



Storage Water Heater Steam-to-Water Mega-Pack System

Operating and Maintenance Manual



*Designed and Manufactured in
Accordance with
ASME Code Section VIII, Div 1*



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Operating and Installation Instructions (Pneumatic / Pilot-Operated)

Congratulations on your purchase of a new Ace Boiler, Packaged Storage Water Heater. In this book, we have included installation and maintenance instructions that, if followed, will provide you with many years of service from your new unit. Also included are instruction manuals for each of the controls furnished with the heater. Please read them carefully. They should be helpful in both the installation and service of this unit. Keep these instructions with the heater for future reference.

The Ace Packaged Storage Water Heater is of rugged construction, yet of simple design. The heater uses steam (or water) from a boiler to heat domestic hot water in the tank. The storage heater's temperature control system enables it to control the heated water within the tank at the desired temperature. This close control is accomplished by placing the temperature control element directly in the constant flow path of the circulated domestic water. The integral circulator constantly recirculates water over the heat exchanger.

Lined Packaged Storage Water Heaters feature construction with rust free austenitic stainless fittings and copper tubes for all domestic water contact surfaces, providing a high quality, low maintenance and an extremely cost effective domestic water heating package.

The heat exchanger tubes are rolled and flared into a carbon or stainless steel tube sheet. Each storage heater is constructed and stamped in accordance with Section VIII of the ASME Code, which is stamped on the vessel nameplate.

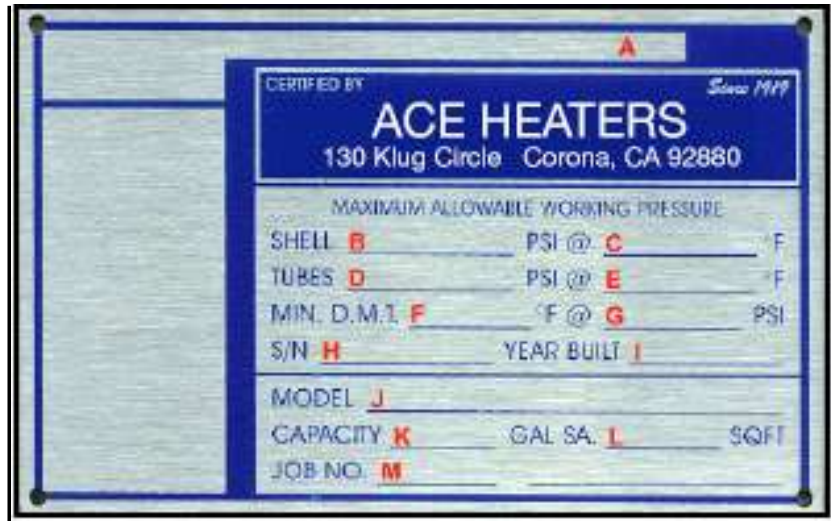
Experience in the field has proven that the Ace Packaged Storage Water Heater, if properly applied and maintained, will give many years of efficient, dependable and economical service.

The Packaged Storage Water Heater Nameplate And Model Number

The Packaged Storage Water Heater Nameplate

The following illustration is an accurate depiction of the nameplate found on the Packaged Storage Water Heater.

- A. NB or serial number
- B. Shell pressure
- C. Shell temperature
- D. Tube pressure
- E. Tube temperature
- F. Min. Atmospheric Pressure
- G. Atmospheric temperature
- H. Serial number
- I. Year built
- J. Model number
- K. Capacity
- L. Square feet
- M. Job number



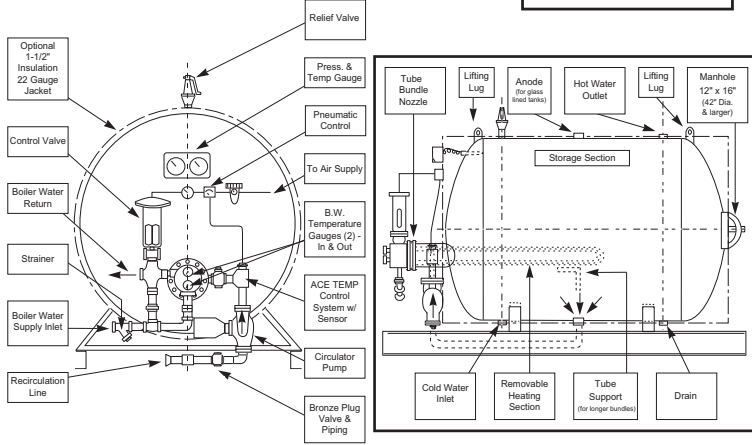
The Packaged Storage Water Heater Model Number

P H G 72 10 - G - 2. 1066 S A

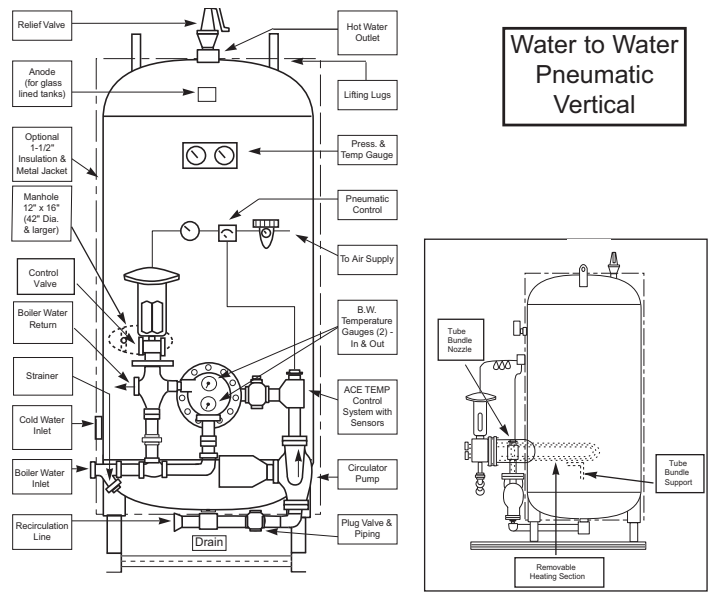
- P = Packaged
- H = Type (H = Horizontal, V = Vertical)
- G = Tank Design Pressure (G = 125, J = 150)
- 72 = Tank Diameter
- 10 = Shell Length in feet
- G = Lining Code (G = glass, K = precrete, U = unlined, C = cement, X = special, S = stainless)
- 2 = # of Passes
- 1066 = Coil model number (10 = diameter, 66 = length)
- S = Heating medium (S = steam, W = water, H = hi-temp water)
- A = Valve control (A = pneumatic, S = self-contained, P = pilot-operated)

Parts of the Packaged Storage Water Heater (Pneumatic / Self-Contained)

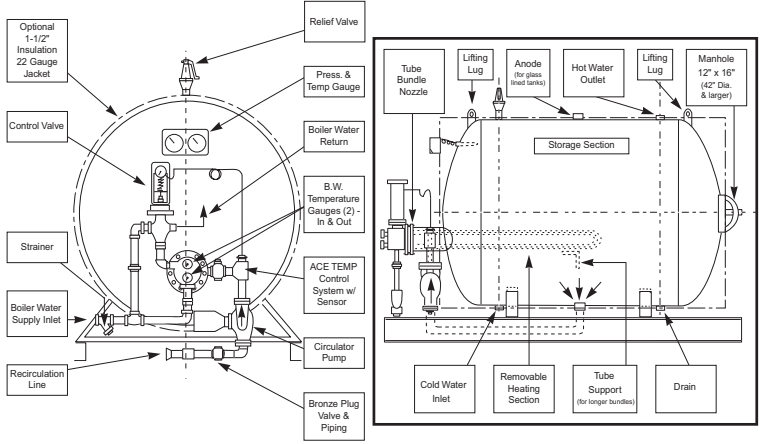
Water to Water Pneumatic Horizontal



Water to Water Pneumatic Vertical



Water to Water Self-Operating Horizontal



Water to Water Self-Operating Vertical

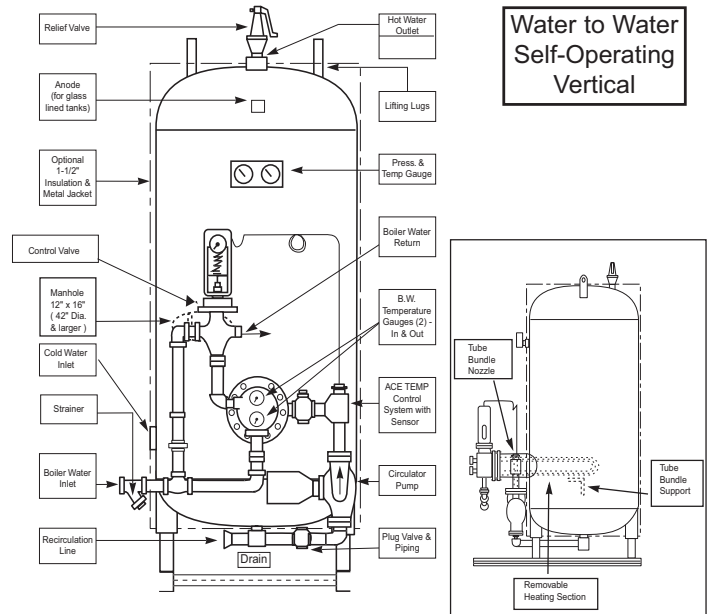


Diagram may vary from actual model

How It Works!

The Packaged Storage Water Heater is designed to heat domestic hot water using existing plant steam or hot water. The control valve regulates the heating medium through the tube bundle.

As there is a demand for domestic hot water, the temperature control bulb will sense the drop in water temperature. The temperature bulb sends a signal to the control valve to open and allow steam or hot boiler water into the heat exchanger tube bundle. As the steam or hot water passes through the tubes, the domestic water in the tank is heated.

The circulator constantly circulates the domestic water over the heat exchanger coil, contributing to the heat transfer.

Receiving Your Packaged Storage Water Heater

Check Equipment Received. Inspect the unit for any shipping damage. Make sure you have received all loose parts, such as listed on the “Bill of Lading”. Larger strainers and valves, usually 2-1/2” and above, are shipped loose. Note any damages or shortages on the bill of lading prior to signing it. If the unit is received damaged or missing parts, it is your responsibility to notify the shipping company and file a freight claim. Ace Boiler cannot send replacement parts for freight damaged or missing equipment as warranty items. Permission to return goods must be received from the factory prior to shipping. Goods returned without a Returned Goods Authorization number will not be accepted. Purchased parts are subject to replacement only under the manufacturer’s warranty. The warranty does not include the cost for labor, removal, or installation of the warranted part.

General Installation Instruction



NOTE: *All electrical and piping installation should only be accomplished by qualified personnel following all applicable local, and state codes required for their installation.*

Code Requirements: It is very important that your installation comply with all federal, state and local codes as well as meet good industry practices as shown in publications issued by ASME, AGA, UL, ASHRAE, ABMA, etc.

Placement: The storage heater was either fabricated as a vertical or horizontal unit. It should be installed on a solid foundation, preferably a concrete pad. Provide adequate clearance for normal inspection and maintenance purposes and allow tube pull clearance to remove the exchanger for servicing. A minimum clearance of 24” is recommended from all accessories for ease of maintenance. Make sure the heater is level, from side to side and front to back. Use metal shims if necessary.

Piping: All piping to and from the heater must be provided with adequate supports and expansion compensation so that pipe stresses are not transmitted to the unit. The relief valve and the double-safety solenoid valve, if supplied, should be piped to a safe drain.

Stud Nuts: During shipment, the bonnet and shell flange nuts may loosen and should be re-tightened before start-up. Tighten these nuts to the torques specified later in this manual. After the unit has been in operation for a few days, check and retighten. Note: Bolting is independent on the bonnet and shell-side flanges through the use of a threaded tube sheet flange(s). Therefore, stud bolt nuts must be re-tightened on both sides. See Figure 1.1 for single wall bolting arrangement and Figure 1.2 for double wall bolting arrangement.

Torque's: The following are recommended bolt torque requirements

| Bolt Size | Min Torque | Max Torque |
|-----------|--------------|--------------|
| 1/2" | 45 ft-lbf. | 60 ft-lbf. |
| 5/8" | 90 ft-lbf. | 120 ft-lbf. |
| 3/4" | 150 ft-lbf. | 200 ft-lbf. |
| 7/8" | 240 ft-lbf. | 320 ft-lbf. |
| 1" | 368 ft-lbf. | 490 ft-lbf. |
| 1 1/8" | 533 ft-lbf. | 710 ft-lbf. |
| 1 1/4" | 750 ft-lbf. | 1000 ft-lbf. |
| 1 1/2" | 1200 ft-lbf. | 1600 ft-lbf. |

Notes:

- * Spray each stud bolt and nut generously with penetrating oil before re-torque.
- ** Gasket thickness before compression. All partition gaskets are 1/8" in width before compression. All gaskets expand twice their width after compression.
- *** These are recommended torque values. Stud bolts must not be stressed above 60% of their yield strength.

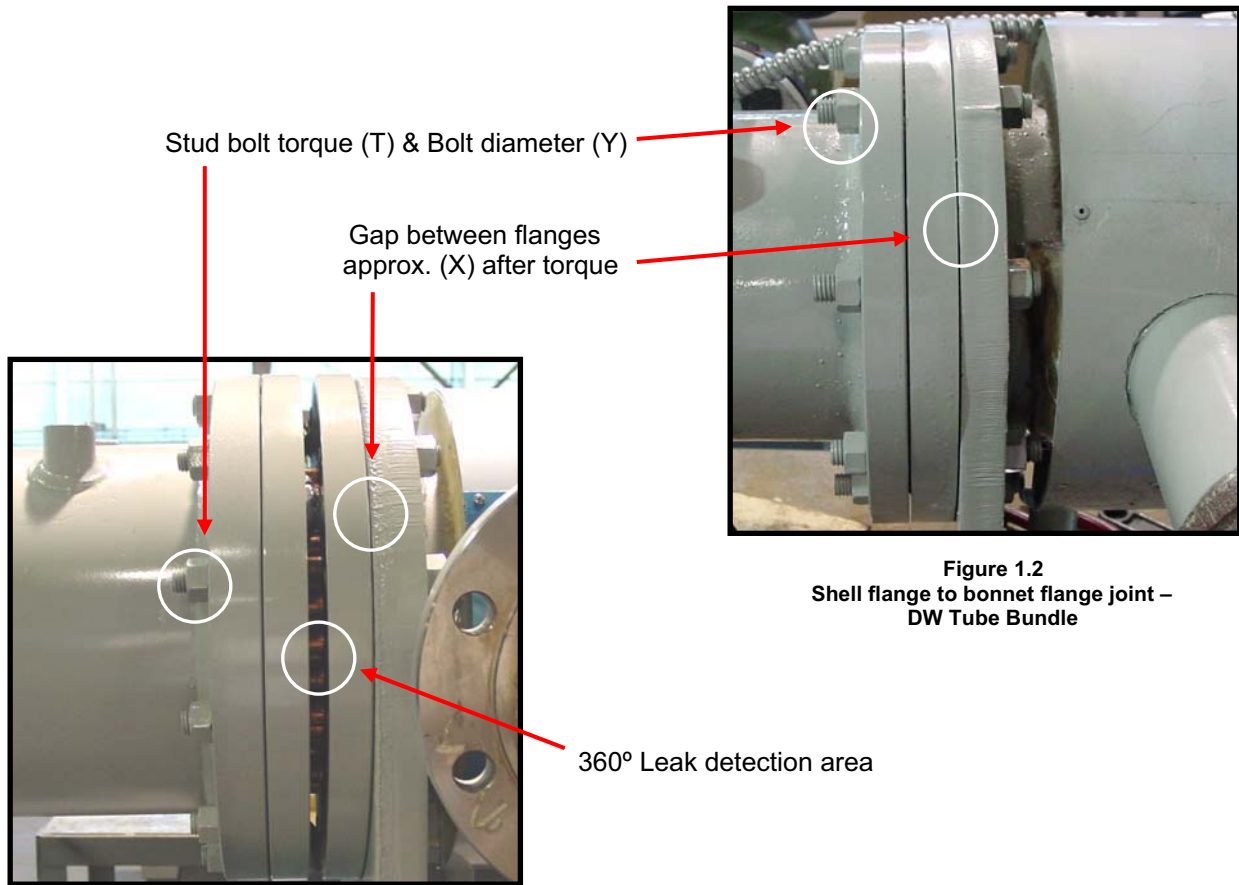


Figure 1.1
Shell flange to bonnet flange joint – SW Tube Bundle

Figure 1.2
Shell flange to bonnet flange joint – DW Tube Bundle

Water Connections: Pipe cold domestic water in, hot out, and drain according to the cover drawing.

Steam Piping: Check the steam supply pressure. The steam supply pressure should not exceed the maximum pressure specified on the control valve, relief valve, or vessel nameplate.

Condensate: The condensate outlet of the steam trap is to be connected to condensate return line.

Relief Valve: The relief valve discharge must be piped to a floor drain to eliminate the potential of scalding burns. The drain line must be the same size as the relief valve outlet and have a downward slope to insure proper drainage. The drain line termination should be visible to see discharge. Check the relief valve nameplate. The unit's operating pressure cannot exceed that listed on the relief valve.

Electrical: Standard units only require power to the circulation pump. If optional electrical equipment such as a safety solenoid is included, power is to be wired according to the wiring diagram. Verify the electrical supply using a voltmeter. The voltage tie-in leads are indicated on the wiring diagram. This unit contains sensitive control components and should be protected by a suitable commercial grade surge protection device. The Packaged Storage Water Heater must be installed in accordance with the National Electric Code and in accordance with all state and local codes.

Water Treatment: We, the manufacturer of your Packaged Storage Water Heater, wish to call to your attention the necessity for a sound approach to proper water treatment. The Packaged Storage Water Heater uses boiler steam or hot water as its heating medium. On steam systems, boiler makeup water continuously introduces contaminants; scale forming solids, corrosive minerals and oxygen, which can cause corrosion or scale formation inside the Packaged Storage Water Heater tube bundle. Whenever appreciable amounts of raw makeup water are continuously added to your system, we recommend that the problem be brought to the attention of a qualified water consultant. Proper treatment will insure longer product life and reduced maintenance.

Before Start-up

Installation and Hook-up

- 1 Place tank in location desired, and level tank carefully to insure levelness of heating coil loops which are installed in the tank. Provide sufficient clearance in front to permit removal of the tube bundle.
- 2 Remove temporary pipe plugs and caps from all tapping and discard. Inspect and clean all openings.
- 3 Install cold water supply line to bottom connection marked Cold Inlet on drawing. Install a gate valve and union for supply shut-off as desired.
- 4 Install hot water supply line to service from top connection marked Hot Outlet on drawing. A valve at this connection is desirable but not necessary.
- 5 Install relief valve(s) in top connection of tank, and pipe relief valve outlet(s) to a safe drain area.
- 6 Hook warm return circulation line to tee provided near pump if return line is to be used. A check and gate valve should be installed in return line, with flow through check valve toward generator.
- 7 Hook hot water or steam supply to upper coil supply line. A gate valve should be installed.
- 8 Hook up hot water return to boiler, or for steam, hook up condensate return to boiler condensate return tank. Pipe size to correspond to opening size provided. This pipe must run horizontal, or pitch gradually to condensate tank, with condensate level to be below tube or coil level in generator.
- 9 **CAUTION:** Do not introduce steam or water without having the safety relief valves installed on tank, as excessive pressure may result, with damage to tank or heating coil.
- 10 Water circulating pump should be wired to run continuously.
- 11 Storage water heaters are hydrostatically tested in accordance with code requirements, and are certified as satisfactory by inspection agencies agree upon by manufacturer and purchaser. However, normal yielding of gaskets will occur in the interval between hydrostatic testing in the manufacturer's shop and installation at the job site. Therefore, all external bolted joints should be properly retightened after installation and again after the exchanger has been heated, to prevent leaks and blowing out of gaskets. Follow industry recognized flange bolt tightening practices
- 12 In all installations, care should be taken to eliminate or minimize transmission of fluid pulsations and mechanical vibrations to the tank or tube bundle.
- 13 Install anodes (shipped loose) on all glass lined tanks. ***Failure to install anodes will void warranty.***

Start-up Instruction

- 1 It is assumed that installation is complete and that all connections have been made, including: electrical, steam, domestic water, instrument air, vents, drains and safety valve discharge lines.
- 2 If an optional control box is included, make sure the power switch is in the "off" position.
- 3 Set the temperature controller on the pilot to a minimal water temperature output, following instruction in the technical data sheet provided (factory does not present).
- 4 If option is provided, adjust the high limit control 12° to 15°F higher than the desired hot water outlet temperature.
- 5 Ensure the shut-off valve on the bonnet side (heating medium side) is closed.
- 6 Slowly fill the packaged storage water heater with domestic water, making sure all air is evacuated prior to start-up.
- 7 Plant steam, used as the heating medium, is controlled by a pilot operated control valve. The pilot utilizes upstream steam pressure to modulate the control valve based on the temperature of the thermostatic element. Steady upstream supply steam pressure is imperative to the temperature control.
- 8 If an optional control panel is included, turn the control panel switch to "On" position (the manual steam supply valve should be closed). The green light should come on. At the same time, it will energize the solenoid to open the pilot control line to the valve. Make sure the circulator pump is running. (Please refer to the pump instruction manual for details.)
- 9 Manually open the main steam shut-off valve upstream of the control valve and SLOWLY allow steam to pass through the control valve. Continue until the shut-off valve is 100% open.
- 10 The packaged storage water heater will now function automatically, reacting according to demand fluctuations and will stabilize once limits are met.
- 11 Observe the entire system over a period of large demand fluctuations and readjust as necessary by adjusting the pilot control wheel. (See enclosed technical instruction on the temperature pilot).
- 12 After initial start-up, it is recommended to inspect the upstream strainer for any dirt or debris that may have accumulated. This should be done in accordance with company recommended safety procedures.

Shut Down Instructions

- 1 Close the main upstream shut-off valve to the packaged storage water heater.
- 2 De-energize all electrical power to the packaged storage water heater.
- 3 Allow the unit to cool down (Approximately 24 hours).
- 4 Close domestic water inlet and outlet shut-off valves.

Safety Features

- 1 The pilot-operated steam control valve is designed to fail closed in the event of an over-temp condition or power failure.
- 2 The relief valve is designed to relieve the pressure in the packaged storage water heater in the event the system pressure exceeds its set point.
- 3 The double safety solenoid (Optional) is designed to dump the domestic water in the shell in the event that the water temperature exceeds the set point on the high limit control (Optional).

Operation of Storage Water Heater

- 1 The entire system should be clean before starting operation to prevent plugging of tubes. Under some conditions, the use of strainers in the pipe may be required.
- 2 When placing unit in operation, open a vent and start to circulate the cold medium only. Be sure that the passages in the tank are entirely filled with cold fluid before closing the vents. The hot medium should be introduced gradually until all passages are filled with liquid or steam. Then close vents and slowly bring the unit up to temperature. (Relief valve or faucet may be used as a vent.)
- 3 Start operation gradually. Do not admit hot fluid to the unit suddenly when empty or cold. Do not stock unit with cold fluid when unit is hot.
- 4 Start the circulating pump (to run constantly). **Note: Do not run the circulating pump without water in the system, as this may damage the pump.**
- 5 Slowly turn on manual hot water or steam supply valve to coil and check for possible leaks in piping, flanges and gaskets.
- 6 Make sure the gate valve on auxiliary air vent and steam trap is open (if provided on the equipment).
- 7 Return line out of coil should start to warm up quickly, indicating boiler water or steam is heating tank.
- 8 The automatic hot water or steam control valve may require adjustment to set to desired tank temperature. If the tank does not get hot enough, the steam valve should be adjusted (screwed in) to a higher number. If the tank temperature is too hot, screwing out to a lower number will be necessary. See valve catalog for further instructions regarding maintenance and adjustments of the control valve. Once the temperature regulator is set, it will maintain a constant tank temperature by modulating the hot water or steam supply to any demand or temperature change of the water stored in the tank, up to the capacity of the coil to produce hot water.
- 9 Ordinarily, once the temperature regulator is set properly, and the strainers and valves are clean and operating properly, no further attention is needed for several months of operation.
- 10 Do not operate equipment under conditions in excess of those specified on nameplate.
- 11 In shutting down, flow of hot medium should be shut off first. If it is necessary to stop circulation of cooling medium, the circulation of hot medium should also be stopped, by bypassing or otherwise.
- 12 When shutting down the system, all fluids should be drained to minimize the possibility of freezing and corrosion. To guard against water hammer, condensate should be drained from steam heaters and similar apparatus when starting up or when shutting down. To minimize water retention after draining the tube side of water cooled exchangers should be blown out with air.

Trouble-shooting Guide

a **Water temperature too high**

- 1 Check the setting of the pilot controller and adjust the hand wheel as necessary.
- 2 Confirm steam supply pressure to the valve does not exceed that specified in the List of Materials.
- 3 Bad sensing element.
- 4 Check bleed port for proper orifice fitting (No. 4A) and/or plugging.
- 5 Check for dirt under valve seats.
- 6 Valve disc is worn.

b **Banging or pinging**

- 1 Check steam traps for proper operation.
- 2 Check for proper condensate drainage. Clean out all dirt and debris.
- 3 Check for back pressure in the condensate line.

c **Erratic temperature control**

- 1 Make sure the circulator pump is pumping.
- 2 Check for proper direction of the circulator pump. The pump should be flowing from the tank to the nozzle neck.
- 3 Check steam traps for debris and proper operation.
- 4 Confirm steam supply pressure to the valve is steady and agrees with that specified in the List of Materials.
- 5 The hand wheel on the pilot controller needs adjustment.
- 6 Check the control temperature bulb for exterior scale or build up and clean if necessary.
- 7 Check for debris in pilot and valve.

d **Poor recovery**

- 1 Check the setting of the pilot controller and adjust the hand wheel as necessary.
- 2 Confirm steam supply pressure to the control valve meets that specified in the list of materials. Check for a clogged strainer, a partially closed supply valve or other obstructions.
- 3 Make sure the packaged storage water heater is not trying to supply more hot water than it was designed for. (See performance listed in List of Materials).
- 4 Check to make sure that the proper bleed port orifice fitting (No. 4A) is on the unit. (See the pilot Technical Data Sheets enclosed).
- 5 Check for plugging of the control pipe and the orifice in the No. 5A restriction flow elbow.
- 6 Check the steam trap for any foreign matter and functionality.
- 7 Main valve diaphragm may be broken. Test with air or water before dismantling.
- 8 Shut unit down, remove bonnet and coil. Inspect for scale and fouling, which restrict heat transfer. Clean with an approved chemical treatment

e **Control valve not closing**

- 1 Check the setting of the pilot controller and adjust the hand wheel as necessary.
- 2 Confirm steam supply pressure to the valve does not exceed that specified in the List of Materials.
- 3 Check bleed port No. 4A for proper orifice fitting and/or foreign matter.
- 4 Check the thermostatic sensing element for kinks & operability.
- 5 Main valve or pilot may be held open by foreign debris.
- 6 Valve disc is worn.

Maintenance Instruction

The following service is recommended for proper and safe use of this equipment monthly or more often.

- 1 Open relief valve(s) momentarily by lifting try lever to be sure valve(s) will open and are operational.
- 2 Check tank pressure gauge. Pressure of system should not exceed pressure rating on tank or relief valve name plate.
- 3 Check steam pressure gauge to confirm steam supply is adequate. (Gauge will not show pressure except while system is heating, as pressure connection down stream of automatic steam valve.) Check tank thermometer, preferably when hot water demand is low, to verify that the steam valve is functioning to control temperature of tank within desired limits.

NOTE: Tank is supplied with temperature or pressure relief valve(s) which will open automatically should the water temperature exceed 2100°F or rated relief valve pressure.

- 4 Open drain valve at rear of tank for about ½ minute, and flush to drain to remove any mud or sludge from circulation line and bottom of tank.
- 5 Oil pump motor with 6 to 10 drops of S.A.E. 30 non-detergent motor oil, in each of 2 oil cups on motor.
- 6 Oil pump bearing housing with 1 or 2 teaspoons of oil of S.A.E. 30 motor oil as above, in pump bearing oil cup. **CAUTION:** Do not over-oil motor bearings, as this will result in rapid dust collection and overheating of motor.
- 7 Clean pump motor air intake and exhaust slots with a soft brush or vacuum cleaner.
- 8 Inspect anodes on glass lined tanks. Replace anodes if 5/8" or less in diameter. Failure to maintain anodes will void warranty. Keep all records of anode inspection and replacement for warranty guarantee.

Yearly Maintenance

A thorough cleaning of interior of tank and exterior of tank coil surfaces should be performed as required, or after the first year's service, to establish a basis for future need of services.

TO CLEAN TANK, PROCEED AS FOLLOWS:

- 1 Shut off steam or boiler water supply to tank coil.
- 2 Shut off cold water supply to bottom of tank.
- 3 Shut off hot water supply valve at top of tank if one is used.
- 4 Turn off electric supply to circulating pump.
- 5 Open drain valve at bottom rear of tank and relieve pressure on tank.
- 6 Open relief valve on top of tank, or remove it by unscrewing valve, to allow air to enter tank so water will drain freely, and drain tank fully.
- 7 Remove one manhole bolt and crab assembly, and loosen other bolt about ½"
- 8 With a block of wood about ½" long and a #2 hammer, hold the manhole cover and tap to break the gasket loose, and dislodge cover from manhole ring. This cover may now be pushed into the tank and remove to outside, by rotating the manhole cover after removing the crab from bolt, and using the bolt for a handle to prevent dropping the cover within tank. The interior of tank may be viewed thru the open manhole. If the tank is cement lined, any sludge, mud, or other deposits may be washed out thru the drain, and lining scrubbed off with a coarse brush or wire brush. The copper tank coil should be inspected for buildup of sediment or lime deposits on the tubes.

- 9 A new manhole gasket will probably be required when replacing the manhole cover. To facilitate replacement of the manhole gasket, and cover, it will be helpful to tape the gasket to the cover with 4 pieces of adhesive tape, to avoid slippage of gasket from cover. Gasket and cover should be centered carefully before tightening bolts, to avoid gasket leaking or blowing out.
- 10 Oil and tighten bolts moderately, refill tank and allow pressure to build up on tank before attempting to fully tighten bolts, as the water pressure will help seal the gasket.

Maintenance of Tube Bundle

Inspection of Unit

Frequently and at regular intervals, observe interior and exterior conditions of all tubes and keep them clean. Tube cleaning negligence may result in complete stoppage of flow through some tube, with consequent overheating of these tubes and compared to surrounding tubes, resulting in severe expansion strains and leaking tube joints.

Indication of Fouling

Tube bundles subject to fouling scaling should be cleaned periodically. A light sludge or scale coating on the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicate cleaning is necessary. (Assuming the unit has been checked for air or vapor binding and this has been found not to be the cause.) Since the difficulty of cleaning increases rapidly as the scale thickens or deposit increases, the intervals between cleaning should not be excessive.

Access to Tubes

To clean or inspect inside of tubes, remove the cap.
CAUTION: Do not loosen heads until you are sure all pressure is off equipment, and the unit is drained.

Tube Bundle Removal

When removing the tube bundle from the tank for inspection or cleaning, care should be exercised to see it is not damaged by improper handling. Tube bundles are often of great weight, yet the tubes are small and of relatively thin metal. The bundle, therefore, should rest on parts designed to carry it, i.e., on the tube sheets, baffles, or support plates. For withdrawing tube bundles from the tank, the use of steel eye bolts which are screwed into the tube sheet is recommended for the attachment of the cable or other pulling devices. Steel rods inserted through the tubes, and bolted to a bearing plate at the end of the bundle may also be used. When steel cables are used for lifting vertical tube bundles, the cable should be attached to the lifting eyes where possible. An alternate method is to use

steel rods as described above. If the tube bundle has been in service for a considerable length of time without being removed, it may be necessary to use a hydraulic jack on the tube sheet to get it started. A good-sized steel bearing plate should be inserted between jack and tube sheet and tube ends should be protected by means of a filler board.

Handling Tube Bundles Outside Shell

Do not handle tube bundles with hooks or other tools, which might damage tubes. Bundles should be moved out on cradles or skids. Horizontal tube bundles should be lifted by means of suitable slings. Baffles can be easily bent and damaged by dragging a bundle over a rough surface. Since the proper functioning of the apparatus depends upon a close fit between the outside of the baffle and the inside of the shell, any damage to the baffles must be carefully avoided.

Cleaning Procedures

- 1 Do not attempt to clean tubes by blowing steam through individual tubes. This overheats the tube and results in the same expansion strains and leaks as for plugged tubes.
- 2 Do not blow out tube bundle with air when fluids normally handled are inflammable.
- 3 In cleaning a tube bundle, tube should not be hammered on with any metallic tools. In case it is necessary to use a scraper, care should be exercised to see that the scraper is not sharp enough to cut the metal of the tubes.

Tube Rolling

To tighten a loose tube joint, use a suitable roller type tube expander. Do not roll tubes that are not leaking, as it needlessly thins and work hardens the tube wall.

Gasket Replacement

Gasket and gasket surfaces should be thoroughly cleaned and should be free of scratches and other defects. Gasket should be properly positioned before attempting to retighten bolts. It is recommended that when a heavy heat exchanger is dismantled for any purpose, it needs to be reassembled with new gaskets. This will tend to prevent future leaks and/or damage to the gasket-seating surface of the heat exchanger. Composition gaskets become dried out and brittle so that they do not always provide an effective seal when re-used, they may provide an imperfect seal or result in deformation and damage to the gasket contact surface of the exchanger. Follow industry recognized flange bolt tightening practices.

Lifting and Pulling Mechanisms

The following are safe loads for steel rods and eye bolts:

Rods:

| Size Tubes | Size Rods | Safe Load per Rod |
|-------------|-----------|-------------------|
| 5/8" | 3/8" | 1,000lbs. |
| 3/4" | 1/2" | 2,000lbs. |
| 1" – larger | 5/8" | 3,000lbs. |

Eye Bolts:

| Size | Safe Load |
|--------|------------|
| 3/4" | 4,000lbs. |
| 1" | 6,000lbs. |
| 1 1/4" | 10,100lbs. |
| 1 1/2" | 15,000lbs. |

Cleaning Methods

Provide convenient means for cleaning tube bundle frequently as suggested below:

- 1 Circulating hot wash oil or light distillate through and over the tube at high velocity will effectively remove sludge or other similar soft deposits.
- 2 Circulating hot fresh water may wash out soft salt deposits.
- 3 Some commercially available cleaning compounds may be used to assist in removing sludge or coke, provided hot wash oil or water, as described above, does not give satisfactory results.
- 4 Removal of various scales and foreign material by chemical cleaning is now being quite extensively practiced. Certain qualified organizations will check the nature of deposits to be removed, furnish proper acid solutions containing inhibitors, and provide equipment and personnel for a complete apparatus and piping cleaning job.
- 5 If none of the above methods are effective for the removal of a hard scale, coke, or other deposits, mechanical means may be used.

Material Safety Data Sheets

Some of Ace Heaters products contain materials that have been recognized as posing health risks. Material Safety Data Sheets for these materials are available from your local Manufacturer's rep. When requesting this information, be sure to have the model number and serial number available.

If you do not know who your local Manufacturer's Rep is, you can find out by logging into the www.aceheaters.com website, and clicking on the Representative tab found in the table of contents.

Ace Heaters, LLC
130 Klug Circle
Corona, CA 92878
Phone: 951.738.2230
www.aceheaters.com



FACTORY LIMITED WARRANTY POLICY

The Ace Factory limited warranty provides assurance that all products are free from manufactureres defects at the time of shipment and meet specifications and performance described in the product literature.

It is important to understand the difference between a factory warranty and an installed warranty. There are many factors that can occur to the products after they are shipped that the company has no control over and can not fully verify. These includes:

1. Hidden damage during the shipping.
2. Handling damage.
3. Damage during storage.
4. Installation conditions.
5. Other unknown variables in the system design: maintenance, pulsation and vibrations.

The installed warranty is the responsibility of the architech, specifying engineer, contractor and/or owner who jointly have control over the application, installation, location, operating and maintenance conditions.

The Ace Heaters, LLC warranty excludes extended liabilities. Extended liability typically occurs when products are installed without proper drainage, flooding containment or when safety devices are not tested and repaired or replaced when needed.

