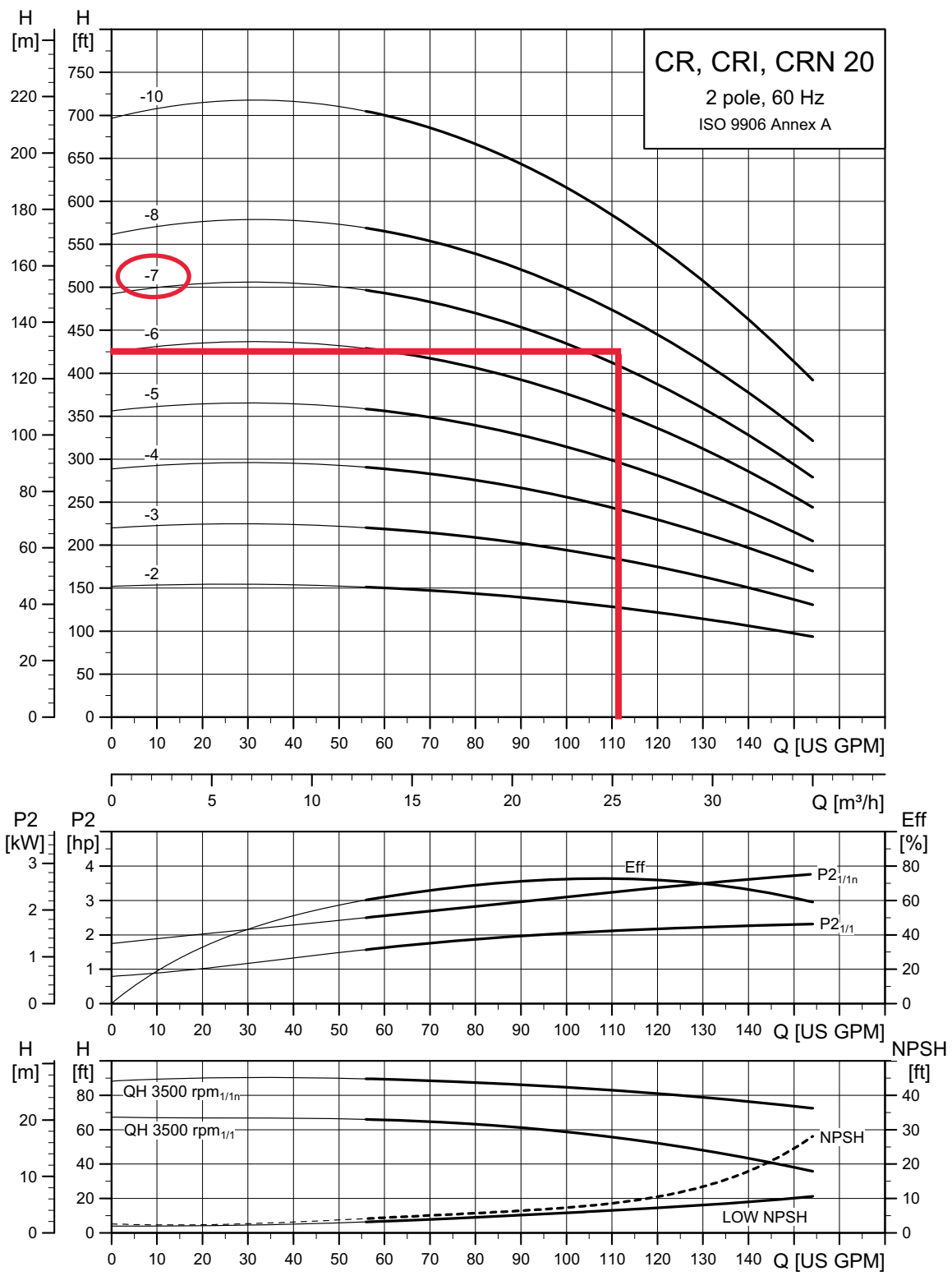
CR, CRI, CRN

Installation and operating instructions



Low-NPSH pumps with 2-pole motor: CR, CRI, CRN 20 **112 GPM @ 425' TDH (175 PSIG)**

Low-NPSH pumps with 2-pole motor



For information about dimensions of the individual pumps, see page 96.

TM05 7085 0513

English (GB) Installation and operating instructions

Original installation and operating instructions

These installation and operating instructions describe Grundfos CR, CRI and CRN pumps, 0.37 - 75 kW.

Sections 1-4 give the information necessary to be able to unpack, install and start up the product in a safe way.

Sections 5-10 give important information about the product, as well as information on service, fault finding and disposal of the product.

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Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. General information

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER



Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING



Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION



Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard



Consequence of ignoring the warning.
- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.



Observe these instructions for explosion-proof products.



A blue or grey circle with a white graphical symbol indicates that an action must be taken.



A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.



If these instructions are not observed, it may result in malfunction or damage to the equipment.



Tips and advice that make the work easier.

2. Receiving the product

2.1 Transporting the product

WARNING

Falling objects

- Death or serious personal injury
- Keep the product in a stable and fixed position during transportation.
- Wear personal protective equipment.



2.2 Unpacking the product

WARNING

Falling objects

- Death or serious personal injury
- Keep the product in a stable position during unpacking.
- Wear personal protective equipment.



2.3 Inspecting the product

Before you install the product, do the following:

1. Check that the product is as ordered.
2. Check that no visible parts have been damaged.

If parts are damaged or missing, contact your local Grundfos sales company.

2.4 Lifting the product

WARNING

Falling objects

- Death or serious personal injury
- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

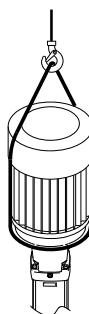


Note that typically the centre of gravity of the pump is close to the motor.

When lifting the entire product with motor, follow these instructions:

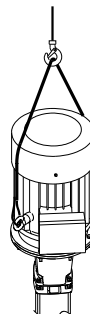
- Pump with motor sizes 0.37 - 5.5 kW:
Lift the pump in the motor flange by means of straps or the like.
- Pump with motor sizes 7.5 - 22 kW:
Lift the pump by means of the motor eyebolts.
- Pump with motor sizes 30-45 kW:
Lift the pump by means of the lifting brackets on the motor flange.
- Pump with motor sizes 55-75 kW:
Lift the pump by means of the eyebolts on the motor side.

0.37 - 5.5 kW



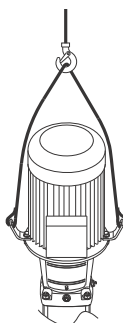
TM04 0339 0608

7.5 - 22 kW



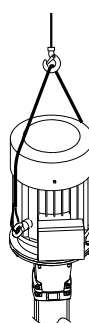
TM04 0341 0608

30-45 kW



TM05 9564 4113

55-75 kW



TM04 0341 0608

Fig. 1 Lifting points

In case of CR, CRI and CRN pumps with other motors than MG or Siemens, we recommend that you lift the pump by means of the straps in the motor flange.

3. Installing the product

3.1 Mechanical installation

WARNING

Contamination when pumping drinking water

Death or serious personal injury

- Before the pump is used for supplying drinking water, flush the pump thoroughly with clean water.
- Do not use the pump for drinking water if the internal parts have been in contact with particles or substances not suitable for water intended for human consumption.



3.1.1 Lifting the product

WARNING

Falling objects

Death or serious personal injury

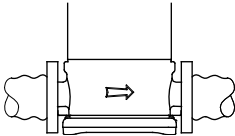
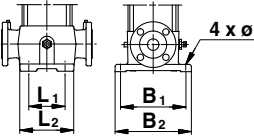
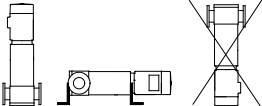
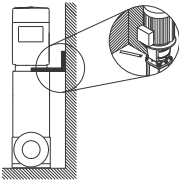
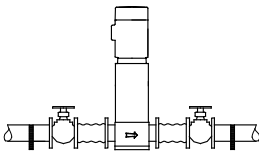
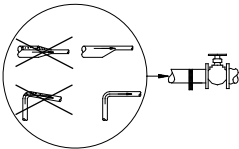
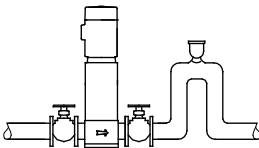
- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.



For lifting instructions, see section [2.4 Lifting the product](#).

3.1.2 Installation guidelines

The pump must be secured to a horizontal, plane and solid foundation with bolts through the holes in the base plate. When installing the pump, be aware of the information below in order to avoid damaging the pump.

Illustration	Information
1 	TM02 0013 3800 Arrows on the pump base show the direction of flow of liquid through the pump.
2 	TM00 2256 3393 This information is stated in fig. 3 in the appendix: • port-to-port lengths • dimensions of the base plate • pipe connections • diameter and position of anchor bolts.
3 	TM01 1241 4097 You can install the pump vertically or horizontally. CR, CRN 120 and 150, 75 kW, only vertically. However, the motor must neither fall below the horizontal plane nor be installed upside down. Make sure that an adequate supply of cool air reaches the motor cooling fan. Motors above 4 kW must be supported.
3a 	TM05 7705 1013 Additional support. As the centre of gravity of the pump is relatively high, we recommend that pumps installed on ships, in areas with risk of earth quake or in systems which can be moved, are equipped with an additional support bracket. You can fit the bracket from the motor stool to the bulkhead of the ship, a rigid wall in a building or to a rigid part.
4 	TM02 0116 3800 To minimise possible noise from the pump, we recommend that you fit expansion joints on either side of the pump. Build a foundation and carry out mechanical installation as described in section 3.1.3 Foundation. Fit the isolating valves on either side of the pump to avoid draining the system if the pump needs to be removed for cleaning, repair or replacement. Always protect the pump against backflow by means of a non-return valve.
5 	TM02 0114 3800 Install the pipes so that air pockets do not occur, especially on the inlet side of the pump.
6 	TM02 0115 3800 Fit a vacuum valve close to the pump if the installation has one of these characteristics: • The outlet pipe slopes downwards away from the pump. • There is a risk of siphon effect. • Protection against backflow of unclean liquids is needed.

3.1.3 Foundation

WARNING

Falling objects

Death or serious personal injury

- Keep the product in a stable and fixed position before installing it.
- Make sure that the foundation is suitable for the weight of the product.

We recommend that you install the pump on a concrete foundation which is heavy enough to provide permanent and rigid support for the entire pump. The foundation must be capable of absorbing any vibration, normal strain or shock. The concrete foundation must have an absolutely level and even surface.

Place the pump on the foundation, and fasten it. The base plate must be supported on the whole area.

The following instruction applies when mounting the pump in both vertical and horizontal position. Place the pump on the foundation, and fasten it. See fig. 2.

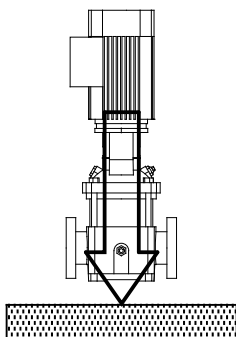


Fig. 2 Correct installation

TM04 0342 0608

The recommended length and width of the foundation are shown in fig. 3. Note that for pumps with motor size below or equal to 30 kW, the length and width of the foundation must be 200 mm larger than the base plate.

For pumps with motor size equal to 37 kW or above, the length and width must always be 1.5 x 1.5 (L_f x B_f) m.

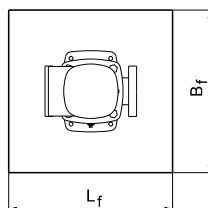
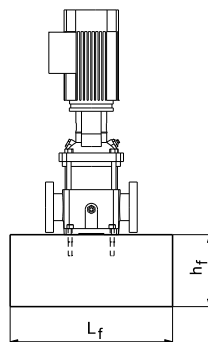


Fig. 3 Foundation, vertical mounting

TM04 0343 0608

The foundation length and width must always be 200 mm larger than the length and width of the pump. See fig. 4.

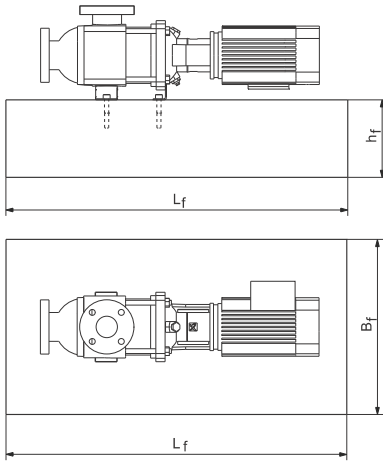


Fig. 4 Foundation, horizontal mounting

The mass of the foundation must be at least 1.5 times the total mass of the pump. The minimum height of the foundation (hf) can then be calculated:

$$h_f = \frac{M_{\text{pump}} \times 1.5}{L_f \times B_f \times \delta_{\text{concrete}}}$$

The density (δ) of concrete is usually taken as 2200 kg/m³.

In installations where noise-less operation is particularly important, we recommend that you use a foundation with a mass up to 5 times that of the pump.

The foundation must be provided with anchor bolts for fixing the base plate. See fig. 5.

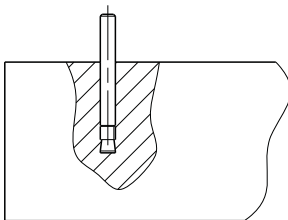


Fig. 5 Bolt in foundation

When the anchor bolts are in position, place the pump on the foundation. Then align the base plate using shims, if necessary, so that it is completely horizontal. See fig. 6.

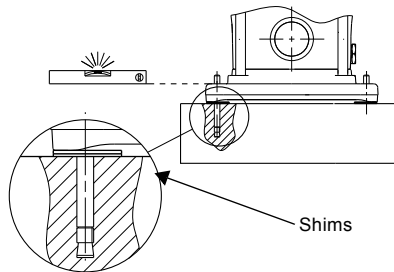


Fig. 6 Alignment with shims

3.1.4 Vibration dampening

Elimination of noise and vibrations is best achieved by means of a concrete foundation, vibration dampers and expansion joints.

If you use vibration dampers, install them under the foundation. For pumps with motor size below or equal to 30 kW, you can use vibration dampers as shown in fig. 7.

For pumps with motor sizes equal to 37 kW or above, use a Sylomer® plate as shown in fig. 8.

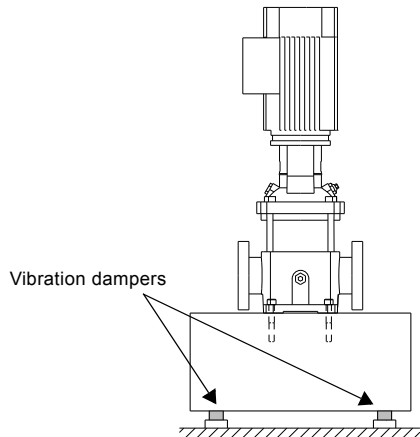


Fig. 7 Pump on vibration dampers

TM04 0362 0608

TM05 9579 4113

TM03 4588 2206

TM04 1691 1008

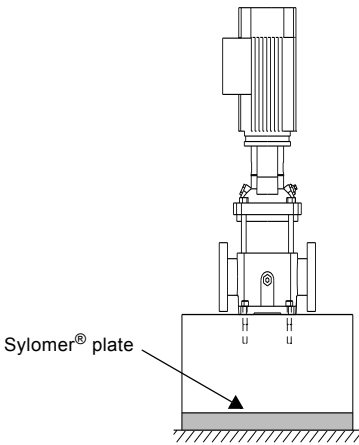


Fig. 8 Pump on Sylomer® plate

TM04 1692 1008

3.1.5 Outdoor installation

When the pump is installed outdoors, we recommend that you provide the motor with a rain cover. We also recommend that you open one of the drain holes in the motor flange.

3.1.6 Tightening torques

WARNING



Flange gasket blowout

Death or serious personal injury
- Tighten flange bolts according to the torque values stated in the installation and operating instructions.

The table shows the recommended torques for base plate anchor bolts and flange bolts.

The bolt quality must be minimum class 8.8.

CR, CRI, CRN	Base [Nm]	Flange bolts [Nm]		
		Bolt size	DIN, JIS, ANSI	Oval
1s-5	40	M10	-	50-60
10-20	50	M12	60	60-70
		M16	100	70-80
32-150	70	M20	150	-
		M24	200	-

3.1.7 Flange forces and torques

If not all loads reach the maximum permissible value stated in the tables below, one of these values may exceed the normal limit. Contact Grundfos for further information.

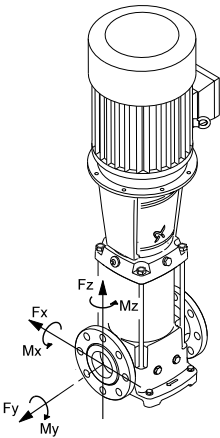


Fig. 9 Flange forces and torques

- Y-direction: Inlet or outlet
Z-direction: Direction of chamber stack
X-direction: 90 ° from inlet or outlet

The following tables represent the values that apply according to the material quality.

TM04 0346 2013

Force limits

Flange, DN [mm]	Type	CR - Cast iron pump housing			CRI, CRN - Stainless steel pump housing		
		Force, Y- direction [N]	Force, Z- direction [N]	Force, X- direction [N]	Force, Y- direction [N]	Force, Z- direction [N]	Force, X- direction [N]
25/32	1s-5	338	394	319	675	788	638
40	10	413	469	375	825	938	750
50	15 and 20	563	581	506	1125	1163	1013
65	32	694	788	638	1388	1575	1275
80	45	938	769	844	1875	1538	1688
100	64 and 90	1256	1013	1125	2513	2025	2250
125/150	120 and 150	1256	1013	1125	2513	2025	2250

Torque limits

Flange, DN [mm]	Type	CR - Cast iron pump housing			CRI, CRN - Stainless steel pump housing		
		Torque, Y- direction [Nm]	Torque, Z- direction [Nm]	Torque, X- direction [Nm]	Torque, Y- direction [Nm]	Torque, Z- direction [Nm]	Torque, X- direction [Nm]
25/32	1s-5	300	175	125	600	350	250
40	10	400	275	200	800	550	400
50	15 and 20	450	325	250	900	650	500
65	32	500	350	300	1000	700	600
80	45	325	400	550	650	800	1100
100	64 and 90	375	475	625	750	950	1250
125/150	120 and 150	375	475	625	750	950	1250

3.1.8 Positioning the terminal box

You can turn the terminal box to four positions, in 90 ° steps. Follow this procedure:

1. If necessary, remove the coupling guards. Do not remove the coupling.
2. Remove the bolts securing the motor to the pump.
3. Turn the motor to the required position.
4. Replace and tighten the bolts.
5. Replace the coupling guards.

Carry out the electrical connection as shown in the diagram inside the terminal box cover.

3.2 Electrical connection



Follow the instructions for the motor when carrying out the electrical connections.

The electrical connection must be carried out by an authorised electrician in accordance with local regulations.

WARNING

Electric shock

- Death or serious personal injury
- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.
 - Connect the pump to an external main switch close to the pump and to a motor-protective circuit breaker or a CUE frequency converter. Make sure you can lock the main switch in OFF position (isolated). Type and requirements as specified in EN 60204-1, 5.3.2.