Product problems are often caused by the condition of the water, the lack of water treatment and/or the improper treatment of the water, insufficient combustion air, improper draft conditions, bolts not re-tightened, pipes not flushed and cleaned of oil, metal chips, rags, vibration and pulsation etc. These are installation, operating and/or maintenance conditions that are beyond the seller's responsibility and are not covered by the factory warranty, but may be covered by the installer's warranty.

The factory warranty covering company products is based upon extensive product development and testing. Combustion products under go certification testing and approvals to Underwriters Laboratory (UL) standards. Auditing of the production of combustion products is conducted by a nationally recognized testing laboratory.

Pressure vessel products are designed and manufactured to American Society of Mechanical Engineering (ASME) and National Board (NB) Design standards. Design reviews, factory product manufacturing quality inspections and testing are carried out by a third party National Board authorized inspection agency.

Ace Heaters, LLC products have proven themselves in service for over 85 years which indicates that the company products perform exceedingly well when normal installation, operating and maintenance conditions exist.

The following is a review from the terms and conditions of sale. Also included in paragraph two, below, is the Ace Heaters LLC nonconformance policy.

1. Ace Heaters, LLC warrants its products against defective material and/or workmanship only. The warranty does not apply to operational failures, electrical failures, gasket leaks, and/or other malfunctions caused by improper application, installation and/or maintenance.
2. It is the buyer's responsibility to inspect and accept the product, when received, as conforming to their purchase order, specifications and approved drawings. All claims for non-conformance, errors, shortages, etc. must be made within 10 days after receipt of the shipment.
3. Ace Heaters, LLC do not provide a warranty or guarantee, express or implied, in any manner, form, usage of trade, merchantability or fitness which extend beyond the product description and quotation.
4. Ace Heaters, LLC liability is limited to the factory repair or replacement of warranty failures, or non-conformance, upon the return of the product to the factory.
5. Ace Heaters, LLC is not liable for any direct or consequential damages.
6. Ace Heaters, LLC warranty is based upon section 23161(2) of the uniform commercial code and is printed in the term and conditions of sale which is referenced in every quotation, on the back of sales order acknowledgements and invoices. It is legally correct and is an industry standard policy.

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Water Heater – Water Quality Requirements

Properly ensuring the water within the water heater is treated is essential for maintaining the water heaters performance over time and preserving the components connected to the system. It is advisable to manage any water treatment program under the guidance of a water treatment specialist.

Water heaters can suffer from scale buildup and chemically induced corrosion due to poor water quality. Among these problems, the most common is the formation of scale inside the unit, which predominantly occurs on the hottest surface; the u-tube bundle heat exchanger. The accumulation of scale in the unit can lead to a reduction in the water heater's capacity as it coats the heat exchanger surface.

Poor water quality can contribute to chemically induced corrosion of the heat exchanger or the vessel. Different forms of chemically induced corrosion may arise, including general corrosion, pitting corrosion, and stress corrosion. Such corrosion has the potential to significantly decrease the lifespan of the vessel or the tube bundle. General corrosion might manifest as a uniform deterioration of the tube, tubesheet, or vessel material, eventually causing material failure. Pitting corrosion involves the creation of small pits on the tubes, tubesheet, or shell, which can ultimately lead to material failure. Stress corrosion results in stress corrosion cracking. This refers to the development of brittle cracks along the metal's stress lines and grain boundaries. Stress corrosion cracking is more likely to affect materials like austenitic stainless steel, such as the grade 316L commonly used in the water heater's vessel, tubes, and tubesheet. This type of corrosion is associated with the presence of chlorides in the water. The likelihood of stress corrosion cracking increases with higher concentrations of chlorides and temperatures.

Under normal design and operating conditions, the water temperatures within a water heater usually remain below the threshold required for stress corrosion to occur.

Ace Heaters, LLC requires all water heaters to be operated within the following ranges to help control corrosion and scaling:

| Water Property | Range |
|--|-----------------------------------|
| Alkalinity (CO ₃ , HCO ₃) | Less than 300 ppm |
| Chlorides | Less than 100 ppm |
| Conductivity | Less than 1,500 ppm (3,000 uS/cm) |
| pH | 6-8 |
| Silica | Less than 150 ppm |
| Sulfates | Less than 250 ppm |
| Total Dissolved Solids | Less than 50 ppm |
| Total Hardnes (Ca and Mg) | Less than 150 ppm |



WARRANTY

Limited

Ace Heaters, LLC provides a limited warranty on its products against **defective material and/or workmanship only**. This limited warranty is not applicable to operational failures, electrical failures, gasket leaks, wear or malfunctions caused by improper application, storage, installation, and/or maintenance.

Product Period - The following Limited Warranty period are from date of shipment:

Tanks

Tanks - Carbon Steel: One Year

Tanks - Stainless Steel: Three Years

Storage Water Heaters Single-wall or Double-wall Tank/Exchanger Coils: One Year

Clean Steam Generators: One Year

Linings: (Pro-rated Warranty)

Magnesium Anodes must be used at all times to maintain the Limit Warranty

Section VIII Tanks:

Epoxy: 30" dia. and above (Three years)

Glass: 24" dia. and under (One year).

Glass: 30" dia. and above (Five years).

Cement: (Five years).

Pre-Krete: (Ten years).

Section IV Tanks: SW Model Only

Glass (One year) & Epoxy (Three years).

Minipacks™ Single-wall or Double-wall: One Year

Shell & Tube Heat Exchangers Single-wall or Double-wall: One Year

Atlas™ Series Condensing Boiler (Heat Exchanger): One Year

Triton™ Series Near Condensing Boiler (Heat Exchanger): Twelve Years

Liberty™ Series Condensing Boiler (Heat Exchanger): Ten Years

B-Series Copper Fin Boiler: Three Years

Controls: Components manufactured by other than Ace Heaters, LLC such as controls, instruments, forced draft burner, etc., provided with the boilers and packaged products are not covered by the Ace Heaters, LLC Warranty. However, Ace Heaters, LLC extends to the customer the same warranty provided by the manufacturer to Ace Heaters, LLC. The customer shall receive the full benefits of adjustments made to Ace Heaters, LLC by the manufacturer.

Any claim for adjustment under this limited warranty must be made within the warranty period. Ace Heaters, LLC's liability shall be limited to factory repair or, at Ace Heaters, LLC's option, replacement of all parts which, upon test and examination by Ace Heaters, LLC, prove to be defective material and/or workmanship and within the above limited warranty. If required by Ace Heaters, LLC, parts which are claimed to be defective must be promptly delivered to the Ace Heaters, LLC facility, transportation charges prepaid. This warranty does not cover the cost of labor, removal, or installation of the warranted item during the limited period. This warranty is limited to the above and applies only for the period set forth. Ace Heaters, LLC will not be liable for any loss damage, direct, incidental or consequential damages of any kind, whether based upon warranty, contract, negligence or strict liability and arising in connection with the sale, use or repair of the products. Ace heaters's maximum liability shall exceed the contract price for the product's merchantability or fitness for any particular purpose and in no event shall be held responsible for any consequential damages.

For complete Limited Warranty conditions see Section G and H under terms and condition of sale.

Ace Heaters, LLC, also doing business as Ace Heaters, LLC, is referred to herein as Ace Heaters, LLC



Ace Heater, LLC

130 Klug Circle, Corona CA 92878

PHONE: (951) 738-2230 • FAX: (951) 281-4959

www.aceheaters.com

Ace Heaters, LLC

WARNING

PRODUCT SAFETY NOTICE

ACE BOILER AND WATER HEATER PRODUCTS OPERATE AT HIGH TEMPERATURE AND PRESSURES

- Before using this product, read and understand instructions. Save these instructions for future use.
- Before servicing, to prevent serious burns or injury, the boiler and water heater products must be cooled to less than 80°F (27°C) and the pressure must be 0 psi (0 bar).
- Turn off the electrical power before making electrical connections to prevent electrical shock.
- These products must be placed in a controlled location where untrained or unqualified personnel cannot access the operating or safety controls, must not be able to come in contact with high temperature or high pressure parts and must not perform maintenance or demolition work.
- All work performed must be by qualified properly equipped personnel trained in the proper application, installation, and maintenance or demolition of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.
- ACE Boilers and Water Heaters are complete package units with safety and operating controls and are constructed with non ASBESTOS materials. Any replacement gaskets, refractory, insulation, etc used must not contain Asbestos.
- No additional insulation is required on the Boilers and Water Heaters.
- Additions or replacement of insulation on any connecting pipes or accessories to the Boilers and/or Water Heaters must be of "NON-ASBESTOS" and contain only non-hazardous materials.
- Crystalline Silica, a material known to cause cancer, may be encapsulated in some refractory or insulation materials and must be handled only by authorized trained personnel. Crystalline Silica as used is encapsulated and is not harm full in this form. Care must be taken during removal or replacement of refractory or insulation to remove it in bulk form and avoid generation or inhalation of dust. Removal must be properly performed by trained, qualified and equipped personnel. This is also true of Asbestos not contained in ACE products but may be otherwise contained in replacement materials or parts, in connecting piping or other nearby products.
- All safety and operating controls must be set within the specified operating limits and tested periodically to assure proper operation. All limit and operating controls must be installed in series on the boiler.
- Connect drain pipes to a safe drain to prevent serious personal injury from relief valve discharge and or from boiler blow down discharge.
- After installation, check for proper operation of all limit and operating controls before leaving the site.
- Perform scheduled and annual inspections including checking Controls for proper calibration and performance.

Failure to follow these warnings, to allow access by unauthorized persons and the use of non-properly trained and equipped personnel in the operation, service, modification, removal or demolition of these products or replacement of parts with non-authorized factory non-asbestos materials could cause damage, personal injury or death.



Ace Heaters. LLC
www.aceheaters.com

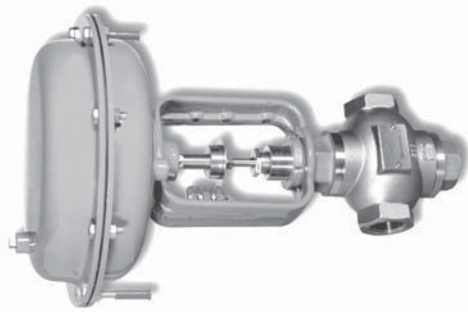
PRODUCT SPECIFICATION

March 2005

PNEUMATIC ACTUATED INDUSTRIAL VALVES

SERIES: **2800** SIZES 1/2 to 2 INCHES

Precision Globe Control Valves



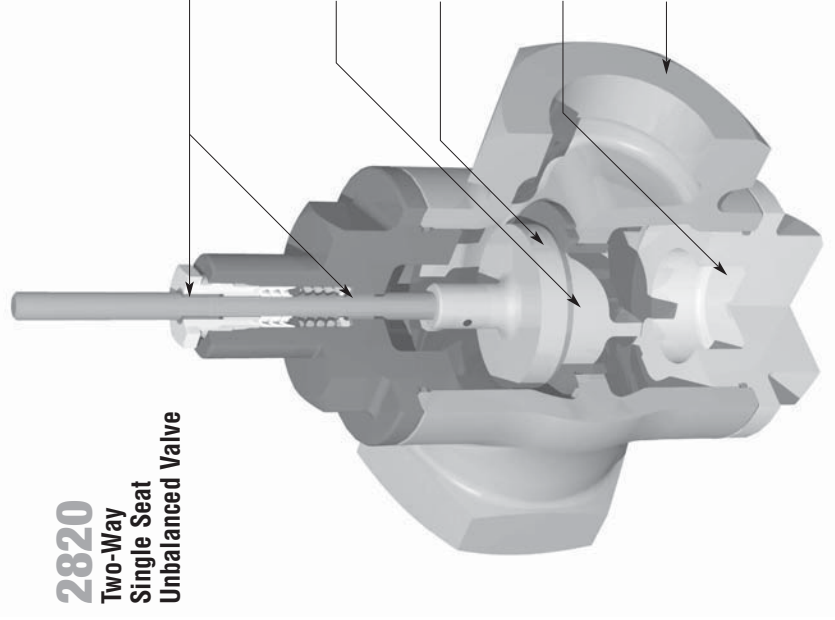
WARREN CONTROLS

Two-Way and Three-Way, Reciprocating,
Bronze or Stainless Steel Body Valves
for Process and Utility Applications

Table of Contents

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2820 Two-Way Single Seat Unbalanced Valve



Flexible Design Options
provide optimum performance and extended reliability in a cost effective, application specific package.

Dual Point PEEK Bearing Stem Guiding
provides both stability and low friction, yielding reduced hysteresis and optimum control.

Trim
available in 316SS, 17-4 pH, Alloy 6, PEEK, and PTFE.

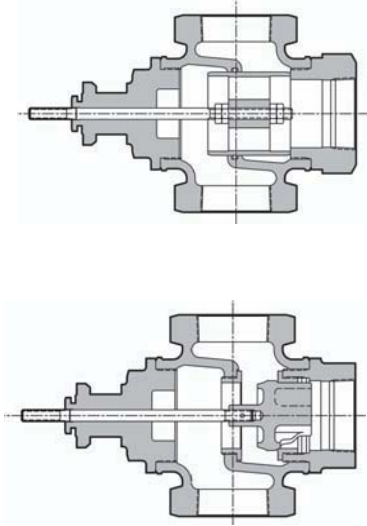
Port Guided Plug Assembly
provides stability and desired equal percentage flow characteristic.

Lower Plug
offers easy access for inspection and clean out.

Rugged Body
with a selection of port reductions.

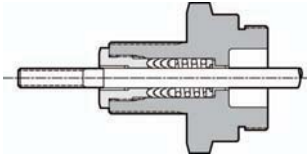


SERIES: 2800
Precision Globe
Control Valves

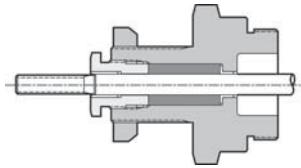


2830
Three-Way Mixing Valve
Bronze Body

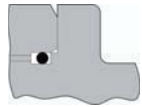
2832
Three-Way Diverting/Mixing Valve
Bronze Body



Guided Low-Friction TFE V-Ring Packing Spring Loaded



Adjustable Graphite Packing



Fluoraz O-Ring Upper and Lower Body Seals in Stainless Steel Body Valves

Description

Warren Controls Series 2800 Precision Globe Control Valves feature rugged bronze or stainless steel bodies with a variety of trim materials and port sizes. The equal percentage and linear plugs in the 2-way valves and linear plugs in the 3-way valves provide excellent modulating control of a wide variety of fluids for pressure, temperature, level, and flow applications from -20 to 500°F. The Series 2800 is ideally suited where value and long life are important objectives for applications including but not limited to the Chemical, Food & Beverage, General Service, Refining, and Pharmaceutical Industries.

2600 Emrick Blvd., Bethlehem, PA 18020-8010 www.WarrenControls.com
Tel: 800-922-0085 or 610-317-0800 Fax: 610-317-2989



3 For additional applications, and/or products call: 800-922-0085 or visit: www.WarrenControls.com

PS 2800 C 0916

Body Style Versus Application

2-Way Valves (Control of Liquids, Gases, and Steam)

2820 Two-Way Single Seat Unbalanced Valve

The most commonly applied solution with ANSI Class IV and VI shut-off.

- Sizes:** 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 3 inch
- Body:** ANSI B16.15 Bronze 250LB Threaded (NPT) or 316 Stainless Steel 300LB Threaded (NPT)
- Trim:** F0% or Linear, 316 Stainless Steel, Alloy 6, TFE, PEEK, or 17-4 PH Hardened Stainless Steel
- Shut-off:** ANSI Class IV (Stainless Steel and Alloy 6 Trim), ANSI Class VI (TFE and PEEK Trim)
- Packing:** Guided Low-Friction TFE V-Ring, Spring Loaded (-32 to 450°F), Adjustable Graphite Packing (-32 to 500°F)
- Temperature:** -32 to 400°F (Bronze 250LB Threaded Body w/ TFE or PEEK Trim) -32 to 500°F (316 Stainless Steel 300LB Threaded Body w/ Stainless Steel or Alloy 6 Trim)
- Rangeability:** 50:1



| Body Pressure-Temperature Ratings: | |
|------------------------------------|------------------------------|
| Temperature (F) | 250 THD Bronze SS 300 THD SS |
| +32° to 150°F | 400 720 |
| 150° | 400 670 |
| 175° | 392 645 |
| 200° | 385 620 |
| 225° | 375 605 |
| 250° | 365 590 |
| 275° | 350 575 |
| 300° | 335 560 |
| 325° | 317 548 |
| 350° | 300 537 |
| 375° | 275 526 |
| 400° | 250 515 |
| 450° | - 497 |
| 500° | - 480 |

Pressure ratings are PSIG

For applications below 32° consult factory.

For applications above 375° 300 THD Stainless Steel Body is recommended.

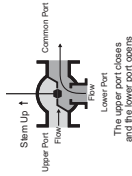
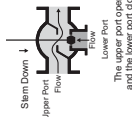
| Trim Materials | Flowing Differential Pressure Limit |
|------------------------|-------------------------------------|
| Bronze | 50 PSID |
| 316 Stainless Steel | 100 PSID |
| TFE | 100 PSID |
| PEEK | 100 PSID |
| 17-4 PH Hardened Steel | 200 PSID |
| Alloy 6 | 300 PSID |

3-Way Valves (Control of Liquids)

2830 Three-Way Mixing Valve

This valve has two inlets and one outlet, and is the simplest solution for mixing or bypass applications with ANSI Class IV shut-off. In normal applications the inlet pressures are near equal and control is possible from 5% to 95% of travel with inlet pressures up to 100 PSI.

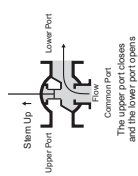
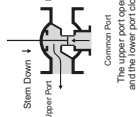
- Sizes:** 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 3 inch
- Body:** ANSI B16.15 Bronze 250LB Threaded (NPT) or 316 Stainless Steel 300LB Threaded (NPT)
- Trim:** Linear, 316 Stainless Steel
- Packing:** Guided Low-Friction TFE V-Ring, Spring Loaded (-32 to 450°F), Adjustable Graphite Packing (-32 to 500°F)
- Temperature:** -32 to 400°F (Bronze 250LB Threaded) -32 to 500°F (316 Stainless Steel 300LB Threaded)
- Rangeability:** 50:1



2832 Three-Way Diverting/Mixing Valve

Designed as a diverting valve with one inlet and two outlets with ANSI Class III shut-off. However, flow can be reversed for mixing if this port configuration is desirable. The difference between the upper port and lower port pressure must not exceed 50 PSID.

- Sizes:** 1, 1-1/2, 2, 3 inch
- Body:** ANSI B16.15 Bronze 250LB Threaded (NPT) or 316 Stainless Steel 300LB Threaded (NPT)
- Trim:** Linear, Bronze (Bronze 250LB Threaded), or 316 Stainless Steel (316 Stainless Steel 300LB Threaded)
- Packing:** Guided Low-Friction TFE V-Ring, Spring Loaded (-32 to 450°F), Adjustable Graphite Packing (-32 to 500°F)
- O-Ring:** EPR (Bronze 250LB Threaded), Fluoraz 797 (316 Stainless Steel 300LB Threaded)
- Temperature:** -32 to 300°F (Bronze 250LB Threaded) -32 to 500°F (316 Stainless Steel 300LB Threaded)
- Rangeability:** 50:1



Flow Coefficients (Cv) Versus Travel

| Valve | | 2820 Flow Coefficients (Cv) | | | | | | | | | |
|--------------------------------------|------------|-----------------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Two-Way Single Seat Unbalanced Valve | | % Travel | | | | | | | | | |
| Valve Size (In) | Trim Style | 100% | 90% | 80% | 70% | 60% | 50% | 40% | 30% | 20% | 10% |
| 1/2 | EQ | 0.876 | FULL 4.90 | 4.78 | 3.53 | 2.57 | 1.92 | 1.52 | 0.95 | 0.69 | 0.43 |
| | LINEAR | 0.626 | 1.5R 3.20 | 3.16 | 2.29 | 1.61 | 1.19 | 0.75 | 0.51 | 0.39 | 0.26 |
| 3/4 | EQ | 0.626 | 2.5R 6.00 | 5.44 | 4.44 | 3.96 | 3.42 | 2.82 | 2.40 | 2.01 | 1.20 |
| | LINEAR | 0.876 | FULL 6.00 | 5.40 | 4.80 | 4.20 | 3.60 | 3.00 | 2.40 | 1.80 | 0.60 |
| 1 | EQ | 0.876 | 1.5R 7.20 | 7.09 | 5.53 | 3.51 | 2.53 | 1.73 | 1.24 | 0.88 | 0.52 |
| | LINEAR | 0.626 | 3.5R 5.50 | 5.31 | 3.73 | 2.64 | 1.95 | 1.21 | 0.86 | 0.70 | 0.43 |
| 1-1/4 | EQ | 0.626 | 2.5R 9.00 | 8.78 | 6.88 | 4.70 | 3.42 | 2.40 | 1.61 | 1.12 | 0.66 |
| | LINEAR | 0.876 | FULL 9.00 | 8.78 | 7.68 | 6.58 | 5.48 | 4.38 | 3.60 | 2.88 | 2.16 |
| 1-1/2 | EQ | 0.876 | 1.5R 10.0 | 9.70 | 7.50 | 5.30 | 3.88 | 2.70 | 1.97 | 1.22 | 0.78 |
| | LINEAR | 0.626 | 3.5R 8.00 | 8.38 | 6.09 | 3.64 | 2.58 | 1.74 | 1.25 | 0.89 | 0.52 |
| 2 | EQ | 0.626 | 4.5R 12.0 | 11.59 | 9.38 | 6.64 | 4.96 | 3.42 | 2.40 | 1.61 | 1.12 |
| | LINEAR | 0.876 | FULL 12.0 | 11.59 | 10.49 | 9.39 | 8.29 | 7.19 | 6.09 | 4.99 | 3.89 |
| 2-1/2 | EQ | 0.626 | 5.5R 15.0 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 | 3.36 | 2.40 | 1.61 |
| | LINEAR | 0.876 | FULL 15.0 | 14.46 | 13.36 | 12.26 | 11.16 | 10.06 | 8.96 | 7.86 | 6.76 |
| 3 | EQ | 0.626 | 6.5R 18.0 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 | 3.36 | 2.40 |
| | LINEAR | 0.876 | FULL 18.0 | 17.33 | 16.23 | 15.13 | 14.03 | 12.93 | 11.83 | 10.73 | 9.63 |
| 3-1/2 | EQ | 0.626 | 7.5R 21.0 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 | 3.36 |
| | LINEAR | 0.876 | FULL 21.0 | 20.20 | 19.10 | 18.00 | 16.90 | 15.80 | 14.70 | 13.60 | 12.50 |
| 4 | EQ | 0.626 | 8.5R 24.0 | 23.07 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 |
| | LINEAR | 0.876 | FULL 24.0 | 23.07 | 21.87 | 20.77 | 19.67 | 18.57 | 17.47 | 16.37 | 15.27 |
| 4-1/2 | EQ | 0.626 | 9.5R 27.0 | 25.94 | 23.07 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 |
| | LINEAR | 0.876 | FULL 27.0 | 25.94 | 24.74 | 23.64 | 22.54 | 21.44 | 20.34 | 19.24 | 18.14 |
| 5 | EQ | 0.626 | 10.5R 30.0 | 28.81 | 25.94 | 23.07 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 |
| | LINEAR | 0.876 | FULL 30.0 | 28.81 | 27.61 | 26.51 | 25.41 | 24.31 | 23.21 | 22.11 | 21.01 |

2-Way Valves (Control of Liquids, Gases, and Steam)

| Valve | | 2830 Flow Coefficients (Cv) | | | | | | | | | |
|------------------------|------------|-----------------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Three-Way Mixing Valve | | % Travel | | | | | | | | | |
| Valve Size (In) | Trim Style | 100% | 90% | 80% | 70% | 60% | 50% | 40% | 30% | 20% | 10% |
| 1/2 | EQ | 0.876 | FULL 6.30 | 6.30 | 4.78 | 3.53 | 2.57 | 1.92 | 1.52 | 0.95 | 0.69 |
| | LINEAR | 0.626 | 1.5R 4.00 | 3.96 | 2.82 | 2.01 | 1.44 | 1.00 | 0.75 | 0.51 | 0.39 |
| 3/4 | EQ | 0.626 | 2.5R 8.00 | 7.99 | 6.09 | 3.64 | 2.58 | 1.74 | 1.25 | 0.89 | 0.52 |
| | LINEAR | 0.876 | FULL 8.00 | 7.99 | 7.09 | 6.19 | 5.29 | 4.39 | 3.49 | 2.59 | 1.69 |
| 1 | EQ | 0.626 | 3.5R 10.0 | 9.70 | 7.50 | 5.30 | 3.88 | 2.70 | 1.97 | 1.22 | 0.78 |
| | LINEAR | 0.876 | FULL 10.0 | 9.70 | 8.80 | 7.90 | 7.00 | 6.10 | 5.20 | 4.30 | 3.40 |
| 1-1/4 | EQ | 0.626 | 4.5R 12.0 | 11.59 | 9.38 | 6.64 | 4.96 | 3.42 | 2.40 | 1.61 | 1.12 |
| | LINEAR | 0.876 | FULL 12.0 | 11.59 | 10.69 | 9.79 | 8.89 | 7.99 | 7.09 | 6.19 | 5.29 |
| 1-1/2 | EQ | 0.626 | 5.5R 15.0 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 | 3.36 | 2.40 | 1.61 |
| | LINEAR | 0.876 | FULL 15.0 | 14.46 | 13.56 | 12.66 | 11.76 | 10.86 | 9.96 | 9.06 | 8.16 |
| 2 | EQ | 0.626 | 6.5R 18.0 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 | 3.36 | 2.40 |
| | LINEAR | 0.876 | FULL 18.0 | 17.33 | 16.23 | 15.13 | 14.03 | 12.93 | 11.83 | 10.73 | 9.63 |
| 2-1/2 | EQ | 0.626 | 7.5R 21.0 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 | 3.36 |
| | LINEAR | 0.876 | FULL 21.0 | 20.20 | 19.10 | 18.00 | 16.90 | 15.80 | 14.70 | 13.60 | 12.50 |
| 3 | EQ | 0.626 | 8.5R 24.0 | 23.07 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 | 4.68 |
| | LINEAR | 0.876 | FULL 24.0 | 23.07 | 21.87 | 20.77 | 19.67 | 18.57 | 17.47 | 16.37 | 15.27 |
| 3-1/2 | EQ | 0.626 | 9.5R 27.0 | 25.94 | 23.07 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 | 6.36 |
| | LINEAR | 0.876 | FULL 27.0 | 25.94 | 24.74 | 23.64 | 22.54 | 21.44 | 20.34 | 19.24 | 18.14 |
| 4 | EQ | 0.626 | 10.5R 30.0 | 28.81 | 25.94 | 23.07 | 20.20 | 17.33 | 14.46 | 11.59 | 8.64 |
| | LINEAR | 0.876 | FULL 30.0 | 28.81 | 27.61 | 26.51 | 25.41 | 24.31 | 23.21 | 22.11 | 21.01 |

3-Way Valves (Control of Liquids)

| Valve | | 2832 Flow Coefficients (Cv) | | | |
|----------------------------------|------------|-----------------------------|-------|-------|------|
| Three-Way Diverting/Mixing Valve | | % Travel | | | |
| Valve Size (In) | Trim Style | 100% | Upper | Lower | 100% |
| 1 | LINEAR | 12 | 15 | 15 | 12 |
| | LINEAR | 22 | 26 | 26 | 22 |
| 2 | LINEAR | 40 | 47 | 47 | 40 |

Sizing Reference

| Steam Table | | | | | |
|---------------------|----------|----------|-----------------------|---------------------|--------------------|
| Steam Pressure PSIG | Temp. °F | Temp. °C | Sensible Heat BTU/Lb. | Latent Heat BTU/Lb. | Total Heat BTU/Lb. |
| 0 | 212 | 100 | 180 | 971 | 1151 |
| 10 | 239 | 115 | 207 | 962 | 1169 |
| 25 | 266 | 130 | 236 | 954 | 1170 |
| 50 | 297 | 147 | 267 | 912 | 1179 |
| 75 | 320 | 160 | 290 | 896 | 1186 |
| 100 | 338 | 170 | 309 | 881 | 1190 |
| 125 | 353 | 178 | 325 | 868 | 1193 |
| 150 | 365 | 185 | 339 | 858 | 1197 |
| 200 | 387 | 197 | 362 | 838 | 1202 |
| 250 | 406 | 208 | 381 | 821 | 1204 |
| 300 | 422 | 217 | 399 | 805 | 1204 |
| 400 | 448 | 231 | 438 | 778 | 1216 |
| 500 | 470 | 243 | 453 | 762 | 1205 |
| 600 | 489 | 254 | 475 | 729 | 1204 |

Rectangular Tank Capacity in Gallons
 Height x Width x Length (inches)
 Gallons = $\frac{\text{Height} \times \text{Width} \times \text{Length}}{230}$
 or
 Gallons = $H \times W \times L (\text{ft.}) \times 7.5$

Circular Tank Storage Capacity in Gallons
 Storage = $6D^2 \times L$ (Gallons)
 Where:
 D = Tank Diameter in Feet
 L = Length in Feet

Heating Water with Steam

Quick Method

$$\text{GPM} = \frac{\text{CFM} \times (\text{°F air temp. rise})}{1000 \times (\text{°F water temp. drop})}$$

$$\text{Lbs./Hr.} = \frac{\text{GPM}}{2} \times \Delta T$$

Accurate Method

$$\text{Lbs./Hr.} = \frac{\text{GPM} \times 500 \times \Delta T}{h_f}$$

Heating or Cooling Water with Water

$$\text{GPM}_1 = \frac{\text{°F water}_2 \text{ temp. rise or drop}}{\text{°F water}_1 \text{ temp. rise or drop}} \times \text{GPM}_2$$

Heating or Cooling Water

$$\text{GPM} = \frac{\text{BTU / Hr.}}{(\text{°F water temp. rise or drop}) \times 500}$$

Heating Oil with Steam

$$\text{Lbs./Hr.} = \frac{\text{CFM}}{900} \times (\text{°F oil temp. rise})$$

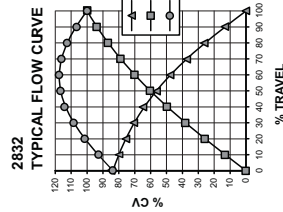
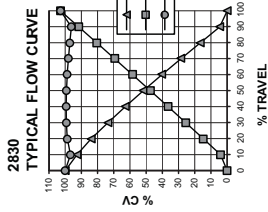
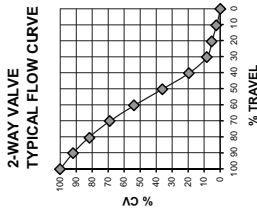
Load Sizing Calculations

Glossary of Terms

- t = Time in Hours
- Cp = Specific Heat of Liquid
- S = Specific Gravity of Fluid
- W = Weight in Lbs.
- ΔT = Temperature Rise or Fall in °F
- h_{fg} = Latent Heat of Steam

Conversion Factors

- 1 Lb. Steam / Hr. = 1000 BTU / Hr.
- 1 Cubic Meter = 264 U.S. Gallons
- 1 Cubic Foot Water = 62.4 Lbs.
- 1 PSI = 2.04 inches of Mercury
- 1 PSI = 2.3 Feet of Water
- 1 U.S. Gallon Water = 231 Cubic Inches
- 1 U.S. Gallon Water = 8.33 Lbs.



Shut-Off ΔP Ratings

NOTES:

- 2820 Seat closure ANSI Class IV (Stainless Steel and Alloy 6 Trim), ANSI Class VI (TFE and PEEK Trim).
- Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.
- See Actuators, Positioners, and Accessories section for explanation of spring ranges.

| Valve | | Actuator | | | | Shut-Off ΔP Two-Way, Single Seat Unbalanced | | | |
|----------------|-----------------|------------------|--------------------------|-----------------------------------|----------------|---|-----------|----------|--|
| Trim Size (IN) | Valve Size (IN) | Plug Travel (IN) | Pneumatic Actuator Range | Medium Shut-off ΔP in PSI | | | | | |
| | | | | Fall Closed | Reverse Acting | Direct Acting | Fall Open | | |
| | | | | 3-15 PSI | 1-17 PSI | 0-30 PSI | 0-40 PSI | 0-40 PSI | |
| 0.626 | 1/2 | 3/4 | DL49 | N/A | 226 | 386 | 704 | 720 | |
| | thru | | | N/A | 67 | 386 | 720 | 720 | |
| | 1-1/4 | | | High | 720 | 720 | 720 | 720 | |
| 0.876 | 1/2 | 3/4 | DL49 | N/A | 90 | 171 | 333 | 496 | |
| | thru | | | Low | 8 | 171 | 720 | 720 | |
| | 2 | | | High | 415 | 577 | 659 | 720 | |
| 1.126 | 1 | 3/4 | DL49 | N/A | 38 | 88 | 186 | 284 | |
| | thru | | | Low | N/A | 88 | 137 | 720 | |
| | 2 | | | High | 235 | 334 | 383 | 720 | |
| | | | | Low | N/A | 60 | 144 | 720 | |
| | | | | High | N/A | 60 | 144 | 720 | |
| 1.438 | 1-1/4 | 3/4 | DL49 | N/A | 11 | 42 | 102 | 162 | |
| | thru | | | Low | N/A | 42 | 72 | 555 | |
| | 2 | | | High | N/A | 132 | 193 | 223 | |
| | | | | Low | N/A | 24 | 76 | 720 | |
| | | | | High | N/A | 24 | 76 | 697 | |
| | | | | Xtra-High | N/A | 231 | 335 | 720 | |
| 1.676 | 1-1/4 | 3/4 | DL84XR | N/A | 24 | 46 | 68 | 113 | |
| | thru | | | Low | N/A | 24 | 46 | 401 | |
| | 2 | | | High | N/A | 24 | 46 | 335 | |
| | | | | Low | N/A | 11 | 49 | 506 | |
| | | | | High | N/A | 11 | 49 | 506 | |
| | | | | Xtra-High | N/A | 163 | 240 | 278 | |
| 2.126 | 2 | 3/4 | DL84XR | N/A | 278 | 354 | 392 | N/A | |
| | thru | | | Low | N/A | 7 | 21 | 186 | |
| | | | | High | N/A | 7 | 21 | 200 | |
| | | | | Xtra-High | N/A | 94 | 141 | 449 | |
| | | | | Low | N/A | N/A | 23 | N/A | |
| | | | | High | N/A | N/A | 307 | N/A | |
| | | | | Xtra-High | N/A | 94 | 141 | 165 | |
| | | | | Low | N/A | 165 | 212 | 236 | |

N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure

N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure

Shut-Off ΔP Ratings

NOTES:

- 2830 Mixing Valves have two inlets and one outlet. Published shut-off values are with respect to worst case conditions with zero downstream pressure on the outlet port and zero upstream pressure on the opposing inlet port. Pneumatic Actuators used with the 2830 are direct acting. The upper port fails closed on loss of air pressure to the actuator.
- 2830 Seat closure ANSI Class IV.
- Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.