Consider whether it is necessary to install an emergency stop switch.

The operating voltage and frequency are marked on the motor nameplate. Make sure that the motor is suitable for the power supply on which it is used and that the motor terminal connection is correct. You will find a wiring diagram in the terminal box.

3.2.1 Cable entry/screwed connection

All motors are supplied without screwed cable entries. The table below shows the numbers and sizes of cable entry holes of the terminal box according to the standard EN 50262.

Motor [kW]	Number and size of cable entries	Description
0.25-0.55	2 x M20 x 1.5	The holes have precast threads and are closed with knock-out cable entries.
0.75-3.0	2 x M20	The holes are closed with knock-out cable entries.
4.0-7.5	4 x M25	The holes are closed with knock-out cable entries.
11-22	2 x M20 4 x M40	The holes are closed with knock-out cable entries.
30-45	2 x M50 x 1.5	Blanking plug.
55-75	2 x M63 x 1.5	Blanking plug.

3.2.2 Three-phase connection

	Mains supply [V]		
	Delta connection		Star connection
50 Hz	220-240	/	380-415
	380-415	/	660-690
60 Hz	220-277	/	380-480 ¹⁾
	380-480	/	660-690

1) 60 Hz motors, 0.37 - 1.1 kW: 220-277/380-440 V.

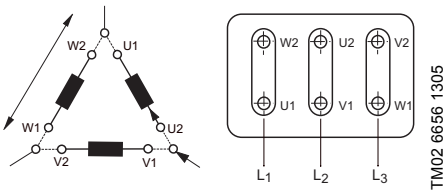


Fig. 10 Delta connection

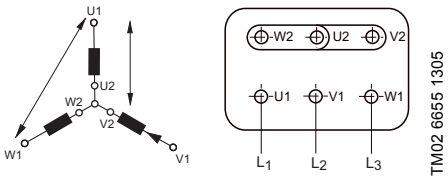


Fig. 11 Star connection

If the motor is provided with PTC sensors or PTO contacts, the connection must be in accordance with the wiring diagram in the terminal box.

Connect three-phase motors to a motor-protective circuit breaker.

3.2.3 Single-phase connection

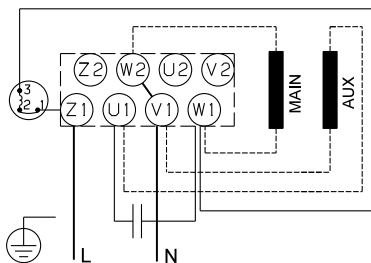


Fig. 12 Connection, 220-230 V, 0.37 - 0.75 kW

TM04 1693 1008

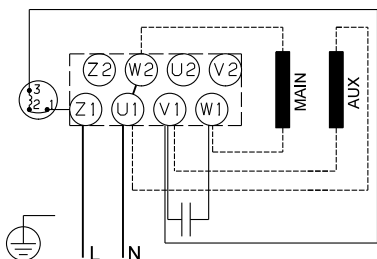


Fig. 13 Connection, 240 V, 0.37 - 0.75 kW

TM04 1694 1008

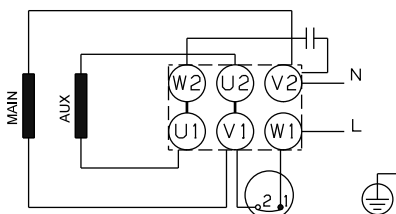


Fig. 14 Connection, 220-230 V, 1.1 - 2.2 kW

TM04 0345 0608

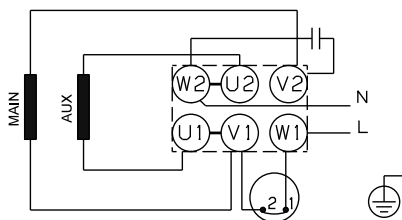


Fig. 15 Connection, 240 V, 1.1 - 2.2 kW

TM04 0344 0608

Single-phase Grundfos motors incorporate a thermal switch and require no additional motor protection.

3.2.4 Frequency converter operation

You can use three-phase motors for frequency converter operation following the conditions below. This section applies to motors defined in IEC 60034.

3.2.5 General conditions

Protect all motors used with frequency converters against voltage peaks and dU/dt according to IEC 60034-17. Grundfos recommends that you use insulated bearings for motors from frame size 225 (45 kW/2-pole, 30 kW/4-pole and 22 kW/6-pole).

3.2.6 Mains voltage dependent conditions

200-240 V

No output filters are required for frequency converter operated motors with mains voltages up to 240 V.

380-500 V

For frequency converter operated motors with power cable length less than 25 m and mains supply up to 460 V, no additional motor protection against voltage peaks is required. For frequency converter operated motors with power cable length of more than 25 m or mains supply higher than 460 V, sine-wave filters are required.

500 V and higher

Always use sine-wave filters for motors marked with 500 V or higher voltages.



Motors with reinforced insulation can be supplied as an option. These motors are according to IEC 60034-25 and therefore there is no need for sine-wave filters. This does not eliminate the requirement for insulated bearings from frame size 225.

Exception

- Protect Grundfos motors types MG 71 and MG 80 (up to 1.1 kW/2-pole and up to 0.75 kW/4-pole) for supply voltages up to and including 440 V without phase insulation against voltage peaks above 650 V between the supply terminals.
- If you use MG 71 and MG 80 without phase insulation for input voltages above 240 V, it requires that you use sine-wave filters at the output of the frequency converter.

MG 71 and MG 80 with phase insulation for use with variable frequency drives are available as standard products.

Motors supplied by Grundfos

You can connect all three-phase MG motors with phase insulation to a frequency converter.

Other motor makes than those supplied by Grundfos

Contact Grundfos or the motor manufacturer.

3.2.7 Phase insulation, MG 71 and 80

MG motors, frame sizes 71 and 80, do not have phase insulation as standard. The motors are not suitable for frequency converter operation as they are not protected against the voltage peaks caused by the frequency converter operation. Only motors with a rated voltage equal to 460 V or above have phase insulation.



Frequency converter operation of MG motors without phase insulation will cause damage to the motor.

We recommend that you protect all other motors against voltage peaks higher than 1200 V by 2000 V/µsec.

You can eliminate the above disturbances, that is both increased acoustic noise and detrimental voltage peaks, by fitting an LC filter between the frequency converter and the motor.

For further information, contact the frequency converter or motor supplier.

4. Starting up the product

WARNING



Corrosive liquids

- Death or serious personal injury
- Wear personal protective equipment.

WARNING



Toxic liquids

- Death or serious personal injury
- Wear personal protective equipment.

CAUTION



Hot or cold liquid

- Minor or moderate personal injury
- Wear personal protective equipment.
- Pay attention to the direction of the vent hole when you fill the pump with liquid and vent it.
- Make sure that no persons are hurt by the escaping liquid.



Fill the pump with liquid and vent it before you start the pump.



Pay attention to the direction of the vent hole during liquid filling and venting. Make sure that the escaping liquid does not cause damage to the motor or other components.



If the pump runs dry, the pump bearings and the shaft seal may be damaged.

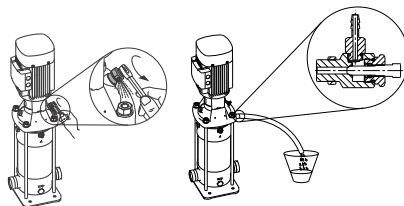


Fig. 16 Vent valve, standard and an optional solution with hose connection

Follow the startup instructions in the appendix.

CR, CRI, CRN 1s to 5

For these pumps, we recommend that you open the bypass valve during startup. See fig. 18 for bypass valve location. The bypass valve connects the inlet and outlet sides of the pump, thus making the filling procedure easier. Close the bypass valve again when the operation is stable.

When pumping liquids containing air, we recommend that you leave the bypass valve open if the operating pressure is lower than 6 bar.

Close the bypass valve if the operating pressure constantly exceeds 6 bar. Otherwise, the material at the opening will be worn because of the high liquid velocity.

4.1 Shaft seal run-in

WARNING



Corrosive liquids

- Death or serious personal injury
- Wear personal protective equipment.

WARNING



Toxic liquids

- Death or serious personal injury
- Wear personal protective equipment.



CAUTION

Hot or cold liquid

- Minor or moderate personal injury
- Wear personal protective equipment.



Make sure that a leakage does not cause damage to the equipment.

The seal faces are lubricated by the pumped liquid, meaning that there may be a certain amount of leakage from the shaft seal.

When you start the pump for the first time, or when you install a new shaft seal, a certain run-in period is required before the leakage is reduced to an acceptable level. The time required for this depends on the operating conditions, that is every time the operating conditions change, a new run-in period will be started.

Under normal conditions, the leaking liquid will evaporate. As a result, no leakage will be detected.

4.2 Frequency of starts and stops

Motor size [kW]	Maximum number of starts per hour
0.37 - 2.2	250
3-4	100
5.5 - 11	50
18.5 - 22	40
30	90
37	50
45	80
55	50
75	50

4.3 Operating the product

For operating the product safely, observe the following hazard statements:

WARNING

Contamination when pumping drinking water



Death or serious personal injury

- Do not use the pump for drinking water if the internal parts have been in contact with particles or substances not suitable for water intended for human consumption.

WARNING

Airborne noise



Death or serious personal injury

- Wear personal protective equipment.

See fig. 4 in the appendix.

WARNING

Too high pressure and leakage



Death or serious personal injury

- Do not run the pump against a closed outlet valve.



CAUTION

Hot or cold surface

- Minor or moderate personal injury
- Make sure that no one can accidentally come into contact with hot or cold surfaces.



Hot or cold surfaces



CAUTION

Hot or cold liquid

- Minor or moderate personal injury
- Wear personal protective equipment.



Figure 17 shows which pump parts get as hot or cold as the pumped liquid.

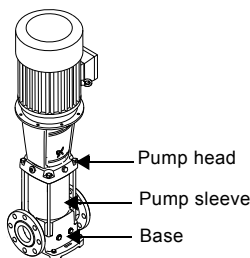


Fig. 17 Hot or cold surfaces on a CR, CRI and CRN pump

For motor bearing maintenance at ambient temperatures above 40 °C, see section 10. *Disposing of the product.*

TM04 0361 0608

5. Product introduction

5.1 Identification

5.1.1 Type key for CR, CRI, CRN 1s, 1, 3, 5, 10, 15 and 20

Example	CR	3-	10	X-	X-	X-	X-	XXXX
Type range: CR, CRI, CRN								
Rated flow rate in m ³ /h								
Number of impellers								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for rubber pump parts								
Code for shaft seal								

5.1.2 Type key for CR, CRN 32, 45, 64, 90, 120 and 150

Example	CR	32-	2	1-	X-	X-	X-	X-	XXXX
Type range: CR, CRN									
Rated flow rate in m ³ /h									
Number of stages									
Number of impellers with reduced diameter									
Code for pump version									
Code for pipe connection									
Code for materials									
Code for rubber pump parts									
Code for shaft seal									

5.2 Intended use of the product

Only use the CR, CRI and CRN pumps according to the specification stated in these installation and operating instructions.

5.2.1 Applications

Grundfos multistage in-line centrifugal pumps, types CR, CRI and CRN, are designed for a wide range of applications.

CR, CRI, CRN

CR, CRI and CRN pumps are suitable for liquid transfer, circulation and pressure boosting of cold or hot clean liquids.

CRN

Use CRN pumps in systems where all parts in contact with the liquid are made of high-grade stainless steel.

5.2.2 Pumped liquids

DANGER



Fire and explosion

- Death or serious personal injury
- Do not use the pump for flammable, combustible or explosive liquids.

WARNING

Chemical attack and leakage



- Death or serious personal injury
- Do not use the pump for liquids which can attack the pump materials chemically.
- Contact Grundfos if in doubt.

WARNING

Corrosive liquids



- Death or serious personal injury
- Wear personal protective equipment.

WARNING

Toxic liquids



- Death or serious personal injury
- Wear personal protective equipment.

CAUTION

Hot or cold liquid



- Minor or moderate personal injury
- Wear personal protective equipment.

CR, CRI and CRN pump are suitable for pumping thin, clean, non-flammable, non-combustible or non-explosive liquids, not containing solid particles or fibres.

When pumping liquids with a density and/or viscosity higher than that of water, use motors with correspondingly higher outputs, if required.

6. Servicing the product

DANGER

Electric shock



- Death or serious personal injury
- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Falling objects



- Death or serious personal injury
- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section [2.4 Lifting the product](#).

WARNING

Falling objects



- Death or serious personal injury
- Keep the product in a stable and fixed position when working on it.

WARNING

Corrosive liquids



- Death or serious personal injury
- Wear personal protective equipment.

WARNING

Toxic liquids



- Death or serious personal injury
- Wear personal protective equipment.

WARNING

Contamination when pumping drinking water



- Death or serious personal injury
- Before the pump is used for supplying drinking water, flush the pump thoroughly with clean water.
- Do not use the pump for drinking water if the internal parts have been in contact with particles or substances not suitable for water intended for human consumption.
- Always use original spare parts suitable for drinking water.

**CAUTION****Hot or cold liquid**

- Minor or moderate personal injury
- Wear personal protective equipment.

**CAUTION****Hot or cold surface**

- Minor or moderate personal injury
- Make sure that no one can accidentally come into contact with hot or cold surfaces.



We recommend that you repair pumps with motors of 7.5 kW and above at the installation site. Necessary lifting equipment must be available.

6.1 Contaminated products**CAUTION****Biological hazard**

- Minor or moderate personal injury
- Flush the product thoroughly with water and rinse the product parts in water after dismantling.



The product will be classified as contaminated if it has been used for a liquid which is injurious to health or toxic.

If you request Grundfos to service the product, contact Grundfos with details about the liquid before returning the product for service. Otherwise, Grundfos can refuse to accept the product for service.

Any application for service must include details about the liquid.

Clean the product in the best possible way before you return it.

Costs of returning the product are to be paid by the customer.

6.2 Service documentation**6.2.1 Pump**

Service documents and service kits are available in Grundfos Product Center (<http://product-selection.grundfos.com>).

6.2.2 Motor**Grundfos motors**

Service documentation is available in Grundfos Product Center (<http://product-selection.grundfos.com/>).

If you have any questions, please contact the nearest Grundfos company or service workshop.

Other motors makes than MG

Contact the motor manufacturer.

6.3 Maintaining the product**DANGER****Electric shock**

- Death or serious personal injury
- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

**WARNING****Falling objects**

- Death or serious personal injury
- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.



For lifting instructions, see section [2.4 Lifting the product](#).

WARNING



Falling objects

- Death or serious personal injury
- Keep the product in a stable and fixed position when working on it.

WARNING



Corrosive liquids

- Death or serious personal injury
- Wear personal protective equipment.

WARNING



Toxic liquids

- Death or serious personal injury
- Wear personal protective equipment.



CAUTION

Hot or cold liquid

- Minor or moderate personal injury
- Wear personal protective equipment.



CAUTION

Hot or cold surface

- Minor or moderate personal injury
- Make sure that no one can accidentally come into contact with hot or cold surfaces.



6.3.1 Pump

The pump bearings and the shaft seal are maintenance-free.

6.3.2 Motor

Carry out maintenance as described in the instructions for the motor which are supplied with the pump.

Motor bearings

Motors not fitted with grease nipples are maintenance-free.

Motors fitted with grease nipples must be lubricated with a high-temperature, lithium-based grease. See the instructions on the fan cover.

In the case of seasonal operation where the motor is idle for more than 6 months of the year, we recommend that you grease the motor when you take the pump out of operation.

Depending on the ambient temperature, replace or lubricate the motor bearings according to the table below. The table applies to 2-pole motors. The number of operating hours stated for bearing replacement are guidelines only.

Motor size [kW]	Bearing replacement interval [operating hours]				
	40 °C	45 °C	50 °C	55 °C	60 °C
0.37-0.75	18000	-	-	-	-
1.1-7.5	20000	15500	12500	10000	7500
Motor size [kW]	Lubrication interval [operating hours]				
	40 °C	45 °C	50 °C	55 °C	60 °C
11-18.5	4500	3400	2500	1700	1100
22	4000	3100	2300	1500	1000
30-55	4000	3000	2000	1500	-
75	2000	1500	1000	500	-

Intervals for 4-pole motors are twice as long as those for 2-pole motors.

If the ambient temperature is lower than 40 °C, then replace or lubricate the bearings at the intervals mentioned under 40 °C.

7. Taking the product out of operation

7.1 Frost protection

CAUTION



Hot or cold liquid

Minor or moderate personal injury

- Pay attention to the direction of the vent hole and drain plug when draining the pump. Make sure that the escaping liquid does not cause injury to persons.
- Wear personal protective equipment.



Pay attention to the direction of the vent hole and drain plug when draining the pump. Make sure that the escaping liquid does not cause damage to the motor or other components.

Drain pumps which are not being used during periods of frost to avoid damage.

To drain the pump loosen the vent screw in the pump head and remove all drain plugs from one side of the pump base.

Do not tighten the vent screw and replace the drain plug until the pump is to be used again.

CR, CRI, CRN 1s to 5

Before replacing the drain plug in the base, screw the bypass valve out against the stop. See fig. 18.

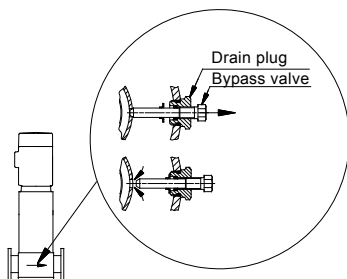


Fig. 18 Location of drain plug and bypass valve

Fit the drain plug by tightening the large union nut followed by the bypass valve.

TM01 1243 4097

7.2 Taking the product permanently out of operation

Observe the following if the pump is to be permanently taken out of operation and removed from the pipe system.

DANGER

Electric shock



- Death or serious personal injury
- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Falling objects



- Death or serious personal injury
- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section [2.4 Lifting the product](#).

WARNING

Falling objects



- Death or serious personal injury
- Keep the product in a stable and fixed position when working on it.

WARNING

Corrosive liquids



- Death or serious personal injury
- Wear personal protective equipment.

WARNING

Toxic liquids



- Death or serious personal injury
- Wear personal protective equipment.

CAUTION

Hot or cold liquid



- Minor or moderate personal injury
- Wear personal protective equipment.



CAUTION

Hot or cold surface



- Minor or moderate personal injury
- Make sure that no one can accidentally come into contact with hot or cold surfaces.



8. Fault finding the product

DANGER

Electric shock



- Death or serious personal injury
- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Corrosive liquids



- Death or serious personal injury
- Wear personal protective equipment.

WARNING

Toxic liquids



- Death or serious personal injury
- Wear personal protective equipment.

WARNING

Falling objects



- Death or serious personal injury
- Keep the product in a stable and fixed position when working on it.

CAUTION

Hot or cold liquid



- Minor or moderate personal injury
- Wear personal protective equipment.

CAUTION

Hot or cold surface



- Minor or moderate personal injury
- Make sure that no one can accidentally come into contact with hot or cold surfaces.



Fault	Cause	Remedy
1. The motor does not run when started.	a) Supply failure.	Connect the power supply.
	b) The fuses are blown.	Replace fuses.
	c) The motor-protective circuit breaker has tripped.	Reactivate the motor-protective circuit breaker.
	d) The thermal protection has tripped.	Reactivate the thermal protection.
	e) The main contacts in the motor-protective circuit breaker are not making contact or the coil is faulty.	Replace the contacts or the magnetic coil.
	f) The control circuit is defective.	Repair the control circuit.
	g) The motor is defective.	Replace the motor.
2. The motor-protective circuit breaker trips immediately when the power supply is switched on.	a) One fuse is blown or the automatic circuit breaker has tripped.	Replace the fuse or cut in the circuit breaker.
	b) The contacts in the motor-protective circuit breaker are faulty.	Replace the motor-protective circuit breaker contacts.
	c) The cable connection is loose or faulty.	Fasten or replace the cable connection.
	d) The motor winding is defective.	Replace the motor.
	e) The pump is mechanically blocked.	Remove the mechanical blocking of the pump.
	f) The motor-protective circuit breaker setting is too low.	Set the motor-protective circuit breaker correctly.
3. The motor-protective circuit breaker trips occasionally.	a) The motor-protective circuit breaker setting is too low.	Set the motor-protective circuit breaker correctly.
	b) Low voltage at peak times.	Ensure a stable power supply.
4. The motor-protective circuit breaker has not tripped, but the pump does not run.	a) See 1 a), b), d), e) and f).	

Fault	Cause	Remedy
5. The pump performance is not constant.	a) The pump inlet pressure is too low (cavitation).	Check the inlet conditions.
	b) The inlet pipe or pump is partly blocked by impurities.	Clean the inlet pipe or pump.
	c) The pump draws in air.	Check the inlet conditions.
6. The pump runs, but gives no water.	a) The inlet pipe or pump is blocked by impurities.	Clean the inlet pipe or pump.
	b) The foot or non-return valve is blocked in closed position.	Repair the foot or non-return valve.
	c) There is a leakage in the inlet pipe.	Repair the inlet pipe.
	d) There is air in the inlet pipe or pump.	Check the inlet conditions.
	e) The motor runs in the wrong direction of rotation.	Change the direction of rotation of the motor.
7. The pump runs backwards when switched off.	a) There is a leakage in the inlet pipe.	Repair the inlet pipe.
	b) The foot or non-return valve is defective.	Repair the foot or non-return valve.
8. Leakage in shaft seal.	a) The shaft seal is defective.	Replace the shaft seal.
9. Noise.	a) Cavitation.	Check the inlet conditions.
	b) The pump does not rotate freely due to frictional resistance as a result of incorrect pump shaft position.	Adjust the pump shaft. Follow the procedure in fig. 6, 7, 8 or 9 in the appendix.
	c) Frequency converter operation.	See section 3.2.4 Frequency converter operation .

9. Technical data

9.1 Operating conditions

9.1.1 Liquid temperature

Figure 1 in the appendix states the relationship between liquid temperature range and maximum permissible operating pressure.



The maximum permissible operating pressure and liquid temperature ranges apply to the pump only.

9.1.2 Ambient temperature and altitude

Motor power [kW]	Motor make	Motor efficiency class	Maximum ambient temperature [°C]	Maximum altitude above sea level [m]
0.37 - 0.55	Grundfos MG	-	+40	1000
0.75 - 22	Grundfos MG	IE3	+60	3500
30.0 - 75.0	Siemens	IE3	+55	2750

If the ambient temperature exceeds the above temperature values or the pump is installed at an altitude exceeding the above altitude values, the motor must not be fully loaded due to the risk of overheating. Overheating may result from excessive ambient temperatures or the low density and consequently low cooling effect of the air.

In such cases, it may be necessary to use a motor with a higher rated output.

Example

Figure 19 shows that the load of an IE3 motor at an ambient temperature of 70 °C must not exceed 89 % of the rated output.

If the pump is installed 4750 m above sea level, the motor must not be loaded more than 89 % of the rated output.

In cases where both the maximum temperature and the maximum altitude are exceeded, the derating factors must be multiplied ($0.89 \times 0.89 = 0.79$).

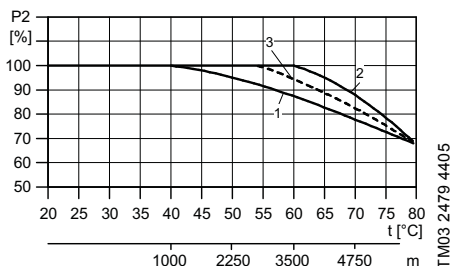


Fig. 19 Motor output in relation to temperature and altitude

Pos.	Motor power [kW]	Motor make
1	0.37 - 0.55	MG
	0.37 - 22	MGE
2	0.75 - 22	MG
3	30.0 - 75.0	Siemens

9.1.3 Maximum permissible operating pressure and liquid temperature for the shaft seal



The diagram below applies to clean water and water containing antifreeze liquids.

CR, CRI, CRN 1s to 20 and CR, CRN 32 to 150

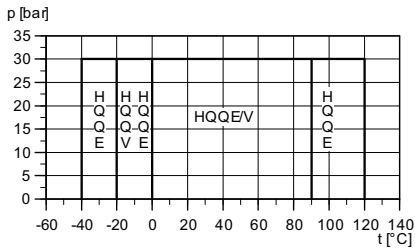


Fig. 20 Maximum permissible operating pressure and liquid temperature

Standard shaft seal	Motor [kW]	Temperature range [°C]
HQQE	0.37 - 45	-40 to +120
HBQE	55-75	0 to 120
HQQV	0.37 - 45	-20 to +90
HBQV	55-75	0 to 90

You can clean CRI and CRN pumps in place (CIP) with a type H shaft seal with EPDM rubber parts, HxxE and liquids up to 150 °C for maximum 15 minutes.



The pumping of liquids above 120 °C may result in periodical noise and reduced pump life.

CR, CRI, CRN pumps are not suitable for the pumping of liquids above 120 °C for long periods.

9.1.4 Minimum inlet pressure

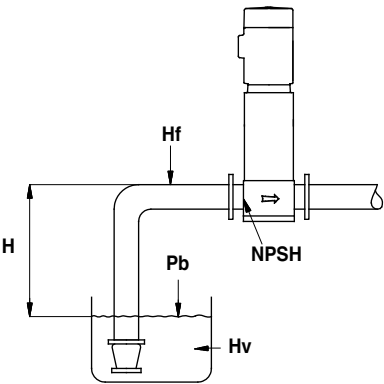


Fig. 21 Schematic view of open system with a CR pump

Calculate the maximum suction lift "H" in m head as follows:

- $H = Pb \times 10.2 - NPSH - H_f - H_v - H$
- Pb = Barometric pressure in bar. Barometric pressure can be set to 1 bar. In closed systems, Pb indicates the system pressure in bar.
- $NPSH$ = Net Positive Suction Head in m head, to be read from the NPSH curve in Appendix (at the highest flow the pump will be delivering).
- H_f = Friction loss in the inlet pipe in m head at the highest flow the pump will be delivering.
- H_v = Vapour pressure in m head. See fig. 5 in the appendix.
- t_m = Liquid temperature.
- H_s = Safety margin = minimum 0.5 m head.

If the calculated "H" is positive, the pump can operate at a suction lift of maximum "H" m head. If the calculated "H" is negative, an inlet pressure of minimum "H" m head is required. There must be a pressure equal to the calculated "H" during operation.

Example

$P_b = 1 \text{ bar}$.

Pump type: CR 15, 50 Hz.

Flow rate: $15 \text{ m}^3/\text{h}$.

NPSH (see the appendix): 1.1 m head.

$H_f = 3.0 \text{ m head}$.

Liquid temperature: 60°C .

H_v (from fig. 5 in the appendix): 2.1 m head.

$H = P_b \times 10.2 - \text{NPSH} - H_f - H_v - H_s [\text{m head}]$.

$H = 1 \times 10.2 - 1.1 - 3.0 - 2.1 - 0.5 = 3.5 \text{ m head}$.

This means that the pump can operate at a suction lift of maximum 3.5 m head.

Pressure calculated in bar: $3.5 \times 0.0981 = 0.343 \text{ bar}$.

Pressure calculated in kPa: $3.5 \times 9.81 = 34.3 \text{ kPa}$.

9.1.5 Maximum permissible inlet pressure

The tables in the appendix state the maximum permissible inlet pressure. However, the actual inlet pressure + the maximum pump pressure at no flow must always be lower than the values stated in fig. 1 in the appendix.

The pumps are pressure-tested at a pressure of 1.5 times the values stated in fig. 1 in the appendix.

9.1.6 Minimum flow rate**WARNING****Too high pressure and leakage**

Death or serious personal injury

- Do not run the pump against a closed outlet valve.

Due to the risk of overheating, do not use the pump at flows below the minimum flow rate.

The curves below show the minimum flow rate as a percentage of the rated flow rate in relation to the liquid temperature.

--- = air-cooled top.

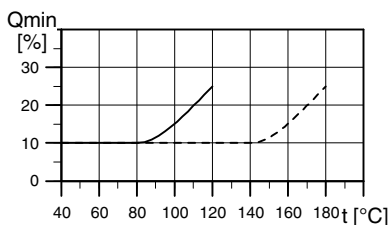


Fig. 22 Minimum flow rate

9.2 Electrical data

See the motor nameplate.

9.3 Dimensions and weights

Dimensions: See fig. 3 in the appendix.

Weights: See label on the packing.

9.3.1 Sound pressure level

See fig. 4 in the appendix.

10. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

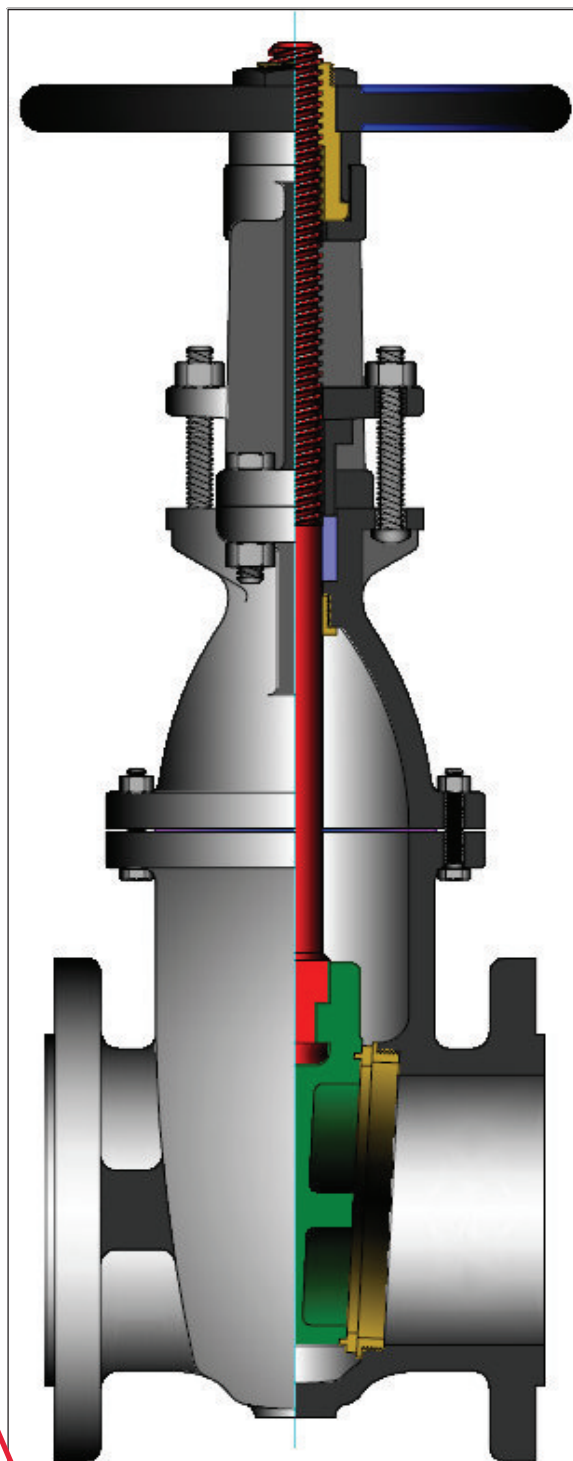
1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

See also end-of-life information at www.grundfos.com/product-recycling.

TM01 2816 2302



MSS SP-70 GATE VALVE
BOLTED BONNET, FLANGED ENDS
2 TO 24" (50 TO 600 mm) CLASSES 125 TO 250
CAST IRON OR 3% NICKEL IRON RISING STEM



Class	Trim	Fig. No.
125	Bronze	1793
	Iron	1816
	T316 SS	1893
250	Bronze	1797

STANDARD MATERIALS

FIGURE NUMBER		1793	1797	1816	1893
CLASS		125	250	125	125
PART		MATERIALS			
Body		A126-B			3% Nickel
Bonnet		A126-B			3% Nickel
Yoke		A126-B			A126-B
Wedge		A126-B			3% Nickel
Wedge Seat Ring		B62	-	A351-CF8M	
Body Seat Ring		B62	-	A351-CF8M	
Stem		B16	A276-410	A276-316	
Stem Bushing		B62			
Stem Bushing Lock Nut		A536			
Gland Flange		A536			
Gland Flange Bolt		A307-A			
Gland Flange Nut		A563-A			
Gland		B62	A126-B		
Packing		Non-Asbestos			
Gasket		Non-Asbestos			
Backseat Ring	2 - 12"	B62	A276-410	316 SST	
	14 - 24"	B16			
Hand Wheel		A126-B or A536			
Hand Wheel Nut		A536			
Body / Bonnet Stud		A307-A			
Body / Bonnet Nut		A563-A			
Bonnet / Yoke Bolt		A307-A			
Bonnet / Yoke Nut		A563-A			

Design Specifications

Item	Applicable Specification
Wall thickness	ASME B16.1
Pressure - temperature ratings	MSS SP-70
General valve design	MSS SP-70 Type I
End to End dimensions	ASME B16.10
Flange design	ASME B16.1
Materials	ASTM

DESIGN FEATURES:

- **Seat faces** lapped for smooth finish and superior sealing.
- **Stems** are non-rotating with surface finish to optimize packing seal.
- **Each valve** is shell and seat pressure tested per industry standard MSS SP-70.
- **Gland** is two piece gland / gland flange design for optimal alignment and uniform packing compression.
- **Renewable** seat rings.
- **Body** has 5 tapping bosses.
- **Solid** wedge design
- **Class 125** have flat faced end flanges, class 250 has raised face end flanges.

GATE VALVE DIMENSIONS (CLASSES 125 & 250).

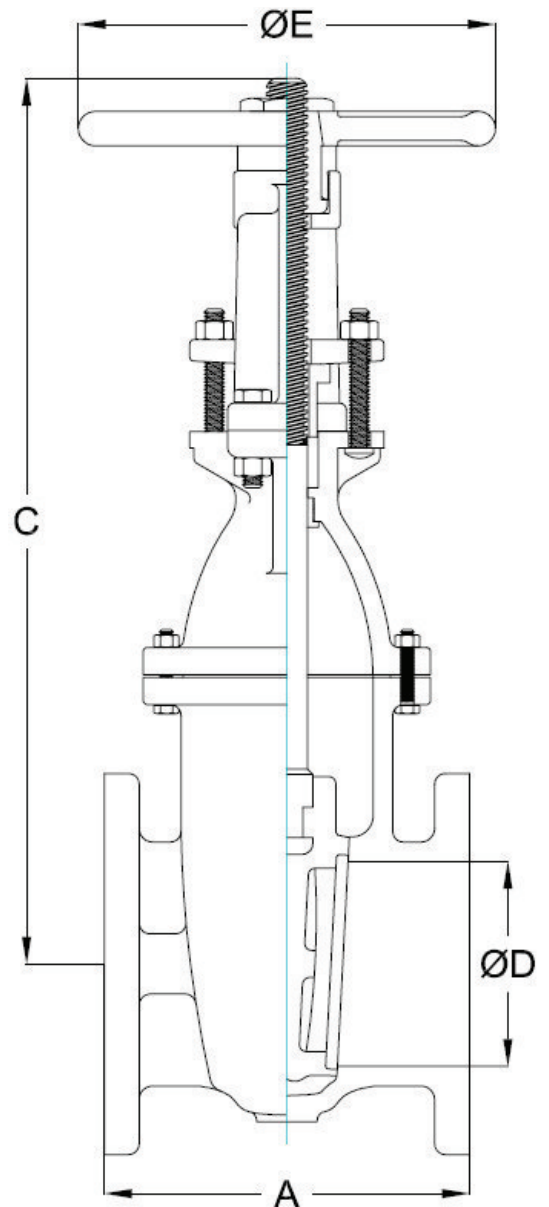
SIZE	FIG 1793, 1816, & 1893				FIG 1797			
	A	C	D	E	A	C	D	E
in								
mm								
2	7.00	14.7	2.00	7.0	8.50	15.0	2.00	7.0
50	178	374	51	178	216	382	51	178
2½	7.50	16.7	2.50	7.0	9.50	17.1	2.50	8.0
65	191	423	64	178	241	434	64	203
3	8.00	18.9	3.00	8.0	11.13	19.4	3.00	10.0
80	203	479	76	203	283	492	76	254
4	9.00	23.4	4.00	10.0	12.00	23.6	4.00	12.0
100	229	595	102	254	305	600	102	305
5	10.00	27.7	5.00	12.0	15.00	27.9	5.00	12.0
125	254	704	127	305	381	709	127	305
6	10.50	32.2	6.00	12.0	15.88	32.4	6.00	14.0
150	267	819	152	305	403	824	152	356
8	11.50	39.5	8.00	14.0	16.50	40.6	8.00	16.0
200	292	1002	203	356	419	1030	203	406
10	13.00	48.2	10.00	16.0	18.00	49.0	10.00	18.0
250	330	1223	254	406	457	1246	254	457
12	14.00	56.1	12.00	18.0	19.75	56.8	12.00	20.0
300	356	1424	305	457	502	1442	305	508
14	15.00	62.5	14.00	20.0				
350	381	1586	356	508				
16	16.00	71.1	16.00	22.0				
400	406	1805	406	559				
18	17.00	79.0	18.00	24.0				
450	432	2007	457	610				
20	18.00	87.1	20.00	24.0				
500	457	2213	508	610				
24	20.00	100.5	24.00	30.0				
600	508	2553	610	762				

SIZE	FIG 1793, 1816, & 1893			FIG 1797		
	WT	lb	C _v	WT	lb	C _v
in		kg			kg	
mm						
2	36		240	53		240
50	16			24		
2½	48		390	70		390
65	22			32		
3	60		560	102		560
80	27			46		
4	103		1000	157		1000
100	47			71		
5	143		1600	198		1600
125	65			90		
6	186		2400	259		2400
150	84			117		
8	298		4500	451		4500
200	135			205		
10	441		7000	649		7000
250	200			294		
12	628		10500	913		10500
300	285			414		
14	880		14300			
350	399					
16	1166		18600			
400	529					
18	1467		24500			
450	665					
20	1824		30300			
500	827					
24	2618		43600			
600	1188					

C = Center to top open

WT = Weight

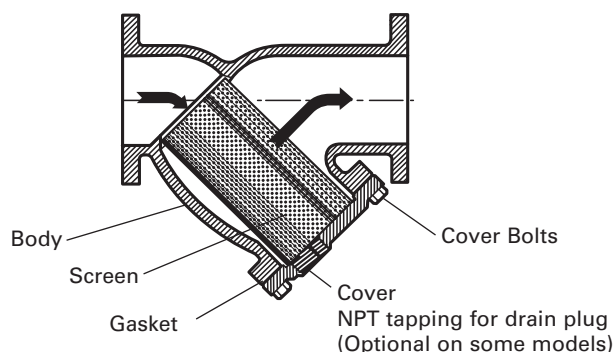
C_v = Flow Coefficient



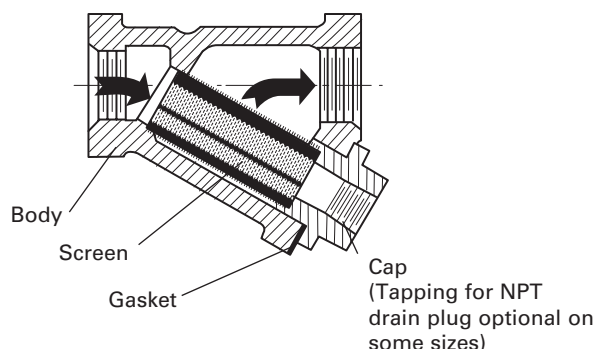
Installation, Operation and Maintenance

"Y" Strainers

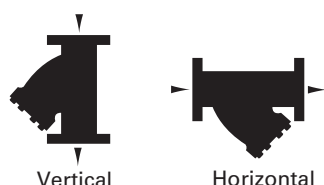
Typical flanged end "Y" strainer



Typical threaded "Y" strainer



Mounting Positions



The cover of the "Y" side should face down

Before installing the "Y" strainer, be sure its pressure rating is correct for the system. If the end connections are threaded or designed for soldering or brazing, be sure the piping is straight and not at an angle or offset. If the strainer has flanged ends, be sure the flanges of the connecting piping are square with the pipe so that no undue stresses are put on the strainer or piping when tightening flange bolts. Tighten in sequence, crossing to opposites.