Maximum air pressure
DL49...30PSIG
DL84 & 84XR...30PSIG

- Published shut-off values are for diverting applications. The values are worst case and based on the pressure difference between the inlet and the outlet that is closed. Consult the factory if the required shut-off exceeds the published value and the pressure at the inlet and both outlets is known. For proper operation in diverting applications, the pressure difference between both outlets must not exceed 50 PSI. Consult the factory for shut-off values for 2832 mixing applications. Pneumatic Actuators used with the 2832 are direct acting. The upper port fails closed on loss of air pressure to the actuator.
- 2832 Seat closure ANSI Class III.
- Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

Maximum air pressure
DL49...30PSIG
DL84 & 84XR...30PSIG

| Valve | | Actuator | | | | Shut-Off ΔP Three-Way Mixing | | | |
|----------------|-----------------|------------------|--------------------------|------------------------------------|---------------|---|-------------------|----------|--|
| Trim Size (IN) | Valve Size (IN) | Plug Travel (IN) | Pneumatic Actuator Range | Maximum Shut-off ΔP in PSI | | | | | |
| | | | | Upper Port Closed | Direct Acting | Air Signal to Actuator | Lower Port Closed | | |
| | | | | 3-15 PSI | 1-17 PSI | 0-30 PSI | 0-40 PSI | 0-40 PSI | |
| 0.626 | 1/2 | 9/16 | DL49 | N/A | 67 | 226 | 350 | 720 | |
| | thru | | | Low | N/A | 226 | 386 | 720 | |
| | 1 | | | High | 545 | 720 | 720 | 720 | |
| 0.876 | 1/2 | 9/16 | DL49 | N/A | 8 | 90 | 260 | 423 | |
| | thru | | | Low | N/A | 90 | 171 | 720 | |
| | 2 | | | High | 252 | 415 | 496 | 720 | |
| 1.126 | 1/2 | 9/16 | DL49 | N/A | N/A | 38 | 142 | 240 | |
| | thru | | | Low | N/A | 38 | 88 | 683 | |
| | 2 | | | High | 137 | 235 | 284 | 720 | |
| 1.676 | 1-1/4 | 3/4 | DL49 | N/A | N/A | 2 | 48 | 93 | |
| | thru | | | Low | N/A | 2 | 24 | 283 | |
| | 2 | | | High | 46 | 91 | 113 | 315 | |
| | | | | Low | N/A | 11 | 49 | 715 | |
| | | | | High | N/A | 11 | 49 | 486 | |
| 2.126 | 2 | 3/4 | DL49 | N/A | 163 | 240 | 278 | N/A | |
| | thru | | | Low | N/A | N/A | N/A | 174 | |
| | | | | High | N/A | 21 | 48 | 62 | |
| | | | | Xtra-High | N/A | N/A | 23 | 188 | |
| | | | | Low | N/A | N/A | 23 | 81 | |
| | | | | High | N/A | N/A | 23 | 129 | |
| | | | | Xtra-High | N/A | 94 | 141 | 165 | |
| | | | | Low | N/A | 165 | 212 | 284 | |

N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure

N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure

6) See Actuators, Positioners, and Accessories section for explanation of spring ranges.

| Valve | | Actuator | | | | Shut-Off ΔP Three-Way Diverting/Mixing | | | |
|-----------------|------------------|--------------------------|------------------------------------|---------------|------------------------|---|----------|----------|--|
| Valve Size (IN) | Plug Travel (IN) | Pneumatic Actuator Range | Maximum Shut-off ΔP in PSI | | | | | | |
| | | | Upper Port Closed | Direct Acting | Air Signal to Actuator | Lower Port Closed | | | |
| | | | | 3-15 PSI | 1-17 PSI | 0-30 PSI | 0-40 PSI | 0-40 PSI | |
| 1 | 3/4 | DL49 | High | 110 | 113 | 115 | N/A | N/A | |
| 1-1/2 | 3/4 | DL49 | High | 113 | 115 | 118 | N/A | N/A | |
| | | DL84 | High | N/A | 110 | 113 | N/A | N/A | |
| 2 | 3/4 | DL49 | High | 110 | 113 | 115 | N/A | N/A | |
| | | DL84 | High | 108 | 110 | 113 | N/A | N/A | |

- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.
- Maximum air pressure
DL49...30 PSIG
DL84...30 PSIG

6) See Actuators, Positioners, and Accessories section for explanation of spring ranges.

Dimensions & Weights

| Component | 2820 Dimension (IN) by Valve Size (IN) | |
|-----------|--|--------------------------------------|
| Variable | 1/2, 3/4, 1 | 1-1/4 & 1-1/2 |
| A | 250THD 300THD | 5-3/4 6-1/8 |
| B | 250THD 300THD | 3-1/4 3-7/8 |
| C | DL49 Direct* DL49 Reverse DL84 Direct* DL84 or 84XR Reverse | 15-1/4 14-5/8 19-1/4 18-5/8 |
| H | DL49 W/760 | 1-3/4 1-3/4 |
| Item | DL84 or 84XR | 2-3/4 4-1/4 |
| Variable | Weight (LB) by Valve Size (IN) | |
| 250THD | 1/2, 3/4, 1 | 1-1/4 & 1-1/2 |
| 300THD | 8 | 14-1/2 |
| | | 15-1/2 |
| | | 19 |

| Component | 2830 Dimension (IN) by Valve Size (IN) | |
|-----------|--|------------------|
| Variable | 1/2, 3/4, 1 | 1-1/4 & 1-1/2 |
| A | 250THD 300THD | 5-3/4 6-1/8 |
| B | 250THD 300THD | 3-3/4 3-3/8 |
| C | DL49 Direct* DL84 or 84XR Direct* | 15-1/4 15-7/8 |
| H | DL49 W/760 | 1-3/4 1-3/4 |
| Item | DL84 or 84XR | 4-1/4 4-1/2 |
| Variable | Weight (LB) by Valve Size (IN) | |
| 250THD | 1/2, 3/4, 1 | 1-1/4 & 1-1/2 |
| 300THD | 9 | 15-1/2 |
| | | 20 |
| | | 18-1/2 |

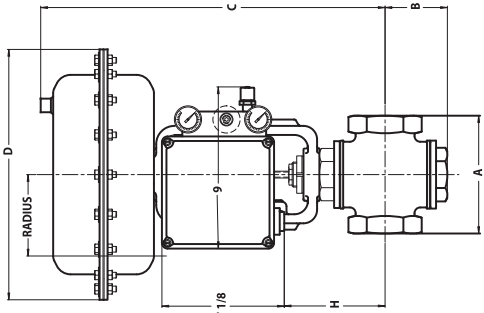
| Component | 2832 Dimension (IN) by Valve Size (IN) | |
|-----------|---|--------------------------------------|
| Variable | 1 | 1-1/2 |
| A | 250THD 300THD | 5-3/4 6-1/8 |
| B | 250THD 300THD | 3-1/2 3-3/8 |
| C | DL49 Direct* DL84 Direct* DL49 W/760 | 15-1/4 19-1/4 19-7/8 19-7/8 |
| H | DL49 W/760 | 1-3/4 1-3/4 |
| Item | DL84 | 4-1/4 4-1/2 |
| Variable | Weight (LB) by Valve Size (IN) | |
| 250THD | 1 | 1-1/2 |
| 300THD | 8 | 16-1/2 |
| | | 21 |
| | | 18-1/2 |

* Includes 1-3/8 inch for air fitting
H = Centerline of pipe to bottom of positioner
CF = Consult factory
N/A = Not Available

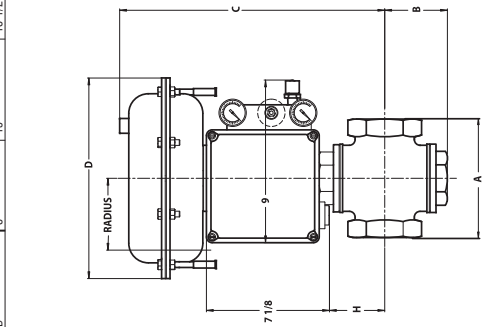
Actual shipping weights may vary.

Face to face dimensions conform to historical Warren Controls standard and are NOT ANSI/ISA compatible.

| Actuator | Weight (LB) | Dimension (IN) |
|--------------|-------------|-------------------------------|
| DL49 | 24-1/2 | D DL49 11 |
| DL84 or 84XR | 48-1/2 | Radius DL49 7-7/8 |
| DL84 or 84XR | 48-1/2 | (W/760) DL84 or 84XR 8-1/8 |
| Positioner | Weight (LB) | |
| 760 | 10 | |



2-WAY or 3-WAY w/ DL84 or 84XR & 760 Positioner



2-WAY or 3-WAY w/ DL49 & 760 Positioner

Actuators, Positioners, & Accessories

Actuators

| Actuator Size | Spring Range (PSI) | | | | |
|---------------|--------------------|------|------|-------|-----------|
| | Action | Low | Full | High | Xtra-High |
| DL49 | Direct | 3-9 | 4-13 | 8-12 | N/A |
| DL49 | Reverse | 4-10 | 5-14 | 10-14 | N/A |
| DL84 | Direct | 3-9 | 3-15 | 9-15 | N/A |
| DL84 | Reverse | 3-9 | 3-15 | 9-15 | N/A |
| DL84XR | Direct | N/A | N/A | N/A | See Note |
| DL84XR | Reverse | N/A | N/A | N/A | See Note |

Note: The spring range of XR (Extended Range) actuators varies with travel. These actuators require positioners or I/Ps for modulating control.

Effective Area: DL49 (49 Sq In), DL84 & 84XR (84 Sq In)

Springs: Multiple

Max Air Supply: 30PSIG

Air Connections: 1/4 NPT

Diaphragm: Buna-N Fabric Reinforced

Diaphragm Chambers: Steel

Diaphragm: Ductile Iron

Yoke: 300 Series Stainless Steel

Stem: DL49 Epoxy-Coated

Finish: DL84, 84XR Acrylic Enamel

Ambient Temperature: DL49 -20 to 160°F

DL84, 84XR -40 to 180°F

Mounting: Vertical Above or Below Valve

Available on DL84 & 84XR

Handwheel: Not available on DL49

Positioners

Split Ranging with Positioners
Positioners are sometimes used to "Split-Range" two control valves in a parallel configuration within a piping scheme. This technique is used to obtain higher rangeability than could otherwise be achieved with a single control valve. Typically one smaller valve supplying 15% to 35% of total flow is mated with a larger valve supplying 65% to 85% of total flow.

The best-matched pair will each be providing similar rangeability for each respective flow contribution to the manifold. Calculated as maximum flow / minimum controllable flow, the smaller valve should not be attempting to control flow below 5% of stroke. Estimate Cv from Cv tables vs. stroke to calculate this.

The chosen positioners would then have a Low Range signal for the smaller valve and a High Range Signal for the larger valve. With this, a single control signal can be sequentially applied to each valve. At mid-signal range, the little valve is completely open while the larger valve is just starting to open. Controllability for wide process set point ranges is dramatically improved.

BLX Models:



BLX Electro-Pneumatic
Models:

BFP: Full Range Signal (3-15 PSIG)
BLP: Low Range Signal (3-9 PSIG)
BHP: High Range Signal (9-15 PSIG)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Supply Pressure: Pneumatic 145 PSIG Max **Not to exceed actuator rating**
Air Consumption: 0.19 SCFM at 30 PSIG

BLX Electro-Pneumatic
Models:

BFE: Full Range Signal (4-20 mA)
BLE: Low Range Signal (4-12 mA)
BHE: High Range Signal (12-20 mA)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Supply Pressure: 21.8 to 145 PSIG **Not to exceed actuator rating**
Air Consumption: 0.21 SCFM at 30 PSIG

BLX Electro-Pneumatic: Intrinsically Safe
Models:

BFI: Full Range Signal (4-20 mA)
BLI: Low Range Signal (4-12 mA)
BHI: High Range Signal (12-20 mA)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Approvals & Ratings: Class I, Div 1, Groups A, B, C, D, E, F, G.
EM Intrinsically Safe: Class I, Div 1, Groups A, B, C, D, E, F, G.
CSA Intrinsically Safe: Class II, Div 1, Groups E, F, G.
Class III

Class I, Div 2, Groups A, B, C, D
Class II, Div 2, Groups E, F, G
Supply Pressure: 30 to 145 PSIG **Not to exceed actuator rating**
Air Consumption: 0.21 SCFM at 30 PSIG

Factory Default Settings

| Positioners | | Input Signal | Failure Modes |
|-------------|-----------------|--------------------------|---------------------------------------|
| Valve Type | Actuator Action | Electro-Pneumatic Signal | Loss of Supply Valve Fails... |
| 2820 | Direct | 3-15 PSI 4-20 mA | Valve Fails... Open |
| | Reverse | 3-15 PSI 4-20 mA | Open Closed |
| 2830 & 32 | Direct | 3-15 PSI 4-20 mA | Upper Port Closed/ Lower Port Open |
| | Reverse | 3-15 PSI 4-20 mA | Upper Port Open/ Lower Port Closed |

* Valves with Fail Freeze Positioners Fail in Last Position on Loss of Signal.

| Positioner Feedback | | Signal | Settings |
|---------------------|-----------------|-----------------|----------|
| Valve Type | Actuator Action | Feedback Signal | Switch 1 |
| 2820 | Direct | 4-20 mA | Switch 2 |
| | Reverse | 4-20 mA | Open |
| 2830 & 32 | Direct | 4-20 mA | Open |
| | Reverse | 4-20 mA | Open |

* Reduced feedback span for valves with 780 and less than 1 inch travel.

| I/P's | | Input Signal | Failure Modes |
|------------|-----------------|--------------------------|---------------------------------------|
| Valve Type | Actuator Action | Increasing Signal | Loss of Signal Valve Fails... |
| 2820 | Direct | As Required For Shut-off | Open |
| | Reverse | As Required For Shut-off | Open |
| 2830 & 32 | Direct | As Required For Shut-off | Upper Port Closed/ Lower Port Open |
| | Reverse | As Required For Shut-off | Upper Port Open/ Lower Port Closed |

| SOLENOIDS (without Positioners or I/P's) | | Input Signal | Failure Modes |
|--|-----------------|--------------------------|---------------------------------------|
| Valve Type | Actuator Action | Increasing Signal | Loss of Signal Valve Fails... |
| 2820 | Direct | As Required For Shut-off | Open |
| | Reverse | As Required For Shut-off | Open |
| 2830 & 32 | Direct | As Required For Shut-off | Upper Port Closed/ Lower Port Open |
| | Reverse | As Required For Shut-off | Upper Port Open/ Lower Port Closed |

If the Solenoid is used with a Positioner or an I/P, refer to the Positioner or I/P listings for factory default settings and failure modes with the solenoid not failed.

| Proximity MARK 1 Position Indication Switches Feedback | | Feedback Signal | Settings |
|--|-----------------|-----------------|----------------|
| Valve Type | Actuator Action | Feedback Signal | Switch 1, 3, 5 |
| 2820 | Direct | 0-350 ohm | Switch 2, 4, 6 |
| | Reverse | 0-350 ohm | Open |
| 2830 & 32 | Direct | 0-350 ohm | Open |
| | Reverse | 0-350 ohm | Open |

* Span varies from approx 155 to 350 ohm depending on actuator and travel.

| Air Filter Regulators | | Output Pressure |
|-----------------------|-----------------|-----------------|
| Actuator | DL49, 84 & 84XR | 30 PSIG |

2600 Emrick Blvd., Bethlehem, PA 18020-8010 www.WarrenControls.com
Tel: 800-922-0085 or 610-317-0800 Fax: 610-317-2989

Configurations

1. SELECTIONS Please make a selection from each table of OPTIONS below to make a complete model number string.

28N

2. OPTIONS

| VALVE BODY | | Valve Type | Size | Body Material | End Connection | Trim Style | Trim Material | Trim Cv | Packing Type |
|------------|-------------------|------------------------------|--------------------|---|---|---|--|---|--------------|
| 20 | 2-Way Single Seat | 050 1/2 inch 075 3/4 inch | B Bronze F CF8M | S Screwed NOTE: Additional end connections are available-check with the factory. | E Equal % L Linear Types 30/32 Linear Only | S 316SS B Bronze G Alloy 6 H 17-4 PH T Teflon P PEEK | F Full Port 1 1st Port Reduction 2 1st Port Reduction 3 3rd Port Reduction 4 4th Port Reduction NOTE: Port reductions only available on Type 20/30. Check factory for availability. | T Teflon G Graphite Stainless Steel Type 20 Boluses come standard w/PEEK bearings. Used for Temp. up to 500 F. | |
| 30 | 3-Way Mixing | 100 1 inch 125 1-1/4 inch | | | | | | | |
| 32 | 3-Way Diverting | 150 1-1/2 inch 200 2 inch | | | | | | | |

VALVE TYPE/TRIM MATERIAL COMBINATIONS:

| SIZE | TRIM MATERIAL | | | T | P |
|----------------|---------------|---------|--------|--------|------|
| | S | B | H | | |
| 050 1/2 inch | 316SS | Alloy 6 | 17-4PH | Teflon | PEEK |
| 075 3/4 inch | 20, 30 | N/A | 20 | 20 | 20 |
| 100 1 inch | 20, 30 | N/A | 20 | 20 | 20 |
| 125 1-1/4 inch | 20, 30, 32SS | 32 BRZ | 20 | 20 | 20 |
| 150 1-1/2 inch | 20, 30 | N/A | 20 | 20 | 20 |
| 200 2 inch | 20, 30, 32SS | 32 BRZ | 20 | 20 | 20 |

VALVE TYPE/ACTUATOR COMPATIBILITY:

| VALVE STYLE | VALVE SIZES | ACTUATORS |
|-------------|-------------|-------------|
| Type 20 | 1/2" - 2" | DL49 |
| Type 20 | 1" - 2" | DL84 |
| Type 20 | 1-1/4" - 2" | DL8XR |
| Type 30 | 1/2" - 2" | DL49 |
| Type 30 | 1-1/4" - 2" | DL84 |
| Type 30 | 2" | DL8XR |
| Type 32 | 1/2" - 2" | DL49 & DL84 |

See Shut-off/OP Ratings for details.

WARREN CONTROLS

ACTUATED INDUSTRIAL VALVES

1800 SERIES
Heavy Globe Control Valves

2800 SERIES
Precision Globe Control Valves

2900 SERIES
High Capacity General Purpose Globe Control Valves

3800 SERIES
E-Ball Rotary Control Valves

5800 SERIES
Compact Globe Control Valves

- styles:**
- 2-way balanced
 - 2-way unbalanced
 - 3-way mixing
 - 3-way diverting

- styles:**
- 2-way unbalanced
 - 3-way mixing
 - 3-way diverting

- styles:**
- 2-way balanced
 - 2-way unbalanced
 - 3-way mixing
 - 3-way diverting

- styles:**
- 2-way rotary
 - flow to open
 - flow to close

- styles:**
- 2-way cage-retained seat

sizes 2-1/2 to 12 in.

class 300

ends 150,300 RF fig.

body Cast Iron, WCB, CF8M

trim 316 SST, Alloy 6

Cv up to 1649

temp. -20° to 800°F

body limit to 740 psi

shutoff class III, IV

rangeability 50:1

- Heavy Duty
- Severe Service
- High Pressure Differentials
- Corrosive Materials, Liquids, Gases & Steam
- Modulating or On/Off Control

sizes 1/2 to 2 in.

class 250 & 300

ends Butt-weld, NPT

body Bronze, CF8M

trim Bronze, 316SST, 17-4PH, Alloy 6, TFE, PEEK

Cv up to 40

temp. -20° to 500°F

body limit to 720 psi

shutoff class III, IV, VI

rangeability 50:1

- Economical
- Precision Control
- Suited for Gases, Steam, or Liquids that are Not Viscous or Solids Bearing
- General Purpose
- Moderate Pressure Drops
- Compatible Liquids and Gas, Steam & Water
- Modulating or On/Off Control

sizes 2-1/2 to 10 in.

class 125 & 250

ends Flange

body Cast Iron

trim Bronze, 300SS, 17-4PH, Alloy 6

Cv up to 960

temp. -20° to 400°F

body limit to 400 psi

shutoff class II, III, IV

rangeability 100:1

- High Capacity
- General Purpose
- Moderate Pressure Drops
- Various Trim Options include Ceramic for Slurries or Gritty Materials & Teflon® for Class VI Shutoff
- High Efficiency, Compact Design
- High Pressure Drops
- Typically Suited for High Force Piston Actuators for Steam, Chemicals & Dirty Fluids
- Minimizes Cavitation or Flashing Effects

sizes 1 to 8 in.

class 300

ends 150,300 RF fig.

body WCB, CF8M

trim 316 SST, Alloy 6, Ceramic, TFE, PEEK

Cv up to 1420

temp. -20° to 800°F

body limit to 740 psi

shutoff class IV, VI

rangeability 100:1

- Eccentric
- Segmented Ball
- Well Suited for Erosive Service
- Various Trim Options include Ceramic for Slurries or Gritty Materials & Teflon® for Class VI Shutoff
- Highly Efficient, Compact Design
- High Pressure Drops
- Typically Suited for High Force Piston Actuators for Steam, Chemicals & Dirty Fluids
- Minimizes Cavitation or Flashing Effects

ACCESSORIES

Positioners, I/P's & Limit Switches

Air Filter Regulators

ASCO Solenoids

Special Options

| | | | |
|--|--------------------------------|--------------------|--------------------------------|
| 0000 None | 0 None | A 320G184 | S Special Ops or Set-Up |
| B-P BLX Pneumatic | A Type 300, 0-30 PSI | B 320G202 | T SS Tubing |
| B-E BLX Electro-Pneumatic | B Type 300, 0-60 PSI | L FR320G184 | G SS Tubing |
| B-I BLX Electro-Pneum. Intri. Safe | D Type 350SS, 0-100 PSI | M FR320G202 | B SS Tubing and Tagging |
| B-X BLX Electro-Pneum. Exp. Proof | | | |
| B-Y BLX Electro-Pneum. Fail Fringe | | | |
| 76P Moore 760 Pneumatic | | | |
| 76E Moore 760 Electro-Pneumatic | | | |
| 510 Westlock (CoT) Electro-Pneumatic | | | |
| 520 Westlock (CoT) Intelligent-Keyrad | | | |
| 530 Westlock (CoT) Intelligent-Hart | | | |
| 540 Westlock (CoT) Found Fieldbus | | | |
| PX11 Mark 1 Series - 2 ea. SPDT | | | |
| PX12 Mark 1 Series - 2 ea. SPDT w/2k Pk | | | |
| PX13 Mark 1 Series - 2 ea. SPDT w/4-20 Feedback | | | |
| PX14 Mark 1 Series - 4 ea. SPDT | | | |
| PX15 Mark 1 Series - 6 ea. SPDT | | | |
| MAP1 Type 500X (IP, 3-9 PSI) | | | |
| MAP2 Type 500X (IP, 3-15 PSI) | | | |
| MAP3 Type 500X (IP, 3-15 PSI) | | | |
| MAP4 Type 500X (IP, 1-17 PSI) | | | |
| MAP5 Type 500X (IP, 6-30 PSI) | | | |
| MAP6 Type 500X (IP, 0-30 PSI) | | | |
| MAP9 Type 950X (IP, 3-15 EXP) | | | |

4th digit spec.
F Full Stroke
L Low of 5/16 Range
H High of 5/16 Range
M Modulating
W W/20 Feedback

4th digit spec.
O No Address
L when Lit Swals
F w/4-20 Feedback
B w/switch & modck

Note: Standard pneumatic tubing is copper. SS tubing **T** is optional.
 SS tagging **tr** (two lines, 24 characters/line) is optional.
 SS tubing and tagging together **trB** is optional.

FAILURE MODES:

| MODE | VALVE TYPE | ACTUATOR ACTION |
|--------------|------------|-----------------|
| Closed | 20 | Release |
| Open | 20 | Direct |
| Upper Closed | 30/32 | Direct |
| Upper Open | 30/32 | Reverse |

ACTUATOR/BODY COMPATIBILITY:

| DIAPHRAGMS | BODY |
|----------------------------|----------------|
| 49 49 Sq.In. (DL49) | For 28N Bodies |
| 84 84 Sq.In. (DL84) | For 28N Bodies |
| 8X (DL8XR) | For 28N Bodies |

Warren Controls does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Warren Controls product remains solely with the purchaser and end-user.

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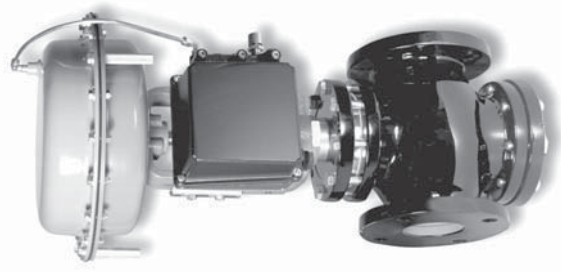
PRODUCT SPECIFICATION

March 2005

PNEUMATIC ACTUATED INDUSTRIAL VALVES

SERIES: 2900 SIZES 2-1/2 to 10 INCHES

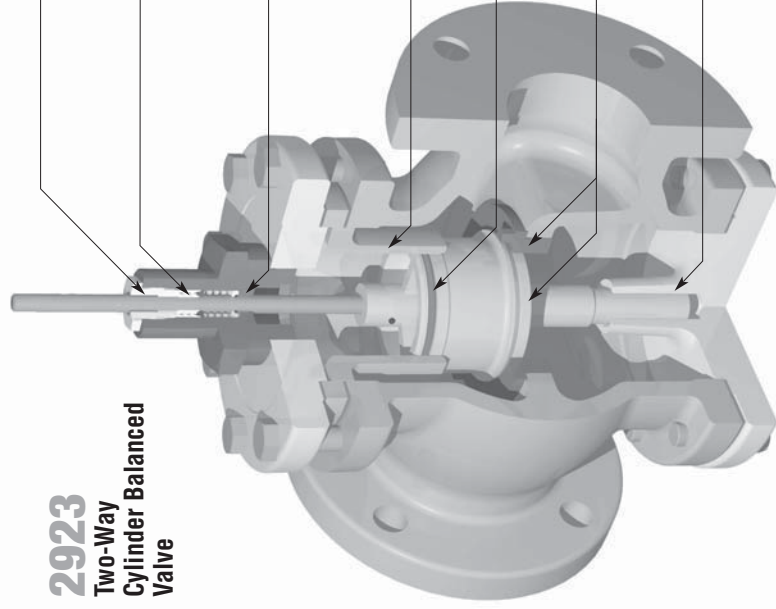
High Capacity, General Purpose, Globe Control Valves



WARREN CONTROLS

Two-Way and Three-Way, Reciprocating, Iron Body
Valves for Process and Utility Applications

2923 Two-Way Cylinder Balanced Valve



Peek Bearing

for low friction provides stem guiding and protects packing box from external debris.

Robust Spring-Loaded PTFE V-Ring Packing

has low friction and is self adjusting for zero maintenance.

Peek Bearing in Lower Bonnet Assembly

provides stem guiding and protects packing box from entrained solids for longer packing life.

Thick Balancing Chamber

in bronze, 300 SS, or 17-4PH.

EPDM O-Ring or Fluoraz O-Ring (for higher temperatures)

maintains pressure balance seal.

Plug and Seat

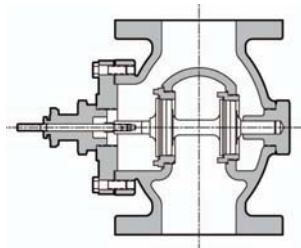
in choice of Bronze, 300 SS, 17-4PH, or Alloy 6 provide Class IV shut off.

Bottom Post Guide

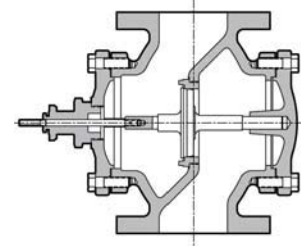
for additional stability, allowing higher pressure drop.



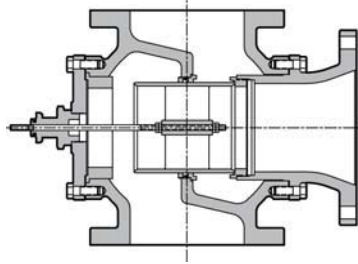
SERIES: 2900
High Capacity
General Purpose Globe
Control Valves



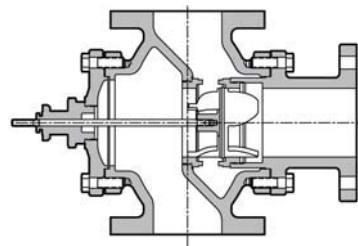
2922
**Two-Way Double Seat
Balanced Valve**



2920
**Two-Way Single Seat
Unbalanced Valve**



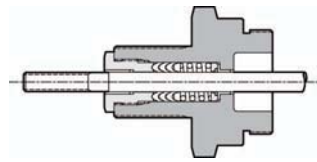
2932
**Three-Way
Diverting/Mixing
Valve**



2930
**Three-Way
Mixing Valve**

Description

Warren Controls Series 2900 High Capacity General Purpose Globe Control Valves feature rugged iron bodies with a variety of trim materials. The equal percentage plugs in the 2-way valves and linear plugs in the 3-way valves provide excellent modulating control of a wide variety of fluids. The Series 2900 is ideally suited where valve and long life are important objectives for applications including but not limited to: Food & Beverage, Packaged Water Heaters, Pharmaceutical, General Service, and Waste Water having moderate pressure drops and temperatures from -20° to 400°F.



**Guided Low-Friction
TFE V-Ring Packing
Spring-Loaded**

Body Style Versus Application

2-Way Valves (Control of Liquids, Gases, and Steam)

2920 Two-Way Single Seat Unbalanced Valve

The most commonly applied solution for sizes 3" and under with ANSI Class IV shut-off.

Sizes: 2-1/2, 3, 4, 5, 6, 8, 10 inch

Body: ANSI B16.1 Iron 125LB Flange or 250LB Flange

Trim: E0%, Bronze (2-1/2 thru 6), 300 Series Stainless Steel (2-1/2 thru 10), or 17-4 PH Hardened Stainless Steel (2-1/2 thru 6)

Packing: Guided Low-Friction TFE V-Ring, Spring Loaded

Temperature: +32 to 350°F (125 FLG)

Rangeability: 50:1

Rangeability: 50:1

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3-Way Valves (Control of Liquids)

2930 Three-Way Mixing Valve

This valve has two inlets and one outlet, and is the simplest solution for mixing or bypass applications with ANSI Class IV shut-off. In normal applications the inlet pressures are near equal and control is possible from 5% to 95% of travel with inlet pressures up to 100 PSI.

Sizes: 2-1/2, 3, 4, 5, 6, 8 inch

Body: ANSI B16.1 Iron 125LB Flange or 250LB Flange

Trim: Linear, Bronze (2-1/2 thru 6) or 300 Series Stainless Steel (2-1/2 thru 8)

Packing: Guided Low-Friction TFE V-Ring, Spring Loaded

Temperature: +32 to 350°F (125 FLG)

Rangeability: 50:1

Rangeability: 50:1

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2932 Three-Way Diverting/Mixing Valve

Designed as a diverting valve with one inlet and two outlets with ANSI Class II shut-off. However, flow can be reversed for mixing if this port configuration is desirable. The difference between the upper port and lower port pressure must not exceed 50PSID.

Sizes: 2-1/2, 3, 4, 5, 6, 8 inch

Body: ANSI B16.1 Iron 125LB Flange or 250LB Flange

Trim: Linear, Bronze or 300 Series Stainless Steel

Packing: Guided Low-Friction TFE V-Ring, Spring Loaded

O-Ring: EPR

Temperature: +32 to 300°F (2-1/2 through 6)

Rangeability: 50:1

Rangeability: 50:1

Rangeability: 50:1

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3 For additional applications, and/or products call: 800-922-0085 or visit: www.WarrenControls.com



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Tel: 800-922-0085 or 610-317-0800 Fax: 610-317-2989

Flow Coefficients (Cv) Versus Travel

| Valve Size (IN) | Trim Style | 2920 Flow Coefficients (Cv) | | | | | | | | | |
|-----------------|------------|--------------------------------------|------|------|------|------|------|------|------|------|------|
| | | Two-Way Single Seat Unbalanced Valve | | | | | | | | | |
| | | % Travel | | | | | | | | | |
| | | 100% | 90% | 80% | 70% | 60% | 50% | 40% | 30% | 20% | 10% |
| 2-1/2 | EO | 65.0 | 55.6 | 43.8 | 29.8 | 15.4 | 8.07 | 5.67 | 4.11 | 2.81 | 1.49 |
| 3 | EO | 90.0 | 83.6 | 75.1 | 63.8 | 49.2 | 31.6 | 12.9 | 4.75 | 3.37 | 1.99 |
| 4 | EO | 170 | 159 | 143 | 122 | 95.1 | 69.9 | 31.3 | 15.6 | 9.89 | 4.11 |
| 5 | EO | 280 | 258 | 230 | 194 | 150 | 102 | 54.7 | 23.1 | 14.0 | 6.40 |
| 6 | EO | 360 | 333 | 298 | 255 | 203 | 144 | 83.6 | 34.1 | 14.6 | 7.10 |
| 8 | EO | 450 | 400 | 366 | 318 | 250 | 186 | 130 | 81.9 | 44.6 | 18.3 |
| 10 | EO | 650 | 556 | 457 | 359 | 267 | 186 | 117 | 64.1 | 26.5 | 4.87 |

| Valve Size (IN) | Trim Style | 2922 Flow Coefficients (Cv) | | | | | | | | | |
|-----------------|------------|------------------------------------|------|------|------|------|------|------|------|------|------|
| | | Two-Way Double Seat Balanced Valve | | | | | | | | | |
| | | % Travel | | | | | | | | | |
| | | 100% | 90% | 80% | 70% | 60% | 50% | 40% | 30% | 20% | 10% |
| 2-1/2 | EO | 70.0 | 59.5 | 45.9 | 30.2 | 15.7 | 8.60 | 6.36 | 4.12 | 3.44 | 2.75 |
| 3 | EO | 100 | 87.6 | 71.2 | 50.8 | 28.7 | 12.2 | 8.94 | 6.56 | 4.60 | 3.27 |
| 4 | EO | 200 | 180 | 155 | 126 | 91.0 | 53.3 | 17.8 | 8.36 | 6.07 | 4.54 |
| 5 | EO | 260 | 239 | 212 | 178 | 138 | 100 | 74.3 | 53.8 | 32.2 | 9.86 |
| 6 | EO | 350 | 323 | 286 | 238 | 178 | 113 | 63.2 | 44.8 | 27.5 | 9.83 |
| 8 | EO | 600 | 619 | 557 | 475 | 370 | 246 | 118 | 43.9 | 29.0 | 14.2 |
| 10 | EO | 960 | 886 | 796 | 689 | 574 | 474 | 383 | 285 | 181 | 72.3 |

2-Way Valves (Control of Liquids, Gases, and Steam)

| Valve Size (IN) | Trim Style | 2923 Flow Coefficients (Cv) | | | | | | | | | |
|-----------------|------------|---------------------------------|------|------|------|------|------|------|------|------|------|
| | | Two-Way Cylinder Balanced Valve | | | | | | | | | |
| | | % Travel | | | | | | | | | |
| | | 100% | 90% | 80% | 70% | 60% | 50% | 40% | 30% | 20% | 10% |
| 2-1/2 | EO | 65.0 | 55.6 | 43.8 | 29.8 | 15.4 | 8.07 | 5.67 | 4.11 | 2.81 | 1.49 |
| 3 | EO | 90.0 | 83.6 | 75.1 | 63.8 | 49.2 | 31.6 | 12.9 | 4.75 | 3.37 | 1.99 |
| 4 | EO | 170 | 159 | 143 | 122 | 95.1 | 69.9 | 31.3 | 15.6 | 9.89 | 4.11 |
| 5 | EO | 280 | 258 | 230 | 194 | 150 | 102 | 54.7 | 23.1 | 14.0 | 6.40 |
| 6 | EO | 360 | 333 | 298 | 255 | 203 | 144 | 83.6 | 34.1 | 14.6 | 7.10 |

3-Way Valves (Control of Liquids)

| Valve Size (IN) | Trim Style | 2930 Flow Coefficients (Cv) | | | | | | | | | |
|-----------------|------------|-----------------------------|-------|----------|-------|-------|----------|-------|-------|----------|--|
| | | Three-Way Mixing Valve | | | | | | | | | |
| | | Travel 100% | | | | | | | | | |
| | | Upper | Lower | Combined | Upper | Lower | Combined | Upper | Lower | Combined | |
| 3 | LINEAR | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | |
| 4 | LINEAR | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | |
| 5 | LINEAR | 270 | 270 | 270 | 270 | 270 | 270 | 270 | 270 | 270 | |
| 6 | LINEAR | 347 | 347 | 347 | 347 | 347 | 347 | 347 | 347 | 347 | |
| 8 | LINEAR | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | |

| Valve Size (IN) | Trim Style | 2932 Flow Coefficients (Cv) | | | | | | | | | |
|-----------------|------------|----------------------------------|-------|----------|-------|-------|----------|-------|-------|----------|--|
| | | Three-Way Diverting/Mixing Valve | | | | | | | | | |
| | | Travel 100% | | | | | | | | | |
| | | Upper | Lower | Combined | Upper | Lower | Combined | Upper | Lower | Combined | |
| 2-1/2 | LINEAR | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | |
| 3 | LINEAR | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 | |
| 4 | LINEAR | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | |
| 5 | LINEAR | 196 | 196 | 196 | 196 | 196 | 196 | 196 | 196 | 196 | |
| 6 | LINEAR | 270 | 270 | 270 | 270 | 270 | 270 | 270 | 270 | 270 | |
| 8 | LINEAR | 425 | 425 | 425 | 425 | 425 | 425 | 425 | 425 | 425 | |

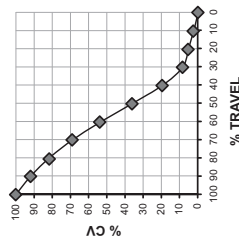
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Tel: 800-922-0085 or 610-317-0800 Fax: 610-317-2989



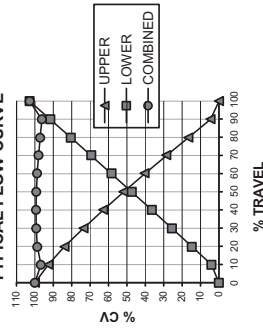
WARREN CONTROLS

Sizing Reference

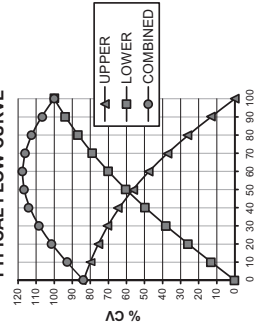
2-WAY VALVE TYPICAL FLOW CURVE



2930 TYPICAL FLOW CURVE



2932 TYPICAL FLOW CURVE



| Steam Table | | | | | |
|---------------------|----------|----------|-----------------------|---------------------|--------------------|
| Steam Pressure PSIG | Temp. °F | Temp. °C | Sensible Heat BTU/Lb. | Latent Heat BTU/Lb. | Total Heat BTU/Lb. |
| 0 | 212 | 100 | 180 | 971 | 1151 |
| 10 | 239 | 115 | 207 | 962 | 1159 |
| 25 | 266 | 130 | 236 | 954 | 1170 |
| 50 | 297 | 147 | 267 | 912 | 1179 |
| 75 | 320 | 160 | 290 | 896 | 1186 |
| 100 | 338 | 170 | 309 | 881 | 1190 |
| 125 | 353 | 178 | 325 | 868 | 1193 |
| 150 | 365 | 185 | 339 | 858 | 1197 |
| 200 | 387 | 197 | 362 | 838 | 1200 |
| 250 | 406 | 208 | 381 | 821 | 1204 |
| 300 | 422 | 217 | 399 | 805 | 1207 |
| 400 | 448 | 231 | 438 | 778 | 1216 |
| 500 | 470 | 243 | 453 | 762 | 1205 |
| 600 | 489 | 254 | 475 | 729 | 1204 |

Rectangular Tank Capacity in Gallons

Gallons = $\frac{\text{Height} \times \text{Width} \times \text{Length (inches)}}{230}$

or

Gallons = $H \times W \times L \text{ (ft.)} \times 7.5$

Circular Tank Storage Capacity in Gallons

Storage = $6D^2 \times L \text{ (Gallons)}$

Where:

D = Tank Diameter in Feet

L = Length in Feet

Load Sizing Calculations

Glossary of Terms

t = Time in Hours

C_p = Specific Heat of Liquid

S = Specific Gravity of Fluid

W = Weight in Lbs.