For maximum efficiency, a differential pressure gauge installed across the inlet and outlet will indicate pressure loss due to clogging and may be used as a guide to determine when cleaning is required. Normally, when differential pressure reaches 5–10psi, screen must be cleaned. If the strainer is equipped with a blow-down valve, open and flush out until any sediment is removed. If the strainer is not fitted for blow-down cleaning, (strainer must be off line), remove the cover or cap and clean the screen. Reinstall the screen in the strainer in the same position as before and tighten cover or cap. Replace the gasket if necessary.

Keeping a spare, clean screen will minimize shut down time.

Warning

Individuals performing removal and disassembly should be provided with suitable protection from possibly hazardous liquids.

Note: Large size "Y" strainers are supplied with Breech-Lok screens. To remove screen, rotate screen 45°, Breech-lok will disengage.

Spare Parts

To order replacement screens or gaskets, which are the only items normally required, you should specify the following:

- A. Size and model number of strainer or casting number as it appears on the body of the strainer
- B. Specify the type of service. For example: water, steam, gas, oil, air. The working pressure and temperature of the system and the particle size to be strained out should also be specified.

CALIFORNIA PROPOSITION 65 WARNING

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. (California law requires this warning to be given to customers in the State of California.)

For more information: www.watts.com/prop65

Limited Warranty: Mueller Steam Specialty warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. This shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** Any implied warranties that are imposed by law are limited in duration to one year.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights.



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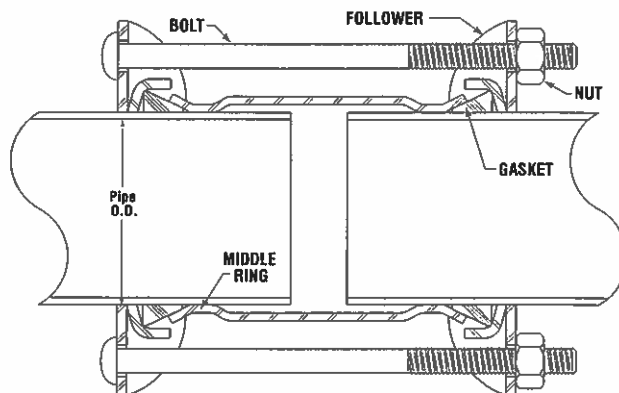
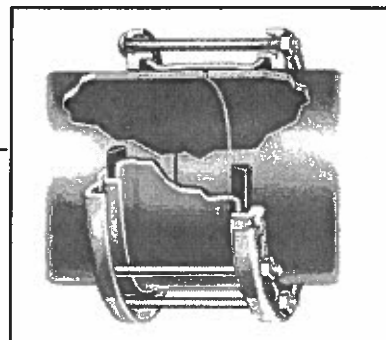
A Watts Water Technologies Company

DRESSER®

Engineering Data

The basic working principle of a Dresser coupling...

The cutaway view at right shows the basic components of a **Dresser** coupling consisting of one cylindrical middle ring, two follower rings, two resilient gaskets of special Dresser compound and a set of steel trackhead bolts. The middle ring has a conical flare at each end to receive the wedge portion of the gaskets. The follower rings confine the outer ends of the gaskets. Tightening the bolts draws the follower rings toward each other, compressing the gaskets in the spaces formed by follower rings, middle ring flares and pipe surface. This produces a flexible, leak-proof seal.



Basic Dresser Style 38 Coupling Components

Torque Recommendations

Bolt torque recommendations are listed on all Dresser Installation Instructions as supplied with each product. The use of torque wrenches facilitates uniform tightening of all bolts to proper torque ensuring the coupled joint seals as required.

Dresser Coatings

AL-CLAD™ Epoxy Coating

Dresser fusion-bonded, grey epoxy coating has outstanding physical properties and can be utilized in many piping system applications due to such features as:

- High coating dielectric strength.
- Excellent disbondment resistance in cathodically protected systems.
- Resistant to soil stress and fungi.
- Excellent adhesion in an oven-cured factory application.

All constituents of the cured film are FDA approved for exposure to fluids for human consumption and provide an excellent coating for use on components of cathodic protected distribution systems. Thermoset epoxy coatings meet DOT and Federal regulation 192.461. Please consult the factory for special line content applications.

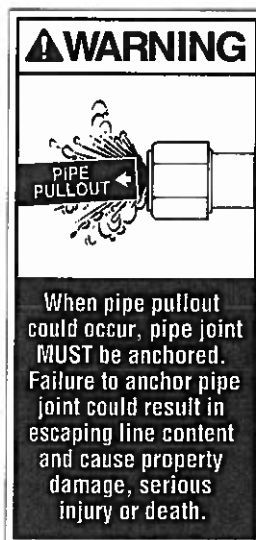
Dresser Shopcoat

Dresser Shopcoat provides a suitable base over which primers and final coatings can be applied. Dresser shopcoat provides a smooth, clean, non-greasy, non-sticky surface and protects all products from corrosion in normal storage situations. It is compatible with primer and enamel coatings of either hard or soft grades of plasticized or unplasticized coal tar enamels, and with asphalt coatings. For above

ground, Dresser Shopcoat will take most of the usual types of paint, including paints with color added, without bleeding through.

Field Coatings

Field coating of Dresser coupled joints in underground service is usually done with the same type of coating used on the pipe itself. Application instructions and recommendations of the firm supplying the coating should be followed. Contact Dresser engineering department for assistance with your coating solution requirements.



DRESSER®

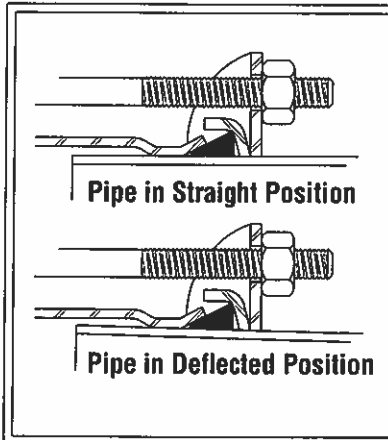
Coupling deflection, movement, expansion and contraction

Laying out curves with standard Dresser couplings and straight sections of pipe

Presented in tabular form in the table at right entitled "Radius of Curve and Deflection of Pipe in Feet", this chart indicates (1) radius of circle for any given degrees of deflection and pipe length, (2) length of pipe for any given radius and deflection or (3) degrees deflection necessary for any given pipe length and radius. This information is worked out for the more commonly used pipe lengths and degrees deflection.

RADIUS OF CURVE AND DEFLECTION OF PIPE IN FEET												
Length of Pipe Sec. (feet)	Radius of Curve (Feet)						Deflection of Pipe (Feet)					
	Varying degrees deflection in each coupling						Varying degrees deflection in each coupling					
	1°	2°	3°	4°	5°	6°	1°	2°	3°	4°	5°	6°
6	344	172	115	84	66	57	0' 1/4	0' 2-1/2	0-3-3/4	0' 5	0' 6-1/4	0-7-1/2
12	687	344	229	172	138	114	0' 2-1/2	0' 5	0' 7-1/2	0' 10	1' 5/8	1' 3
16	916	458	306	229	183	153	0' 3-3/8	0' 6-3/4	0' 10	1' 1-1/2	1' 4-3/4	1' 8
18	1031	516	344	258	206	172	0' 3-3/8	0' 7-1/2	0' 11-1/4	1' 3-1/8	1' 6-7/8	1' 10-1/2
20	1145	573	382	286	229	191	0' 4-1/4	0' 8-3/8	1' 5/8	1' 4-3/4	1' 8-7/8	2' 1
30	1718	860	573	430	344	286	0' 6-1/4	1' 5/8	1' 6-7/8	2' 1	2' 7-7/8	3' 1-5/8
40	2291	1146	764	573	458	382	0' 8-3/8	1' 4-3/4	2' 1	2' 9-1/2	3' 5-7/8	4' 2-1/8

Maximum Recommended Laying Deflection Dresser Style 38 Couplings			
From 3/8" ID to 2" ID Inclusive: 6°			
From 2" ID to 14" OD Inclusive: 4°			
With Middle Ring Lengths:	5"	7"	10"
14" OD - 20" OD Inclusive	2-1/2°	4°	4°
20" OD - 30" OD Inclusive	2°	4°	4°
30" OD - 37" OD Inclusive	1-1/2°	3°	3-1/2°
37" OD - 42" OD Inclusive		2-1/2°	3-1/2°
42" OD - 49" OD Inclusive		2°	3°
49" OD - 54" OD Inclusive		2°	3°
54" OD - 66" OD Inclusive		2°	2-1/2°
66" OD - 78" OD Inclusive			2°
78" OD - 90" OD Inclusive			1-1/2°

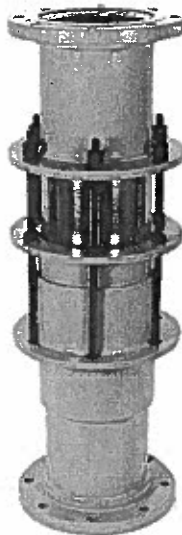


WARNING

When pipe pullout could occur, pipe joint **MUST** be anchored. Failure to anchor pipe joint could result in escaping line content that could cause property damage, serious injury or death.

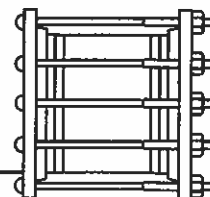
Expansion & Contraction

Each Dresser coupling 10" ID and larger will safely accommodate up to 3/8" longitudinal pipe movement. This is equivalent to the amount of movement resulting from a 120° temperature variation in a 40-foot length of steel pipe. If pipe is not buried, anchorage should be provided to prevent excessive accumulation of movement. For repeated movements such as on a bridge or above ground, or if expansion exceeds 3/8" per joint, a Dresser expansion joint should be used.



Dresser Style 63
Expansion Joint

DRESSER



How to specify pipe ends for Dresser couplings

How to Specify Ends* on Steel Pipe

On orders and in specifications, the ends on steel pipe to be used with Dresser couplings may be specified briefly as follows:

- The pipe shall be furnished with plain ends for Dresser couplings in accordance with A.W.W.A. (American Water Works Association) Steel Water Pipe Specifications.

If specifications are to be detailed, the following may be used:

For pipe above 5" OD to 10-3/4" OD inclusive:

- The pipe shall be sufficiently free from indentations, projections or roll marks for a distance of 8" from the end of the pipe to make a tight joint with the rubber-gasket type of coupling. The outside diameter of the pipe shall not be more than 1/64" smaller than the nominal outside diameter for a distance of 8" from the end of the pipe and shall permit the passing for a distance of 8" of a ring gauge which has a bore 1/16" larger than the nominal outside diameter of the pipe. The minimum outside pipe diameter shall be determined by the use of a steel tape circumferentially applied to prevent the shipment of undersize, out-of-round pipe which, if measured diametrically through the maximum diameter or checked with a No-Go ring gauge, might appear within the specified tolerance.

For pipe larger than 10-3/4" OD:

- The pipe shall be sufficiently free from indentations, projections or roll marks for a distance of 8" from the end of the pipe to make a tight joint with the rubber-gasket type of coupling. The outside diameter of the pipe shall not be more than 1/32" smaller than the nominal outside diameter for a distance of 8" from the end of the pipe and shall permit the passing for a distance of 8" of a ring gauge which has a bore 3/32" larger than the nominal outside diameter of the pipe. The minimum outside pipe diameter shall be determined by the use of a steel tape circumferentially applied to prevent the shipment of undersize, out-of-round pipe which, if measured diametrically through the maximum diameter or checked with a No-Go ring gauge, might appear within the specified tolerance.

*While Dresser couplings require only plain-end pipe, other kinds of pipe ends (such as threaded, beveled or grooved) can be used if such pipe is already on hand.

How to Specify Ends on Cast/Ductile Iron Pipe

On orders and in specifications, the ends on cast or ductile iron pipe to be used with Dresser couplings may be specified briefly as follows:

- The pipe shall be furnished with plain ends for Dresser couplings in accordance with A.W.W.A. (American Water Works Association) specifications on tolerances.

If further specifications are desired, the following may be added:

- The pipe shall be smooth and round for a distance of 8" from each end. The maximum plus or minus variation from nominal outside diameters for each size shall not exceed dimensions as shown in chart at right.

- The maximum outside pipe diameter shall be such as to permit the passing of a ring gauge having an internal bore not greater than .01" larger than the maximum allowable outside diameter of the pipe.

This ring gauge shall go over the end of the pipe for a distance of 8"

for all sizes up to and including 24" and for a distance of 12" on sizes above 24".

Size	Maximum Variation
3" - 16"	.06"
18" - 24"	.08"
30" - 42"	.10"
48"	.12"
54" - 60"	.15"

- The minimum outside diameter shall be determined by use of a steel tape circumferentially applied to prevent the shipment of undersized, out-of-round pipe which, if measured diametrically through the maximum diameter or checked with a No-Go ring gauge, might appear within the specified tolerance.

Methods of Supporting Coupled Lines

Shown below are three options for supporting pipeline connections when using Dresser couplings. **Figure A** shows the offset method near the pipe joint for diameters 6" and smaller with pipe lengths up to 20 feet. Suitable for any pressure providing pipe is anchored to support for high pressure. **Figure B** indicates the center-type support for diameters from 6" to 16" and lengths not over 20 feet.

This method is suitable for pressures up to 25 lb. maximum with pipe fully anchored to supports.

Figure C shows the "Two & One" method for all sizes and any length of pipe up to 40 feet. Suitable for any pressure providing pipe is adequately anchored. When utilizing this method each length of pipe must be anchored to one (and ONLY one) support.

Fig. A
Offset

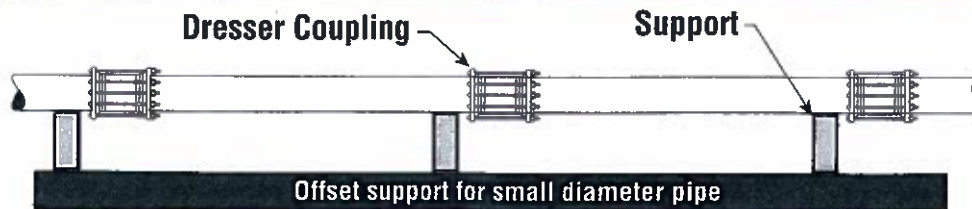


Fig. B
Center Type

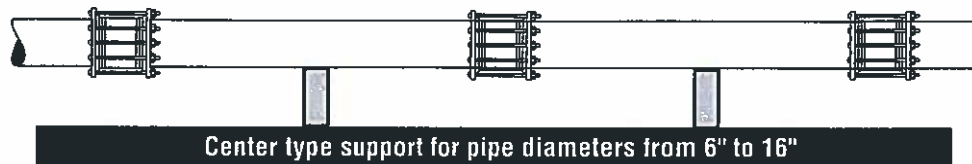
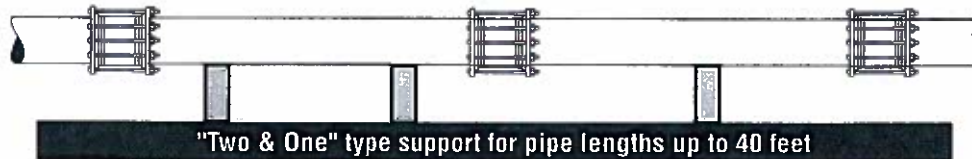


Fig. C
Two & One



DRESSER MANUFACTURING DIVISION, DRESSER INDUSTRIES, INC., BRADFORD, PA.

FORCES TO CAUSE PIPE DEFLECTION IN A DRESSER COUPLING

No. G-356

REV. A

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DRAWN BY

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APPROVED BY

DATE

SCALE

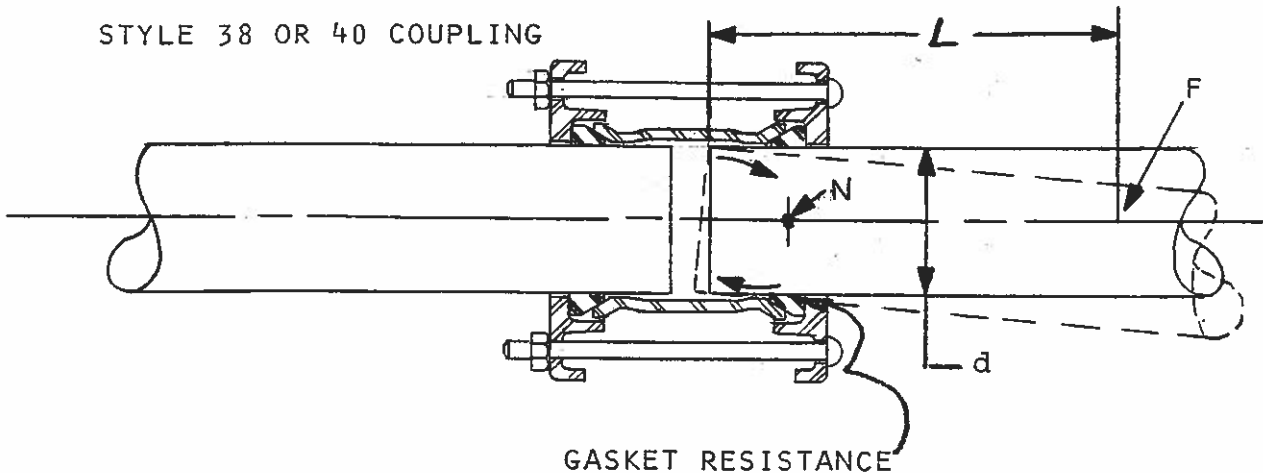
NO. SHEETS

FILE NO.

2/10/71

223-G

STYLE 38 OR 40 COUPLING



$$Gr = \frac{Rd \times d}{2}$$

F = FORCE ACTING ON PIPE TO PRODUCE DEFLECTION

L = LEVER ARM - DISTANCE FROM POINT OF APPLICATION OF "F" TO COUPLING CENTERLINE

d = PIPE DIAMETER

Gr = RESISTANCE OF GASKET TO SLIPPAGE

*R = 1000

*AS THE PIPE ROTATES ABOUT A CENTER "N", NO SLIPPAGE OR SHEAR FORCES EXIST AT THIS POINT. THE FORCE "F" IS AN AVERAGE OF THE 1000# PER INCH OF DIAMETER MULTIPLIED BY THE PIPE DIAMETER DIVIDED BY 2.

EXAMPLE: FOR A LEVER ARM OF 8 FT. AND A 20" O.D. COUPLED JOINT, THE FORCE "F" TO CAUSE DEFLECTION IS:

$$F \times L = Gr$$

$$F \times 96 = \frac{(20 \times 1000) \times 20}{2}$$

$$F = \frac{400,000}{192}$$

$$F = 2,083 \text{ LBS.}$$

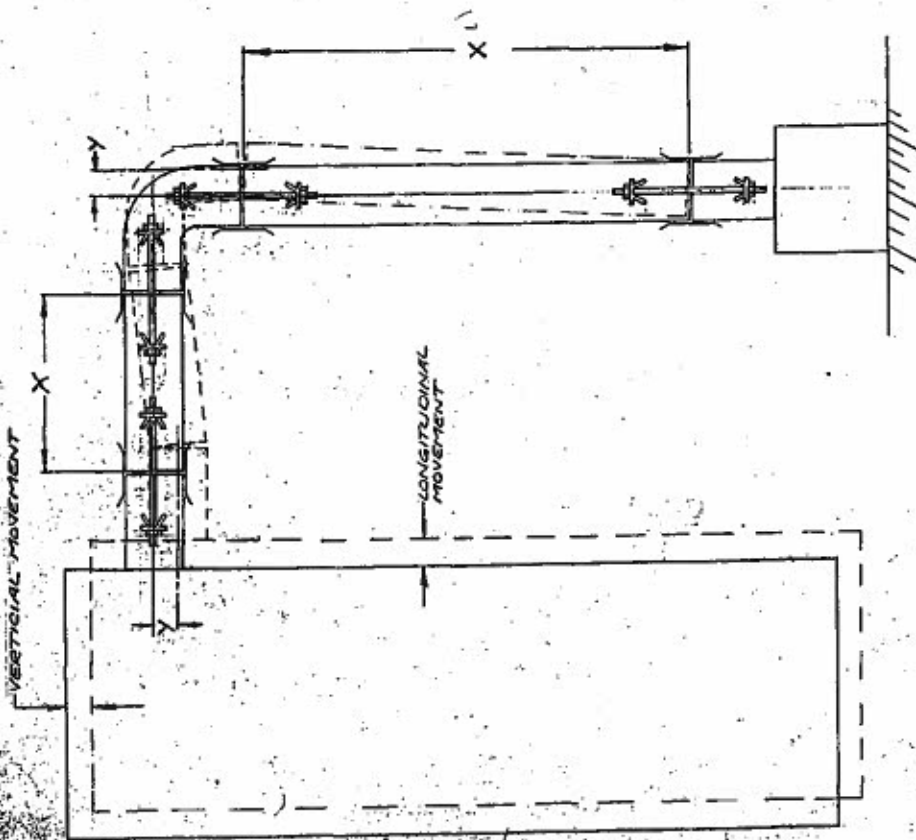
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DATE 5 BY AJP

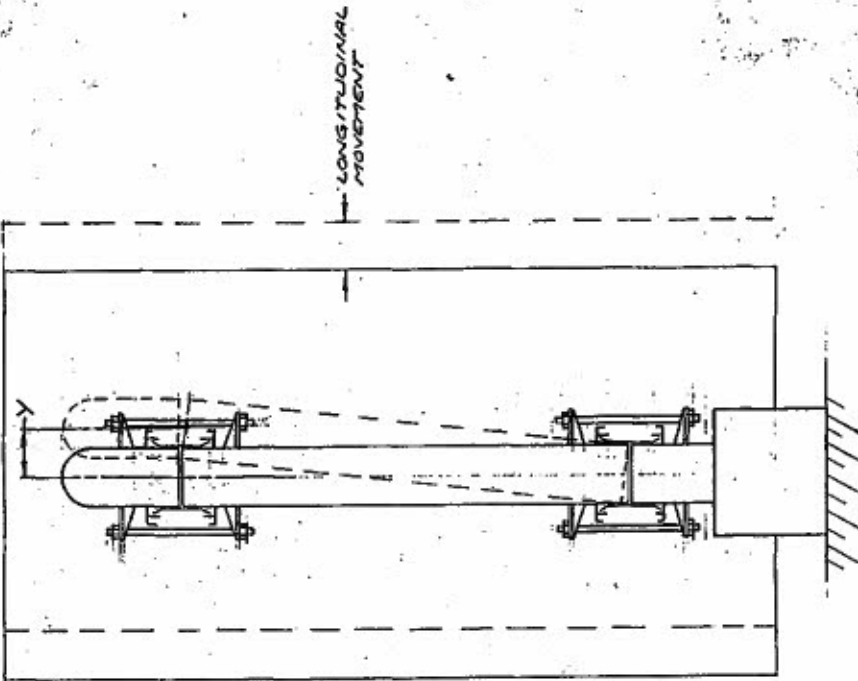
REVISIONS

REV. SEE RECORD PRINT	10/1/72	A	JJC	ELA
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FOR ALLOWABLE COUPLING ANGLE OF DEFLECTION SEE LATEST DRESSER CATALOG.



$X = \text{SINE OF ALLOWABLE COUPLING ANGLE OF DEFLECTION}$



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REVISIONS	DATE	BY	APP

LATERAL MOVEMENT OF PIPES FITTED WITH DRESSER STYLE 38 COUPLINGS
 DRESSER MANUFACTURING DIVISION,
 DRESSER INDUSTRIES, INC., BRADFORD, PA.

DATE 9-12-62
 FILE NO. 223-G
 DWG. NO.
 REV.
 G-270

PR 6207-543

SA 1000 BARBERS A-3 SURVIVOR OF 100-74

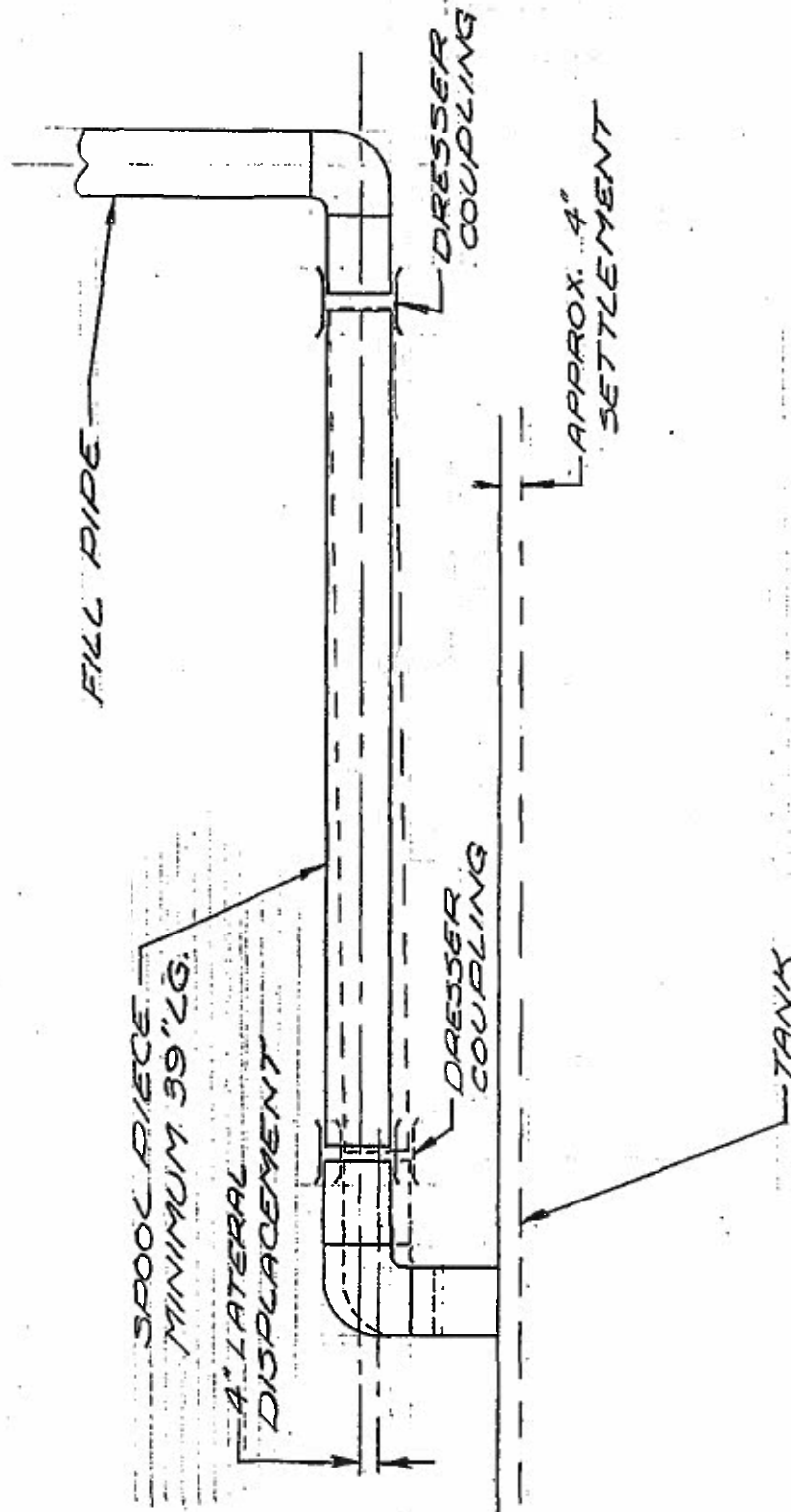
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REVISIONS	DATE	BY	APP

DRESSER MANUFACTURING DIVISION, DRESSER INDUSTRIES, INC., BRADFORD, PA.

ACCOMMODATING SETTLEMENT WITH DRESSER COPLS. No. **G-265**

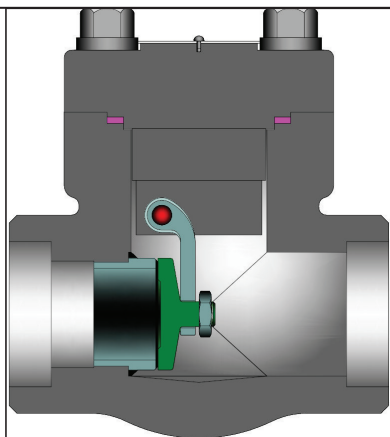
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STDS	RTH	<i>[Signature]</i>		2-2-62	NONE		



SPPOOL PIECE
MINIMUM 39" LG.

4" LATERAL
DISPLACEMENT

FOR CUSTOMER APPROVAL



Class	Bore	Fig. No.
150	Standard	SW01
	Full	SWL1
300	Standard	SW03
	Full	SWL3
600	Standard	SW06
	Full	SWL6
800	Standard	SW08
	Full	SWL8
1500	Standard	SW15
	Full	SWL5
1680	Standard	SW16
2500	Standard	SW25
2690	Standard	SW26

DESIGN FEATURES:

- **Standard trim** is stellite faced seat rings and 13% chrome disc (API trim 8). Other trims available on request.
- **Seat faces** lapped for smooth finish and superior sealing.
- **Wall thickness** per heavy wall API 602 requirements.
- **Swivel disc** for improved seat alignment and longer life.
- **Each valve** is shell and seat pressure tested per industry standard API 598.
- **Check valve** are suitable for service in horizontal line with cap vertical or in a vertical line with flow upward.
- **Carrier Pin** is confined within the body wall and is not accessible from the exterior, thus no side body penetrations, eliminating a common leak path.
- **End Flanges** have the following raised faces per ASME B16.5:
Classes 150-300: 1/16" (2mm).
Classes 600: 1/4" (7mm).

STANDARD MATERIALS (Other materials available)

PART	MATERIALS			
Body	A105	A182 F11	A182 F22	A182 F316 (1)
Cap	A105	A182 F11	A182 F22	A182 F316
Disc	A276 T420			A276 T316
Seat Ring	SST 410 + Stellite 6 Faced			316 SST
Gasket (2)	Spiral Wound SST with Graphite			Spiral Wound SST with PTFE
Carrier	304 SST			316 SST
Carrier Pin	304 SST			316 SST
Disc Nut	A182 F304 or A194 Gr. 8			A182 F316 or A194 Gr. 8M
Body / Cap Bolting (2)	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8M
Identification Plate	Series 300 SST			

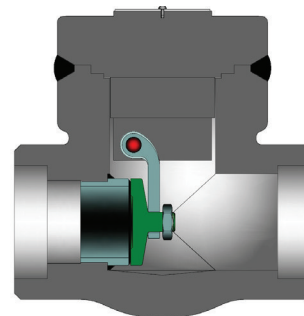
- (1) Threaded and weld end valve bodies A182 F316L
- (2) Welded bonnets also available.

NOTE: See page 51 for flow, safety and maintenance information.

Design Specifications

Item	Applicable Specification
Wall thickness	API 602
Pressure - temperature ratings	ASME B16.34
General valve design	API 602 & B16.34
End to End dimensions	ASME B16.10
Flange design	ASME B16.5
Thread design	ASME B1.20.1
Butt Weld design	ASME B16.25
Socket Weld design	ASME B16.11
Materials	ASTM

- **Other** available options as follows:
-Alternate valve materials such as chrome and stainless steel alloys
-Alternate trim materials
-NACE service
-Special cleaning for applications such as oxygen or chlorine
-Other options available as specified



Welded Bonnet Design

SWING CHCK VALVE DIMENSIONS (CLASS 150—800).

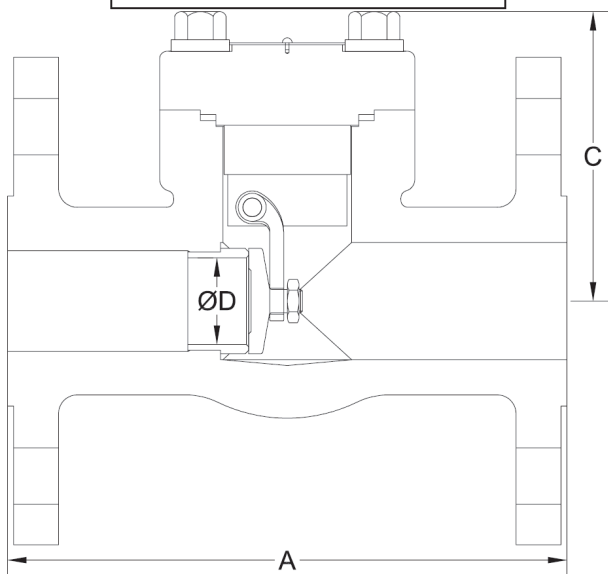
SIZE	ASME 150			ASME 300			ASME 600		
	Bolted Bonnet			Bolted Bonnet			Bolted Bonnet		
	Standard Bore			Standard Bore			Standard Bore		
in	A	C	D	A	C	D	A	C	D
mm	FE			FE			FE		
½	4.25	2.2	0.39	6.00	2.2	0.39	6.50	2.2	0.39
13	108	55	10	152	55	10	165	55	10
¾	4.62	2.2	0.50	7.00	2.2	0.50	7.50	2.2	0.50
19	117	55	13	178	55	13	190	55	13
1	5.00	2.8	0.69	8.00	2.8	0.69	8.50	2.8	0.69
25	127	72	18	203	72	18	216	72	18
1¼	5.50	3.2	0.91	8.50	3.2	0.91	9.00	3.2	0.91
32	140	81	23	216	81	23	229	81	23
1½	6.50	3.6	1.12	9.00	3.7	1.12	9.50	3.7	1.12
38	165	91	29	229	94	29	241	94	29
2	8.00	4.4	1.26	10.50	4.4	1.38	11.50	4.4	1.38
50	203	112	32	267	112	35	292	112	35

SIZE	ASME 800											
	Bolted Bonnet						Welded Bonnet					
	Standard Bore			Full Bore			Standard Bore			Full Bore		
in	A	C	D	A	C	D	A	C	D	A	C	D
mm	WE			WE			WE			WE		
¼	3.11	2.2	0.26	-	-	-	3.11	2.2	0.26	-	-	-
6	79	55	7	-	-	-	79	55	7	-	-	-
⅜	3.11	2.2	0.39	-	-	-	3.11	2.2	0.39	-	-	-
10	79	55	10	-	-	-	79	55	10	-	-	-
½	3.11	2.2	0.39	3.62	2.2	0.50	3.11	2.2	0.39	3.62	2.2	0.50
13	79	55	10	92	55	13	79	55	10	92	55	13
¾	3.62	2.2	0.50	4.37	3.0	0.69	3.62	2.2	0.50	4.37	3.0	0.69
19	92	55	13	111	72	18	92	55	13	111	72	18
1	4.37	3.0	0.69	4.72	3.2	0.91	4.37	3.0	0.69	4.72	3.2	0.91
25	111	72	18	120	81	23	111	72	18	120	81	23
1¼	4.72	3.2	0.91	4.72	3.7	1.12	4.72	3.2	0.91	4.72	3.7	1.12
22	120	81	23	120	94	29	120	81	23	120	94	29
1½	4.72	3.7	1.12	5.51	4.4	1.40	4.72	3.7	1.12	5.51	4.4	1.42
38	120	94	29	140	112	36	120	94	29	140	112	36
2	5.51	4.4	1.38	6.30	5.2	1.85	5.51	4.4	1.38	6.30	5.2	1.85
50	140	112	35	160	132	47	140	112	35	160	132	47