ΔT = Temperature Rise or Fall in °F

h_{fg} = Latent Heat of Steam

Heating Water with Steam

Quick Method

$\text{GPM} = \frac{\text{Lbs./Hr.}}{2} \times \Delta T$

Accurate Method

$\text{Lbs./Hr.} = \frac{\text{GPM} \times 500 \times \Delta T}{h_{fg}}$

Heating or Cooling Water with Water

$\text{GPM}_1 = \frac{\text{GPM}_2 \times \text{°F water}_2 \text{ temp. rise or drop}}{\text{°F water}_1 \text{ temp. rise or drop}}$

Heating or Cooling Water

$\text{GPM} = \frac{\text{BTU / Hr.}}{(\text{°F water temp. rise or drop}) \times 500}$

Heating Oil with Steam

$\text{Lbs./Hr.} = \frac{\text{GPM} \times (\text{°F oil temp. rise})}{4}$

Heating Air with Water

$\text{GPM} = 2.16 \times \frac{\text{CFM} \times (\text{°F air temp. rise})}{1000 \times (\text{°F water temp. drop})}$

Heating Liquids with Steam

$\text{Lbs./Hr.} = \frac{\text{GPM} \times 60 \times C_p \times W}{h_{fg}} \times \Delta T$

Heating Liquids in Steam Jacketed Kettles

$\text{Lbs./Hr.} = \frac{\text{GPM} \times C_p \times S \times 8.33}{h_{fg}} \times \Delta T$

General Liquid Heating

$\text{Lbs./Hr.} = \frac{W \times C_p}{h_{fg}} \times \Delta T$

Heating Air with Steam

$\text{Lbs./Hr.} = \frac{\text{CFM}}{900} \times \Delta T$

Shut-Off ΔP and Cv Ratings

Valve Actuator Shut-Off ΔP Two-Way Single Seat Unbalanced 2920

| Valve Size (IN) | Cv Rating | Plug Travel (IN) | Pneumatic Actuator Range | Maximum Shut-off ΔP in PSI | | Fall Open Direct Acting | | | |
|-----------------|-----------|------------------|--------------------------|----------------------------|---------------|-------------------------|---------------------|---------------------|---------------------|
| | | | | Reverse Acting | Direct Acting | 3-15 PSI (1-17 PSI) | 0-30 PSI (0-30 PSI) | 0-40 PSI (0-40 PSI) | 0-40 PSI (0-40 PSI) |
| 2 1/2 | 65 | 3/4 | DL49 | N/A | N/A | 20 | 40 | 170 | N/A |
| | | | | N/A | N/A | N/A | N/A | 130 | N/A |
| | | | | N/A | N/A | 10 | 140 | N/A | N/A |
| | | | | N/A | N/A | 63 | 97 | 319 | N/A |
| | | | | N/A | N/A | 12 | N/A | 217 | N/A |
| | | | | N/A | N/A | 114 | N/A | 217 | N/A |
| | | | | N/A | N/A | 165 | N/A | N/A | N/A |
| | | | | N/A | N/A | 148 | N/A | N/A | N/A |
| | | | | N/A | N/A | 5 | 28 | 28 | 400 |
| | | | | N/A | N/A | 5 | 28 | 28 | 400 |
| | | | | N/A | N/A | 145 | 169 | 309 | 400 |
| | | | | N/A | N/A | 609 | 400 | 309 | 400 |
| 3 | 90 | 3/4 | DL49 | N/A | N/A | 10 | 23 | 113 | N/A |
| | | | | N/A | N/A | 3 | 89 | 217 | N/A |
| | | | | N/A | N/A | 39 | 63 | 217 | N/A |
| | | | | N/A | N/A | 4 | N/A | 146 | N/A |
| | | | | N/A | N/A | 4 | N/A | 146 | N/A |
| | | | | N/A | N/A | 39 | 63 | 75 | N/A |
| | | | | N/A | N/A | 75 | 99 | 110 | N/A |
| | | | | N/A | N/A | 15 | 15 | 373 | N/A |
| | | | | N/A | N/A | 15 | 15 | 373 | N/A |
| | | | | N/A | N/A | 113 | 113 | 210 | 373 |
| | | | | N/A | N/A | 285 | N/A | N/A | N/A |
| 4 | 170 | 1 1/4 | DL84 | N/A | N/A | 17 | 30 | 117 | N/A |
| | | | | N/A | N/A | N/A | N/A | 77 | N/A |
| | | | | N/A | N/A | 37 | N/A | 77 | N/A |
| | | | | N/A | N/A | 3 | 31 | 49 | 166 |
| | | | | N/A | N/A | 3 | 3 | 205 | N/A |
| | | | | N/A | N/A | 49 | 58 | 58 | 205 |
| | | | | N/A | N/A | 140 | 140 | N/A | N/A |
| 5 | 280 | 1 1/2 | DL115 | N/A | N/A | 8 | 16 | 72 | N/A |
| | | | | N/A | N/A | N/A | N/A | 46 | N/A |
| | | | | N/A | N/A | 16 | 21 | N/A | 46 |
| | | | | N/A | N/A | 17 | 29 | 105 | 163 |
| | | | | N/A | N/A | N/A | N/A | 70 | 128 |
| | | | | N/A | N/A | 34 | 34 | N/A | 128 |
| | | | | N/A | N/A | 81 | 81 | N/A | N/A |
| 6 | 360 | 1 1/2 | DL84 | N/A | N/A | 3 | 9 | 46 | N/A |
| | | | | N/A | N/A | N/A | N/A | 30 | N/A |
| | | | | N/A | N/A | 9 | 17 | 70 | 111 |
| | | | | N/A | N/A | N/A | N/A | 46 | 87 |
| | | | | N/A | N/A | 17 | 21 | N/A | 87 |
| 8 | 450 | 2 | DL115XR | N/A | N/A | 54 | 54 | N/A | N/A |
| | | | | N/A | N/A | N/A | N/A | 44 | 83 |
| | | | | N/A | N/A | 16 | 20 | N/A | 83 |
| | | | | N/A | N/A | 44 | 44 | N/A | N/A |
| 10 | 650 | 2 1/2 | DL115 | N/A | N/A | 3 | 7 | 37 | 60 |
| | | | | N/A | N/A | N/A | N/A | 23 | 46 |
| | | | | N/A | N/A | 7 | 10 | N/A | 46 |
| | | | | N/A | N/A | 20 | 20 | N/A | N/A |

Valve Actuator Shut-Off ΔP Two-Way Double Seat Balanced 2922

| Valve Size (IN) | Cv Rating | Plug Travel (IN) | Pneumatic Actuator Range | Maximum Shut-off ΔP in PSI | | Fall Open Direct Acting | | | |
|-----------------|-----------|------------------|--------------------------|----------------------------|---------------|-------------------------|---------------------|---------------------|-----|
| | | | | Reverse Acting | Direct Acting | 3-15 PSI (1-17 PSI) | 0-30 PSI (0-30 PSI) | 0-40 PSI (0-40 PSI) | |
| 2 1/2 | 70 | 3/4 | DL49 | N/A | N/A | 113 | 250 | 388 | 400 |
| | | | | N/A | N/A | 113 | 250 | N/A | 113 |
| | | | | N/A | N/A | 34 | 270 | 400 | 400 |
| | | | | N/A | N/A | 34 | 270 | 400 | 400 |
| | | | | N/A | N/A | 39 | 39 | 267 | 400 |
| 3 | 100 | 3/4 | DL49 | N/A | N/A | 39 | 153 | N/A | 39 |
| | | | | N/A | N/A | 381 | 400 | 400 | 400 |
| | | | | N/A | N/A | 169 | 169 | 400 | 400 |
| | | | | N/A | N/A | 169 | 169 | N/A | N/A |
| | | | | N/A | N/A | 400 | 400 | 400 | 400 |
| 4 | 200 | 3/4 | DL49 | N/A | N/A | N/A | N/A | 117 | 267 |
| | | | | N/A | N/A | N/A | N/A | N/A | 400 |
| | | | | N/A | N/A | 202 | 372 | 400 | 400 |
| | | | | N/A | N/A | N/A | N/A | 44 | 400 |
| | | | | N/A | N/A | 400 | 400 | 400 | 400 |
| 5 | 260 | 1 1/4 | DL84 | N/A | N/A | N/A | N/A | 340 | 400 |
| | | | | N/A | N/A | N/A | N/A | N/A | 400 |
| | | | | N/A | N/A | 340 | 400 | N/A | 400 |
| 6 | 350 | 1 1/4 | DL84 | N/A | N/A | N/A | N/A | 242 | 400 |
| | | | | N/A | N/A | N/A | N/A | N/A | 400 |
| | | | | N/A | N/A | 242 | 400 | 400 | 400 |
| 8 | 580 | 1 1/2 | DL84 | N/A | N/A | N/A | N/A | 85 | 232 |
| | | | | N/A | N/A | N/A | N/A | N/A | 400 |
| | | | | N/A | N/A | 85 | 232 | 305 | 400 |
| 10 | 960 | 1 1/2 | DL84 | N/A | N/A | N/A | N/A | 13 | 134 |
| | | | | N/A | N/A | N/A | N/A | N/A | 400 |
| | | | | N/A | N/A | 13 | 134 | 195 | 400 |

Shut-Off ΔP and Cv Ratings

NOTES:

- 2920 Seat closure ANSI Class IV.
- Inlet pressure **cannot** exceed Body Pressure-temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.

NOTES:

- 2922 Seat closure ANSI Class III.
- Inlet pressure **cannot** exceed Body Pressure-temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.

Maximum air pressure DL49...30PSIG DL84 & 84XR...40PSIG DL115 & 115XR...40PSIG

Maximum air pressure DL49...30PSIG DL84 & 84XR...30PSIG

Do Not Use DL115 OR 115XR Actuators on Valves With Bronze Trim.

Do Not Use DL115 Actuators on Valves With Bronze Trim.

See Actuators, Positioners, and Accessories section for explanation of spring ranges.

See Actuators, Positioners, and Accessories section for explanation of spring ranges.

Shut-Off ΔP and Cv Ratings

| Valve Size (in) | Cv Rating (in) | Plug Travel (in) | Actuator | | Shut-Off ΔP Two-Way Cylinder Balanced 2923 | | | | | | |
|-----------------|----------------|------------------|---------------------------|----------------|--|-------------|-----------|---------------|----------|----------|----------|
| | | | Pneumatic Spring Actuator | Reverse Acting | Maximum Shut-Off ΔP in PSI | Fall Closed | Fall Open | Direct Acting | | | |
| 2-1/2 | 65 | 3/4 | DL49 | DL49 | 0-30 PSI | 0-40 PSI | 3-15 PSI | 1-17 PSI | 0-30 PSI | 0-40 PSI | 0-40 PSI |
| | | | Low | Low | N/A | N/A | 124 | 288 | N/A | N/A | N/A |
| | | | High | High | 206 | 370 | N/A | N/A | 42 | 400 | N/A |
| | | | Low | Low | N/A | N/A | 53 | 400 | N/A | N/A | N/A |
| | | | High | High | 400 | 400 | N/A | N/A | 400 | 400 | N/A |
| 3 | 90 | 3/4 | DL49 | DL49 | N/A | N/A | 53 | 193 | 400 | N/A | N/A |
| | | | Low | Low | N/A | N/A | N/A | N/A | 400 | N/A | N/A |
| | | | High | High | 123 | 253 | 333 | N/A | N/A | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | 353 | 400 | N/A | N/A |
| | | | High | High | 353 | 400 | N/A | N/A | 400 | N/A | N/A |
| 4 | 170 | 1 1/4 | DL84 | DL84 | N/A | N/A | N/A | 182 | 389 | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | N/A | N/A | 400 | N/A |
| | | | High | High | 182 | 389 | 400 | N/A | N/A | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | 343 | 400 | 400 | N/A |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | 400 | N/A |
| 5 | 280 | 1 1/2 | DL84 | DL84 | N/A | N/A | N/A | 79 | 230 | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | N/A | N/A | 400 | N/A |
| | | | High | High | 79 | 230 | 306 | N/A | N/A | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | 219 | 400 | 400 | N/A |
| | | | High | High | 219 | 400 | 400 | N/A | N/A | 400 | N/A |
| 6 | 360 | 1 1/2 | DL84 | DL84 | N/A | N/A | N/A | N/A | 127 | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | N/A | N/A | 400 | N/A |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | 400 | N/A |
| | | | Low | Low | N/A | N/A | N/A | 124 | 290 | 400 | 400 |
| | | | High | High | 124 | 290 | 373 | 373 | N/A | N/A | 400 |
| | | | Xtra-High | Xtra-High | N/A | N/A | 400 | 400 | N/A | N/A | N/A |

NOTES:

- 2923 Seat closure ANSI Class IV.
- Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.
Maximum air pressure DL49...30PSIG DL84...30PSIG DL115 & 115XR...40PSIG
- Do Not Use DL115 OR 115XR Actuators on Valves With Bronze Trim.
- See Actuators, Positioners, and Accessories section for explanation of spring ranges.

Shut-Off ΔP and Cv Ratings

NOTES:

- 2930 Mixing Valves have two inlets and one outlet. Published shut-off values are with respect to worst case conditions with zero downstream pressure on the outlet port and zero upstream pressure on the opposing inlet port. Pneumatic Actuators used with the 2930 are direct acting. The upper port fails closed on loss of air pressure to the actuator.
- 2930 Seat closure ANSI Class IV.
- Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.
Maximum air pressure DL49...30PSIG DL84 & 84XR...30PSIG DL115 & 115XR...40PSIG
- Do Not Use DL115 OR 115XR Actuators on Valves With Bronze Trim.
- See Actuators, Positioners, and Accessories section for explanation of spring ranges.

| Valve Size (in) | Cv Rating (in) | Plug Travel (in) | Actuator | | Shut-Off ΔP Three-Way Mixing 2930 | | | | | | |
|-----------------|----------------|------------------|---------------------------|----------------|---|-------------------|---------------|-------------------|----------|----------|----------|
| | | | Pneumatic Spring Actuator | Reverse Acting | Maximum Shut-Off ΔP in PSI | Upper Port Closed | Direct Acting | Lower Port Closed | | | |
| 2-1/2 | 69 | 3/4 | DL49 | DL49 | 0-30 PSI | 0-40 PSI | 3-15 PSI | 1-17 PSI | 0-30 PSI | 0-40 PSI | 0-40 PSI |
| | | | Low | Low | N/A | N/A | N/A | N/A | 11 | 31 | 161 |
| | | | High | High | 10 | 30 | 40 | N/A | N/A | N/A | 121 |
| | | | Low | Low | N/A | N/A | 12 | N/A | 54 | 88 | 310 |
| | | | High | High | 63 | 97 | 114 | N/A | N/A | N/A | 208 |
| | | | Xtra-High | Xtra-High | 114 | 148 | 165 | N/A | N/A | N/A | 208 |
| | | | Low | Low | N/A | N/A | 5 | 28 | 28 | 82 | 129 |
| | | | High | High | N/A | N/A | 5 | 28 | 28 | N/A | 283 |
| | | | Xtra-High | Xtra-High | 88 | 145 | 169 | 169 | N/A | N/A | 283 |
| 3 | 86 | 3/4 | DL49 | DL49 | N/A | N/A | 400 | 400 | N/A | N/A | 129 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 3 | 17 | 107 |
| | | | High | High | 3 | 16 | 23 | N/A | N/A | N/A | 79 |
| | | | Xtra-High | Xtra-High | 3 | 16 | 23 | N/A | N/A | N/A | 86 |
| | | | Low | Low | N/A | N/A | 4 | N/A | N/A | N/A | 211 |
| | | | High | High | N/A | N/A | 4 | N/A | N/A | N/A | 140 |
| | | | Xtra-High | Xtra-High | 39 | 63 | 75 | N/A | N/A | N/A | 140 |
| | | | Low | Low | N/A | N/A | 15 | 15 | 53 | 85 | 296 |
| | | | High | High | N/A | N/A | 15 | 15 | N/A | N/A | 199 |
| | | | Xtra-High | Xtra-High | 64 | 96 | 113 | 113 | N/A | N/A | 199 |
| 4 | 156 | 1 3/8 | DL84 | DL84 | N/A | N/A | 295 | 295 | N/A | N/A | 85 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 14 | 27 | 114 |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | N/A | 74 |
| | | | Xtra-High | Xtra-High | 17 | 30 | 37 | N/A | N/A | N/A | 74 |
| | | | Low | Low | N/A | N/A | 3 | 3 | 25 | 43 | 162 |
| | | | High | High | N/A | N/A | 3 | 3 | N/A | N/A | 107 |
| | | | Xtra-High | Xtra-High | 31 | 49 | 58 | 58 | N/A | N/A | 107 |
| 5 | 270 | 1 3/8 | DL84 | DL84 | N/A | N/A | 136 | 136 | N/A | N/A | 43 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 5 | 14 | 70 |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | N/A | 44 |
| | | | Xtra-High | Xtra-High | 8 | 16 | 21 | N/A | N/A | N/A | 44 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 13 | 24 | 100 |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | N/A | 65 |
| | | | Xtra-High | Xtra-High | 17 | 28 | 34 | 34 | N/A | N/A | 65 |
| 6 | 347 | 1 3/8 | DL84 | DL84 | N/A | N/A | 84 | 84 | N/A | N/A | 24 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 2 | 8 | 46 |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | N/A | 28 |
| | | | Xtra-High | Xtra-High | 3 | 9 | 12 | N/A | N/A | N/A | 28 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 7 | 15 | 67 |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | N/A | 43 |
| | | | Xtra-High | Xtra-High | 9 | 17 | 21 | 21 | N/A | N/A | 43 |
| 8 | 450 | 2 1/2 | DL115 | DL115 | N/A | N/A | 56 | 56 | N/A | N/A | 15 |
| | | | Low | Low | N/A | N/A | N/A | N/A | 6 | 14 | 64 |
| | | | High | High | N/A | N/A | N/A | N/A | N/A | N/A | 41 |
| | | | Xtra-High | Xtra-High | 9 | 16 | 20 | 20 | N/A | N/A | 41 |
| | | | Low | Low | N/A | N/A | 38 | 38 | N/A | N/A | 14 |
| | | | High | High | N/A | N/A | 38 | 38 | N/A | N/A | 14 |
| | | | Xtra-High | Xtra-High | N/A | N/A | 38 | 38 | N/A | N/A | 14 |

Shut-Off ΔP and Cv Ratings

| Valve | Actuator | Shut-Off ΔP | | | |
|-------------------|-----------|----------------------------|------------------------|-------------------|------------------------|
| | | Three-Way Diverting/Mixing | | | |
| Valve Size (IN) | Cv Rating | Upper Port Closed | | Lower Port Closed | |
| | | Direct Acting | Air Signal to Actuator | Direct Acting | Air Signal to Actuator |
| 2 1/2 1687/5 3/4" | DL49 | 106 | 108 | 104 | 106 |
| 3 85/95 3/4" | DL49 | 104 | 106 | 104 | 106 |
| 4 160/180 3/4" | DL49 | 102 | 104 | 104 | 106 |
| 5 195/220 1-1/4" | DL115 | 99 | 102 | 104 | 108 |
| 6 270/300 1-3/8" | DL115 | 97 | 99 | 102 | 106 |
| 8 425/510 1-1/2" | DL115 | 99 | 101 | 104 | 106 |

2932

| Valve | Actuator | Shut-Off ΔP | | | |
|-------------------|-----------|----------------------------|------------------------|-------------------|------------------------|
| | | Three-Way Diverting/Mixing | | | |
| Valve Size (IN) | Cv Rating | Upper Port Closed | | Lower Port Closed | |
| | | Direct Acting | Air Signal to Actuator | Direct Acting | Air Signal to Actuator |
| 2 1/2 1687/5 3/4" | DL49 | 106 | 108 | 104 | 106 |
| 3 85/95 3/4" | DL49 | 104 | 106 | 104 | 106 |
| 4 160/180 3/4" | DL49 | 102 | 104 | 104 | 106 |
| 5 195/220 1-1/4" | DL115 | 99 | 102 | 104 | 108 |
| 6 270/300 1-3/8" | DL115 | 97 | 99 | 102 | 106 |
| 8 425/510 1-1/2" | DL115 | 99 | 101 | 104 | 106 |

NOTES:

- Published shut-off values are for diverting applications. The values are worst case and based on the pressure difference between the inlet and the outlet that is closed. Consult the factory if the required shut-off exceeds the published value and the pressure at the inlet and both outlets is known. For proper operation in diverting applications, the pressure difference between both outlets must not exceed 50 psi. Consult the factory for shut-off values for 2932 mixing applications. Pneumatic Actuators used with 2932 are direct acting. The upper port fails closed on loss of air pressure to the actuator.
- 2932 Seat closure ANSI Class II.
- Inlet pressure **cannot** exceed Body Pressure-temperature Rating.
- The 3-15 and 1-17 columns of the table apply to valves with control signals coming directly from I/P transducers with matching ranges. The 0-30 and 0-40 columns apply to valves with a positioner or an I/P transducer of suitable range.
- N/A indicates that the air signal is not capable of providing any shut-off or it exceeds the actuator's maximum air pressure.

Maximum air pressure
DL49...30PSIG
DL84...30PSIG
DL115...40PSIG

- See Actuators, Positioners, and Accessories section for explanation of spring ranges.

Dimensions & Weights

| Component | Dimension (IN) by Valve Size (IN) | | | | | | | | | |
|------------------------|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 2-1/2 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 10 | 20 |
| Variable | 9 | 10 | 13 | 15-3/4 | 17-3/4 | 16-1/4 | 16-1/4 | 21-3/8 | 21-3/8 | 21-3/8 |
| A | 125FLG | 9-5/8 | 10-3/4 | 13-5/8 | 16-5/8 | 18-5/8 | 16-1/4 | 21-3/8 | 21-3/8 | 21-3/8 |
| 250FLG | 4-3/4 | 5-3/8 | 6-3/8 | 7-3/8 | 8 | 8-7/8 | 9-7/8 | 9-7/8 | 9-7/8 | 9-7/8 |
| B | DL49 Direct* | 17-5/8 | 18-1/2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| DL49 Reverse | 17 | 17-7/8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| DL84 Direct* | 21-5/8 | 22-1/2 | 23-1/2 | 24-1/8 | 24-3/4 | N/A | N/A | N/A | N/A | N/A |
| DL84 Reverse | 21 | 21-7/8 | 22-7/8 | 23-1/2 | 24-1/8 | N/A | N/A | N/A | N/A | N/A |
| DL115 or 115XR Direct* | 34 | 34-7/8 | 35-7/8 | 36-1/2 | 37-1/8 | 38-3/8 | 39-1/8 | 39-1/8 | 39-1/8 | 39-1/8 |
| DL115 or 115XR Reverse | CF | CF | CF | CF | CF | CF | CF | CF | CF | CF |
| H | DL49 | 4-1/4 | 5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| W/760 | DL84 or 84XR | 6 | 6-7/8 | 7-7/8 | 8-1/2 | 9 | N/A | N/A | N/A | N/A |
| DL115 or 115XR Direct | 11-1/8 | 11-7/8 | 13 | 13-5/8 | 14-1/4 | 15-1/2 | 16 | 16 | 16 | 16 |
| DL115 or 115XR Reverse | CF | CF | CF | CF | CF | CF | CF | CF | CF | CF |
| Item | Weight (LB) by Valve Size (IN) | | | | | | | | | |
| Variable | 2-1/2 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 10 | 20 |
| 125FLG | 55 | 72 | 119 | 134 | 175 | 270 | 417 | 417 | 417 | 417 |
| 250FLG | 64 | 77 | 131 | 166 | 233 | 360 | 510 | 510 | 510 | 510 |

| Component | Dimension (IN) by Valve Size (IN) | | | | | |
|------------------------|-----------------------------------|--------|--------|--------|--------|--------|
| | 2-1/2 | 3 | 4 | 5 | 6 | 6 |
| Variable | 9 | 10 | 13 | 15-3/4 | 17-3/4 | 17-3/4 |
| A | 125FLG | 9-5/8 | 10-3/4 | 13-5/8 | 16-5/8 | 18-5/8 |
| 250FLG | 4-3/4 | 5-3/8 | 6-3/8 | 7-3/8 | 8-1/2 | 8-1/2 |
| B | DL49 Direct* | 18-1/8 | 19 | N/A | N/A | N/A |
| DL49 Reverse | 17-1/2 | 18-3/8 | N/A | N/A | N/A | N/A |
| DL84 Direct* | 22-1/8 | 23 | 24-1/8 | 24-1/8 | 24-3/8 | 25-1/4 |
| DL84 Reverse | 21-1/2 | 22-3/8 | 23-1/2 | 24-1/8 | 24-3/8 | 25-1/4 |
| DL115 or 115XR Direct* | N/A | N/A | N/A | N/A | N/A | N/A |
| DL115 or 115XR Reverse | N/A | N/A | N/A | N/A | N/A | N/A |
| H | DL49 | 4-3/4 | 5-1/2 | N/A | N/A | N/A |
| W/760 | DL84 | 6-1/2 | 7-3/8 | 8-1/2 | 9 | 9-5/8 |
| DL115 or 115XR Direct | N/A | N/A | N/A | N/A | N/A | N/A |
| DL115 or 115XR Reverse | N/A | N/A | N/A | N/A | N/A | N/A |
| Item | Weight (LB) by Valve Size (IN) | | | | | |
| Variable | 2-1/2 | 3 | 4 | 5 | 6 | 6 |
| 125FLG | 57 | 75 | 127 | 149 | 197 | 197 |
| 250FLG | 66 | 80 | 139 | 181 | 256 | 256 |

Face to face dimensions conform to historical Warren Controls standard and are NOT ANSI/ISA compatible.

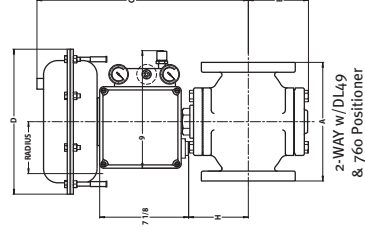
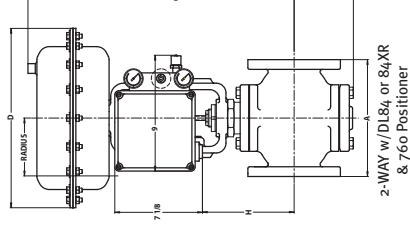
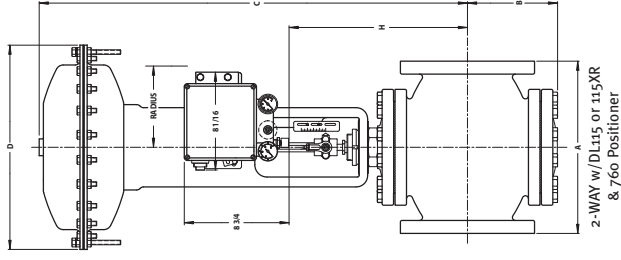
RADIUS is from centerline of actuator to outside edge of positioner.

Positioner Removal Clearance
Allow 3-1/4 Inch beyond 760 for cover removal/service.

| Component | Dimension (IN) by Valve Size (IN) | | | | | | | | | |
|--------------|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 2-1/2 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 10 | 20 |
| Variable | 7-3/4 | 9 | 11-3/8 | 12 | 14-1/8 | 16-1/4 | 16-1/4 | 21-3/8 | 21-3/8 | 21-3/8 |
| A | 125FLG | 8-3/8 | 9-3/4 | 12 | 12-7/8 | 14-1/2 | 15-1/4 | 21-3/8 | 21-3/8 | 21-3/8 |
| 250FLG | 4-7/8 | 4-3/8 | 5 | 6-7/8 | 7-3/8 | 8-7/8 | 9-7/8 | 9-7/8 | 9-7/8 | 9-7/8 |
| B | DL49 Direct* | 17-1/4 | 17-1/2 | 19 | N/A | N/A | N/A | N/A | N/A | N/A |
| DL49 Reverse | 16-5/8 | 16-7/8 | 18-3/8 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| DL84 Direct* | 21-1/4 | 21-1/2 | 23 | 24 | 24-7/8 | 26 | 26-3/4 | 26-3/4 | 26-3/4 | 26-3/4 |
| DL84 Reverse | 20-5/8 | 20-7/8 | 22-3/8 | 23-3/8 | 24-1/4 | 25-3/8 | 26-1/8 | 26-1/8 | 26-1/8 | 26-1/8 |
| H | DL49 | 3-3/8 | 4 | 5-5/8 | N/A | N/A | N/A | N/A | N/A | N/A |
| W/760 | DL84 | 5-5/8 | 5-7/8 | 7-3/8 | 8-3/8 | 9-1/4 | 10-3/8 | 10-3/8 | 10-3/8 | 10-3/8 |
| Item | Weight (LB) by Valve Size (IN) | | | | | | | | | |
| Variable | 2-1/2 | 3 | 4 | 5 | 6 | 8 | 10 | 10 | 10 | 20 |
| 125FLG | 32 | 42 | 77 | 124 | 169 | 290 | 435 | 435 | 435 | 435 |
| 250FLG | 42 | 54 | 96 | 162 | 220 | 380 | 540 | 540 | 540 | 540 |

* includes 1-3/8 inch for air fitting
H = Centerline of pipe to bottom of positioner
CF = Consult factory
N/A = Not Available

Consult factory for drawings, weights, and dimensions of configurations not shown.



Actuators, Positioners, & Accessories

Dimensions & Weights

| Component | Dimension (IN) by Valve Size (IN) | | | | |
|-----------|-----------------------------------|--------|--------|--------|--------|
| Variable | 2-1/2 | 3 | 4 | 5 | 6 |
| A | 125FLG | 9 | 10 | 13 | 15-3/4 |
| B | 250FLG | 9-5/8 | 10-3/4 | 13-5/8 | 16-1/4 |
| C | DL49 Direct* | 17-5/8 | 18-1/2 | N/A | N/A |
| D | DL84 or 84XR Direct* | 21-5/8 | 22-1/2 | 23-1/2 | 23-1/8 |
| E | DL115 or 115XR Direct* | 34 | 34-7/8 | 35-7/8 | 34-3/4 |
| F | DL49 | 4-1/4 | 5 | N/A | N/A |
| G | DL84 or 84XR | 6 | 6-7/8 | 7-7/8 | 6-3/4 |
| H | DL115 or 115XR Direct | 11-1/8 | 11-7/8 | 13 | 11-7/8 |

* Includes 1-3/8 inch for air filling
 H = Centerline of pipe to bottom of positioner
 CF = Consult factory
 N/A = Not Available

| Actuator | Dimension (IN) |
|------------------------|----------------|
| DL49 | 11 |
| DL84 or 84XR | 15-7/8 |
| DL115 or 115XR | 16-3/4 |
| DL49 | 7-7/8 |
| DL84 or 84XR | 8-1/8 |
| DL115 or 115XR Direct | 10-5/8 |
| DL115 or 115XR Reverse | CF |

| Actuator | Weight (LB) |
|-----------------|-------------|
| DL49 | 24-1/2 |
| DL84 or 84XR | 48-1/2 |
| DL115 Direct | 84 |
| DL115XR Direct | 92 |
| DL115 Reverse | CF |
| DL115XR Reverse | CF |

| Positioner | Weight (LB) |
|------------|-------------|
| 760 | 10 |

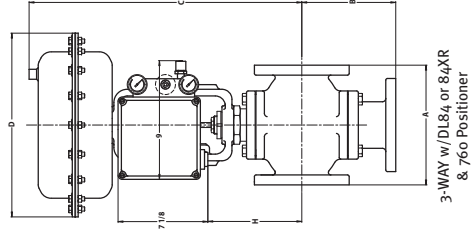
| Component | Dimension (IN) by Valve Size (IN) | | | | |
|-----------|-----------------------------------|--------|--------|--------|--------|
| Variable | 2-1/2 | 3 | 4 | 5 | 6 |
| A | 125FLG | 9 | 10 | 13 | 14-1/8 |
| B | 250FLG | 9-5/8 | 10-3/4 | 13-5/8 | 16-1/4 |
| C | DL49 Direct* | 17-5/8 | 18-1/2 | 19-1/4 | N/A |
| D | DL84 or 84XR Direct* | 21-5/8 | 22-1/2 | 23-1/4 | 23-7/8 |
| E | DL115 or 115XR Direct* | N/A | N/A | 35-3/8 | 36-7/8 |
| F | DL49 | 4-1/4 | 5 | 5-7/8 | N/A |
| G | DL84 or 84XR | 6 | 6-7/8 | 7-7/8 | 8-1/4 |
| H | DL115 or 115XR Direct | N/A | N/A | 12-3/4 | 13-5/8 |

* Includes 1-3/8 inch for air filling
 H = Centerline of pipe to bottom of positioner
 CF = Consult factory
 N/A = Not Available

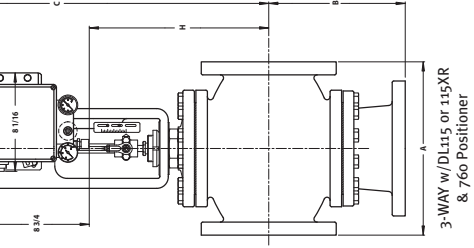
| Actuator | Dimension (IN) |
|------------------------|----------------|
| DL49 | 11 |
| DL84 or 84XR | 15-7/8 |
| DL115 or 115XR | 16-3/4 |
| DL49 | 7-7/8 |
| DL84 or 84XR | 8-1/8 |
| DL115 or 115XR Direct | 10-5/8 |
| DL115 or 115XR Reverse | CF |

| Actuator | Weight (LB) |
|-----------------|-------------|
| DL49 | 24-1/2 |
| DL84 or 84XR | 48-1/2 |
| DL115 Direct | 84 |
| DL115XR Direct | 92 |
| DL115 Reverse | CF |
| DL115XR Reverse | CF |

| Positioner | Weight (LB) |
|------------|-------------|
| 760 | 10 |



3-WAY w/ DL84 or 84XR & 760 Positioner



3-WAY w/ DL115 or 115XR & 760 Positioner

Actuators

| Actuator | Spring Range (PSI) | | | | |
|------------------|--------------------|------|------|-------|-----------|
| | Action | Low | Full | High | Xtra-High |
| DL49 | Direct | 3-9 | 4-13 | 8-12 | N/A |
| DL84 & DL115 | Reverse | 4-10 | 5-14 | 10-14 | N/A |
| DL84 & DL115 | Direct | 3-9 | 3-15 | 9-15 | N/A |
| DL84XR & DL115XR | Reverse | N/A | N/A | N/A | See Note |
| DL84XR & DL115XR | Direct | N/A | N/A | N/A | See Note |

Note: The spring range of XR (Extended Range) actuators varies with travel. These actuators require positioners or I/Ps for modulating control.