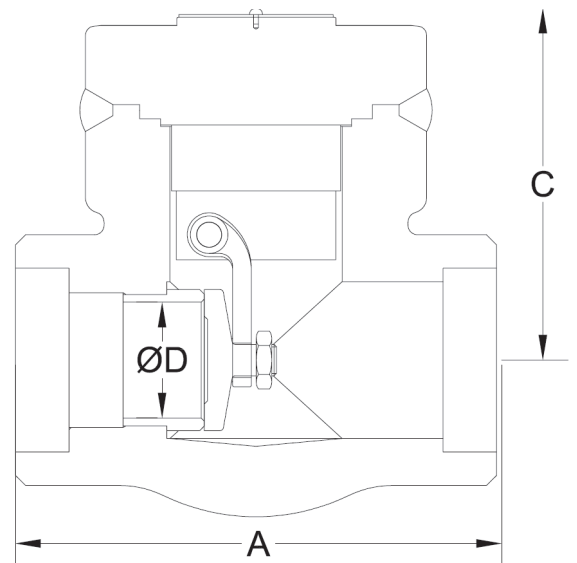
**ADDITIONAL MATERIALS
AND CLASSES AVAILABLE
UPON REQUEST.**

**WE = Socket Weld / Threaded Ends
FE = Flanged Ends**

C = Center to top

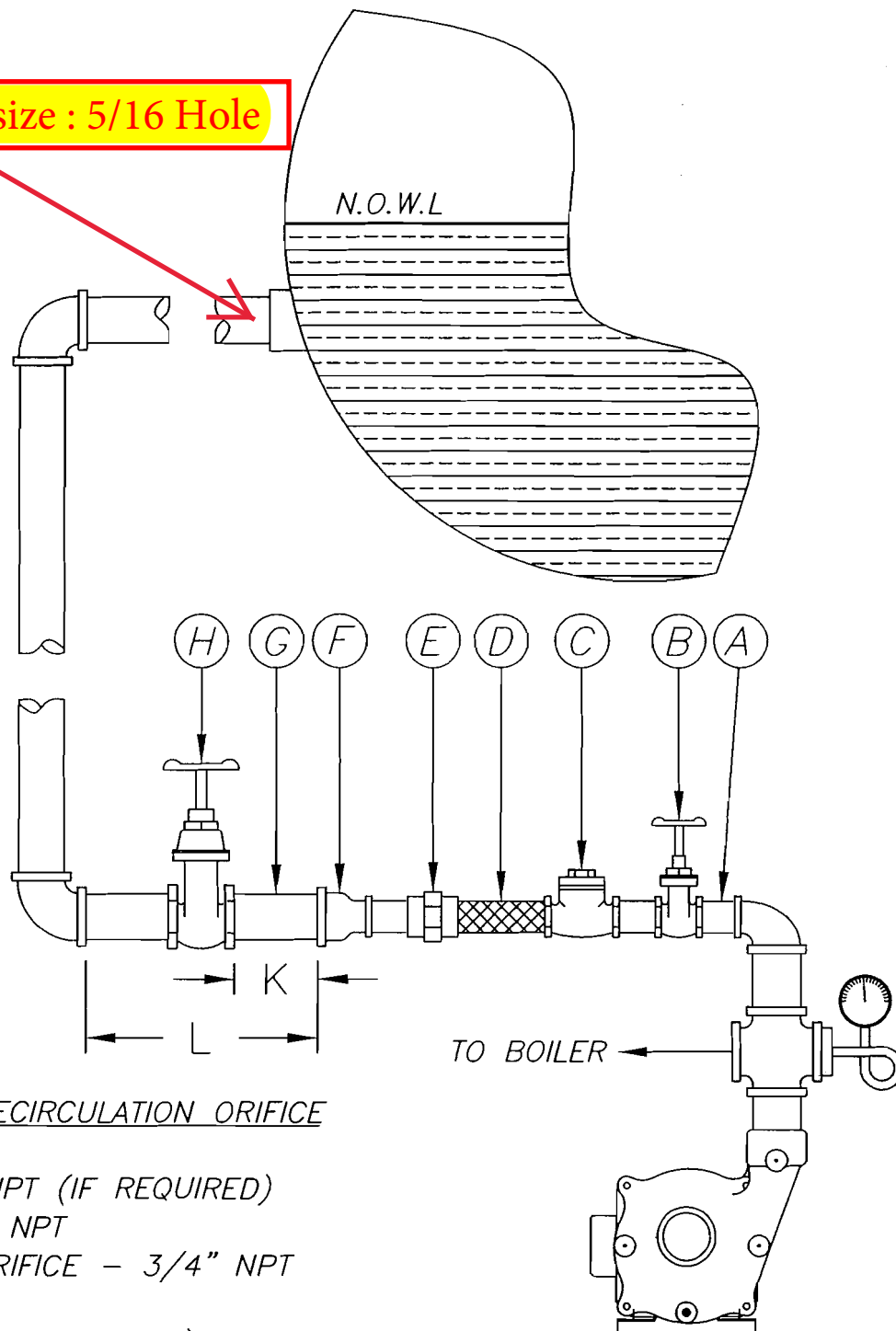


Bolted Bonnet Flanged Ends Design



Welded Bonnet Socket Weld Ends Design

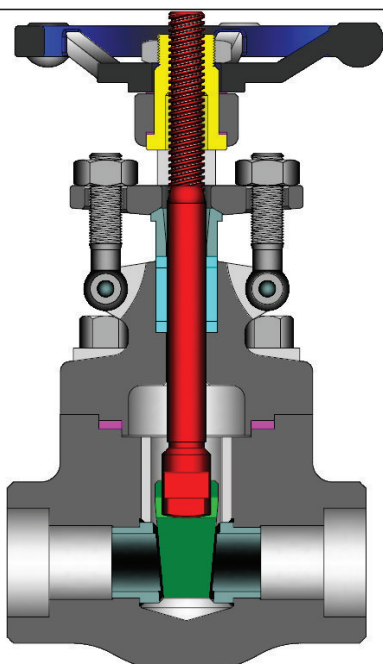
Recirculation Orifice size : 5/16 Hole



TYPICAL INSTALLATION— RECIRCULATION ORIFICE

- A. 3/4" PIPE
- B. GATE VALVE — 3/4" NPT (IF REQUIRED)
- C. CHECK VALVE — 3/4" NPT
- D. BFS RECIRCULATION ORIFICE — 3/4" NPT
- E. UNION — 3/4" NPT
- F. REDUCING COUPLING (IF REQUIRED)
- G. PIPING DOWNSTREAM OF ORIFICE SIZED FOR APPROXIMATELY 20' HEAD LOSS/100' PIPE
- H. GATE VALVE — SIZE = "G"
- J. TANK CONNECTION — SIZE = "G"
- K. AS CLOSE AS POSSIBLE
- L. MINIMUM DISTANCE BEFORE ANY BEND = 18"

bfs INDUSTRIES, LLC
BUTNER, NORTH CAROLINA



Class	Bore	Fig. No.
150	Standard	GA01
	Full	GAL1
300	Standard	GA03
	Full	GAL3
600	Standard	GA06
	Full	GAL6
800	Standard	GA08
	Full	GAL8
1500	Standard	GA15
	Full	GAL5
1680	Standard	GA16
2500	Standard	GA25
2690	Standard	GA26

DESIGN FEATURES:

- **Wedges** are accurately guided thru the entire stroke.
- **Standard trim** is stellite faced seat rings, 13% chrome wedge seat surfaces, and 13% chrome stem (API trim 8). Other trims available on request.
- **Seat faces** lapped for smooth finish and superior sealing.
- **Stems** are non-rotating with surface finish to maximize packing seal for low fugitive emissions.
- **Each** valve is shell, seat and back-seat pressure tested per industry standard API 598.
- **Gland** is two piece gland / gland flange design for optimal alignment and uniform packing compression.

STANDARD MATERIALS (Other materials available)

PART	MATERIALS			
Body	A105	A182 F11	A182 F22	A182F316 (1)
Bonnet	A105	A182 F11	A182 F22	A182 F316
Wedge	SST 420			A182 F316
Seat Ring	SST 410 + Stellite 6 Faced			SST 316
Stem	A182 F6a			A182 F316
Stem Bushing	A 439 Ductile NI-Resist Gr. D2			
Gland Flange	A105			Series 300 SST
Eye Bolt	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8M
Eye Bolt Nut	A194 Gr. 2H	A194 Gr. 7		A194 Gr.8M
Gland	SST 420			SST 316
Packing	Graphite			PTFE
Packing Washer / Packing Spacer	SST 410			SST 316
Gasket (2)	Spiral Wound SST with Graphite			Spiral Wound SST with PTFE
Hand Wheel	Malleable Iron or Steel			
Hand Wheel Nut	Malleable Iron or Steel			
Key	Steel			
Body / Bonnet Bolting (2)	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8M
Identification Plate	Series 300 SST			

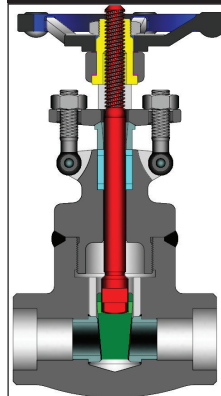
- (1) Threaded and weld end valve bodies A182 F316L
- (2) Welded bonnet design also available.

NOTE: See page 51 for flow, safety and maintenance information.

- **End Flanges** have the following raised faces per ASME B16.5:
Classes 150-300: 1/16" (2mm).
Classes 600: 1/4" (7mm).
- **Weld ends** are available per ASME B16.25/B16.11 or per customer's specification.
- **Extended** body ends available on gate valves.
- **Other** available options as follows:
-Alternate valve materials such as chrome and stainless steel alloys
-Alternate trim materials
-NACE service
-Special cleaning for applications such as oxygen or chlorine
-Other options available as specified.

Design Specifications

Item	Applicable Specification
Wall thickness	API 602
Pressure - temperature ratings	ASME B16.34
General valve design	API 602 & B16.34
End to End dimensions	ASME B16.10
Flange design	ASME B16.5
Thread design	ASME B1.20.1
Butt Weld design	ASME B16.25
Socket Weld design	ASME B16.11
Materials	ASTM

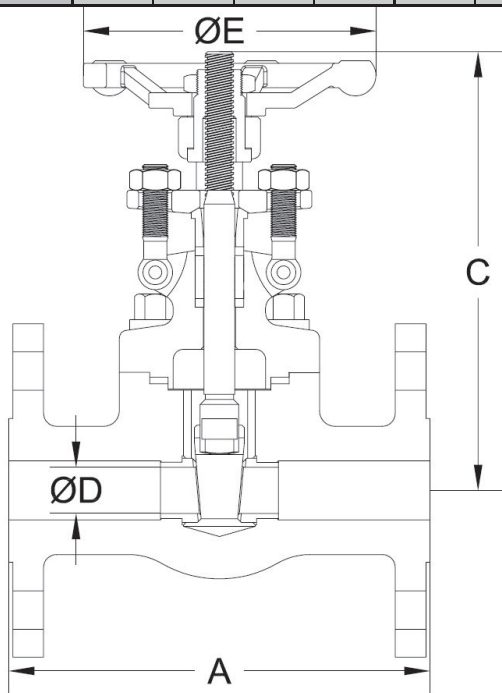


Welded Bonnet Design

GATE VALVE DIMENSIONS (CLASS 150—800).

SIZE	ASME 150				ASME 300				ASME 600			
	Bolted Bonnet				Bolted Bonnet				Bolted Bonnet			
	Standard Bore				Standard Bore				Standard Bore			
in	A	C	D	E	A	C	D	E	A	C	D	E
mm	FE				FE				FE			
½	4.25	6.0	0.50	3.9	5.50	6.0	0.50	3.9	6.50	6.0	0.50	3.9
13	108	153	13	100	140	153	13	100	165	153	13	100
¾	4.62	6.0	0.50	3.9	6.00	6.0	0.50	3.9	7.50	6.0	0.50	3.9
19	117	153	13	100	152	153	13	100	190	153	13	100
1	5.00	7.3	0.71	4.9	6.50	7.3	0.71	4.9	8.50	7.3	0.71	4.9
25	127	185	18	125	165	185	18	125	216	185	18	125
1¼	5.50	8.7	0.94	6.3	7.00	8.7	0.94	6.3	9.00	8.7	0.94	6.3
32	140	222	24	160	178	222	24	160	229	222	24	160
1½	6.50	9.4	1.14	6.3	7.50	9.4	1.14	6.3	9.50	9.4	1.14	6.3
38	165	240	29	160	190	240	29	160	241	240	29	160
2	7.00	11.0	1.46	7.1	8.50	11.0	1.46	7.1	11.50	11.0	1.46	7.1
50	178	279	37	180	216	279	37	180	292	279	37	180

SIZE	ASME 800															
	Bolted Bonnet								Welded Bonnet							
	Standard Bore				Full Bore				Standard Bore				Full Bore			
in	A	C	D	E	A	C	D	E	A	C	D	E	A	C	D	E
mm	WE				WE				WE				WE			
¼	3.11	5.9	0.31	3.9	-	-	-	-	3.11	6.2	0.31	3.9	-	-	-	-
6	79	149	8	100	-	-	-	-	79	157	8	100	-	-	-	-
¾	3.11	5.9	0.39	3.9	-	-	-	-	3.11	6.2	0.39	3.9	-	-	-	-
10	79	149	10	100	-	-	-	-	79	157	10	100	-	-	-	-
½	3.11	6.0	0.50	3.9	3.62	6.0	0.50	3.9	3.11	6.3	0.50	3.9	3.62	6.3	0.50	3.9
13	79	153	13	100	92	153	13	100	79	161	13	100	92	161	13	100
¾	3.62	6.0	0.50	3.9	4.37	7.3	0.71	4.9	3.62	6.3	0.50	3.9	4.37	7.5	0.71	4.9
19	92	153	13	100	111	185	18	125	92	161	13	100	111	190	18	125
1	4.37	7.3	0.71	4.9	4.72	8.7	0.94	6.3	4.37	7.5	0.71	4.9	4.72	8.7	0.94	6.3
25	111	185	18	125	120	222	24	160	111	190	18	125	120	220	24	160
1¼	4.72	8.7	1.14	6.3	4.72	9.4	1.14	6.3	4.72	8.7	1.14	6.3	4.72	9.4	1.14	6.3
22	120	222	29	160	120	240	29	160	120	220	29	160	120	240	29	160
1½	4.72	9.4	1.14	6.3	5.51	11.0	1.46	7.1	4.72	9.4	1.14	6.3	5.51	11.0	1.46	7.1
38	120	240	29	160	140	279	37	180	120	240	29	160	140	279	37	180
2	5.51	11.0	1.46	7.1	6.30	13.1	1.89	7.9	5.51	11.0	1.46	7.1	6.30	12.6	1.89	7.9
50	140	279	37	180	160	333	48	200	140	279	37	180	160	319	48	200

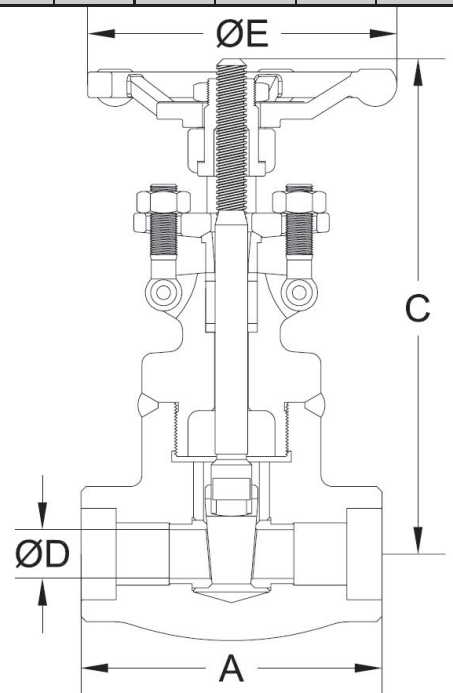


Bolted Bonnet Flanged Ends Design

**ADDITIONAL
MATERIALS AND
CLASSES
AVAILABLE UPON
REQUEST.**

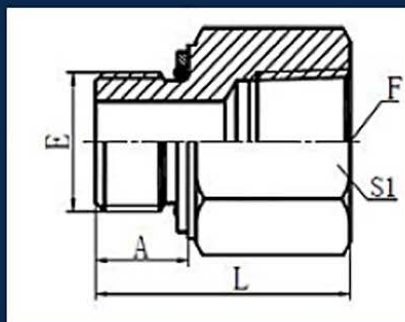
WE = Socket Weld /
Threaded Ends
FE = Flanged ends

C = Center to top open



Welded Bonnet Socket Weld Ends Design

BSP Male O-Ring/NPT Female
Material: Steel



Specifications

E - Thread	G1/2-14
F - Thread	Z1/2-14 NPT
A	14.0 mm
L	43 mm
S1	30 mm

Bourdon Tube Pressure Gauges Stainless Steel Series

Type 232.53 - Dry Case

Type 233.53 - Liquid-filled Case

WIKA Datasheet 23X.53

Applications

- With liquid filled case for applications with high dynamic pressure pulsations or vibration
- Suitable for corrosive environments and gaseous or liquid media that will not obstruct the pressure system
- Process industry: chemical/petrochemical, power stations, mining, on and offshore, environmental technology, mechanical engineering and plant construction

Product features

- Excellent load-cycle stability and shock resistance
- All stainless steel construction
- Positive pressure ranges to 15,000 psi (1,000 bar)

Specifications

Design

ASME B40.100 & EN 837-1

Sizes

2", 2½" & 4" (50, 63 and 100 mm)

Accuracy class

2" & 2½": ± 2/1/2% of span (ASME B40.100 Grade A)
4": ± 1.0% of span (ASME B40.100 Grade 1A)

Ranges

Vacuum / compound to 200 psi (16 bar)
Pressure from 15 psi (1 bar) to 15,000 psi (1,000 bar)
or other equivalent units of pressure or vacuum

Working pressure

2" & 2½":	Steady:	3/4 scale value
	Fluctuating:	2/3 full scale value
	Short time:	full scale value
4":	Steady:	full scale value
	Fluctuating:	0.9 x full scale value
	Short time:	1.3 x full scale value

Operating temperature

Ambient: -40°F to +140°F (-40°C to +60°C) - dry
-4°F to +140°F (-20°C to +60°C) - glycerine filled
-40°F to +140°F (-40°C to +60°C) - silicone filled
Medium: +212°F (+100°C) maximum



Bourdon Tube Pressure Gauge Model 232.53 - 2½"

Temperature error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% of span for every 18°F (10°K) rising or falling.

Weather protection

Weather tight (NEMA 4X / IP65)

Pressure connection

Material: 316 stainless steel
Lower mount (LM) or center back mount (CBM)
Lower back mount (LBM) for 4" size
1/8" NPT, 1/4" NPT or 1/2" NPT limited to wrench flat area

Bourdon tube

Material: 316 stainless steel
> 1,500 psi (100 bar): C-shape,
≤ 1,500 psi (100 bar): Helical type

Movement

Stainless steel

Dial

White aluminum with black lettering, 2" and 2½" with stop pin

Pointer

Black aluminum

Case

304 stainless steel with vent plug and SS crimp ring
Welded case / socket connection

Window

Polycarbonate

Liquid filling

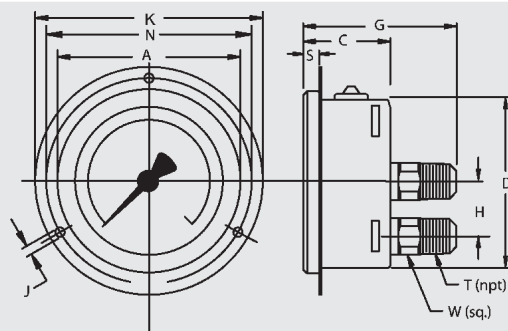
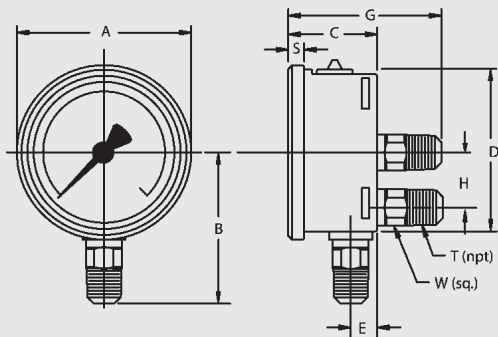
Glycerine 99.7% - Type 233.53

Optional extras

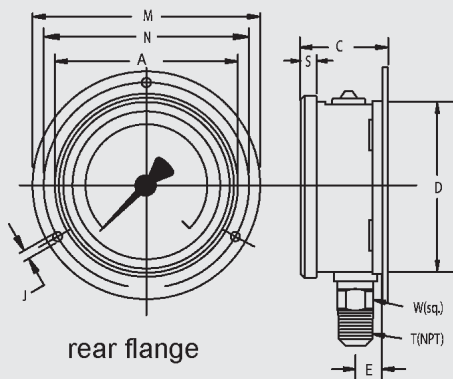
- SS restrictor
- SS front flange
- SS rear flange (2½" and 4" only)
- Zinc-plated steel or SS u-clamp bracket (field installable - see note)
- Cleaned for oxygen service
- Red drag pointer or mark pointer (2½" and 4" only)
- External zero adjustment (4" size only)
- Other pressure connections
- Silicone or Halocarbon Oil case filling
- Other pressure scales available:
bar, kPa, MPa, kg/cm² and dual scales

Note: U-clamp bracket for 2" must be ordered with gauge

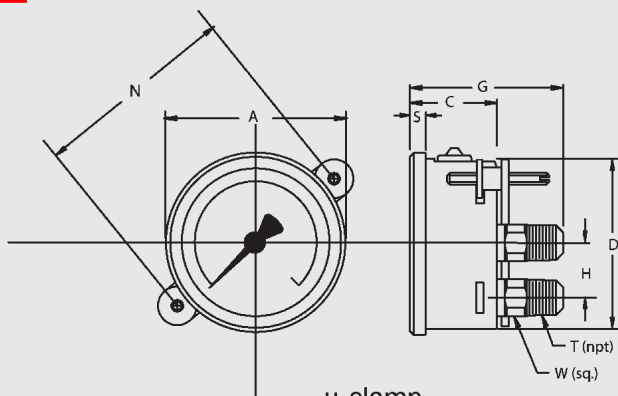
Dimensions



front flange



rear flange



u-clamp

Size		A	B	C	D	E	G	H	J	K	M	N	S	T	W	Weight
2"	mm	55	48	30	50	12	53	-	3.6	71	71	60	5.5		14	0.27 lb. dry
	in	2.17	1.89	1.18	1.97	0.47	2.09	-	0.14	2.80	2.80	2.36	0.22	1/4"	0.55	0.33 lb. filled
2.5"	mm	69	54	32	62	13	54	-	3.6	85	88.1	75	6.5		14	0.36 lb. dry
	in	2.69	2.13	1.26	2.45	0.51	2.13	-	0.14	3.35	3.47	2.95	0.26	1/4"	0.55	0.44 lb. filled
4"	mm	107	87	48	100	15.5	79.5	30	4.8	132	132	116	8		22	1.10 lb. dry
	in	4.21	3.43	1.89	3.91	0.61	3.13	1.18	0.19	5.20	5.20	4.57	0.31	1/2"	0.87	1.76 lb. filled

Recommended panel cutout is dimension D + 3 mm

Ordering information

Pressure gauge model / Nominal size / Scale range / Size of connection / Optional extras required
Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing.
Modifications may take place and materials specified may be replaced by others without prior notice.



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Accessories

PRESSURE GAUGES

Coil Syphons

885 Series Coil Syphons are designed for use on steam service to form a pocket of water between the pressure gauge and the process steam, thereby preventing the steam from reaching the bourdon tube of the pressure gauge. Trerice Coil Syphons are constructed of steel, brass, or 304 stainless steel with a 180° coil for use on a variety of requirements. Other materials and coil styles are available; consult factory.



885 Series Coil Syphons

Item No.	Material	Style	Connection Size (NPT)	Maximum Pressure (psig)	Maximum Temperature	Approximate Shipping Weight
885-1	Welded steel, schedule 40	180° coil	1/4	600	750°F	0.4 lbs [0.18 kg]
885-1.1	Welded steel, schedule 40	180° coil	1/2	800	650°F	1.4 lbs [0.64 kg]
885-2	Seamless brass, schedule 40	180° coil	1/4	250	406°F	0.4 lbs [0.18 kg]
885-3	Chrome plated brass, schedule 40	180° coil	1/4	250	406°F	0.4 lbs [0.18 kg]
885-4	Welded 304SS, schedule 40	180° coil	1/4	1300	650°F	0.4 lbs [0.18 kg]
885-4.1	Welded 304SS, schedule 40	180° coil	1/2	1000	650°F	1.4 lbs [0.64 kg]
885-6	Welded 316SS, schedule 40	180° coil	1/4	1300	650°F	0.4 lbs [0.18 kg]
885-6.1	Welded 316SS, schedule 40	180° coil	1/2	1000	650°F	1.4 lbs [0.64 kg]

Needle Valves

735/740 Series Needle Valves are of the rising stem type and are designed to shut off the flow of the process media to the pressure instrument, thereby allowing the instrument to be isolated from the pressure media or removed from service. Needle valves may also be used to throttle flow and aid in dampening pulsations. Trerice Needle Valves are constructed from brass, carbon steel and stainless steel for use on a variety of pressure media. **It is recommended to place a needle valve, ball valve or gauge cock in line before every pressure gauge installation.**



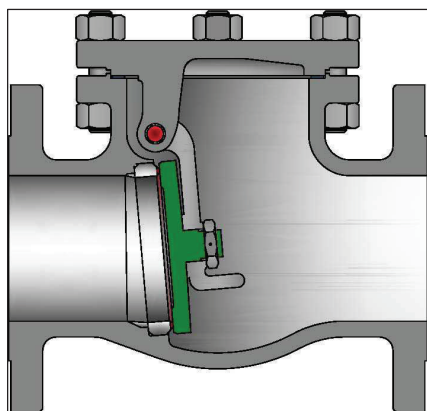
735/740 Series Needle Valves

Item No.	Type	Connection Size (NPT)	Body	Seat	Stem	Packing	Maximum Pressure (psig)	Maximum Temperature	Approximate Shipping Weight
735-2	F X F	1/4	Brass	Brass	Brass	Teflon	2000	300°F	0.3 lbs [0.14 kg]
735-4	F X F	1/4	Carbon steel	Teflon	316SS	Teflon	4000	500°F	0.3 lbs [0.14 kg]
735-8	F X F	1/4	316SS	316SS	316SS	Teflon	6000	500°F	0.3 lbs [0.14 kg]
735-9	M X F	1/4	316SS	316SS	316SS	Teflon	6000	500°F	0.3 lbs [0.14 kg]
740-3	F X F	1/2	Carbon steel	Carbon steel	316SS	Teflon	10,000	200°F	1.0 lbs [0.45 kg]
740-4	M X F	1/2	Carbon steel	Carbon steel	316SS	Teflon	10,000	200°F	1.3 lbs [0.59 kg]
740-9	M X F	1/2	316SS	Delrin	316SS	Teflon	6000	200°F	1.3 lbs [0.59 kg]
740-11	F X F	1/2	316SS	316SS	316SS	Teflon	10,000	200°F	1.0 lbs [0.45 kg]



API 600 WALL SWING CHECK VALVES
BOLTED BONNET, ASME CLASSES 150 TO 1500
CAST CARBON, STAINLESS STEEL OR ALLOY STEEL

STANDARD MATERIALS (Other materials available)



Class	Figure Number
150	1561
300	3061
600	6061
900	9061
1500	1361

PART	MATERIALS			
Body	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M (2)
Cap	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M
Disc	A105+13% CR Faced or WCB+13% CR Faced	WC6+Stellite 6 Faced	WC9+Stellite 6 Faced	A351 Gr. CF8M
Seat Ring	Carbon Steel + Stel- lite 6 Faced	A182 F11 + Stellite 6 Faced	A182 F22 + Stellite 6 Faced	316 SST
Gasket	Class 150: Corrugated SST Encapsulated w/ Graphite Class 300 to 600: Spiral Wound SST with Graphite Class 900-1500: RTJ			Class 150: PTFE Class 300-600: Spi- ral Wound SST with Graphite
Carrier	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M
Carrier Pin	SST 410			316 SST
Disc Nut	Series 300 SST			A193 Gr. B8M
Disc Carrier Hanger (1)	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M
Disc Carrier Hanger Bolts (1)	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8M
Body / Cap Stud	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8
Body / Cap Nut	A194 Gr. 2H	A194 Gr. 7		A194 Gr.8
Identification Plate	Series 300 SST			

(1) 8" Valve size and up. (2) CF3M used for weld end valves.

DESIGN FEATURES:

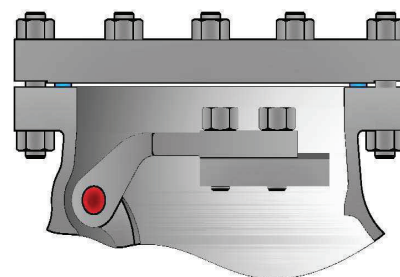
- **Standard trim** is API trim 8 for carbon steel valves, API trim 5 for chrome alloy valves, and API trim 10 for CF8M (T316) valves for optimal performance under normal conditions. Other trim materials available on request.
- **Seat faces** lapped for smooth finish and superior sealing.
- **Wall thickness** per heavy wall API 600 requirements.
- **Swivel disc** for improved seat alignment and longer life.
- **Each valve** is shell and seat pressure tested per industry standard API 598.
- **Check valves** are suitable for service in horizontal line with cap vertical or in a vertical line with flow upward.
- **Carrier Pin** is confined within the body wall and is not accessible from the exterior, thus no side body penetrations, eliminating a common leak path, on classes 150 through 600.
- **End Flanges** have the following raised faces per ASME B16.5:
Classes 150-300: 1/16" (2mm).
Classes 600-1500: 1/4" (7mm).

NOTE: See page 52 for flow, safety and maintenance information.

Design Specifications

Item	Applicable Specification
Wall thickness	API 600
Pressure - temperature ratings	ASME B16.34
General valve design	B16.34
End to End dimensions	ASME B16.10
Flange design	ASME B16.5
Butt Weld design	ASME B16.25
Materials	ASTM

- **Each valve** has a unique certification number that is traceable to the valve certification sheet which includes MTR data, pressure test, inspection result and certificate of conformance.
- **Other** available options as follows:
 - Alternate valve materials such as chrome and stainless steel alloys
 - Alternate trim materials
 - Drain and other auxiliary connections
 - NACE service
 - Special cleaning for applications such as oxygen or chlorine
 - Other options available as specified



Valve design for valve sizes 8" and above all pressure classes.

SWING CHECK VALVE DIMENSIONS (CLASS 150—1500).

SIZE	ASME 150				ASME 300				ASME 600			
in	A	B	C	D	A	B	C	D	A	B	C	D
mm	WE/FE				WE/FE				WE/FE			
2	8.00	4.9	4.6	2.00	10.50	5.0	4.6	2.00	11.50	6.9	7.3	2.00
50	203	126	118	51	267	126	118	51	292	176	185	51
2 ½	8.50	5.6	6.8	2.50	11.50	5.6	6.8	2.50	13.00	7.4	7.9	2.50
65	216	142	172	64	292	142	172	64	330	189	200	64
3	9.50	5.9	7.7	3.00	12.50	5.9	7.7	3.00	14.00	8.3	8.5	3.00
80	241	149	195	76	318	149	195	76	356	212	215	76
4	11.50	6.5	9.1	4.00	14.00	6.5	9.1	4.00	17.00	10.3	10.6	4.00
100	292	166	230	101	356	166	230	102	432	262	270	102
6	14.00	8.2	10.8	6.00	17.50	8.6	11.8	6.00	22.00	14.0	13.5	6.00
150	356	208	273	152	444	219	298	152	559	356	342	152
8	19.50	11.9	15.1	8.00	21.00	13.3	15.6	8.00	26.00	18.5	17.1	7.87
200	495	302	384	203	533	338	397	203	660	469	435	200
10	24.50	14.2	17.8	10.00	24.50	15.3	18.5	10.00	31.00	21.2	20.1	9.75
250	622	360	450	254	622	389	470	254	787	539	510	248
12	27.50	15.7	21.6	12.00	28.00	17.9	22.3	12.00	33.00	23.4	22.6	11.75
300	698	399	549	305	711	455	565	305	838	594	575	298
14	31.00	22.2	20.9	13.25	33.00	23.4	21.7	13.25	35.00	25.4	23.5	12.87
350	787	565	532	337	838	595	550	337	889	645	598	327
16	34.00	23.6	25.3	15.25	34.00	24.9	27.4	15.25	39.00	28.6	27.6	14.75
400	864	599	642	387	864	632	695	387	991	727	700	375
18	38.50	27.9	29.6	17.25	38.50	28.5	30.4	17.00	43.00	32.5	29.1	16.50
450	978	709	752	438	978	723	772	432	1092	826	740	419
20	38.50	26.7	27.0	19.25	40.00	24.9	29.1	19.00	47.00	31.6	32.3	18.25
500	978	679	685	489	1016	632	738	483	1194	802	820	464
24	51.00	33.5	36.0	23.25	53.00	34.8	37.6	23.00	55.00	40.2	39.4	22.00
600	1295	852	915	591	1346	884	955	584	1397	1020	1000	559

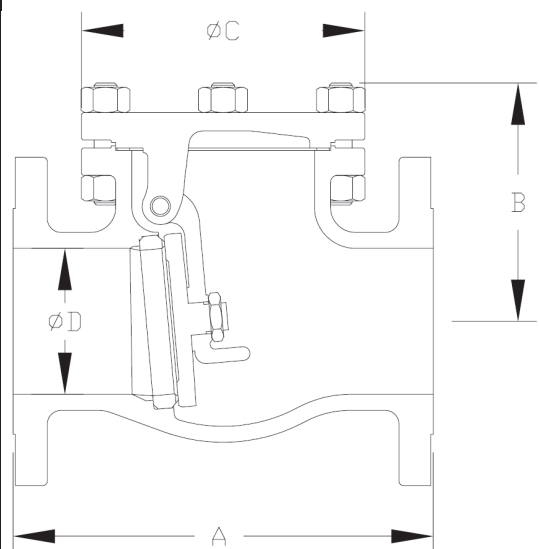
SIZE	ASME 900				ASME 1500			
in	A	B	C	D	A	B	C	D
mm	WE/FE				WE/FE			
2	14.50	9.6	8.9	1.87	14.50	9.6	8.9	1.87
50	368	244	226	47	368	244	226	47
2 ½	16.50	10.2	9.2	2.25	16.50	10.3	9.2	2.25
65	419	260	235	57	419	260	235	57
3	15.00	10.6	10.2	2.87	18.50	12.6	10.4	2.75
80	381	268	258	73	470	319	265	70
4	18.00	12.9	11.6	3.87	21.50	15.8	15.4	3.62
100	457	328	295	98	546	400	390	92
6	24.00	17	15.8	5.75	27.75	18.4	17.2	5.37
150	610	433	400	146	705	468	435	136
8	29.00	23.6	17.5	7.50	32.75	23.8	20.3	7.00
200	737	600	445	191	832	604	515	178
10	33.00	24.4	22.6	9.37	39.00	25.6	22.4	8.75
250	838	620	575	238	991	650	570	222

B = Center to top

WE = Butt Weld ends

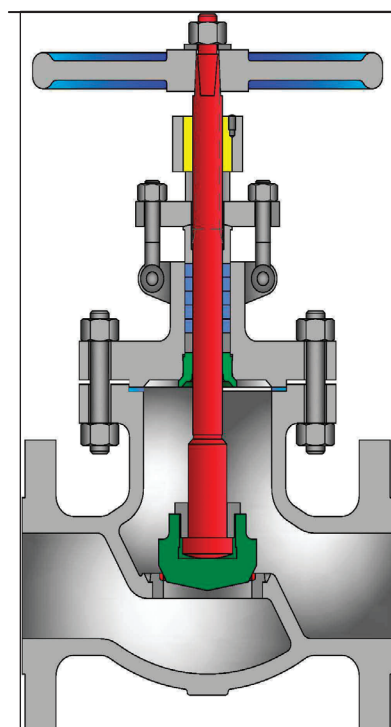
FE = Flanged ends

ADDITIONAL SIZES, MATERIALS AND CLASSES AVAILABLE UPON REQUEST.