Effective Area: DL49 49 Sq In, DL84 & 84XR (84 Sq In)
 DL115 & 115XR (115 Sq In)

Springs: DL49, 84 & 84XR Multiple
 DL115 & 115XR Single

Max Air Supply: DL49, 84 & 84XR 30PSIG
 DL115 & 115XR 40PSIG

Air Connections: 1/4" NPT
 Buna-N Fabric Reinforced

Diaphragm: Diaphragm Chambers: Steel
 DL49, 84 & 84XR Ductile Iron
 DL115 & 115XR Aluminum
 300 Series Stainless Steel

Yoke: DL49 Epoxy-Coated
 DL84, 84XR, 115, & 115XR Acrylic Enamel

Stem: DL49-20 to 160°F

Finish: DL84, 84XR, 115 & 115XR -40 to 180°F

Ambient Temperature: DL49-20 to 160°F

Mounting: Vertical Above or Below Valve
 Available on DL84, 84XR, 115 & 115XR

Handwheel: Not Available on DL49

Positioners

Split Ranging with Positioners
 Positioners are sometimes used to "Split-Range" two control valves in a parallel configuration within a piping scheme. This technique is used to obtain higher rangeability than could otherwise be achieved with a single control valve. Typically one smaller valve supplying 15% to 35% of total flow is mated with a larger valve supplying 65% to 85% of total flow.

The best-matched pair will each be providing similar rangeability for each respective flow contribution to the manifold. Calculated as maximum flow / minimum controllable flow, the smaller valve should not be attempting to control flow below 5% of stroke. Estimate Cv from Cv tables vs. stroke to calculate this.

The chosen positioners would then have a Low Range signal for the smaller valve and a High Range Signal for the larger valve. With this, a single control signal can be used and serially applied to each valve. At mid-signal range, the little valve is completely open while the larger valve is just starting to open. Controllability for wide process set point ranges is dramatically improved.

BLX Models:



Models:

BFP : Full Range Signal (3-15 PSIG)
 BLP : Low Range Signal (3-9 PSIG)
 BHP : High Range Signal (9-15 PSIG)
 Options 2SPDT Limit Switches, 4-20 mA Feedback
 Ingress & Corrosion Protection: NEMA 4X, IP66
 Supply Pressure: Pneumatic: 145 PSIG Max **Not to exceed actuator rating**
 Air Consumption: 0.19 SCFM at 30 PSIG, 0.25 SCFM at 40 PSIG

BLX Electro-Pneumatic

Models:

BFE : Full Range Signal (4-20 mA)
 BLE : Low Range Signal (4-12 mA)
 BHE : High Range Signal (12-20 mA)
 Options 2SPDT Limit Switches, 4-20 mA Feedback
 Ingress & Corrosion Protection: NEMA 4X, IP66
 Supply Pressure: 21.8 to 145 PSIG **Not to exceed actuator rating**
 Air Consumption: 0.21 SCFM at 30 PSIG, 0.28 SCFM at 40 PSIG

BLX Electro-Pneumatic Intrinsically Safe

Models:

BFL : Full Range Signal (4-20 mA)
 BLL : Low Range Signal (4-12 mA)
 BHL : High Range Signal (12-20 mA)
 Options 2SPDT Limit Switches, 4-20 mA Feedback
 Ingress & Corrosion Protection: NEMA 4X, IP66
 Approvals & Ratings: Class I II III, Div 1, Groups A,B,C,D,E,F,G
 EM Intrinsically Safe: Class I, Div 1, Groups A, B, C, D
 CSA Intrinsically Safe: Class I, Div 1, Groups E, F, G, Class III
 Class I, Div 2, Groups A, B, C, D
 Class II, Div 2, Groups E, F, G
 Supply Pressure: 30 to 145 PSIG **Not to exceed actuator rating**
 Air Consumption: 0.21 SCFM at 30 PSIG, 0.28 SCFM at 40 PSIG



WARREN CONTROLS 12

Factory Default Settings

| Positioners | | | Failure Modes | | |
|---------------|-----------------|--------------|-------------------|-------------------------------------|-------------------------------------|
| Valve Type | Actuator Action | Input Signal | Increasing Signal | Loss of Signal* | Loss of Supply Valve Falls... |
| 2920, 22 & 23 | Direct | Pneumatic | 4-20 mA | Valve Closes | Open |
| 2930 & 32 | Reverse | 3-15 PSI | 4-20 mA | Valve Opens | Closed |
| | Direct | 3-15 PSI | 4-20 mA | Upper Port Closes/ Lower Port Opens | Upper Port Closes/ Lower Port Opens |

* Valves with Fail Freeze Positioners Fall in Last Position on Loss of Signal.

| Positioner Feedback | | | Positioner Limit Switches | | |
|---------------------|-----------------|-----------------|---------------------------|-------------------------------------|----------|
| Valve Type | Actuator Action | Feedback Signal | Valve Type | Position | Settings |
| 2920, 22 & 23 | Direct | 4-20 mA | 2920, 22 & 23 | Valve Closes | Closed |
| 2930 & 32 | Reverse | 4-20 mA | 2930 & 32 | Valve Opens | Open |
| | Direct | 4-20 mA | | Upper Port Closes/ Lower Port Opens | Closed |

* Reduced feedback span for valves with 760 and less than 1 inch travel.

| I/P's | | | Failure Modes | | |
|---------------|-----------------|--------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Valve Type | Actuator Action | Input Signal | Increasing Signal | Loss of Signal | Loss of Air Supply |
| 2920, 22 & 23 | Direct | As Required For Shut-off | Closes Valve | Valve Falls... | Valve Falls... |
| 2930 & 32 | Reverse | As Required For Shut-off | Opens Valve | Valve Falls... | Open |
| | Direct | As Required For Shut-off | Closes Lower Port/ Opens Upper Port | Upper Port Closes/ Lower Port Opens | Upper Port Closes/ Lower Port Opens |

SOLENOIDS (without Positioners or I/P's)

| Failure Modes | | | Solenoid De-energized | | |
|---------------|-----------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Valve Type | Actuator Action | Loss of Signal | Valve Falls... | Valve Falls... | Valve Falls... |
| 2920, 22 & 23 | Direct | Closes Valve | Open | Open | Open |
| 2930 & 32 | Reverse | Closes Lower Port/ Opens Upper Port | Upper Port Closes/ Lower Port Opens | Upper Port Closes/ Lower Port Opens | Upper Port Closes/ Lower Port Opens |

If the Solenoid is used with a Positioner or an I/P, refer to the Positioner or I/P listings for factory default settings and failure modes with the solenoid not failed.

Proximity MARK 1 Position Indication Switches Feedback

| Feedback Signal | | | Settings | | |
|-----------------|-----------------|-----------------|---------------|-------------------------------------|--------------------------------------|
| Valve Type | Actuator Action | Feedback Signal | Valve Type | Position | Settings |
| 2920, 22 & 23 | Direct | 0-350 ohm | 2920, 22 & 23 | Valve Closes | Closed |
| 2930 & 32 | Reverse | 0-350 ohm | 2930 & 32 | Valve Opens | Open |
| | Direct | 0-350 ohm | | Upper Port Closes/ Lower Port Opens | Upper Port Closes/ Lower Port Closes |

* Span varies from approx 155 to 350 ohm depending on actuator and travel.

Air Filter Regulators

| Output Pressure | |
|-----------------|--------|
| DL49, 84 & 84XR | 30PSIG |
| DL115 & 115XR | 40PSIG |

2600 Emrick Blvd., Bethlehem, PA 18020-8010 www.WarrenControls.com
Tel: 800-922-0085 or 610-317-0800 Fax: 610-317-2989



Configurations

1. SELECTIONS Please make a selection from each table of OPTIONS below to make a complete model number string.

| 29 | | R | | V A L V E B O D Y | | Trim Cv | | Packing Type | |
|---------------------------|------------------------|---------------|--|--|--|-------------|--|--------------|--|
| Model | Valve Type | Body Material | End Connection | Trim Style | Trim Material | Trim Cv | Packing Type | | |
| 291N 49" or 84" Pneumatic | 20 2-Way Single Seat | R Cast Iron | F 125 lb. Flanged G 250 lb. Flanged | E Equal % Types 20/22/23 L Linear Types 30/32 | B Bronze S 300 SS H 17-4 PH G Alloy 6 Wrought | F Full Port | T Nylon G Graphite Packing Used for Temp up to 500F where Body Pressure Temp is not Violated | | |
| 291 115 Pneumatic | 22 2-Way Double Seated | | | | | | | | |
| | 23 2-Way Cylinder Bbl. | | | | | | | | |
| | 30 3-Way Mixing | | | | | | | | |
| | 32 3-Way Diverting | | | | | | | | |

NOTE: Valve Type 22 is Only Used with 29W Body & DL49/DL44 Actuators.

VALVE TYPE / TRIM MATERIAL COMBINATIONS:

| SIZE | B | | S | | H | | 6 | |
|---------------|--------------------|--------------------|--------------------|--------|---------|--|-----------------|--|
| | Bronze | | 300SS | | 17-4 PH | | Alloy 6 Wrought | |
| 250 2-1/2 in. | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 23 | 23 | | | |
| 300 3 in. | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 23 | 23 | | | |
| 400 4 in. | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 23 | 23 | | | |
| 500 5 in. | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 23 | 23 | | | |
| 600 6 in. | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 22, 23, 30, 32 | 20, 23 | 23 | | | |
| 800 8 in. | 22, 32 | 20, 22, 30, 32 | 20, 22, 30, 32 | N/A | N/A | | | |
| 010 10 in. | 22 | 20, 22 | 20, 22 | N/A | N/A | | | |

VALVE TYPE / ACTUATOR COMPATIBILITY:

| VALVE STYLE | VALVE SIZES | ACTUATORS |
|-------------|--------------|-----------------|
| Type 20 | 2-1/2" - 6" | DL49 & DL54XR |
| Type 20 | 2-1/2" - 6" | DL84 |
| Type 20 | 2-1/2" - 10" | DL115 & DL115XR |
| Type 22 | 2-1/2" - 4" | DL49 & DL84 |
| Type 23 | 5" - 10" | DL49 |
| Type 23 | 2-1/2" & 3" | DL49 |
| Type 23 | 2-1/2" - 6" | DL84 |
| Type 23 | 4" - 6" | DL115 |
| Type 23 | 6" | DL115XR |
| Type 30 | 2-1/2" & 3" | DL49 & DL54XR |
| Type 30 | 2-1/2" - 6" | DL84 |
| Type 30 | 2-1/2" - 6" | DL115 DL115XR |
| Type 32 | 2-1/2" - 4" | DL49 |
| Type 32 | 2-1/2" - 6" | DL84 |
| Type 32 | 4" - 6" | DL115 |

WARREN CONTROLS

ACTUATED INDUSTRIAL VALVES

| 1800 SERIES | 2800 SERIES | 2900 SERIES | 3800 SERIES | 5800 SERIES |
|--|---|--|--|---|
| Heavy Globe Control Valves | Precision Globe Control Valves | High Capacity General Purpose Globe Control Valves | E-Ball Rotary Control Valves | Compact Globe Control Valves |
| styles: | styles: | styles: | styles: | styles: |
| <ul style="list-style-type: none"> 2-way balanced 2-way unbalanced 3-way mixing 3-way diverting | <ul style="list-style-type: none"> 2-way unbalanced 3-way mixing 3-way diverting | <ul style="list-style-type: none"> 2-way balanced 2-way unbalanced 3-way mixing 3-way diverting | <ul style="list-style-type: none"> 2-way rotary flow to open flow to close | <ul style="list-style-type: none"> 2-way cage-retained seat |
| sizes 2-1/2 to 12 in. | sizes 1/2 to 2 in. | sizes 2-1/2 to 10 in. | sizes 1 to 8 in. | sizes 1 to 4 in. |
| class 300 | class 250 & 300 | class 125 & 250 | class 300 | class 300 |
| ends 150,300 RF fig. | ends Butt-weld, NPT | ends Flange | ends 150,300 RF fig. | ends 150,300 RF fig. |
| body Cast Iron, WCB, CF8M | body Bronze, CF8M | body Cast Iron | body WCB, CF8M | body WCB, CF8M |
| trim 316 SST, Alloy 6 | trim Bronze, 316SST, 17-4PH, Alloy 6, TFE, PEEK | trim Bronze, 300SS, 17-4PH, Alloy 6 | trim 316 SST, Alloy 6, Ceramic, TFE, PEEK | trim 316 SST, Alloy 6, TFE, PEEK |
| Cv up to 1649 | Cv up to 40 | Cv up to 960 | Cv up to 1420 | Cv up to 170 |
| temp. -20° to 800°F | temp. -20° to 500°F | temp. -20° to 400°F | temp. -20° to 800°F | temp. -20° to 800°F |
| body limit to 740 psi | body limit to 720 psi | body limit to 400 psi | body limit to 740 psi | body limit to 740 psi |
| shutoff class III, IV | shutoff class III, IV, VI | shutoff class III, IV | shutoff class V, VI | shutoff class IV, VI |
| rangeability 50:1 | rangeability 50:1 | rangeability 50:1 | rangeability 100:1 | rangeability 50:1 |
| <ul style="list-style-type: none"> Heavy Duty Severe Service High Pressure Differentials Corrosive Materials, Liquids, Gases & Steam Modulating or On/Off Control | <ul style="list-style-type: none"> Economical Precision Control Suited for Gases, Steam, or Liquids that are Not Viscous or Solids Bearing | <ul style="list-style-type: none"> High Capacity General Purpose Moderate Pressure Drops Compatible Liquids and Gases, Steam & Water Modulating or On/Off Control | <ul style="list-style-type: none"> Eccentric, Segmented Ball Well Suited for Erosive Service Various Trim Options Include Ceramic for Slurries or Gritty Materials & Teflon® for Class VI Shutoff | <ul style="list-style-type: none"> Highly Efficient, Compact Design High Pressure Drops Typically Suited for High Force Piston Actuators for Steam, Chemicals & Dirty Fluids Minimizes Cavitation or Flashing Effects |

WARREN CONTROLS
 2600 Emrick Blvd., Bethlehem, PA 18020-8010 www.WarrenControls.com
 Tel: 800-922-0085 or 610-317-0800 Fax: 610-317-2989

WARREN CONTROLS

ACCESSORIES

| ACTUATOR | Spring Range | Handwheel | Positioners, I/P's & Limit Switches | Air Filter Regulators | ASCO Solenoids | Special Options |
|---------------------------|-----------------|------------------|-------------------------------------|-----------------------|--------------------------------|--------------------------------|
| 00 None | O None | R Reverse | O None | O None | A 3200G184 | S Special Ops or Set-Up |
| 49 49 (49 Sq.in.) | L Low | D Direct | A Type 300, 0-30 PSI | B 3200G202 | T SS Tubing | |
| 84 84 (84 Sq.in.) | M Medium | F Full | B Type 300, 0-60 PSI | L FR8206184 | G SS Tubing | |
| 8X 84 (84 Sq.in.) | H High | F Full | D Type 350S, 0-100 PSI | M FR8206202 | B SS Tubing and Tagging | |
| 15 15 (15 Sq.in.) | L Low | F Full | M FR8206202 | M FR8206202 | | |
| 5X 5X (115 Sq.in.) | H High | F Full | M FR8206202 | | | |

| POSITIONERS: | 4th digit spec. |
|----------------------------------|------------------------------|
| B-P BLX Pneumatic | F Full Stroke |
| B-E BLX Electro-Pneumatic | L Low of Split Range |
| B-T BLX Electro-Pneumatic | H High of Split Range |
| B-X BLX Electro-Pneumatic | M Modulating |
| B-Y BLX Electro-Pneumatic | N Non-Modulating |
| B-Z BLX Electro-Pneumatic | O On/Off |
| B-1 BLX Electro-Pneumatic | P Positioning |
| B-2 BLX Electro-Pneumatic | R Reverse |
| B-3 BLX Electro-Pneumatic | S Special Ops |
| B-4 BLX Electro-Pneumatic | T Telemetry |
| B-5 BLX Electro-Pneumatic | V Vibration |
| B-6 BLX Electro-Pneumatic | W Wetted |
| B-7 BLX Electro-Pneumatic | X X-Ray |
| B-8 BLX Electro-Pneumatic | Y Yoke |
| B-9 BLX Electro-Pneumatic | Z Zero |

| VALVE TYPE | ACTUATOR ACTION |
|------------|-----------------|
| 20/22 | Reverse |
| 20/22 | Direct |
| 30/32 | Direct |
| 30/32 | Reverse |

| MODE | VALVE TYPE |
|--------------|------------|
| Closed | 20/22 |
| Open | 20/22 |
| Upper Closed | 30/32 |
| Upper Open | 30/32 |

FAILURE MODES:

- 0** No Address
- L** when Lin Switches
- F** w/4-20 feedback
- B** w/switch & feedback

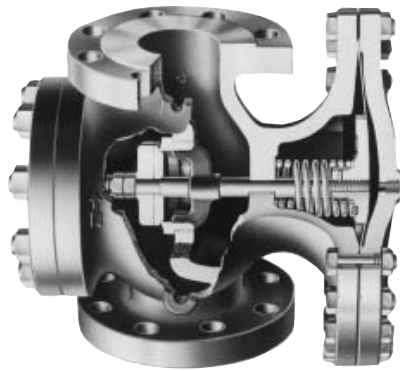
NOTE: Standard pneumatic tubing is copper. SS tubing is optional. SS tagging "G" (Two lines, 24 characters/line) is optional. SS tubing and tagging together "B" is optional.

Warren Controls does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Warren Controls product remains solely with the purchaser and end-user.

TYPE E MAIN VALVE

SIZES 3/8" - 12"
PRESSURES TO 600 PSIG at 750°F

- Normally Closed
- Single Seat
- Balanced Metal Diaphragms
- Protected Main Spring
- Fluid, Gas & Vapor Applications
- Accurate Regulation Unaffected by Service Conditions
- ANSI/FCI 70-2 Class IV Shutoff
- Virtually Frictionless for Long Service Life
- Packless Construction
- Easy In-line Maintenance
- Wide Variety of Pilots for Many Applications
- Minimum Operating ΔP 10 psi (.7 bar)
- Lifetime Warranty against Wire Drawing of Seat & Disc*



TYPE E MAIN VALVE

APPLICATION DATA

- Pressure Regulating for Steam Distribution
- Regulating for Process Control (Temperature or Pressure)
- Maintain Back Pressure or Differential Pressure
- Single Point or Multiple Use Applications
- For use with Self-contained, Pneumatic or Electronic Pilots
- Slow Start-up or Shutdown

VALVE RATINGS

| Valve Ends ASME/ANSI | Pressure PSIG (bar) | Temperature °F (°C) |
|--------------------------|-------------------------|---------------------|
| CAST IRON | 250 (17.2) @ 450 (232) | |
| Class 250 NPT | 125 (8.6) @ 450 (232) | |
| B16.1 Class 125 Flanged | 250 (17.2) @ 450 (232) | |
| CAST STEEL | 300 (21.0) @ 600 (315)† | |
| B16.34 Class 300 NPT | 150 (10.3) @ 500 (260)† | |
| B16.34 Class 150 Flanged | 300 (21.0) @ 600 (315)† | |
| B16.34 Class 300 Flanged | 600 (41.4) @ 600 (315)† | |
| B16.34 Class 600 Flanged | | |

†750°F (400°C) construction available on request.
Other pressure/temperature ratings available; consult factory.
Maximum downstream pressure is 300 psi.
Canadian Registration # OC 0591.9C

Installation Tip/Add EZ Connections for ease of maintenance

OPTIONS

- Composition Disc
- Balanced Construction
- Insulcap Insulating Jacket
- High Temperature Construction
- Low ΔP (LP) Main Spring
- Parabolic Disc
- Integral Mount Pilot
- Secoweld
- Dabspot
- EZ Connections

TYPICAL CONFIGURATIONS

- PRESSURE REDUCINGTYPE ED SERIES
- AIR ADJUSTEDTYPE EA SERIES
- BACK PRESSURETYPE EQ SERIES
- PUMP GOVERNORTYPE EP SERIES
- LOAD ALLOCATINGTYPE EFD
- AIR CONTROLLEDTYPE EAP60
- ELECTRONIC SLOW STARTTYPE ED208D
- SOLENOID CONTROLLEDTYPE EMD
- SOLENOID ACTUATEDTYPE EM
- DIFFERENTIALTYPE EN
- TEMPERATURE CONTROLTYPE ET SERIES

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 |

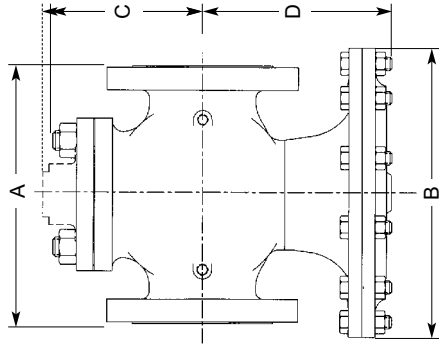
* When installed according to factory specifications.

TYPE E MAIN VALVE SPECIFICATION

The valve shall be self-operated, external pilot type, single seated, metal diaphragm actuated, normally closed design. The valve will function quickly and shut tight on dead end service. Internal parts including seats, discs, stems and diaphragms shall be of stainless steel. There shall be no springs in the stem space and no stuffing box. The valve shall be easy to maintain with all parts accessible without removal from the line.

MATERIALS OF CONSTRUCTION

- Body, Cast IronASTM A126 Cl. B
- Body, Cast BronzeASTM B61 UNS C92200
- Body, Cast SteelASTM A216 WCB
- Stem303 St. St. ASTM A582
- Disc 3/4 - 5"420 St. St. ASTM A743 CA-40
- Disc 6 - 12"304 St. St. ASTM A167/A240
- Seat 3/4 - 5"420 St. St. ASTM A743 CA-40
- Seat 6 - 12"316 St. St. ASTM A743-79 CF-8M
- GasketNon-asbestos
- DiaphragmStainless Steel MIL-S-5059C
- SpringSteel



TYPE E MAIN VALVE

DIMENSIONS inches (mm) AND WEIGHTS pounds (kg)

| SIZE | FACE TO FACE DIMENSIONS | | | | | | C | | | | D* | | APPROX. WT. | | |
|-------|-------------------------|------|--------|-------|------|------|------------|----------------|-------------|-------------|-------------|-------------|-------------|-----------------|-----|
| | A | | B | | C | | Std. Mount | Integral Mount | | Steel | Steel | ANSI | | ANSI | |
| | ANSI | ANSI | ANSI | ANSI | ANSI | ANSI | | Cl & Bz. | Steel | | | NPT | NPT | 125,150,250,300 | 600 |
| 3/8 | 10 | 11 | — | — | — | — | 2 1/4 (70) | 3 1/2 (89) | 3 1/2 (89) | 3 1/2 (89) | 5 1/4 (133) | 5 1/4 (133) | 14 (6) | — | — |
| 1/2 | 12 | 11 | — | — | — | — | 2 1/2 (70) | 3 1/2 (89) | 3 1/2 (89) | 3 1/2 (89) | 5 1/4 (133) | 5 1/4 (133) | 14 (6) | — | — |
| 3/4 | 19 | 11 | — | — | — | — | 2 1/2 (70) | 3 1/2 (89) | 3 1/2 (89) | 3 1/2 (89) | 5 1/4 (133) | 5 1/4 (133) | 14 (6) | — | — |
| 1 | 25 | 13 | 6 | 6 1/2 | 7 | 3 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 1 1/2 | 32 | 16 | 7 1/4 | 7 1/2 | 8 | 4 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 2 | 39 | 18 | 8 1/2 | 8 | 9 | 5 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 2 1/2 | 46 | 19 | 9 1/2 | 9 | 10 | 6 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 3 | 53 | 20 | 10 1/2 | 10 | 11 | 7 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 4 | 60 | 21 | 11 1/2 | 11 | 12 | 8 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 5 | 67 | 22 | 12 1/2 | 12 | 13 | 9 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 6 | 74 | 23 | 13 1/2 | 13 | 14 | 10 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 8 | 88 | 25 | 15 1/2 | 15 | 16 | 12 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 10 | 102 | 27 | 17 1/2 | 17 | 18 | 14 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |
| 12 | 116 | 29 | 19 1/2 | 19 | 20 | 16 | 3 1/4 (86) | 4 1/4 (109) | 4 1/4 (109) | 4 1/4 (109) | 5 1/4 (133) | 5 1/4 (133) | 18 (8) | — | — |

*Add 65% to D dimension for stem removal clearance.

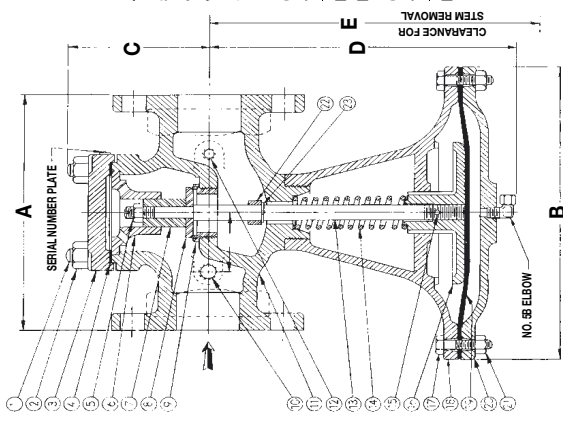
SPENCE ENGINEERING COMPANY, INC. 150 COLDENHAM ROAD, WALDEN, NY 12586-2035

TYPE E2 Main Valve Sizes 3/4" through 12"

The Spence Type E2 Main Valve is of normally closed, single seat design featuring packless construction, Hycar diaphragm 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 Screwed..... | 15 PSIG | (250°F) |
| □ ANSI 125 Flanged..... | 15 PSIG | (250°F) |
- CAST BRONZE RATINGS (Maximum Inlet Conditions)**
- | | | |
|-------------------------|----------|---------------|
| Valve Ends | Pressure | (Temperature) |
| □ ANSI NPT Screwed..... | 15 PSIG | (250°F) |



TYPE E2 MAIN VALVE

DIMENSIONS (inches), WEIGHTS (pounds) AND RATED FLOW COEFFICIENTS (Cv)

| SIZE | A | | OTHER DIMENSIONS | | | | APPROX. WT. | | Cv |
|-------|--------------------|-----------------|------------------|--------|--------|-------|--------------------|-----------------|------|
| | CLBRZ ANSI NPT 125 | CI ANSI NPT 125 | B | C | D | E | CLBRZ ANSI NPT 125 | CI ANSI NPT 125 | |
| 3/4 | 4 1/4 | — | 8 | 2 1/8 | 7 1/4 | 1 1/2 | 18 | — | 7.6 |
| 1 | 5 1/2 | — | 8 | 3 1/8 | 8 1/8 | 1 1/2 | 19 | 21 | 11.7 |
| 1 1/4 | 6 1/2 | 6 3/4 | 9 | 4 1/8 | 8 1/4 | 1 1/2 | 30 | 33 | 18.9 |
| 1 1/2 | 7 1/4 | 6 3/4 | 9 1/4 | 4 1/8 | 8 1/4 | 1 3/4 | 36 | 40 | 27.4 |
| 2 | 7 1/2 | 8 1/2 | 10 1/2 | 5 1/4 | 10 | 1 5/4 | 50 | 57 | 44 |
| 2 1/2 | — | 9 1/2 | 10 1/2 | 5 1/4 | 11 1/2 | 1 7/4 | — | 70 | 68 |
| 3 | — | 10 | 11 1/4 | 6 1/8 | 12 1/4 | 1 9/4 | — | 98 | 96 |
| 4 | — | 11 1/4 | 13 1/2 | 6 3/4 | 13 3/8 | 2 1/4 | — | 135 | 143 |
| 5 | — | 13 1/4 | 14 1/4 | 7 1/2 | 15 | 2 3/8 | — | 185 | 202 |
| 6 | — | 15 1/8 | 16 | 7 1/8 | 16 1/8 | 2 6/8 | — | 250 | 255 |
| 8 | — | 19 | 20 | 9 1/4 | 19 1/4 | 3 0/8 | — | 415 | 465 |
| 10 | — | 23 1/4 | 24 | 10 3/8 | 23 1/8 | 3 8/8 | — | 690 | 748 |
| 12 | — | 26 1/2 | 28 | 12 1/4 | 27 1/4 | 4 4/8 | — | 1060 | 1118 |

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 88 tee. Bleedport 4A restricts the flow and pressure builds under the diaphragm and opens the main valve.

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

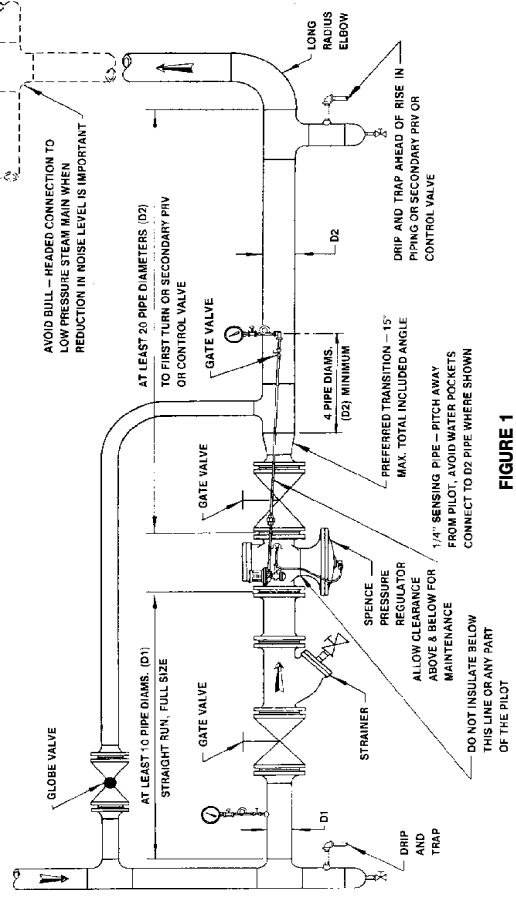


FIGURE 1

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. Scribed 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 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.

INSTALLATION

Screw No. 88 tee into 1/8" pipe tap in pilot. Select tap facing downstream.

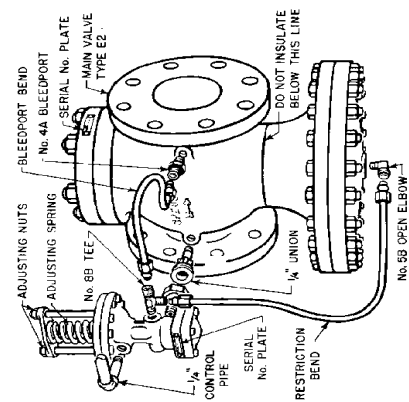
Screw No. 5B elbow into 1/8" pipe tap on underside of main valve diaphragm chamber.

Connect tubing bends as illustrated in Fig. 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.

FIGURE 2



POWERS

A WATTS INDUSTRIES CO.

TECHNICAL INSTRUCTIONS

Accritem Controller Model 3

SPECIFICATIONS

| | |
|---|--|
| Operation | Direct or Reverse Acting |
| Adjustment Dial Range | Standard 50 to 350°F (10 to 177°C) |
| Maximum Supply Pressure at Room Temperature | 35 psi (241.3 kPa) |
| Air Consumption (max.) | 218 cm ³ /s (800 SCIM) |
| Maximum Operating Pressure | 1724 kPa (250 psi) |
| Maximum Operating Temperature | 400°F(204°C) |
| Temperature Response | 0.5°F(0.3°C) |
| Mounting | 1/2" NPT |
| Air or Water Connections | 1/8" NPT |
| Drain Connection (water only) | 1/4" NPT |
| Shipping Weight | 4 lbs. (1.8 kg) |
| Sensitivity (adjustable) | 3.1 to 27.9 kPa/C (1/4 to 2-1/4 psi/F) |
| Maximum Pressure on Wells | 1125 psi (7756 kPa) |
| Stainless Steel no. 744-082 | 525 psi (3619 kPa) |
| Copper no. 744-111 | See page 5 |
| Well Dimensions | |

OPERATION (Direct Acting Controller)

A temperature change in the medium being controlled creates a change in length of the sensitive tube (1). An increase in temperature lengthens the sensitive tube (1) and moves the Invar rod (2) away from the lever (3). The lever (3), which pivots at Point A, is moved to close the exhaust valve (4) by spring (5). This permits the supply (air or water) (S) to increase the pressure in the control line (R) and close the normally-open valve. A decrease in temperature shortens the sensitive tube (1) and moves the Invar rod against the lever (3). The lever (3) moves against the pressure spring (5), to open the exhaust valve (4). This exhausts the pressure in the control line and opens the valve.

The sensitivity adjustment screw (6) regulates the rate of flow of the supply (air or water) to the controller to a change in temperature. Turning the screw clockwise increases the sensitivity by reducing the flow and increasing the response time. Turning the screw counterclockwise decreases the sensitivity by increasing the flow and reducing the response time. Also see Figure 8 on page 6.

SENSITIVITY

The sensitivity of the Accritem controller is adjusted by turning the restriction screw (Figure 2). (The restriction screw is factory-set for air operation.) For water operation, the restriction screw should be opened a minimum of 1/2 turn and con-



Figure 2. Set restriction screw for desired sensitivity. Air: 1/8 turn from closed (minimum). Water: 1/2 turn from closed (minimum).

| | |
|-----------------------------|----------|
| AIR OPERATED: | |
| Rigid Stainless Bulb | |
| Direct Action | 744-1270 |
| Reverse Action | 744-1271 |
| Rigid Copper Bulb | |
| Direct Action | 744-1213 |
| Reverse Action | 744-1214 |
| WATER OPERATED: | |
| Rigid Stainless Bulb | |
| Direct Action | 744-1217 |
| Reverse Action | 744-1218 |

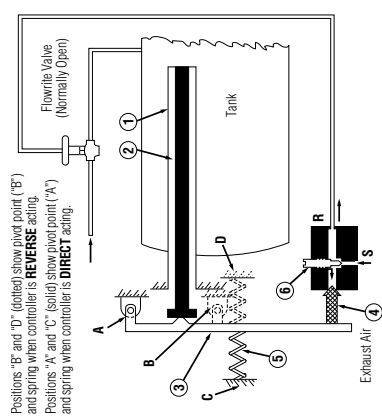


Figure 1.

troller recalibrated. Restriction screw must never be fully closed. Make adjustments slowly, allowing about two (2) minutes after each adjustment for the controller to balance. NOTE: If sensitivity is changed, controller must be recalibrated.

CALIBRATION



Figure 2. Set restriction screw for desired sensitivity. Air: 1/8 turn from closed (minimum). Water: 1/2 turn from closed (minimum).

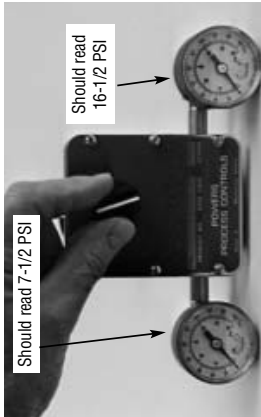


Figure 3. Turn adjusting knob until 52 kPa (7-1/2 psi) control pressure shows on gauge. Read temperature at bulb with an accurate thermometer.

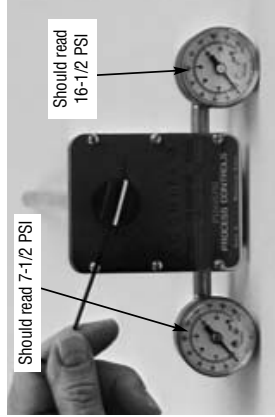


Figure 4. Loosen set screw and turn adjusting knob to indicate temperature at bulb. Tighten set screw. Set controller for desired control temperature.

INSTALLATION (GENERAL INSTRUCTIONS)

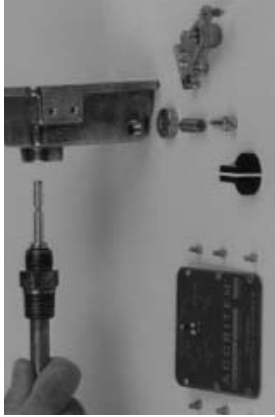


Figure 5.

To disassemble and replace sensitive tube assembly:

The Accritem Controller requires a clean, reliable supply of compressed air or cold water at room temperature and 15 to 20 pounds of pressure. Other fluids may be used, such as gas, oil, etc., providing provision is made for safe disposal. Select sensitive element location with care to insure satisfactory results. Bulb must project entirely into the liquid or air being controlled.

Flush or blow out all lines before making final connections. Put supply pressure through all control lines and check for leaks.

INSTALLATION FOR AIR OPERATION

Controller should normally be installed in horizontal position; however, other positions may be used if the supply and control connections are parallel with the ground and calibration is checked after installation.

INSTALLATION FOR WATER OPERATION

Controller should normally be installed in horizontal position with drain connection at bottom. For positive drainage at all times, drain piping should be 3/8" minimum.

TO CHANGE CONTROLLER ACTION

(See Figures 6 and 7)

1. Turn adjusting knob clockwise to remove tension.
2. Remove adjusting knob and cover.
3. Remove lever spring retainer (D) and spring (E).
4. Relocate lever pivots (F).
5. Turn lever pivots to be snug without binding.
6. Replace lever spring retainer (D) and spring (E).
7. Replace cover and adjusting knob.
8. Recalibrate.

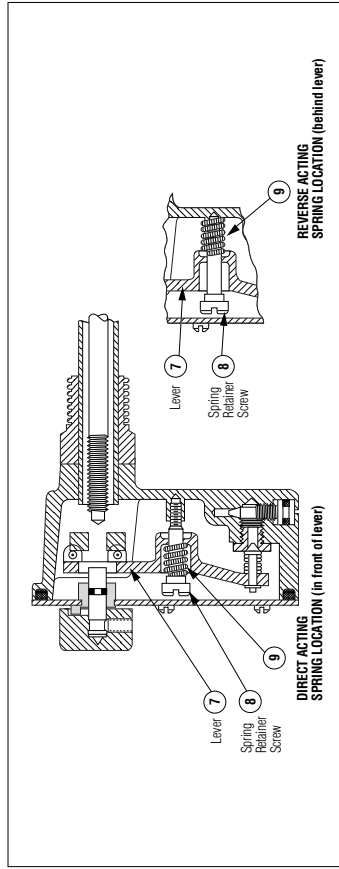


Figure 6.

The parts in Figure 7 are identified by letter in order of disassembly. For item number reference, see Parts Drawing: A (item 3) adjusting knob with set screw, B (item 10) cover screws, C (item 2) cover plate, D (item 8) spring retainer screw, E (item 9) lever spring, F (item 21) lever pivot, G (item 7) lever.

Always locate the controller as close as possible to the controlled device. The piping between the controller and controlled device (valve or damper motor) should be 1/8" NPT brass pipe or 6.4 mm (1/4") OD copper tubing.

Difference in height between Accritem controller and controlled device should be kept to a minimum. When controller is **below** controlled device, elevation cannot exceed 3 m (10') with 104 kPa (15 psi) supply pressure. If controller is **above** controlled device, adjust springs on valve or damper motor to compensate for static head pressure.

PRESSURE CONTROLLER FOR USE WITH WATER

Set pressure at 104-138 kPa (15-20 psi) when water is flowing. Clean strainer at regular intervals.

BOTH AIR AND WATER CONTROLLERS

- To disassemble** (Refer to Parts Drawing and Figure 5):
1. Remove knob (3) after loosening its set screw.
 2. Remove cover plate (2).
 3. Remove spring retainer screw (8) and lever spring (9).
 4. Back out one lever pivot (21) and remove lever (7).
 5. Unscrew sensitive tube assembly (20) from body (1).

To reassemble:

1. Install new sensitive tube assembly (20) to body (1).
2. Install lever (7). Tighten the lever pivot screws (21) as required. The lever must be in the exact center of the body and must move freely but without side play.

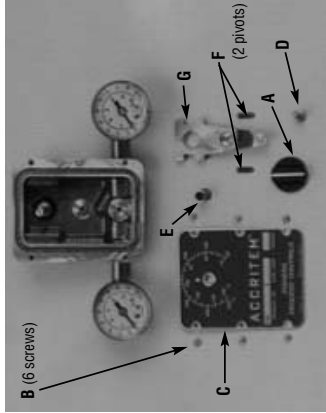


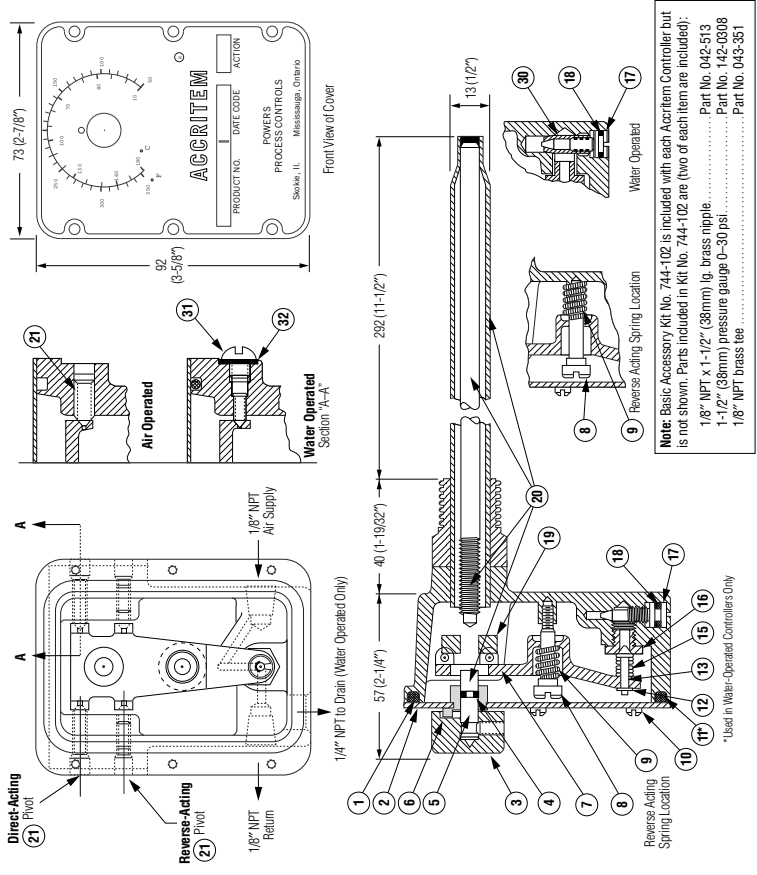
Figure 7.

3. Install screws (3) and gaskets (2) on water-operated controller.
4. Install parts (8) and (9). (Note relationship for direct and reverse acting. See Figure 6.)
5. Back out adjustment screw (5) until collar (10) touches the pivots on the lever (7).
6. Install cover plate (2).
7. Install adjustment knob with set screw (3). The knob indicator (white line on side of knob) should be opposite the dial marking corresponding to the room temperature. Tighten the knob set screw very firmly.
8. Turn the adjusting knob to the desired control temperature for approximate calibration.
9. Recalibrate as required after the controller is installed and connected to the supply and control lines.

NOTE: On units with a date code of 3L48 and later: When replacing a knob (744-036) or cover plate (744-170), a new knob (744-234) and cover plate (744-170D) must be ordered.

PARTS

Dimensions: Millimeters (Inches)



PARTS LIST

| Item | Part Name | Part Numbers | | No. Req'd | Material | Part Numbers | | No. Req'd | Material |
|------|-----------------------------|--------------|----------|-----------|-----------------|--------------|------------|-----------|-----------------|
| | | Air or Gas | Water | | | Air or Gas | Water | | |
| 1 | Body | 744-170D | 744-170D | 1 | Brass | 100-124* | 100-124** | 1 | Phos. Bronze |
| 2 | Cover Plate | 744-234 | 744-234 | 1 | — | 744-155* | 744-163** | 1 | Phos. Bronze |
| 3 | Adjusting Knob w/ Set Screw | 744-234 | 744-234 | 1 | — | 744-075* | 744-075** | 1 | Phos. Bronze |
| 4 | Quad Ring | 047-043 | 047-043 | 1 | — | 744-063* | 744-131*** | 1 | Phos. Bronze |
| 5 | Adjustment Screw | 744-175 | 744-175 | 1 | Brass | 744-072 | 744-134* | 1 | Brass |
| 6 | Cover Screws | 744-061 | 744-061 | 6 | — | 047-049* | 047-045 | 1 | Brass |
| 7 | Lever | — | — | 1 | Brass | — | — | 1 | Brass |
| 8 | Spring Retainer Screw | 744-124 | 744-124 | 1 | — | 744-172 | 744-172 | 1 | — |
| 9 | Lever Spring | 225-073 | 430-021* | 1 | Stainless Steel | 744-154 | 744-154 | 2 | Stainless Steel |
| 10 | Cover Screw | 030-041 | 030-041 | 6 | — | — | — | 4 | Stainless Steel |
| 11 | O-Ring | Not used | 047-050 | 1 | Silicone Rubber | — | — | 4 | Rubber |

* (Pkg. of 10)
 ** Also order O-ring (see item 18).
 *** Material is Stainless Steel
 • Material is Silicone Rubber

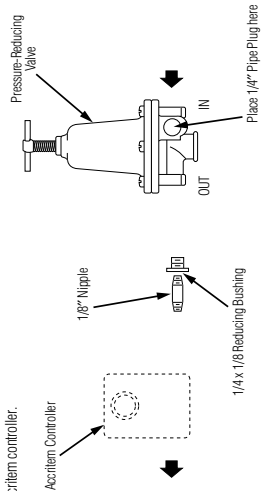
Included in Valve and Seat Kit for Model 3 (Air-Operated Accritem)
 No. 744-168—parts are not available separately.
 ** Included in Valve and Seat Kit for Model 3 (Water-Operated Accritem)
 No. 744-169—parts are not available separately.
 Valve and Seat Kit for Model 3 (Air-Operated Accritem) 744-168
 Valve and Seat Kit for Model 3 (Water-Operated Accritem) 744-169

ACCESSORIES

Dimensions: Millimeters (Inches)

AIR
Accessory Kit No. 744-107
 (Dotted line item not included)

Provides materials necessary to reduce the incoming air supply pressure to within the supply pressure range of the Accritem controller.



OPERATION (continued)

Figure 8. Additional information on controller action and applications.

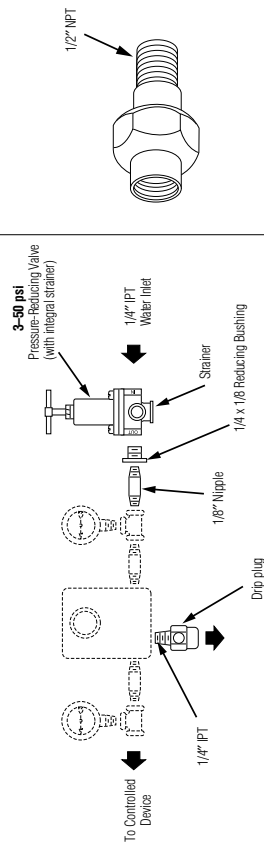
| | APPLICATION | | |
|--|--|--|---|
| | HEATING | COOLING | MIXING |
| ACTION: DIRECT Acting | Normally OPEN valve Valve OPENS on air failure | Normally CLOSED valve Valve CLOSES on air failure | Hot piped to Normally OPEN port of valve Valve opens to HOT flow on air failure |
| REVERSE Acting | Normally CLOSED valve Valve CLOSES on air failure | Normally OPEN valve Valve OPENS on air failure | Hot piped to Normally CLOSED port of valve Valve opens to COLD flow on air failure |

WATER

Accessory Kit No. 744-180
 (Dotted line items not included)

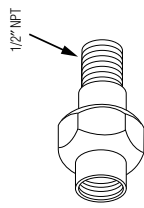
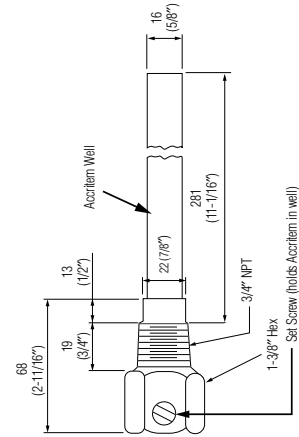
Kit provides materials necessary to convert the Accritem **from** air operation **to** water operation.

Brass Union Assembly No. 744-106
 Provides pressure-tight connection for installing Accritem in pipe or tank where space does not permit rotation of Accritem body.



Supply gauge may also be installed in extra outlet of PRV.

Well Dimensions
 mm (inches)



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. (Installer: California law requires that this warning be given to the consumer.)
 For more information: www.wattsinf.com/jp3965

WARRANTY INFORMATION

Powers warrants that the equipment manufactured by it is free from defects in material and workmanship and, without charge, equipment found to be defective in material and workmanship will be repaired, or at Seller's option, replaced F.O.B. original point of shipment, if written notice of failure is received by Seller within one (1) year after date of shipment, provided said equipment has been properly installed, operated in accordance with Seller's instructions, and provided such defects are not due to abuse or chemical decomposition by chemical vapors, or other causes beyond the control of Seller. The Seller assumes no responsibility for repairs made on Seller's equipment unless done by Seller's authorized personnel, or by written authority from the Seller. The Seller makes no guarantee with respect to material not manufactured by it.

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For Hot Water Boiler Applications

Job Name _____ Contractor _____
 Job Location _____ Approval _____
 Engineer _____ Contractor's P.O. No. _____
 Approval _____ Representative _____

**Series 174A-740
 ASME Water Pressure
 Relief Valves**
 for Pressure Protection of
 Hot Water Heating Boilers

Sizes: 3/4" through 2" (20 - 50mm)



Series 174A
 Bronze body safety relief valves for pressure protection only of all types of hot water heating boiler equipment. Pressure range 30 to 150 psi (2 - 10 bars) with corresponding high ratings from 650,000 to 14,370,000 BTU/hr. Female inlet and outlet connections. Sizes 3/4" to 2" (20 to 50mm).

Series 374A
 Iron body with forged bronze inlet, 550,000 BTU/hr rating. Size 3/4" (20mm) only.

Series 740
 Iron body with expanded outlets for hot water space heating boilers. Pressure range 30 to 75 psi (2 to 5 bars) with corresponding high ratings from 925,000 to 10,700,000 BTU/hr.

- FEATURES**
- Seat located above drain; water can't be trapped and sediment can't foul seat.
 - Non-mechanical seat-to-disc alignment will not stick or freeze.
 - Water seal of high temperature resisting material isolates spring working parts from water during relief.

SPECIFICATIONS
Boiler Relief Valves
 An ASME Section IV certified pressure relief valve shall be installed on each boiler as noted. The valve shall have a BTU rating in excess of the BTU rating of the boiler's heating output. Each hot water space heating boiler shall be equipped with a pressure relief valve set to relieve below the maximum boiler working pressure. The valve shall feature a raised seat and non-mechanical disc alignment. Working parts and spring shall be isolated from any discharge by a high temperature resistant material. Valve shall be a Watts 174A or 740 Series.

OPERATION
 As thermal expansion conditions develop, pressure builds up to the setting of the relief valve. This will cause discharging of small quantity of water.
 Should operating controls fail, permitting runaway firing, the boiler water may reach steam temperatures. The valve will then open to discharge steam at the rate or faster than the boiler can generate it, thus restoring system pressure to a safer level.
Important: The discharge line must be the same size as the valve outlet, and must pitch downward from the valve to a safe place for disposal.
 Valve lever must be tripped at least once a year to insure that waterways are clear. This device is designed for emergency safety relief and shall not be used as an operating control.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligations to make such changes or modifications on Watts products previously or subsequently sold.



MATERIALS

- Series 174A**
 Bronze body construction
 • Nonmetallic disc-to-metal seating
- Series 740**
 Iron body construction
 • Nonmetallic disc-to-metal seating

PRESSURE - TEMPERATURE

Series 174A
 Pressure range: 30 psi to 150 psi (2 to 10 bars) with corresponding high BTU/hr ratings from 650,000 to 14,370,000 BTU/hr.
 Maximum Temperature: 250°F (121°C).

No. 374A
 Pressure range: rated up to 550,000 BTU/hr at a 30 psi (2 bars) setting only.

Series 740
 Pressure range: 30 PSI to 75 psi (2 to 5 bars) with corresponding high ratings from 925,000 to 10,700,000 BTU/hr.
 Maximum Temperature: 250°F (121°C).

STANDARDS



Tested and rated by A.S.M.E. National Board of Boiler and Pressure Vessel Inspectors.
 Meets Military Spec. MIL-V-18634B, Type I, Class 3A, Style A (Bronze Body), Style B (Iron Body).

CAPACITY

BTU/hr Steam Pressure Discharge Capacities
 As tested and rated by the National Board of Boiler and Pressure Vessel Inspectors

| Series 174A | | Series 740 | |
|------------------|--------------------------|--------------------------|--------------------------|
| Set Pressure psi | 1 1/2" x 1 1/4" Model M1 | 1 1/2" x 1 1/4" Model M1 | 1 1/2" x 1 1/4" Model M1 |
| 30 | 2,07 | 2,07 | 2,07 |
| 33 | 2,27 | 2,27 | 2,27 |
| 35 | 2,41 | 2,41 | 2,41 |
| 36 | 2,48 | 2,48 | 2,48 |
| 40 | 2,76 | 2,76 | 2,76 |
| 45 | 3,10 | 3,10 | 3,10 |
| 50 | 3,45 | 3,45 | 3,45 |
| 60 | 4,13 | 4,13 | 4,13 |
| 65 | 4,58 | 4,58 | 4,58 |
| 70 | 4,82 | 4,82 | 4,82 |
| 75 | 5,17 | 5,17 | 5,17 |
| 80 | 5,51 | 5,51 | 5,51 |
| 85 | 5,86 | 5,86 | 5,86 |
| 90 | 6,60 | 6,60 | 6,60 |
| 95 | 6,55 | 6,55 | 6,55 |
| 100 | 6,89 | 6,89 | 6,89 |
| 105 | 7,23 | 7,23 | 7,23 |
| 110 | 7,58 | 7,58 | 7,58 |
| 115 | 7,92 | 7,92 | 7,92 |
| 120 | 8,27 | 8,27 | 8,27 |
| 125 | 8,61 | 8,61 | 8,61 |
| 130 | 8,96 | 8,96 | 8,96 |
| 135 | 9,30 | 9,30 | 9,30 |
| 140 | 9,65 | 9,65 | 9,65 |
| 145 | 9,99 | 9,99 | 9,99 |
| 150 | 10,34 | 10,34 | 10,34 |

| Series 174A | | Series 740 | |
|------------------|--------------------------|--------------------------|--------------------------|
| Set Pressure psi | 1 1/2" x 1 1/4" Model M1 | 1 1/2" x 1 1/4" Model M1 | 1 1/2" x 1 1/4" Model M1 |
| 30 | 2,07 | 2,07 | 2,07 |
| 33 | 2,27 | 2,27 | 2,27 |
| 35 | 2,41 | 2,41 | 2,41 |
| 36 | 2,48 | 2,48 | 2,48 |
| 40 | 2,76 | 2,76 | 2,76 |
| 45 | 3,10 | 3,10 | 3,10 |
| 50 | 3,45 | 3,45 | 3,45 |
| 60 | 4,13 | 4,13 | 4,13 |
| 65 | 4,58 | 4,58 | 4,58 |
| 70 | 4,82 | 4,82 | 4,82 |
| 75 | 5,17 | 5,17 | 5,17 |
| 80 | 5,51 | 5,51 | 5,51 |
| 85 | 5,86 | 5,86 | 5,86 |
| 90 | 6,60 | 6,60 | 6,60 |
| 95 | 6,55 | 6,55 | 6,55 |
| 100 | 6,89 | 6,89 | 6,89 |
| 105 | 7,23 | 7,23 | 7,23 |
| 110 | 7,58 | 7,58 | 7,58 |
| 115 | 7,92 | 7,92 | 7,92 |
| 120 | 8,27 | 8,27 | 8,27 |
| 125 | 8,61 | 8,61 | 8,61 |
| 130 | 8,96 | 8,96 | 8,96 |
| 135 | 9,30 | 9,30 | 9,30 |
| 140 | 9,65 | 9,65 | 9,65 |
| 145 | 9,99 | 9,99 | 9,99 |
| 150 | 10,34 | 10,34 | 10,34 |

DIMENSIONS - WEIGHTS

| Series 174A | | Series 740 | |
|-------------|---------------|------------|-------------|
| No. | Size (mm) | Height in. | Weight lbs. |
| 374A | 3/4 x 3/4 | 92 | 1.13 |
| 174A | 1 x 1 | 130 | 1.50 |
| 174A | 1 1/4 x 1 1/4 | 146 | 3.13 |
| 174A | 1 1/2 x 1 1/2 | 213 | 6.25 |
| 174A | 2 x 2 | 229 | 7.25 |
| 740 | 3/4 x 1 | 143 | 1.88 |
| 740 | 1 x 1 1/4 | 184 | 3.13 |
| 740 | 1 1/4 x 1 1/4 | 222 | 6.13 |
| 740 | 1 1/2 x 1 1/2 | 235 | 7.50 |
| 740 | 2 x 2 | 295 | 16.50 |

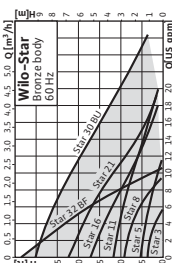
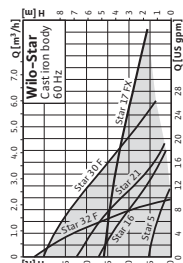
A LEADER IN VALVE TECHNOLOGY
WATTS REGULATOR
 Since 1874
 Water Products Division • Safety & Control Valves
 ISO 9001 certified



Range: Wilo-Star



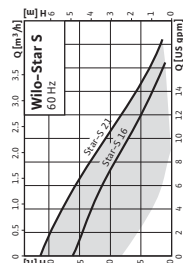
- > Maintenance free single-head circulators
- > Pipe connection:
 - flange
 - flange rotated 90°
 - unions
 - internal sweat
- > Cast iron body for all hot water, heating and air conditioning applications
- > Bronze body for domestic hot water applications
- > Special features:
 - quick connection with spring clips
 - non overload motor



Range: Wilo-Star S



- > Maintenance free single-head circulators with 3 speed motors
- > Flange connection 90° rotated
- > Cast iron housing and bronze body housing for all hot water and heating applications
- > Special features:
 - quick connection with spring clips
 - 3 speed motor
 - non overload motor



Function, Equipment & Technical data Wilo-Star (Cast iron body)

| | Wilo-Star... (Cast iron body) | | | | | | | | | | |
|---|---------------------------------------|------|-------|-------|------|-------|------|-------|------|-------|-----|
| | 5 FX | 16 F | 16 FX | 17 FX | 21 F | 21 FX | 30 F | 30 FX | 32 F | 32 FX | |
| Approved fluids (other fluids on request) | | | | | | | | | | | |
| Heating water | • | • | • | • | • | • | • | • | • | • | • |
| Water/glycol mixtures (max. 32; mixtures with more than 20% glycol require reassessment of the hydraulic criteria) | • | • | • | • | • | • | • | • | • | • | • |
| Domestic hot water | - | - | - | - | - | - | - | - | - | - | - |
| Performance | | | | | | | | | | | |
| Max. delivery head [ft] | 5.5 | 16 | 16 | 17 | 21 | 21 | 30 | 30 | 33 | 33 | |
| Max. delivery head [m] | 1.7 | 4.9 | 4.9 | 5.2 | 6.4 | 6.4 | 9.1 | 9.1 | 10.1 | 10.1 | |
| Max. volume rate of flow [USGPM] | 12 | 16.5 | 16.5 | 50 | 19 | 19 | 26 | 26 | 10.5 | 10.5 | |
| Max. volume rate of flow [m³/h] | 2.7 | 3.7 | 3.7 | 11.4 | 4.3 | 4.3 | 5.9 | 5.9 | 2.4 | 2.4 | |
| Acceptable field of application | | | | | | | | | | | |
| Temperature range for application in heating and cooling installations | 14 °F (-10 °C) up to 230 °F (+110 °C) | | | | | | | | | | |
| Temperature range in domestic hot water system | - | | | | | | | | | | |
| Ambient temperature range | 104 °F (+40 °C) | | | | | | | | | | |
| Max. working pressure P _{max} [psi] | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 |
| Pipe connections | | | | | | | | | | | |
| Flange | - | • | - | - | • | - | • | - | • | - | • |
| Flange rotated 90° | • | - | • | • | - | • | - | • | - | • | - |
| Union connection | - | - | - | - | - | - | - | - | - | - | - |
| Internal sweat | - | - | - | - | - | - | - | - | - | - | - |
| Electrical connections | | | | | | | | | | | |
| Power supply 1~ [V] | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |
| Power frequency [Hz] | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Wilo's quick connection with spring clips | • | • | • | • | • | • | • | • | • | • | • |
| Motor/Electronics | | | | | | | | | | | |
| Number of speed steps | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non overload motor | • | • | • | • | • | • | • | • | • | • | • |
| Insulation class | F | F | F | F | F | F | F | F | F | F | F |

• = available, - = not available

Circulating Pumps

Product review: Wilo-Star/Star S

Circulating Pumps

Product review: Wilo-Star/Star S



Function, Equipment & Technical data Wilo-Star (Cast iron body)

| | Wilo-Star... (Cast iron body) | | | | | | |
|---|----------------------------------|------|-------|-------|------|-------|------|
| | 5 FX | 16 F | 16 FX | 17 FX | 21 F | 21 FX | 32 F |
| Materials | | | | | | | |
| Pump housing - cast iron | • | • | • | • | • | • | • |
| Pump housing - bronze | - | - | - | - | - | - | - |
| Impeller | Plastics (PP - 40 % GF) | | | | | | |
| Shaft | Stainless steel (X140 Cr13) | | | | | | |
| Bearing | Metal impregnated carbon | | | | | | |
| Minimal static inlet pressure at pump suction port [psi] to avoid cavitation at fluid temperatures | | | | | | | |
| 122 °F (50 °C) | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 203 °F (95 °C) | 4,4 | 4,4 | 4,4 | 4,4 | 4,4 | 4,4 | 4,4 |
| 230 °F (110 °C) | 14,5 | 14,5 | 14,5 | 14,5 | 14,5 | 14,5 | 14,5 |

• = available, - = not available

Function, Equipment & Technical data Wilo-Star S (Cast iron body)

| | Wilo-Star S... (Cast iron body) | | |
|---|---|-----------------|-----------------|
| | S 16 F | S 16 FX | S 21 F |
| Approved fluids (other fluids on request) | | | |
| Heating water | • | • | • |
| Water/glycol mixtures (max. 33: mixtures with more than 20% glycol require reassessment of the hydraulic criteria) | • | • | • |
| Domestic hot water | - | - | - |
| Performance | | | |
| Max. delivery head [ft] | 16 | 16 | 21 |
| Max. delivery head [m] | 4.9 | 4.9 | 6.4 |
| Max. volume rate of flow [USGPM] | 16.5 | 16.5 | 19 |
| Max. volume rate of flow [m³/h] | 3.7 | 3.7 | 4.3 |
| Acceptable field of application | | | |
| Temperature range for application in heating and cooling installations | 14 °F (-10 °C) up to 230 °F (+110 °C) | | |
| Temperature range in domestic hot water system | - | - | - |
| Ambient temperature range | 104 °F (+40 °C) | 104 °F (+40 °C) | 104 °F (+40 °C) |
| Max. working pressure P _{max} [psi] | 140 | 140 | 140 |

Electrical connections

| | | | |
|---|-----|-----|-----|
| Power supply 1- [V] | 115 | 115 | 115 |
| Power frequency [Hz] | 60 | 60 | 60 |
| Wilo's quick connection with spring clips | • | • | • |

Motor/Electronics

| | | | |
|-----------------------|---|---|---|
| Number of speed steps | 3 | 3 | 3 |
| Non overload motor | • | • | • |
| Insulation class | F | F | F |

• = available, - = not available

Circulating Pumps

Product review: Wilo-Star/Star S

Circulating Pumps

Product review: Wilo-Star/Star S



Function, Equipment & Technical data Wilo-Star S (Cast iron body)

| | Wilo-Star S... (Cast iron body) | | | |
|---|------------------------------------|-------------------------------|--------|---------|
| | S 16 F | S 16 FX | S 21 F | S 21 FX |
| Materials | | | | |
| Pump housing - cast iron | • | • | • | • |
| Pump housing - bronze | - | - | - | - |
| Impeller | | Plastics (PP - 40 % GF) | | |
| Shaft | | Stainless steel (X40 Cr13) | | |
| Bearing | | Metal impregnated carbon | | |
| Minimal static inlet pressure at pump suction port [psi] to avoid cavitation at fluid temperatures | | | | |
| 122 °F (50 °C) | 0.7 | 0.7 | 0.7 | 0.7 |
| 203 °F (95 °C) | 4.4 | 4.4 | 4.4 | 4.4 |
| 230 °F (110 °C) | 14.5 | 14.5 | 14.5 | 14.5 |

• = available, - = not available

Function, Equipment & Technical data Wilo-Star (Bronze body)

| | Wilo-Star... (Bronze body) | | | | | | | | |
|---|-------------------------------|------|-------|------|-------|--------|--------|-------|-------|
| | 3 BS | 5 BU | 5 BFX | 8 BS | 11 BU | 16 BFX | 21 BFX | 30 BU | 32 BF |
| Approved fluids (other fluids on request) | | | | | | | | | |
| Heating water | • | • | • | • | • | • | • | • | • |
| Water/glycol mixtures (max. 33: mixtures with more than 20% glycol require reassessment of the hydraulic criteria) | • | • | • | • | • | • | • | • | • |
| Domestic hot water | • | • | • | • | • | • | • | • | • |
| Performance | | | | | | | | | |
| Max. delivery head [ft] | 3.5 | 6.5 | 6.5 | 9 | 11.5 | 16 | 21 | 30 | 33 |
| Max. delivery head [m] | 1.1 | 2.0 | 2.0 | 2.7 | 3.5 | 4.9 | 6.4 | 9.1 | 10.1 |
| Max. volume rate of flow [USGPM] | 5.5 | 12 | 12 | 9 | 19.5 | 16.5 | 19 | 26 | 10.5 |
| Max. volume rate of flow [m³/h] | 1.2 | 2.7 | 2.7 | 2.0 | 4.4 | 3.7 | 4.3 | 5.9 | 2.4 |

Acceptable field of application

Temperature range for application in heating and cooling installations
14 °F (-10 °C) up to 230 °F (+110 °C)

Temperature range in domestic hot water system
< 140 °F (+60 °C)

Ambient temperature range
104 °F (+40 °C)

Max. working pressure P_{max} [psi]
140 140 140 140 140 140 140 140 140 140

Pipe connections

Flange - - - - -

Flange rotated 90° - - - - -

Union connection - - - - -

Internal sweat • - - - - -

Electrical connections

Power supply 1~ [V] 115 115 115 115 115 115 115 115 115 115

Power frequency [Hz] 60 60 60 60 60 60 60 60 60 60

Wilo's quick connection with spring clips • • • • •

Motor/Electronics

Number of speed steps 1 1 1 1 1 1 1 1 1 1

Non overload motor • • • • •

Insulation class F F F F F F F F F F

• = available, - = not available

Circulating Pumps

Product review: Wilo-Star/Star S

Circulating Pumps

Product review: Wilo-Star/Star S



Function, Equipment & Technical data Wilo-Star (Bronze body)

| | Wilo-Star... (Bronze body) | | | | | | | | |
|--|-------------------------------|------|-------|------|-------|--------|--------|-------|-------|
| | 3 BS | 5 BU | 5 BFX | 8 BS | 11 BU | 16 BFX | 21 BFX | 30 BU | 32 BF |
| Materials | | | | | | | | | |
| Pump housing - cast iron | - | - | - | - | - | - | - | - | - |
| Pump housing - bronze | • | • | • | • | • | • | • | • | • |
| Impeller | Plastics (PP - 40 % GF) | | | | | | | | |
| Shaft | Stainless steel (X40 Cr13) | | | | | | | | |
| Bearing | Metal impregnated carbon | | | | | | | | |
| Minimal static inlet pressure at pump suction port [psij] to avoid cavitation at fluid temperatures | | | | | | | | | |
| 122 °F (50 °C) | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 203 °F (95 °C) | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| 230 °F (110 °C) | 14.5 | 14.5 | 14.5 | 14.5 | 14.5 | 14.5 | 14.5 | 14.5 | 14.5 |

• = available, - = not available

Function, Equipment & Technical data Wilo-Star S (Bronze body)

| | Wilo-Star S... (Bronze body) | |
|---|---------------------------------------|-----------------|
| | 5 16 BFX | 5 21 BFX |
| Approved fluids (other fluids on request) | | |
| Heating water | • | • |
| Water/glycol mixtures (max. 33: mixtures with more than 20% glycol require reassessment of the hydraulic criteria) | • | • |
| Domestic hot water | • | • |
| Performance | | |
| Max. delivery head [ft] | 16 | 21 |
| Max. delivery head [m] | 4.9 | 6.4 |
| Max. volume rate of flow [USGPM] | 16.5 | 19 |
| Max. volume rate of flow [m³/h] | 3.7 | 4.3 |
| Acceptable field of application | | |
| Temperature range for application in heating and cooling installations | 14 °F (-10 °C) up to 230 °F (+110 °C) | |
| Temperature range in domestic hot water system | - | - |
| Ambient temperature range | 104 °F (+40 °C) | 104 °F (+40 °C) |
| Max. working pressure P _{max} [psi] | 140 | 140 |
| Pipe connections | | |
| Flange | - | - |
| Flange rotated 90° | • | • |
| Union connection | - | - |
| Internal sweat | - | - |
| Electrical connections | | |
| Power supply 1- [V] | 115 | 115 |
| Power frequency [Hz] | 60 | 60 |
| Wilo's quick connection with spring clips | • | • |
| Motor/Electronics | | |
| Number of speed steps | 3 | 3 |
| Non overload motor | • | • |
| Insulation class | F | F |

• = available, - = not available



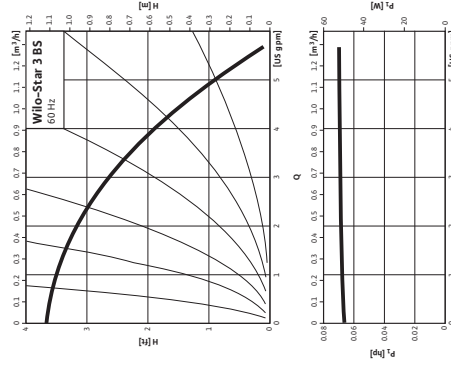
Function, Equipment & Technical data Wilo-Star S (Bronze body)

| | S 16 BFX | S 21 BFX |
|---|-------------------------------|----------|
| Materials | | |
| Pump housing – cast iron | – | – |
| Pump housing – bronze | • | • |
| Impeller | Plastics (PP – 40 % GF) | • |
| Shaft | Stainless steel (X40 Cr13) | |
| Bearing | Metal impregnated carbon | |
| Minimal static inlet pressure at pump suction port [psi] to avoid cavitation at fluid temperatures | | |
| 122 °F (50 °C) | 0.7 | 0.7 |
| 203 °F (95 °C) | 4.4 | 4.4 |
| 230 °F (110 °C) | 14.5 | 14.5 |

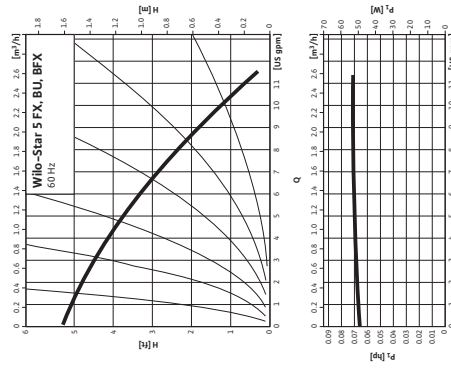
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Pump curves Wilo-Star