API 600 WALL GLOBE VALVES
BOLTED BONNET, ASME CLASS 150 TO 1500
CAST CARBON, STAINLESS STEEL OR ALLOY STEEL



Class	Fig. No.
150	1531
300	3031
600	6031
900	9031
1500	1331

STANDARD MATERIALS (Other materials available)

PART	MATERIALS			
Body	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M (1)
Bonnet	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M
Disc	A105 or A216 WCB + 13% Cr Faced	A217 WC6 + Stellite 6 Faced	A217 WC9 + Stellite 6 Faced	SST 316
Disc Nut	SST 410			SST 316
Seat Ring	A105 or A216 WCB + Stellite 6 Faced	A182 F11 + Stellite 6 Faced	A182 F22 + Stellite 6 Faced	A351 Gr.CF8M
Stem	SST 410			SST 316
Stem Bushing	A 439 Ductile NI-Resist Gr. D2			
Stem Bushing Set Screw	Steel			Series 300 SST
Gland Flange	Carbon Steel			A351 Gr. CF8M
Eye Bolt	A193 Gr. B7			Series 300 SST
Eye Bolt Nut	A194 Gr. 2H			A194 Gr.8
Groove Pin	Steel			Series 300 SST
Gland	SST 410			SST 316
Packing	Graphite			PTFE
Packing Washer	SST 410			SST 316
Gasket	Class 150: Corrugated SST Encapsulated w/ Graphite Class 300 to 600: Spiral Wound SST with Graphite Class 900 to 1500: RTJ			Class 150: PTFE Class 300-600: Spiral Wound SST with PTFE
Back Seat	SST 410			SST 316
Hand Wheel	Malleable Iron or Steel			
Hand Wheel Nut	Malleable Iron or Steel			
Body / Bonnet Stud	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8
Body / Bonnet Nut	A194 Gr. 2H	A194 Gr. 7		A194 Gr.8
Identification Plate	Series 300 SST			

DESIGN FEATURES:

- **Standard trim** is API trim 8 for carbon steel valves, API trim 5 for chrome alloy valves, and API trim 10 for CF8M (T316) valves for optimal performance under normal conditions. Other trim materials available on request.
- **Wall thickness** per heavy wall API 600 requirements.
- **Seat faces** lapped for smooth finish and superior sealing.
- **Swivel disc** for optimal seating and longer seat life.
- **Stems** of hand wheel operated valves are rotating / rising design.
- **Each** valve is shell, seat and backseat pressure tested per industry standard API 598.
- **Gland** is two piece gland / gland flange design for optimal alignment and uniform packing compression.
- **End Flanges** have the following raised faces per ASME B16.5:
Classes 150-300: 1/16" (2mm)
Classes 600-1500: 1/4" (7mm)

(1) Weld end valve body A351 Gr. CF3M

NOTE: See page 52 for flow, safety and maintenance information.

Design Specifications

Item	Applicable Specification
Wall thickness	API 600
Pressure - temperature ratings	ASME B16.34
General valve design	B16.34
End to End dimensions	ASME B16.10
Flange design	ASME B16.5
Butt Weld design	ASME B16.25
Materials	ASTM

- **Weld ends** are available per ASME B16.25 or per customer's specification.
- **Impactor** hand wheel design standard on the following sizes to assist seating.
8" to 12" class 150
6" to 12" class 300
4" to 10" 600
For larger sizes or pressure classes, gears are standard.
- **Each** valve has a unique certification number that is traceable to the valve certification sheet which includes MTR data, pressure test, inspection result and certificate of conformance.
- **Other** available options as follows:
-Alternate valve materials such as chrome and stainless steel alloys
-Alternate trim materials
-Bypass, drain and other auxiliary connections
-Gear, motor, and cylinder actuators available
-NACE service
-Special cleaning for applications such as oxygen or chlorine
-Other options available as specified

GLOBE VALVE DIMENSIONS (CLASS 150—1500).

SIZE	ASME 150					ASME 300					ASME 600				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
in	WE/FE					WE/FE					WE/FE				
mm															
2	8.00	11.9	12.9	2.00	8	10.50	11.9	13.1	2.00	8	11.50	13.6	14.7	2.00	10
50	203	302	327	51	200	267	302	332	51	200	292	346	374	51	250
2 ½	8.50	14.9	16.4	2.50	8	11.50	12.9	14.5	2.50	10	13.00	16.4	17.6	2.50	12
65	216	378	416	64	200	292	328	369	64	250	330	416	448	64	300
3	9.50	14.1	15.4	3.00	10	12.50	14.1	15.4	3.00	12	14.00	17.2	18.7	3.00	14
80	241	357	390	76	250	318	357	390	76	300	356	438	475	76	350
4	11.50	16.5	18.0	4.00	12	14.00	16.7	18.0	4.00	14	17.00	20.2	21.7	4.00	18
100	292	419	457	102	300	356	423	458	102	350	432	514	552	102	450
6	16.00	17.6	19.7	6.00	14	17.50	21.0	23.2	6.00	18	22.00	25.7	27.9	6.00	20
150	406	446	499	152	350	444	534	589	152	450	559	653	709	152	500
8	19.50	20.1	22.6	8.00	18	22.00	23.9	26.3	8.00	18	26.00	29.1	31.6	7.87	22
200	495	511	574	203	450	559	606	669	203	450	660	739	803	200	560
10	24.50	29.5	33.6	10.00	18	24.50	29.7	35.1	10.00	22	31.00	32.7	38.9	9.75	28
250	622	750	853	254	450	622	753	892	254	560	787	830	988	248	710
12	27.50	31.9	36.7	12.00	20	28.00	34.2	41.2	12.00	26	33.00	47.8 (1)		11.75	28
300	698	810	932	305	500	711	868	1047	305	650	838	1215		298	710
14	31.00	42.5 (1)		13.25	24	33.00	45.9 (1)		13.25	24	35.00	51.2 (1)		12.87	32
350	787	1080		337	610	838	1165		337	610	889	1401		327	810
16	36.00	45.1 (1)		15.25	24	34.00	51.4 (1)		15.25	24	39.00	56.4 (1)		14.75	40
400	914	1146		387	610	864	1305		387	610	991	1630		375	1000
18	38.50	50.1 (1)		17.25	28	38.50	57.2 (1)		17.00	24	43.00	61.7 (1)		16.50	40
450	978	1450		438	710	978	1453		432	610	1092	1567		419	1000
20	38.50	55.9 (1)		19.25	28	40.00	62.2 (1)		19.00	40	47.00	67.3 (1)		18.25	40
500	978	1420		489	710	1016	1579		483	1000	1194	1710		464	1000
24	51.00	67.7 (1)		23.25	32	53.00	72.9 (1)		23.00	40	55.00	78.9 (1)		22.00	60
600	1295	1720		591	810	1346	1852		584	1000	1397	2004		559	1500

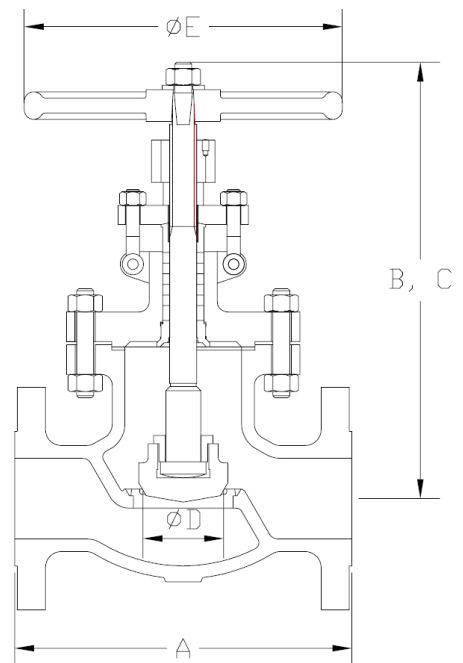
- (1) Gear operators standard for 14" and up classes 150 and 300, 12" and up for class 600, 6" and up for classes 900 and 1500. Height is to top of actuator.

ADDITIONAL SIZES, MATERIALS AND CLASSES AVAILABLE UPON REQUEST.

SIZE	ASME 900					ASME 1500				
	A	B	C	D	E	A	B	C	D	E
in	WE/FE					WE/FE				
mm										
2	14.50	19.0	20.6	1.87	14	14.50	19.0	20.6	1.87	14
50	368	483	523	48	350	368	483	523	48	350
2 ½	16.50	19.0	20.6	2.25	14	16.50	19.0	20.6	2.25	16
65	419	483	523	57	350	419	483	523	57	400
3	15.00	23.8	25.5	2.87	18	18.50	27.9	28.9	2.75	18
80	381	605	648	73	450	470	702	735	70	450
4	18.00	26.0	28.2	3.87	18	21.50	28.0	30.2	3.62	18
100	457	661	716	98	450	546	712	767	92	450
6	24.00	33.6 (1)		5.75	24	27.75	39.2 (1)		5.37	28
150	610	853		146	610	705	996		136	710
8	29.00	43.5 (1)		7.50	28	32.75	47.1 (1)		7.00	32
200	737	1105		191	710	832	1196		178	810
10	33.00	52.4 (1)		9.37	32	39.00	56.2 (1)		8.75	32
250	838	1331		238	810	991	1427		224	810

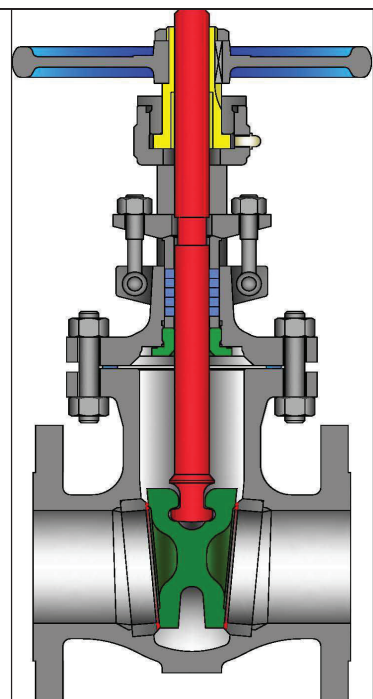
B = Center to top closed
C = Center to top open

WE = Butt weld ends
FE = Flanged ends





API 600 GATE VALVES
BOLTED BONNET, ASME CLASSES 150 TO 1500
CAST CARBON, STAINLESS STEEL OR ALLOY STEEL



Class	Fig. No.
150	1503
300	3003
600	6003
900	9003
1500	1303

DESIGN FEATURES:

- **Flexible Wedge** for improved seating and ease of operation, especially in high temperature service. Wedges are accurately guided thru the entire stroke.
- **Standard trim** is API trim 8 for carbon steel valves, API trim 5 for chrome alloy valves, and API trim 10 for CF8M (T316) valves for optimal performance under normal conditions. Other trim materials available on request.
- **Seat faces** lapped for smooth finish and superior sealing.
- **Stems** are non-rotating with surface finish to maximize packing seal for low fugitive emissions.
- **Bonnet and Yoke arms** designed for ease of gear, motor or cylinder actuator adaptation.
- **Each** valve is shell, seat and back-seat pressure tested per industry standard API 598.
- **Gland** is two piece gland / gland flange design for optimal alignment and uniform packing compression.

STANDARD MATERIALS (Other materials available)

PART	MATERIALS			
Body	A216 Gr. WCB (STANDARD)	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M (1)
Bonnet / Yoke arm	A216 Gr. WCB	A217 Gr. WC6	A217 Gr. WC9	A351 Gr. CF8M
Wedge	A217 Gr CA15 or WCB + 13% CR Faced	WC6 + Stellite 6 Faced	WC9 + Stellite 6 Faced	A351 Gr. CF8M
Seat Ring	Carbon Steel + Stellite 6 Faced	A182 F11 + Stellite 6 Faced	A182 F22 + Stellite 6 Faced	SST 316
Stem	SST 410			SST 316
Stem Bushing	A 439 Ductile NI-Resist Gr. D2			
Stem Bushing Lock Nut	Steel			SST 316
Gland Flange	Carbon Steel			Series 300 SST
Eye Bolt	A193 Gr. B7			A193 Gr. B8
Eye Bolt Nut	A194 Gr. 2H			A194 Gr.8
Groove Pin	Steel			Series 300
Gland	SST 410			SST 316
Packing	Graphite			PTFE
Packing Washer / Packing Spacer	SST 410			SST 316
Gasket	Class 150: Corrugated SST Encapsulated w/ Graphite Class 300 to 600: Spiral Wound SST with Graphite Class 900-1500: RTJ			Class 150: PTFE Class 300-600: Spiral Wound SST with PTFE
Back Seat	SST 410			SST 316
Hand Wheel	Malleable Iron or Steel			
Hand Wheel Nut	Malleable Iron or Steel			
Key	Steel			
Lubricant Fitting	Steel			
Body / Bonnet Stud	A193 Gr. B7	A193 Gr. B16		A193 Gr. B8
Body / Bonnet Nut	A194 Gr. 2H	A194 Gr. 7		A194 Gr.8
Bearing Cap	Carbon Steel			Series 300 SST
Cap Screws	Steel			
Identification Plate	Series 300 SST			

(1) Weld end valve body A351 Gr. CF3M

NOTE: See page 52 for flow, safety and maintenance information.

Design Specifications

Item	Applicable Specification
Wall thickness	API 600
Pressure - temperature ratings	ASME B16.34
General valve design	API 600 & B16.34
End to End dimensions	ASME B16.10
Flange design	ASME B16.5
Butt Weld design	ASME B16.25
Materials	ASTM

- **End Flanges** have the following raised faces per ASME B16.5:
Classes 150-300: 1/16" (2mm).
Classes 600-1500: 1/4" (7mm).
- **Weld ends** are available per ASME B16.25 or per customer's specification.
- **Each** valve has a unique certification number that is traceable to the valve certification sheet which includes MTR data, pressure test report, inspection report and certificate of conformance.
- **Other** available options as follows:
-Alternate valve materials such as chrome and stainless steel alloys
-Alternate trim materials
-Bypass, drain and other auxiliary connections
-Gear, motor, and cylinder actuators available
-NACE service
-Special cleaning for applications such as oxygen or chlorine
-Other options available as specified

GATE VALVE DIMENSIONS (CLASS 150—1500).

SIZE	ASME 150						ASME 300					ASME 600						
in	A		B(1)	C(1)	D	E	A	B(1)	C(1)	D	E	A	B(1)	C(1)	D	E		
mm	FE	WE					WE/FE					WE/FE						
1	5.00	5.00	8.6	9.8	1.00	4.5	6.50	8.6	9.8	1.00	4.5	-	-	-	-	-		
25	127	127	217	248	25	114	165	217	248	25	114	-	-	-	-	-		
1 ½	6.50	6.50	10.7	12.4	1.50	6.0	7.50	10.7	12.4	1.50	6.0	-	-	-	-	-		
40	165	165	271	314	38	152	190	271	314	38	152	-	-	-	-	-		
2	7.00	8.50	12.3	14.6	2.00	7.0	8.50	12.3	14.6	2.00	7.0	11.50	13.5	15.7	2.00	8.0		
50	178	216	313	372	51	178	216	313	372	51	178	292	342	400	51	203		
2 ½	7.50	9.50	12.8	15.6	2.50	7.0	9.50	12.8	15.6	2.50	7.0	13.00	18.1	21.9	2.50	12.0		
65	190	241	324	395	64	178	241	324	395	64	178	330	461	555	64	305		
3	8.00	11.12	14.8	18.1	3.00	9.1	11.12	15.9	19.3	3.00	9.1	14.00	19.2	22.8	3.00	12.0		
80	203	282	375	459	76	230	282	405	490	76	230	356	487	580	76	305		
4	9.00	12.00	17.7	22.1	4.00	10.0	12.00	19.0	23.3	4.00	10.0	17.00	23.0	27.5	4.00	14.0		
100	229	305	450	561	102	254	305	482	593	102	254	432	585	698	102	356		
5	10.00	15.00	24.4	31.1	5.00	12.0	15.00	26.5	33.1	5.00	14.0	-	-	-	-	-		
125	254	381	620	789	127	305	381	674	842	127	356	-	-	-	-	-		
6	10.50	15.88	24.4	31.1	6.00	12.0	15.88	26.5	33.1	6.00	14.0	22.00	32.5	39.1	6.00	20.0		
150	267	403	620	789	152	305	403	674	842	152	356	559	825	993	152	508		
8	11.50	16.50	30.7	39.2	8.00	14.0	16.50	32.8	41.4	8.00	16.0	26.00	35.0	45.4	7.87	22.0		
200	292	419	780	996	203	356	419	833	1051	203	406	660	890	1154	200	560		
10	13.00	18.00	36.4	47.2	10.00	16.0	18.00	39.4	50.3	10.00	20.0	31.00	41.9	52.4	9.75	25.2		
250	330	457	925	1198	254	406	457	1002	1277	254	508	787	1065	1332	248	640		
12	14.00	19.75	42.7	55.6	12.00	20.0	19.75	44.8	57.7	12.00	20.0	33.00	47.3	59.9	11.75	26.8		
300	356	502	1084	1412	305	508	502	1139	1466	305	508	838	1202	1521	298	680		
14	15.00	22.50	47.5	61.5	13.25	20.0	30.00	49.1	63.4	13.25	22.0	35.00	67.4 (1)		12.87	28.3		
350	381	572	1207	1562	337	508	762	1248	1611	337	560	889	1712		327	720		
16	16.00	24.00	51.7	67.8	15.25	22.0	33.00	54.5	70.7	15.25	25.2	39.00	75.2 (1)		14.75	35.4		
400	406	610	1313	1722	387	560	838	1384	1796	387	640	991	1910		375	900		
18	17.00	26.00	58.1	76.4	17.25	25.2	36.00	79.2 (1)		17.00	26.8	43.00	81.1 (1)		16.50	35.4		
450	432	660	1477	1940	438	640	914	2012		432	680	1092	2060		419	900		
20	18.00	28.00	63.3	83.3	19.25	26.7	39.00	87.3 (1)		19.00	28.2	47.00	87.3 (1)		18.25	28.0		
500	457	711	1615	2123	489	680	991	2217		483	720	1194	2217		464	710		
24	20.00	32.00	76.7	101.1	23.25	28.3	45.00	102.9 (1)		23.00	35.4	55.00	104.3 (1)		22.00	32.0		
600	508	813	1948	2568	591	720	1143	2614		584	900	1397	2649		559	810		
30	24.00	36.00	91.9	123.0	29.25	24.0	55.00	130.0 (1)		29.00	24.0							
750	610	914	2334	3125	743	610	1397	3302		737	610							
36	28.00	40.00	107.4	143.1	34.50	24.0	ADDITIONAL SIZES, MATERIALS AND CLASSES AVAILABLE UPON REQUEST.											
900	711	1016	2729	3635	876	610												
42	31.00	44.00	131.7	173.8	40.25	24.0												
1050	787	1118	3345	4415	1022	610												

SIZE	ASME 900					ASME 1500				
in	A	B(1)	C(1)	D	E	A	B(1)	C(1)	D	E
mm	WE/FE					WE/FE				
2	14.50	15.8	18.5	1.87	9.8	14.50	15.8	18.5	1.87	9.8
50	368	402	470	48	250	368	402	470	48	250
2 ½	16.50	18.7	22.1	2.25	12.0	16.50	18.7	22.1	2.25	12.0
65	419	475	561	57	305	419	475	561	57	305
3	15.00	19.5	23.1	2.87	13.8	18.50	20.4	24.1	2.75	15.7
80	381	495	588	73	350	470	518	613	70	400
4	18.00	21.4	25.8	3.87	13.8	21.50	22.1	26.5	3.62	15.7
100	457	543	655	98	350	546	561	674	92	400
6	24.00	30.4	37.3	5.75	22.0	27.75	32.9	40.2	5.37	23.6
150	610	773	948	146	560	705	836	1021	136	600
8	29.00	34.7	43.4	7.50	25.2	32.75	48.0	56.5	7.00	26.0
200	737	882	1102	191	640	832	1219	1435	178	660
10	33.00	40.6	51.2	9.37	30.0	39.00	57.8	68.2	8.75	30.0
250	838	1030	1300	238	762	991	1467	1734	224	762

- (1) Gear operators standard for 18" and up class 300 and 14" and up class 600. Height is to top of actuator.

WE = Butt weld ends
FE = Flanged ends
B = Center to top closed
C = Center to top open