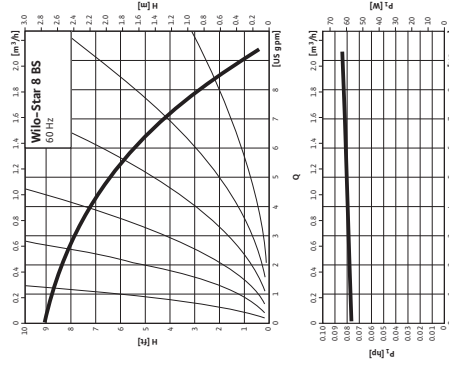
Wilo-Star 3 BS



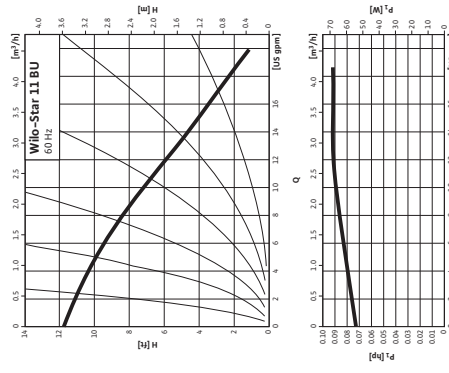
Wilo-Star 5 FX, BU, BFX



Wilo-Star 8 BS



Wilo-Star 11 BU

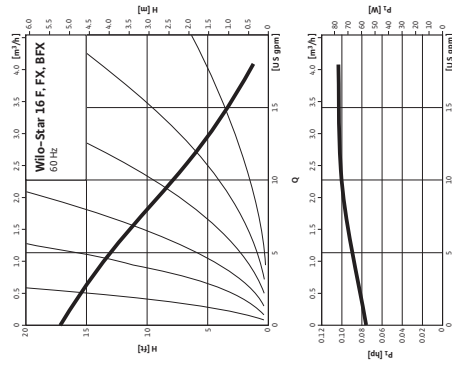




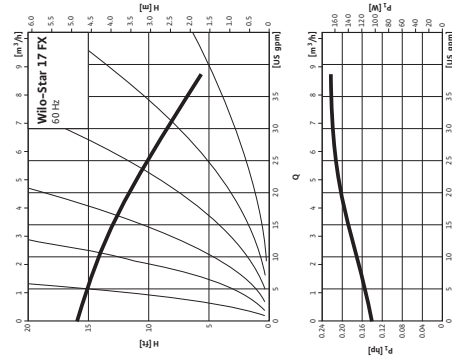
Pump curves Wilo-Star

Pump curves Wilo-Star

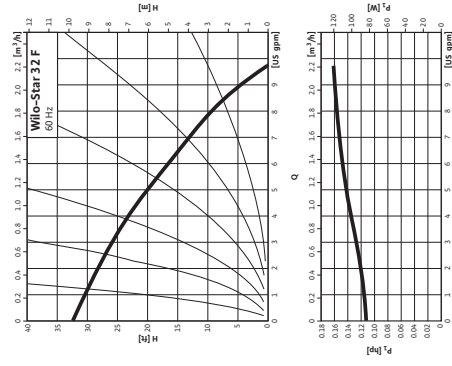
Wilo-Star 16 F, FX, BFX



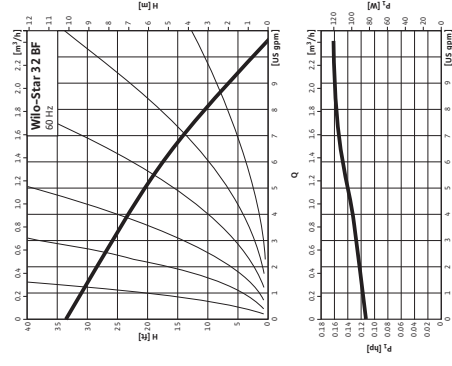
Wilo-Star 17 FX



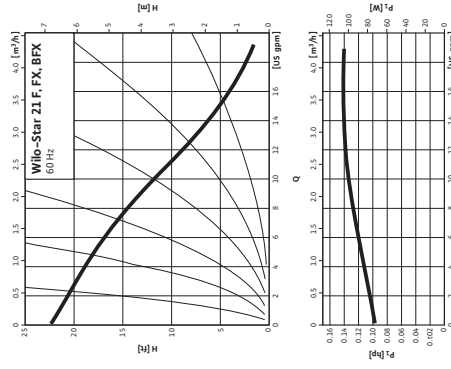
Wilo-Star 32 F



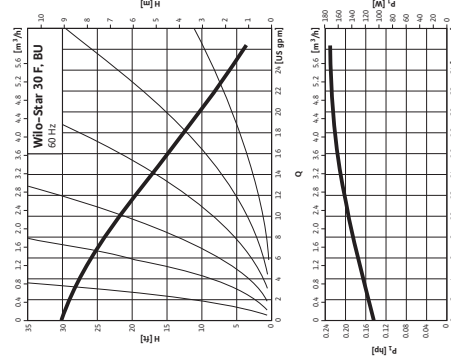
Wilo-Star 32 BF



Wilo-Star 21 F, FX, BFX



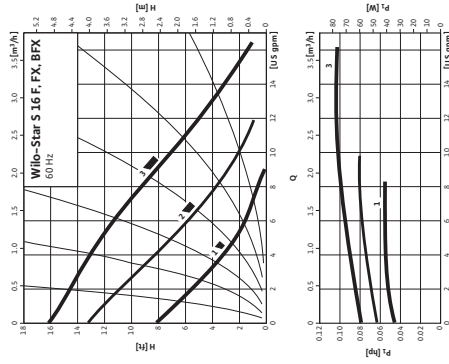
Wilo-Star 30 F, BU



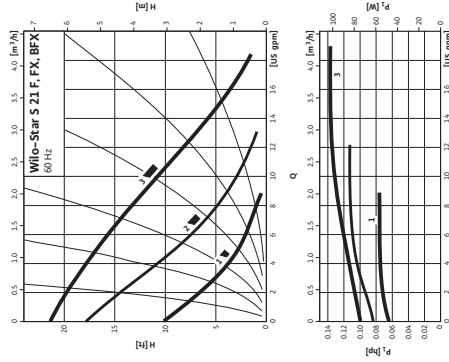
Pump curves Wilo-Star S

Wiring diagrams, motor data

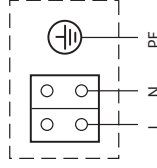
Wilo-Star S 16 F, FX, BFX



Wilo-Star S 21 F, FX, BFX



Wiring diagram



Single phase motor 2-pole, 1-115 V/60 Hz with integrated capacitor

Motor data Wilo-Star

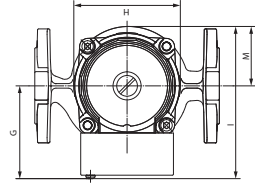
| Wilo-Star... | Rated Power | | Speed | Power consumption | | Current 1-115 V, 60 Hz | Motor protection | Capacitor |
|--------------|-------------|-----|-------|-------------------|-----|------------------------|--|-----------|
| | [hp] | [W] | | [hp] | [W] | | | |
| Star 3... | 0.03 | 20 | 3400 | 0.07 | 50 | 0.49 | - | [μF] |
| Star 5... | 0.03 | 20 | 2700 | 0.07 | 50 | 0.49 | - | 7 |
| Star 8... | 0.03 | 20 | 3000 | 0.09 | 64 | 0.58 | - | 7 |
| Star 11... | 0.03 | 20 | 3000 | 0.09 | 64 | 0.58 | - | 7 |
| Star 16... | 0.05 | 35 | 2700 | 0.11 | 80 | 0.66 | not necessary (blocking-current-proof) | 7 |
| Star 17... | 0.10 | 70 | 3000 | 0.24 | 166 | 1.45 | - | 12 |
| Star 21... | 0.05 | 40 | 2700 | 0.15 | 110 | 0.92 | - | 9 |
| Star 30... | 0.10 | 70 | 2700 | 0.24 | 173 | 1.50 | - | 12 |

Motor data Wilo-Star S...

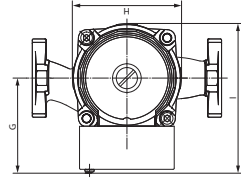
| Wilo-Star S... | Rated Power | | Speed | Power consumption | | Current 1-115 V, 60 Hz | Motor protection | Capacitor |
|----------------|-------------|-----|-----------|-------------------|-----|------------------------|--|-----------|
| | [hp] | [W] | | [hp] | [W] | | | |
| Star S 16... | 0.05 | 35 | max. 2700 | 0.10 | 80 | 0.66 | - | [μF] |
| Star S 21... | 0.05 | 40 | min. 1600 | 0.05 | 41 | 0.55 | not necessary (blocking-current-proof) | 7 |
| | | | max. 2700 | 0.13 | 110 | 0.92 | - | 9 |
| | | | min. 1300 | 0.07 | 56 | 0.52 | - | - |

Dimension, weights

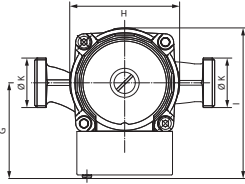
Wilo-Star, Drawing no.: 1



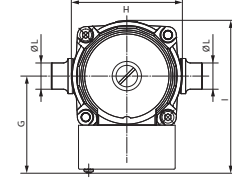
Wilo-Star, Drawing no.: 2



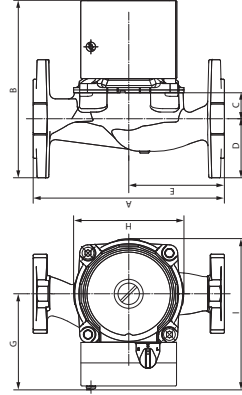
Wilo-Star, Drawing no.: 3



Wilo-Star, Drawing no.: 4



Wilo-Star S, Drawing no.: 5



Dimension, weights

| Wilo-Star... | A | B | C | D | E | F | G | H | I | Ø K | Ø L | M | Weight approx. [lbs] | Draw- ing No. |
|--------------|-------|---------|--------|--------|--------|------|--------|---------|--------|------------|-------|---|----------------------|---------------|
| Star 3 BS 5 | 5 | 4 15/16 | 15/16 | 7/8 | 2 7/8 | 9/16 | 3 3/16 | 3 11/16 | 5 1/16 | 5/8 | 7/8 | - | 6.5 | 4 |
| Star 3 BS 7 | 5 | 4 15/16 | 15/16 | 7/8 | 2 7/8 | 9/16 | 3 3/16 | 3 11/16 | 5 1/16 | 5/8 | 1 1/8 | - | 5.3 | 4 |
| Star 5 BU | 6 | 5 1/8 | 1 5/16 | 1 5/16 | 3 | - | 3 3/16 | 3 11/16 | 5 1/16 | 1 1/4 NPSM | - | - | 6.5 | 3 |
| Star 5 BFX | 6 3/8 | 5 15/16 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 7.2 | 2 |
| Star 5 FX | 6 3/8 | 5 15/16 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 2 |
| Star 8 BS 5 | 5 | 4 15/16 | 15/16 | 7/8 | 2 7/8 | 9/16 | 3 3/16 | 3 11/16 | 5 1/16 | 5/8 | 7/8 | - | 6.5 | 4 |
| Star 8 BS 7 | 5 | 4 15/16 | 15/16 | 7/8 | 2 7/8 | 9/16 | 3 3/16 | 3 11/16 | 5 1/16 | 5/8 | 1 1/8 | - | 5.3 | 4 |
| Star 11 BU | 6 | 5 1/8 | 1 5/16 | 1 5/16 | 3 | - | 3 3/16 | 3 11/16 | 5 1/16 | 1 1/4 NPSM | - | - | 6.5 | 3 |
| Star 16 F | 6 3/8 | 5 1/4 | 7/8 | 1 5/16 | 3 3/16 | - | 3 1/4 | 3 11/16 | 5 3/16 | 5 3/16 | - | - | 6.5 | 1 |
| Star 16 FX | 6 3/8 | 5 15/16 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 2 |
| Star 16 BFX | 6 3/8 | 5 15/16 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 7.2 | 2 |
| Star 17 FX | 8 1/2 | 7 | 1 7/8 | 2 3/16 | 4 1/4 | - | 3 7/8 | 3 7/8 | 5 3/8 | - | - | - | 10.8 | 2 |
| Star 21 F | 6 3/8 | 5 1/4 | 7/8 | 1 5/16 | 3 3/16 | - | 3 1/4 | 3 11/16 | 5 3/16 | - | - | - | 6.5 | 1 |
| Star 21 FX | 6 3/8 | 5 15/16 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 2 |
| Star 21 BFX | 6 3/8 | 5 15/16 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 7.1 | 2 |
| Star 30 BU | 6 | 6 1/8 | 1 1/4 | 1 3/8 | 3 | - | 3 1/4 | 3 3/4 | 5 3/8 | - | - | - | 7.7 | 3 |
| Star 30 F | 6 1/2 | 6 | 1 1/4 | 1 5/16 | 3 1/4 | - | 3 1/4 | 3 3/4 | 5 3/16 | - | - | - | 1 15/16 | 8.0 |
| Star 32 BF | 6 3/8 | 5 3/8 | 7/8 | 1 5/16 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 2 1/16 | 7.7 |
| Star 32 F | 6 3/8 | 5 3/8 | 7/8 | 1 5/16 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 2 1/16 | 6.7 |
| Star S16 F | 6 3/8 | 6 3/8 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 5 |
| Star S16 FX | 6 3/8 | 6 3/8 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 5 |
| Star S16 BFX | 6 3/8 | 6 3/8 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 7.0 | 5 |
| Star S21 F | 6 3/8 | 6 3/8 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 5 |
| Star S21 FX | 6 3/8 | 6 3/8 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 6.5 | 5 |
| Star S21 BFX | 6 3/8 | 6 3/8 | 7/8 | 2 | 3 3/16 | - | 3 3/16 | 3 11/16 | 5 1/16 | - | - | - | 7.1 | 5 |

Circulating Pumps

Wilo-Star/Star S

Dimension, weights

| Wilo-Star... | metric | | | | | | | | | | | | | Weight approx. [kg] | Drawing No. |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|--------|----|---------------------|-------------|
| | A [mm] | B [mm] | C [mm] | D [mm] | E [mm] | F [mm] | G [mm] | H [mm] | I [mm] | Ø K [mm] | Ø L [mm] | M [mm] | | | |
| Star 2 BS 5 | 127 | 125 | 24 | 23 | 64 | 15 | 81 | 93.5 | 128 | 16 | 22 | - | - | 3.0 | 4 |
| Star 2 BS 7 | 127 | 125 | 24 | 23 | 64 | 15 | 81 | 93.5 | 128 | 22 | 28 | - | - | 2.4 | 4 |
| Star 5 BU | 152 | 130 | 18 | 33 | 76 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 3 |
| Star 5 BFX | 162 | 150 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.3 | 2 |
| Star 5 FX | 162 | 150 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 2 |
| Star 8 BS 5 | 127 | 125 | 24 | 23 | 64 | 15 | 81 | 93.5 | 128 | 16 | 22 | - | - | 3.0 | 4 |
| Star 8 BS 7 | 127 | 125 | 24 | 23 | 64 | 15 | 81 | 93.5 | 128 | 22 | 28 | - | - | 2.4 | 4 |
| Star 11 BU | 152 | 130 | 18 | 33 | 76 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 3 |
| Star 16 F | 162 | 134 | 22 | 34 | 81 | - | 82 | 93.5 | 132 | - | - | - | - | 3.0 | 1 |
| Star 16 FX | 162 | 150 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 2 |
| Star 16 BFX | 162 | 150 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.3 | 2 |
| Star 17 FX | 216 | 176 | 33 | 55 | 108 | - | 82 | 96.0 | 130 | - | - | - | - | 4.9 | 2 |
| Star 21 F | 162 | 134 | 22 | 34 | 81 | - | 82 | 93.5 | 132 | - | - | - | - | 3.0 | 1 |
| Star 21 FX | 162 | 150 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 2 |
| Star 21 BFX | 162 | 150 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.2 | 2 |
| Star 30 BU | 152 | 155 | 32 | 35 | 76 | - | 82 | 96 | 130 | - | - | - | - | 3.5 | 3 |
| Star 30 F | 165 | 153 | 31 | 34 | 83 | - | 82 | 96.0 | 132 | - | - | - | 50 | 3.7 | 1 |
| Star 32 BF | 162 | 136 | 24 | 34 | 81 | - | 81 | 93.5 | 128 | - | - | - | 52 | 3.5 | 1 |
| Star 32 F | 162 | 136 | 24 | 34 | 81 | - | 81 | 93.5 | 128 | - | - | - | 52 | 3.1 | 1 |
| Star S 16 F | 162 | 154 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 5 |
| Star S 16 FX | 162 | 154 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 5 |
| Star S 16 BFX | 162 | 154 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.2 | 5 |
| Star S 21 F | 162 | 154 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 5 |
| Star S 21 FX | 162 | 154 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.0 | 5 |
| Star S 21 BFX | 162 | 154 | 22 | 50 | 81 | - | 81 | 93.5 | 128 | - | - | - | - | 3.3 | 5 |

Commercial Gauges Type 1000, 2071A



The tradition of providing accurate, distinctive, reliable pressure instruments continues in Ashcroft 4 1/2" Type 1000 and type 2071A commercial gauges.

Ashcroft 4 1/2" Type 1000 gauges utilize a black steel case and ring, with a glass window. These gauges are appropriate for general industrial applications and can be customized to complement your equipment.

Ashcroft 4 1/2" Type 2071A, Contractor gauges, are constructed with a back flanged aluminum case, painted black, and a chrome ring with glass window. These gauges are designed to meet the needs of heating, ventilating, plumbing and air conditioning contractors. The accuracy of these gauges is ASME B40.1, Grade A, ± 2-1-2%.

Incorporated in both, Type 1000 gauges and Type 2071A gauges, is the PowerFlex™ movement. This movement provides superior resistance to shock, vibration, and pulsation; thereby assuring longer life for your pressure instrument.

True Zero™ indication, a standard feature on these gauges, reduces the potential risk of installing a damaged gauge on your equipment. Other benefits of this unique safety feature include reduced manufacturing and inspection costs.

As in all Ashcroft commercial instruments, the dial artwork is designed to provide gauges that are consistent in appearance, attractive, and easy to read.



Visit our website @ www.dresser.com/instruments/

INSTRUMENT
BEREA OPERATIONS
BULLETIN CG - 10/21

Product Specifications

Ashcroft Model Number: 1000, 2071A

Size: 4 1/2"

Case: 1000 - Black painted steel
2071A - Black painted aluminum with back flange

Ring: 1000 - Black painted steel, friction fit
2071A - Chrome plated steel, friction fit

Window: Glass

Dial: Black figures on white background, steel

Pointer: 1000 - Black, Aluminum
2071A - Adjustable, Black, Aluminum

Bourdon Tube:

1000 - Bronze, soldered, siphon required for steam service
2071A - Bronze, soldered, siphon required for steam service

Movement:

PowerFlex with polyester segment

Socket:

Brass

Connection:

1/4" NPT lower

Ranges: Vacuum - 600 psi and compound

Accuracy: 1000 - ASME B40.1, Grade B, ± 3-2-3%

2071A - ASME B40.1, Grade A, ± 2-1-2%

Optional Features

Case: Case color (other than black)

Window: Plastic

Pointer: Adjustable (Type 1000)

Socket: Nickel Plated

Others: Throttle plugs - 0.007" 0.013", 0.020", 0.063" orifices
Customized dials

Chrome ring (Type 1000)

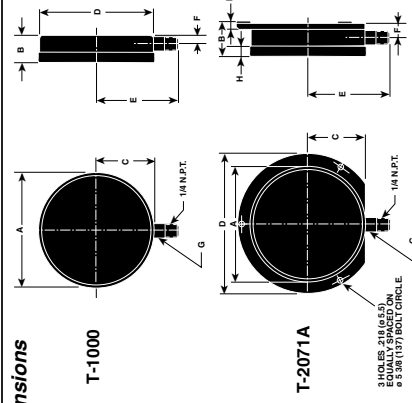
Black ring (Type 2071A)

Non-standard ranges

Special calibration on application

Specifications subject to change without notice.
Subject to standard terms and conditions of sale.
Copyright Instrument Division, Dresser Industries Inc., 1995
CG 10/21 20M K&W 807

Dimensions



| T-1000 4 1/2" | A | B | C | D | E | F | Wrench Pin G | Weight | | |
|-------------------|-------|------|------|-------|------|------|--------------------|--------|------|--------|
| Inches | 4.75 | 1.13 | 2.34 | 4.69 | 3.38 | 0.34 | 9/16 | 12 oz. | | |
| mm | (121) | (29) | (60) | (119) | (86) | (9) | (14) | | | |
| T-2071A 4 1/2" | A | B | C | D | E | F | Wrench Pin G | H | I | Weight |
| Inches | 4.75 | 1.41 | 2.38 | 5.81 | 3.38 | 0.47 | 9/16 | 0.42 | 0.25 | 16 oz. |
| mm | (121) | (36) | (60) | (148) | (86) | (12) | (14) | (11) | (6) | |

How to Order

45 W 1000 H 02L X(AP) 100#
Dial Size: 4 1/2"
PowerFlex Movement
Case type number: 1000
Socket material: Brass
Connection size/location: 1/4" Lower
Option: Adjustable Pointer
Range: 100 psi

Domestic Headquarters

Berea, Kentucky
Harrison Road
Berea, KY 40403
Tel: (606) 986-9393
FAX: 1-800-28 BEREA
(1-800-282-3732)
email: dresser-berea-mkt@dgpa.com

Chicago, Illinois
400 W. Lake Street,
Suite 316
Roseville, IL 60772-3392
Tel: (630) 980-9030
FAX: (630) 989-9440

Houston, Texas
3838 N. Sam Houston
Parkway East, Suite 120
Houston, TX 77032
Tel: (281) 590-7092
FAX: (281) 590-7100

International Headquarters

Stratford, Connecticut
250 E. Main Street
Stratford, CT 06487
Tel: (203) 378-8281
FAX: (203) 385-0499

Hartford, Connecticut
1501 East Main St.
Meriden, CT 06450-2860
Tel: (203) 235-0450
Tel: (203) 235-0593
FAX: (203) 235-0593

Los Angeles, California
3831 Ind. Arthur Blvd.,
Suite 202
Newport Beach, CA 92660
Tel: (714) 852-8948
FAX: (714) 852-8971

Mobile, Alabama

851 South Bellline Hwy., Suite 402, Mobile, AL 36606
Tel: (334) 473-1692 Fax: (334) 473-1782



4 1/2" Gauges
Type 1000, Grade B, (3-2-3%)
Type 2071A, Grade A, (2-1-2%)

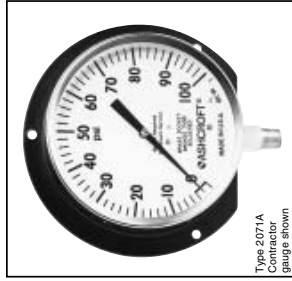
- Type 2071A contractor gauge offers aluminum-back flange case (black), with attractive chrome-plated steel ring
- Type 1000 gauge offers black steel case with black ring and glass window
- Adjustable pointer is standard on contractor gauges
- Patented PowerFlex™ movement with polyester segment
- True Zero™ indication, a unique safety feature

Ashcroft® Type 1000 gauges have a black steel case and ring with a glass window. These gauges are appropriate for general industrial applications and can be customized to complement your equipment.

Ashcroft contractor gauges (Type 2071A) are lightweight, highly sensitive and accurate. These gauges are designed to meet the needs of HVAC and plumbing contractors, and are tested against strict industry specifications. The aluminum case provides corrosion resistance.

The patented PowerFlex movement, in both Types 1000 and 2071A, provides the shock resistance needed for rough treatment.

True Zero indication reduces the potential risk of installing a damaged



Type 2071A Contractor gauge shown

gauge on your equipment. FlutterGuard™ is available to eliminate pointer flutter and extend gauge life.

GAUGE SPECIFICATIONS

| | TYPE 1000 | TYPE 2071A |
|-------------------------------|---|---|
| Size: | 4 1/2" | 4 1/2" |
| Case: | Black-painted steel | Aluminum with back flange, painted black. |
| Ring: | Black-painted steel, friction fit | Chrome-plated steel, friction fit |
| Window: | Glass | Glass |
| Dial: | Black figures on white background | Black figures on white background |
| Pointer: | Black, aluminum | Adjustable, black, aluminum |
| Bourdon tube: | Bronze, soldered | Bronze, soldered |
| Movement: | Patented PowerFlex with polyester segment | Patented PowerFlex with polyester segment |
| Socket: | Brass | Brass |
| Connection: | 1/4" NPT lower | 1/4" NPT lower |
| Ranges: | Vacuum through 600 psi and compound | Vacuum through 600 psi and compound |
| Operating temperature: | -40°F to 150°F | -40°F to 150°F |
| Options: | Case color other than black Plastic window (PD) Chrome ring (13) FlutterGuard (SF) Adjustable pointer (AP) Nickel-plated socket (NP) | Case color other than black Plastic window (PD) Nickel-plated socket (NP) FlutterGuard (SF) Black steel ring Customized dials Throttle plugs: 0.007", 0.013", 0.020", 0.063" orifices Special calibration on application |

TO ORDER THESE TYPE 1000/2071A GAUGES:

| Select: | 45 | W | 2071A | 02L | 300 # |
|---|----|---|-------|-----|-------|
| 1. Dial Size: 4 1/2" | | | | | |
| 2. Patented PowerFlex™ Movement | | | | | |
| 3. Case Type Number: 2071A | | | | | |
| 4. Connection Size/Location: 1/4" NPT lower | | | | | |
| 5. Range: 300 psi | | | | | |

Reference Bulletin CG-10/21

Consult factory for guidance in product selection
 Phone (859) 986-9333, FAX 1-800-282-3732 or
 visit our web site at www.ashcroft.com

MADE IN U.S.A.

For Commercial Water Heater Applications

Job Name _____ Contractor _____
 Job Location _____ Approval _____
 Engineer _____ Contractor's P.O. No. _____
 Approval _____ Representative _____

Series 40, 140, 240 & 340
Automatic Re-seating T&P Relief Valves

The combined 2-in-1 Temperature & Pressure relief valve provides the least expensive and proven means for protection against both excessive temperature and pressure emergency conditions.

Fully automatic temperature and pressure relief protection for domestic hot water supply tanks and heaters based on the latest ANSI Z21.22 Listing Requirements for temperature discharge capacity.

40XL with test lever and extension thermostat for installation in hot water outlet within the allowable distance from the top of the tank based on latest ANSI Z21.22. Sizes: ¾" and 1" (19-25mm).

40L with test lever and short thermostat for installation directly in available tank tapings. Sizes: ¾" and 1" (19-25mm).

Series 140, N240 and 340 have the same basic body construction and advanced design features as the 40 Series and are identical to the 40 Series except for discharge capacity and size of inlet and outlet connections. For complete specifications (including specifications for the 40 Series) see other side. Sizes: 1", 1¼", 1½" and 2" (25, 32, 38 and 50mm).

FEATURES

- Bronze body construction.
- Non-mechanical seat-to-disc alignment.
- Thermostat is accurate and proven. Exclusively designed and manufactured by Watts.
- Tamper-resistant bonnet screws.
- Series 40 and 140 feature a unique thermostat with a special thermo-bonded coating.
- 1" (25mm) and above sizes Model M15, M2 and M4 are standardly furnished with stainless steel thermostat tube.

SPECIFICATIONS

Temperature & Pressure Relief Valves
 Each hot water storage heater shall be equipped with an automatic temperature and pressure relief valve to protect the heater from excessive pressure and excessive temperature. The device shall be certified as meeting the requirements of ASME low pressure heating boiler code and ANSI Z21.22. The BTU discharge capacity of the device shall be in excess of the BTU input rating of the heater. Watts Regulator Company Series 40, 140, 240 and 340.

STANDARDS

ASME Rated, ANSI Z21.22. Design certified and listed by CSA and meet current FHA requirements and ANSI Z21.22 in addition to Military Spec. MIL-V-136-1(2D). Type 1.

PRESSURE - TEMPERATURE

Temperature relief 210°F (98.9°C)
 Pressure range 75-150 psi (5.17-10.34 bars).
 Standard setting 75, 100, 125 and 150 psi (5.17, 6.9, 8.61 and 10.34 bars).

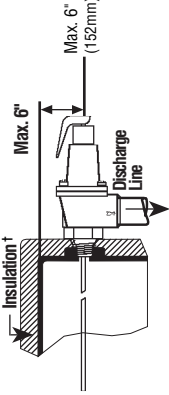


Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

Direct Side Tapping

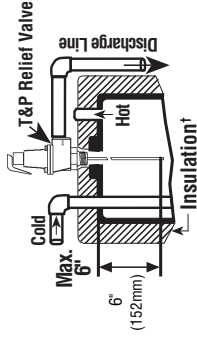
FOR EXTERNAL FLUE HEATERS
 Use extra length extension thermostat to extend into water storage tank.

FOR INTERNAL FLUE HEATERS
 Use short or standard length thermostat. Vertical discharge line must be installed with its direction downward.



For Heaters with Direct Top

Use standard or extra length extension thermostat.



GENERAL RECOMMENDATIONS†

For gas, electric or oil-fired storage water heaters between 180,000 to 200,000 BTU/HR., rating: Use ¾" (19mm) Series 40, 140 tested under ANSI Z21.22 with ratings as certified and listed by CSA.

For gas or oil-fired storage water heaters between 200,000 and 730,000 BTU/HR., rating and for compliance with applicable water heater labeling requirements: Use 1" (25mm) 40, 140, N240 Series tested under ANSI Z21.22 with ratings as certified and listed by CSA.

For installations of gas or oil-fired hot water supply boilers over 730,000 BTU/HR., output heating domestic water and for steam coil storage water heaters:
 Use Series 340, 342 tested under ANSI Z21.22 with rating as certified and listed by CSA.

SPECIAL MODEL; No. 340X-8 MAZ 1½" (38mm) size only. Pressure setting 175 psi (5.17 bars). Temp. 210°F (98.9°C). Certified by CSA only.

| Type No. | Model | Inlet X Outlet (in.) | Thermostat | | | Dimensions (in.) | | | CSA Temp. Rating (BTU/HR) | **ASME Pressure Steam Rating BTU/HR | |
|----------|-------|----------------------|-----------------------------------|--------------------------|-------|------------------|--|--|---------------------------|-------------------------------------|-----------|
| | | | Length (in.) (Below Inlet Thread) | Height (Less Thermostat) | Width | Weight Lbs. | @75psi set pres. @100psi set pres. @125psi set pres. | @75psi set pres. @100psi set pres. @125psi set pres. | | | |
| 40L-3 | M15 | ¾" M x ¾" F | 3 | 5½" | 2½" | 1¾" | 180,000 | 777,600 | 997,600 | 1,217,600 | 1,437,600 |
| 40XL-5 | M15 | ¾" M x ¾" F | 5 | 5½" | 2½" | 1¾" | 200,000 | 777,600 | 997,600 | 1,217,600 | 1,437,600 |
| 40XL-6 | M15 | ¾" M x ¾" F | 6 | 5½" | 2½" | 1¾" | 200,000 | 777,600 | 997,600 | 1,217,600 | 1,437,600 |
| 140S-3 | M15 | ¾" F x ¾" F | 3 | 5½" | 2½" | 1¾" | 180,000 | 777,600 | 997,600 | 1,217,600 | 1,437,600 |
| 140S-5 | M15 | ¾" F x ¾" F | 5 | 5½" | 2½" | 1¾" | 200,000 | 777,600 | 997,600 | 1,217,600 | 1,437,600 |
| 140S-6 | M15 | ¾" F x ¾" F | 6 | 5½" | 2½" | 1¾" | 200,000 | 777,600 | 997,600 | 1,217,600 | 1,437,600 |
| 140X-2 | M15 | 1M x 1F | 2 | 6¼" | 2¼" | 2¼" | 450,000 | 1,155,000 | 1,481,000 | 1,808,000 | 2,194,000 |
| 40XL-4 | M15 | 1M x 1F | 4 | 6¼" | 2¼" | 2¼" | 500,000 | 1,155,000 | 1,481,000 | 1,808,000 | 2,194,000 |
| 40XL-7 | M15 | 1M x 1F | 7 | 6¼" | 2¼" | 2¼" | 500,000 | 1,155,000 | 1,481,000 | 1,808,000 | 2,194,000 |
| *140S-3 | M15 | 1F x 1F | 3 | 5½" | 3 | 2¼" | 570,000 | 1,670,000 | 2,140,000 | 2,610,000 | 3,085,000 |
| *140X-6 | M15 | 1F x 1F | 6 | 5½" | 3 | 2¼" | 670,000 | 1,670,000 | 2,140,000 | 2,610,000 | 3,085,000 |
| *140X-9 | M15 | 1F x 1F | 9 | 5½" | 3 | 2¼" | 670,000 | 1,670,000 | 2,140,000 | 2,610,000 | 3,085,000 |
| *N240X-6 | M2 | 1F x 1F | 6 | 6½" | 3½" | 2¼" | 730,000 | 2,195,000 | 2,817,000 | 3,438,000 | 4,059,000 |
| *N240X-9 | M2 | 1F x 1F | 9 | 6½" | 3½" | 2¼" | 730,000 | 2,195,000 | 2,817,000 | 3,438,000 | 4,059,000 |
| *N241X-5 | M2 | 1¼" M x 1F | 5 | 6½" | 3½" | 2¼" | 730,000 | 2,195,000 | 2,817,000 | 3,438,000 | 4,059,000 |
| *N241X-8 | M2 | 1¼" M x 1F | 8 | 6½" | 3½" | 2¼" | 730,000 | 2,195,000 | 2,817,000 | 3,438,000 | 4,059,000 |
| *340-3 | M2 | 1½" F x 1½" F | 3 | 9¼" | 4½" | 7 | 1,150,000 | 3,450,000 | 4,426,000 | 5,403,000 | 6,379,000 |
| *340X-8 | M4 | 2 M x 1½" F | 8 | 9¼" | 4½" | 8 | 1,150,000 | 3,450,000 | 4,426,000 | 5,403,000 | 6,379,000 |
| *342X-8 | M4 | 2 M x 1½" F | 8 | 9¼" | 4½" | 8 | 1,150,000 | 3,450,000 | 4,426,000 | 5,403,000 | 6,379,000 |

*Standardly furnished with stainless steel thermostat tube.

**ASME capacities are steam pressure ratings and do not reflect the CSA temperature relieving capacity of the valves for selection purposes.

†LL40XL and LLL40XL valves with extended inlet shanks should be used for water heaters that have extra thick insulation. Ask for ES-LL/LL-40XL.

M = Male
 F = Female

Temperature and Pressure Relief Valves should be inspected AT LEAST ONCE EVERY THREE YEARS, and replaced, if necessary, by a licensed plumbing contractor or qualified service technician, to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions can only be detected if the valve and its components are physically removed and inspected. Do not attempt to conduct an inspection on your own. Contact your plumbing contractor for a reinspection to assure continuing safety.



USA: 815 Chestnut St., No. Andover, MA 01845-6088; www.wattsreg.com
 Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattsreg.com



ES-40, 140, 240, 340 0130

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VACUUM BREAKERS

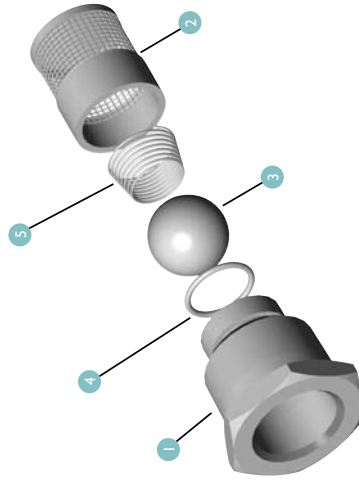
Johnson Vacuum Breakers provide a simple, dependable way to relieve unwanted vacuum which may develop in a closed vessel or pipeline. They can be used to prevent contamination from back siphonage in fluid handling systems, and to protect equipment against collapse or implosion. They combine tight closing with instant response, provide large air venting capacity, and are designed for easy installation and long service life.

OPERATING PARAMETERS

Temperature
Up to 365°F

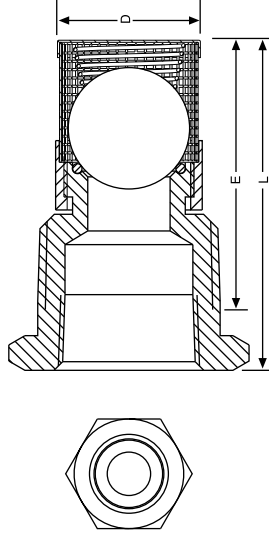
Pressure
Up to 300 psig

Note: Maximum limits vary in relation to changes in pressure, and temperature. Consult Johnson for safe limitations under your specific application conditions. Assembly dimensions are +/- 1/8".



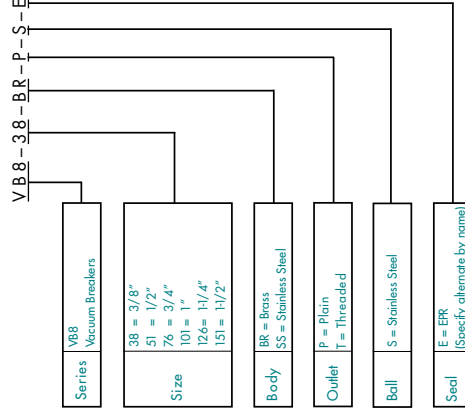
- 1 Body
- 2 Retainer Tube
- 3 Ball
- 4 O-Ring
- 5 Spring

SERIES VB8 VACUUM BREAKERS



| Catalog Number | Pipe Thread Size | Outlet Pipe Size | Total Length "L" | Engaged Length "E" | OD of Tube "D" | Hex Body Size | Diameter of Orifice | Diameter of Ball |
|------------------|------------------|------------------|------------------|--------------------|----------------|---------------|---------------------|------------------|
| VB8-38-BR-P-S-E | 3/8 | 1/4 | 1-1/2 | 1-1/8 | 9/16 | 3/4 | 1/4 | 3/8 |
| VB8-51-BR-P-S-E | 1/2 | 3/8 | 1-3/4 | 1-3/8 | 11/16 | 1 | 9/32 | 1/2 |
| VB8-76-BR-P-S-E | 3/4 | 1/2 | 2-1/8 | 1-5/8 | 13/16 | 1-1/4 | 13/32 | 5/8 |
| VB8-101-BR-P-S-E | 1 | 3/4 | 2-3/8 | 1-7/8 | 1-1/16 | 1-1/2 | 19/32 | 7/8 |
| VB8-126-BR-P-S-E | 1-1/4 | 1 | 2-15/16 | 2-5/16 | 1-5/16 | 1-3/4 | 3/4 | 1-1/16 |
| VB8-151-BR-P-S-E | 1-1/2 | 1-1/4 | 3-1/16 | 2-1/2 | 1-9/16 | 2 | 7/8 | 1-3/16 |

Explanation of Catalog Numbers



Vacuum Required to Open

| Horizontal | Vertical | | No Spring | | |
|-------------------|---|---|---------------------|-------------------------------|---|
| | Top Outlet | Bottom Outlet | | | |
| | | | | | |
| | | | | VB8-38 3/8" | 70 In. H ₂ O 0.32 PSI |
| | VB8-51 1/2" | 9.3 In. H ₂ O 0.68 PSI | | 10.6 In. Hg 1.32 PSI | 4.4 0.32 0.16 |
| | VB8-76 3/4" | 15.3 In. H ₂ O 1.13 PSI | | 15.0 In. Hg 0.54 PSI | 5.1 0.37 0.18 |
| | VB8-101 1" | 10.0 In. H ₂ O 0.73 PSI | | 5.9 In. Hg 0.43 PSI | 6.6 0.48 0.24 |
| | VB8-126 1-1/4" | 10.5 In. H ₂ O 0.77 PSI | | 7.1 In. Hg 0.52 PSI | 6.9 1.54 0.25 |
| VB8-151 1-1/2" | 10.0 In. H ₂ O 0.73 PSI | 4.9 In. Hg 0.36 PSI | 7.9 1.49 0.29 | | |

Note: Stainless Steel Ball was used to arrive at all figures. Values given are averages of test results and may vary slightly.

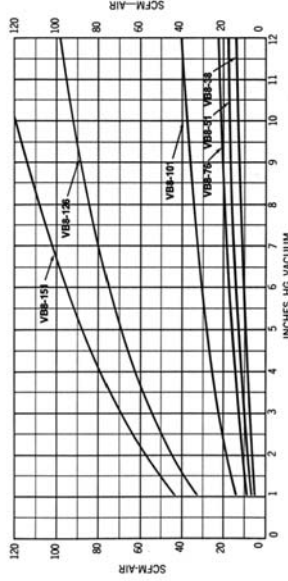


Dimensions are in inches and for reference only. Certified drawings are available on request.



Approximate Series VB8 Air Handling Capacities

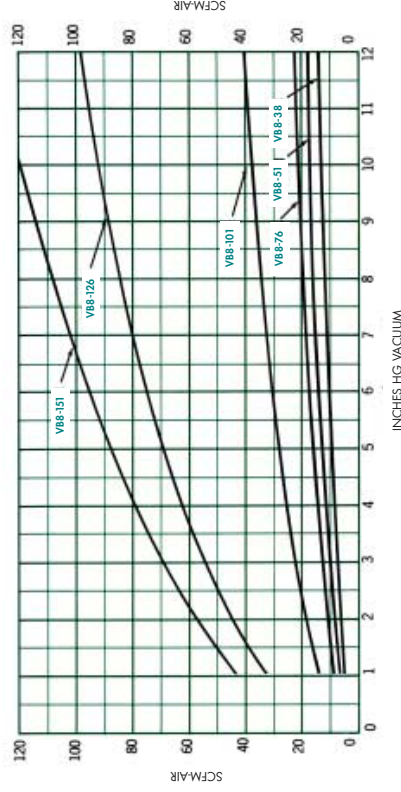
The air handling capacity curves were plotted from calculations using the C_v factors of the vacuum breaker units. The C_v factor is a flow coefficient determined by actual test which mathematically gives the relationship between the rate of flow and the pressure drop. The flow formula used was recommended by the Fluid Controls Institute.



Note: Capacities will vary slightly due to position of installation or kind of ball.

Approximate Series VB8 Air Handling Capacities

The air handling capacity curves were plotted from calculations using the C_v factors of the vacuum breaker units. The C_v factor is a flow coefficient determined by actual test which mathematically gives the relationship between the rate of flow and the pressure drop. The flow formula used was recommended by the Fluid Controls Institute.



NOTE: Capacities will vary slightly due to position of installation or kind of ball.

Typical Installations—JOHNSON VACUUM BREAKERS

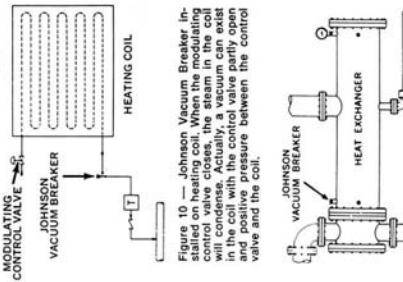


Figure 10—Johnson Vacuum Breaker installed on heating coil. When the modulating control valve closes, the steam in the coil actually, a vacuum only, exists in the coil with the pressure between the control valve and the coil.

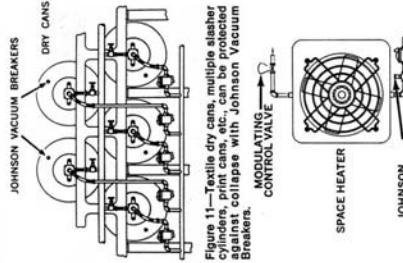


Figure 11—Textile dry cans, multiple flasher cylinders, print cans, etc., can be protected from water collapse with Johnson Vacuum Breakers.

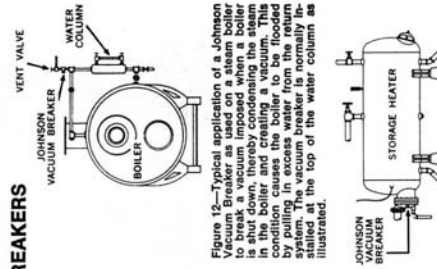


Figure 12—Typical application of a Johnson Vacuum Breaker as used on a steam boiler to break a vacuum imposed when a boiler is shut down. The vacuum breaker is installed in the boiler and creates a vacuum. This condition causes the boiler to be flooded by pulling in excess water from the return line. The vacuum breaker is installed at the top of the water column as illustrated.

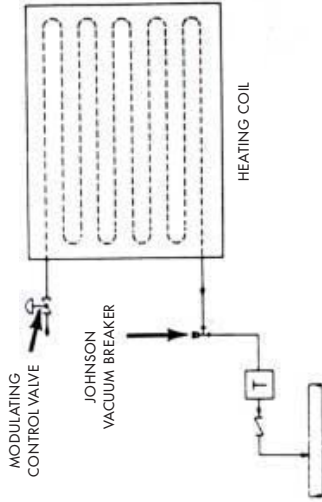
Figure 13—Typical installation of a Johnson Vacuum Breaker in a heat exchanger.

Figure 14—Typical space heater installation with Johnson Vacuum Breaker protection.

Figure 15—Horizontal storage heater with vacuum breaker.

VACUUM BREAKERS

Typical Installations of Johnson Vacuum Breakers



Johnson Vacuum Breaker installed on heating coil. When the modulating control valve closes, the steam in the coil will condense. Actually, a vacuum can exist in the coil with the control valve partly open and positive pressure between the control valve and the coil.

THE JOHNSON CORPORATION

805 Wood Street, Three Rivers, Michigan 49093 USA
 tel: 616.278.1715 fax: 616.279.5980
 www.jocco.com

VACUUM BREAKER INSTALLATION

Figure 1 – Standard Vertical Installation

Pipe as shown if possible for a preventative measure. If the outlet is exposed it can become fouled with dust and dirt. Upon operation this contamination can prevent the vacuum breaker from resealing.



Figure 2 – High Temperature or Hazardous Chemical Service

Pipe as shown for safety reasons. After undeterminable amount of time the vacuum breaker will fail. Having the outlet piped to a safe location eliminates a safety hazard. Although the installation shown is vertical with outlet on the bottom, this should be done regardless of the installation orientation.

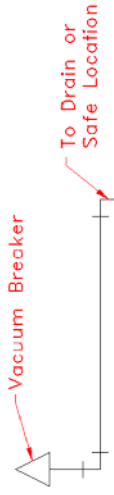


Figure 3 – High Temperature Installation

Piping the vacuum breaker as shown can eliminate the need for special high temperature seals. The temperature at the vacuum breaker varies depending the steam line temperature. The pigtail should be sized to have a flow area equal or greater than that of the vacuum breaker used.

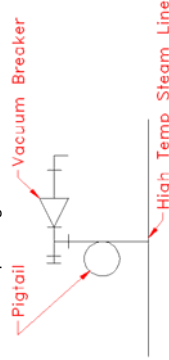
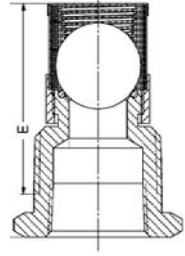


Figure 4 - Engaged Length

When piping in the vacuum breaker, attention should be given to the engaged length "E".

1. The vacuum breaker should never be installed such that the screen is in the flow path. In instances of high velocities the correct operation can be disrupted as well as damage to the vacuum breaker.
2. Vacuum breakers should be installed in pipe couplings to prevent damage on installation. An example of this would be installation in the short side of a pipe tee where the screen could be crushed.



Honeywell

L6006 and L6007

Aquastat® Controllers

Installation Instructions for the Trained Service Technician.

Application

These Aquastat® Controllers operate in response to temperature changes in hydronic heating systems. They provide spdt switching for three-wire applications.

The L6006A,B, and L6007A combine low or high limit and circulator control; L6006C combines circulator control with low and high limit.

The L6006A,B are for horizontal insertion; the A model uses an immersion well; the B model uses a capsule compression fitting for direct immersion. The L6006C is for horizontal or vertical surface mounting. The L6007A is for horizontal or vertical insertion using an immersion well.

If immersion well or capsule compression fitting must be ordered, refer to form 68-0040, Wells and Fittings for Temperature Controllers, for part numbers and ordering information.

ELECTRICAL RATINGS (A):

| | 120 Vac | 240 Vac |
|-------------------|-------------------------|---------|
| Full Load | 8 | 5.1 |
| Locked Rotor | 48 | 30.6 |
| Inductive Current | 0.25 at 1/4 to 12 V.d.c | |

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.

! WARNING

CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

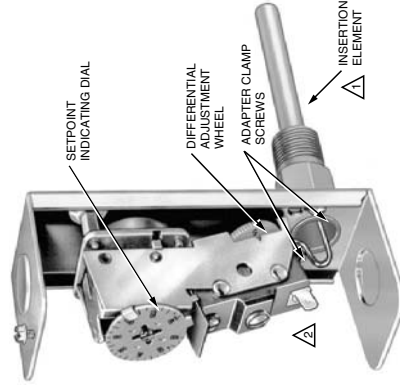
This product is intended for use only in systems with a pressure relief valve.

! CAUTION

Disconnect power supply before connecting wiring to prevent electrical shock or equipment damage.

2. Remove plug (or old well) from boiler tapping.
3. Install the immersion well included with the controller. If boiler tapping is greater than 1/2 in., use a reduction fitting to adapt the boiler opening to the 1 in. threads that are standard with the well or fitting. Fittings with 3/4 in. threads are also available.
4. Fill the system. Make sure that the well is screwed in tightly enough to prevent leakage. Do *not* tighten after controller is secured to well because of possible excessive force on the case.
5. Loosen screw (at top of case, above scale setting), and remove cover. Loosen two screws that secure adapter clamp. See Fig. 2.
6. Insert the sensing element into the immersion well.
7. Fasten the case of the Aquastat® Controller to the well with the adapter clamp. Make certain that the clamp is properly positioned over the groove of the well spud. Also, be sure the flange at the opening of the well fits snugly into the opening of the case. The sensing element bulb must bottom in the well.

Fig. 2—Internal view of L6006A,B (L6006C and L6007 are similar in appearance).



- ▲ WITH VERTICAL MOUNTING OF IMMERSION WELL, ELEMENT IS ATTACHED TO BOTTOM OF THE CASE.
- ▲ SELECT MODELS HAVE SCREW TERMINAL, NOT TAB TERMINAL.

INSTALLING DIRECT IMMERSION MODELS (L6006B)

Install fitting in boiler tapping as follows:

1. Be sure sealing washer is in place as shown in Fig. 3. Make sure that spud of capsule compression fitting is screwed in tightly enough to prevent leaking.
2. Insert immersion bulb (sensing element) through capsule compression fitting. Adjust the adapter clamp so that it fits over the groove at the opening of the capsule compression fitting.
3. Tighten adapter clamp screws so the Aquastat® Controller is firmly attached to the capsule compression fitting.

INSTALLING SURFACE-MOUNTED MODEL (L6006C)

! CAUTION

- Do not replace immersion type Aquastat® Controller with strap-on Aquastat® Controller.
- When mounting the L6006C, do not secure draw nut so tight that retainer clamp could collapse tubing.

NOTE: When mounting the L6006C on piping, use 1 in. (25.4 mm) diameter or larger pipe for accurate temperature sensing. Remove any insulation from the pipe. Thoroughly scrape off all scale, rust, or paint. Mount the controller using the adjustable bracket furnished.

The L6006C is designed for surface mounting on piping or tanks. Mount the L6006C directly on the tank surface using the adjustable mounting bracket as shown in Fig. 4. The control can be mounted in any position. (If mounting the L6006C on piping, see NOTE above.)

WIRING

Disconnect power supply before connecting wiring to prevent electrical shock or equipment damage. All wiring must comply with local electrical codes and ordinances.

Fig. 5 and 6 show typical wiring diagrams of Aquastat® Controllers used in heating systems.

When the W terminal on the device being replaced is a 1/4 in. tab terminal, use the existing wiring harness terminals to install the replacement device. When the W terminal on the device being replaced is a screw terminal, connect the provided wire harness adapter on the 1/4 in. tab terminal of the replacement device. Connect the existing wire to the adapter harness using the provided wire nut.

Operation

For proper selection of settings, follow the boiler manufacturer recommendations.

High limit controller—shuts off burner when water temperature exceeds high limit setting. Burner restarts when temperature drops to high limit setting, less differential.

Low limit controller—maintains minimum boiler temperature for domestic hot water. Turns on burner at temperature setting, minus differential.

Circulator controller—prevents circulation of water that is not hot enough. Breaks circulator circuit at temperature setting minus differential; remakes the circuit when the temperature setting is reached.

Switching action is as follows:

Upon a drop in boiler water temperature (to dial setting, less differential), makes R to B burner contact; breaks R to W contact, preventing circulator operation. Upon a rise in boiler water temperature (to dial setting), breaks R to B burner contact, makes R to W circulator contact.

Adjustment

Set the differential to correspond with the boiler manufacturer recommendations. To adjust models with adjustable differential, rotate the wheel on the back of the snap switch until the desired reading is aligned with the V notch in the frame. The wheel provides an adjustment from 5°F to 30°F (3°C to 17°C). Replace the cover on the Aquastat® Controller.

Adjust control point to correspond with the boiler manufacturer recommendations. To adjust, insert a screwdriver in the slotted screw type head located beneath the window in the cover. Turn the scale to the desired control point.

Fig. 3—Direct immersion model with bulb compression fitting partially removed.

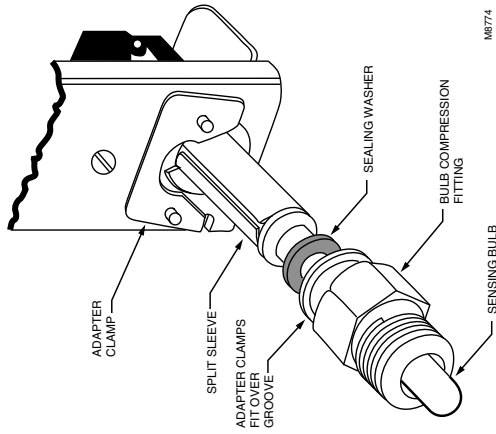
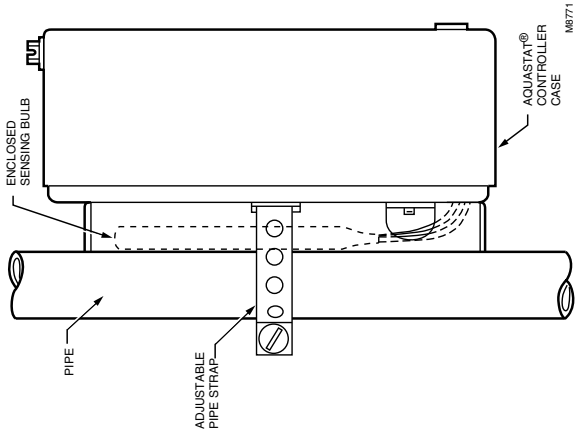


Fig. 4—Mounting L6006C on pipe or tank.



Checkout

Check to make certain that the Aquastat® Controller is installed and adjusted properly. Put the system into operation and observe the action of the device through several cycles to make certain that it provides proper low and/or high limit and circulator control.

Fig. 6—Typical wiring hookup using L6006 and L6007 with L8148A.

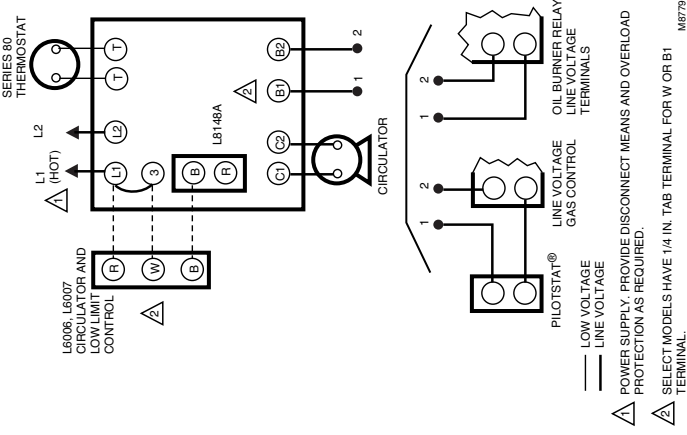
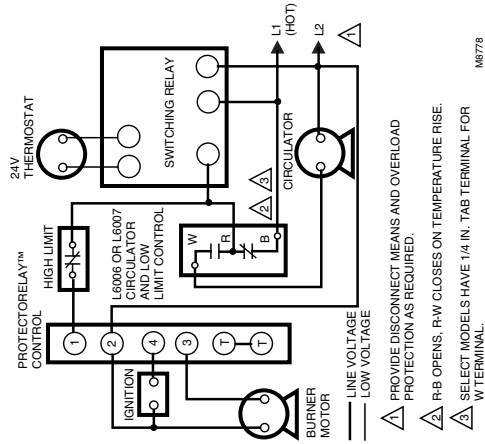


Fig. 5—Typical wiring hookup using the L6006 or L6007 for low limit and circulator control in oil-fired hydronic system.



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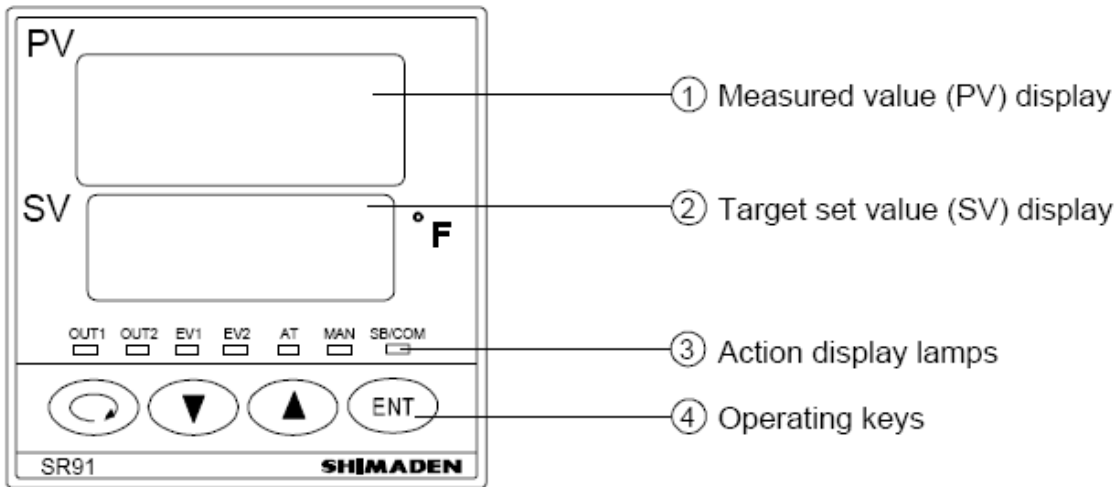
QUALITY IS KEY




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95-5973—3

3

ACE Mini-Pack/SWH Digital Panel (Water)
ACE USB Digital Panel (Steam)



-  **Parameter key:** Used to get to the next parameter or different modes.
Hold to scroll to the first screen.
-  **Arrow keys:** Used to change parameters.
-  **Enter key:** Used to set the parameter after it has been changed.






This instruction should be used with

ACE Mini-Pack/SWH Digital Panel (Water)
SHIMADEN Controller Model **SR93-8I-N-90-1400** (AJAX P/N: **CASR931400**)

Or

ACE USB Digital Panel (Steam)
SHIMADEN Controller Model **SR93-4I-N-90-1400** (AJAX P/N: **CASR96140**)

Entering Setup Mode






- 1) When the power is applied to the unit, display will show temperature or pressure on the PV screen. If not check wiring.
- 2) Hold the  key for **3** seconds to get to the **Setup Mode**.
- 3) Press the  key to go through the different parameters, and the  and  keys to change parameters and  to save the change.

Programming in Setup Mode










- 4) In **Setup Mode**, change the following parameters below.
 *Start programming from **rAnG** parameter
 ** Indicates Steam Controller parameters

| Upper Display | Lower Display | Description |
|---------------|---------------------------------------|--|
| PArA | Set | Setup Mode initial screen |
| LoCK | oFF | Key lock setting |
| P | 10.0 (Water) 10.0 (Steam) | Output proportional band setting |
| I | 60 (Water) 60 (Steam) | Output integral time |
| D | 15 (Water) 50 (Steam) | Output derivative time |
| ñr | 0.0 | Output manual reset |
| SF | 0.40 | Output target value function |
| o_L | 0.0 | Output lower limit **Amuract Wiring Rev.D (Before 3/30/11) – 18.0 |
| o_H | 100.00 | Output high limit |
| StEV | oFF | Event at Standby |
| E1_ñ | Hd | High deviation alarm |
| E1_d | 5.0 (Water) **3.0 (Steam) | High alarm differential |
| E1_i | 1 | High alarm event standby action |
| E2_ñ | Ld | Low deviation alarm |
| E2_d | 0.1 | Low alarm differential |
| E2_i | 1 | Low alarm event standby action |
| Ao_ñ | PV | Analog Output Type |
| Ao_L | 40.0 (Water) **0.0 (Steam) | Analog Output Low Limit |
| Ao_H | 200.0 (Water) **150.0 (Steam) | Analog Output High Limit |
| Act | rA | Reverse acting control |
| SoFt | oFF | Soft start time |
| SV_L | 40.0 (Water) **0.0 (Steam) | Setpoint lower limit |
| SV_H | 180.0 (Water) **Vessel – 8 (Steam) | Setpoint high limit |
| PV_b | 0 | Outlet temperature/pressure bias value |








| | | |
|--------|--|---|
| PV_F | 0 | Outlet temperature/pressure filter time |
| * rAnG | 34 (Water) **92 (Steam) | Sensor and measuring range * Start Here* |
| Unit | F (Water Only) | Temperature unit |
| Sc_L | 0.0 | Input scale lower limit |
| Sc_H | 400.0 (Water) **150.0 (Steam) | Input scale high limit |
| Scdp | 0.0 | Input decimal point position |
| Disp | Pb | Temperature/pressure display at standby |

- 5) When **PArA** shown, press the  key to review the programmed parameters for the second time to check all parameters are set correctly.
- 6) Scroll until **PArA** shown on the display again, hold down the  key for 3 seconds to get to **Operation Mode**.
- 7) Use  and  key to change the **SV** (setpoint value) to within ± 2 F/PSI off the **PV** value. Press the  key to save the new setpoint value.

Programming High and Low Deviation Alarm

- 8) Press the  until **E1Hd** is shown. Using the  and  key to change the value to **20** (for water) or **6** (for steam) and press the  key to save the new High Deviation alarm value.
- 9) Press the  until **E2Ld** is shown. Using the  and  key to change the value to **-10** and press the  key to save the new Low Deviation alarm value.
Note: The High Temperature/Pressure Alarm is activated when **PV** is **E1Hd** above **SP** and Low Temperature/Pressure Alarm is activated when **PV** is **IE2LdI** below **SP**.
- 10) Hold the  key for 3 seconds to display **PV** (measured temperature/pressure) and **SV** (setpoint value).

Testing Manual Valve Control

- 11) Press the  key once to get to valve position screen.
- 12) Hold down the  key until the **MAN** light starts to flash.
- 13) Change the parameter to **99.9** using the  and  key. Check to see that valve opens fully. (Valve should be at 90°)
- 14) Change the parameter to **50** using the  and  key. Check to see that valve opens to half way. (Valve should be at 45°)
- 15) Hold down  key until **MAN** light stops flashing.

Testing Operating Control (Water Only)

- 16) Change the **SV** (setpoint value) so that it is 20° below the **PV** (measured temperature). High Temperature Alarm will activate (dump valve if included) and light will come on.
- 17) Check to see that valve closes fully.
- 18) Deactivate High Temperature Alarm by raising the setpoint value to 10° above the **PV** (measured temperature).







Testing Operating Control (Steam Only)

- 19) Remove Pressure Transducer and apply 15 PSI pressure.
- 20) Change the **SV** (setpoint value) so that it is 7 PSI below the **PV** (measured Pressure).
High Pressure Alarm will activate and light will come on.
- 21) Check to see that valve closes fully.
- 22) Deactivate High Pressure Alarm by raising the setpoint value to 5 PSI above the **PV** (measured pressure)

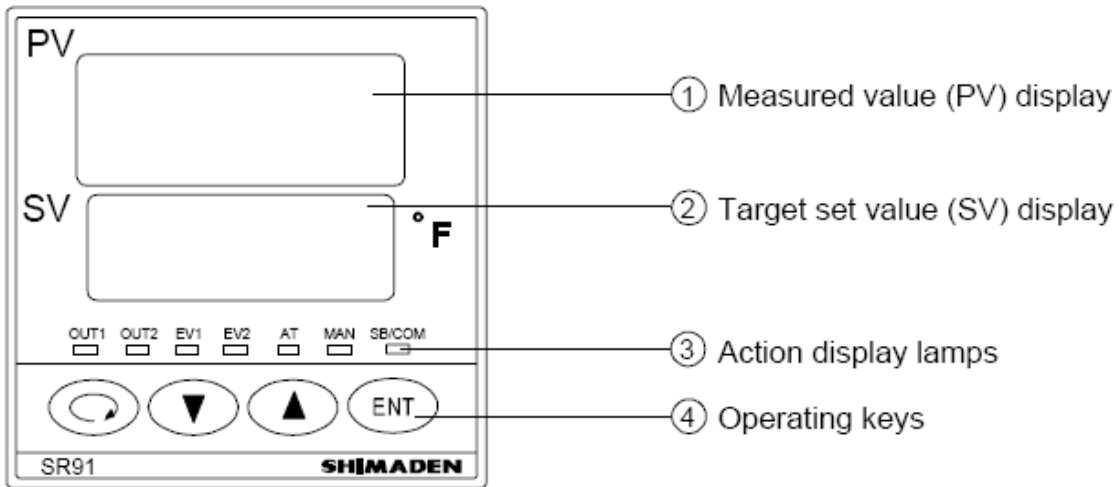
Change Setpoint




- 23) Change the **SV** (setpoint value) 120 F for Water and 10 PSI for Steam.

Enable Key Lock

- 24) Hold down  key until you get see the Setpoint and Process Variable.
- 25) Hold down the  key for 3 seconds to get to the **Setup Mode**.
- 26) Press the  key until you see **LoCK** on the PV screen.
- 27) Change this parameter to **2** and press the  key to save the new parameter.
- 28) Hold down the  key until you PV display shows **PArA**.
- 29) Hold down the  key for **3** seconds to get back to the **Operation Mode**.
- 30) Fill out the **Safety System Test Check Sheet**.

ACE Mini-Pack/SWH BMS Panel (Water)
ACE USB BMS Panel (Steam)



-  **Parameter key:** Used to get to the next parameter or different modes.
Hold to scroll to the first screen.
-  **Arrow keys:** Used to change parameters.
-  **Enter key:** Used to set the parameter after it has been changed.






This instruction should be used with

ACE Mini-Pack/SWH BMS Panel (Water)
SHIMADEN Controller Model **SR93-8I-N-90-1050** (AJAX P/N: **CASR931050**)

Or

ACE USB BMS Panel (Steam)
SHIMADEN Controller Model **SR93-4I-N-90-1050** (AJAX P/N: **CASR931050A**)

Entering Setup Mode






- 1) When the power is applied to the unit, display will show temperature or pressure on the PV screen. If not check wiring.
- 2) Hold the  key for **3** seconds to get to the **Setup Mode**.
- 3) Press the  key to go through the different parameters, and the  and  keys to change parameters and  to save the change.

Programming in Setup Mode










- 4) In **Setup Mode**, change the following parameters below.
 *Start programming from **rAnG** parameter
 ** Indicates Steam Controller parameters

| Upper Display | Lower Display | Description |
|---------------|------------------------------|--|
| PArA | Set | Setup Mode initial screen |
| LoCK | oFF | Key lock setting |
| P | 10.0 (Water) 10.0 (Steam) | Output proportional band setting |
| I | 60 (Water) 60 (Steam) | Output integral time |
| D | 15 (Water) 50 (Steam) | Output derivative time |
| ñr | 0.0 | Output manual reset |
| SF | 0.40 | Output target value function |
| o_L | 0.0 | Output lower limit **Amuract Wiring Rev.D (Before 3/30/11) – 18.0 |
| o_H | 100.00 | Output high limit |
| StEV | oFF | Event at Standby |
| E1_ñ | Hd | High deviation alarm |
| E1_d | 5.0 (Water) **3.0 (Steam) | High alarm differential |
| E1_i | 1 | High alarm event standby action |
| E2_ñ | Ld | Low deviation alarm |
| E2_d | 0.1 | Low alarm differential |
| E2_i | 1 | Low alarm event standby action |
| coññ | Loc | Communication mode |
| Prot | rtu | Communication protocol |
| Addr | 1 | Communication address |
| dAtA | 8n1 | Communication data format |
| SchA | Stx | Start character |
| bcc | 1 | BCC operation type |
| bPS | 9600 | Communication speed |
| dELY | 20 | Communication delay time |
| ñEñ | EEP | Communication memory mode |
| Act | rA | Reverse acting control |
| SoFt | oFF | Soft start time |








| | | |
|--------|--|---|
| SV_L | 40.0 (Water) **0.0 (Steam) | Setpoint lower limit |
| SV_H | 180.0 (Water) **Vessel – 8 (Steam) | Setpoint high limit |
| PV_b | 0 | Outlet temperature/pressure bias value |
| PV_F | 0 | Outlet temperature/pressure filter time |
| * rAnG | 34 (Water) **92 (Steam) | Sensor and measuring range * Start Here* |
| Unit | F (Water Only) | Temperature unit |
| Sc_L | 0.0 | Input scale lower limit |
| Sc_H | 400.0 (Water) **150.0 (Steam) | Input scale high limit |
| Scdp | 0.0 | Input decimal point position |
| Disp | Pb | Temperature/pressure display at standby |

- 5) When **PARA** shown, press the  key to review the programmed parameters for the second time to check all parameters are set correctly.
- 6) Scroll until **PARA** shown on the display again, hold down the  key for 3 seconds to get to **Operation Mode**.
- 7) Use  and  key to change the **SV** (setpoint value) to within ± 2 F/PSI off the **PV** value. Press the  key to save the new setpoint value.

Programming High and Low Deviation Alarm

- 8) Press the  until **E1Hd** is shown. Using the  and  key to change the value to **20** (for water) or **6** (for steam) and press the  key to save the new High Deviation alarm value.
- 9) Press the  until **E2Ld** is shown. Using the  and  key to change the value to **-10** and press the  key to save the new Low Deviation alarm value.
Note: The High Temperature/Pressure Alarm is activated when **PV** is **E1Hd** above **SP** and Low Temperature/Pressure Alarm is activated when **PV** is **IE2LdI** below **SP**.
- 10) Hold the  key for 3 seconds to display **PV** (measured temperature/pressure) and **SV** (setpoint value).

Testing Manual Valve Control

- 11) Press the  key once to get to valve position screen.
- 12) Hold down the  key until the **MAN** light starts to flash.
- 13) Change the parameter to **99.9** using the  and  key. Check to see that valve opens fully. (Valve should be at 90°)
- 14) Change the parameter to **50** using the  and  key. Check to see that valve opens to half way. (Valve should be at 45°)
- 15) Hold down  key until **MAN** light stops flashing.

Testing Operating Control (Water Only)

- 16) Change the **SV** (setpoint value) so that it is 20° below the **PV** (measured temperature). High Temperature Alarm will activate (dump valve if included) and light will come on.
- 17) Check to see that valve closes fully.

- 18) Deactivate High Temperature Alarm by raising the setpoint value to 5° above the **PV** (measured temperature).







Testing Operating Control (Steam Only)

- 19) Remove Pressure Transducer and apply 15 PSI pressure.
20) Change the **SV** (setpoint value) so that it is 7 PSI below the **PV** (measured Pressure).
High Pressure Alarm will activate and light will come on.
21) Check to see that valve closes fully.
22) Deactivate High Pressure Alarm by raising the setpoint value to 5 PSI above the **PV** (measured pressure)

Change Setpoint

- 23) Change the **SV** (setpoint value) 120 F for Water and 10 PSI for Steam.

Enable Key Lock

- 24) Hold down  key until you get see the Setpoint and Process Variable.
25) Hold down the  key for 3 seconds to get to the **Setup Mode**.
26) Press the  key until you see **LoCK** on the PV screen.
27) Change this parameter to **2** and press the  key to save the new parameter.
28) Hold down the  key until you PV display shows **PArA**.
29) Hold down the  key for **3** seconds to get back to the **Operation Mode**.
30) Fill out the **Safety System Test Check Sheet**.

N O T I C E

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W A R N I N G

THIS PRODUCT CONTAINS CRYSTALLINE SILICA, A CHEMICAL KNOWN TO CAUSE CANCER. CONTAINS NO ASBESTOS.

Ace Heaters, LLC

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SO # _____

Serial No. _____

Model No. _____



Aceheaters.com
130 Klug Circle
Corona, CA 92878

(951) 738-2230