a nudyne company

Storage Water Heater
Water-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 / Self-Contained)

Congratulations on your purchase of a new Ace 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.

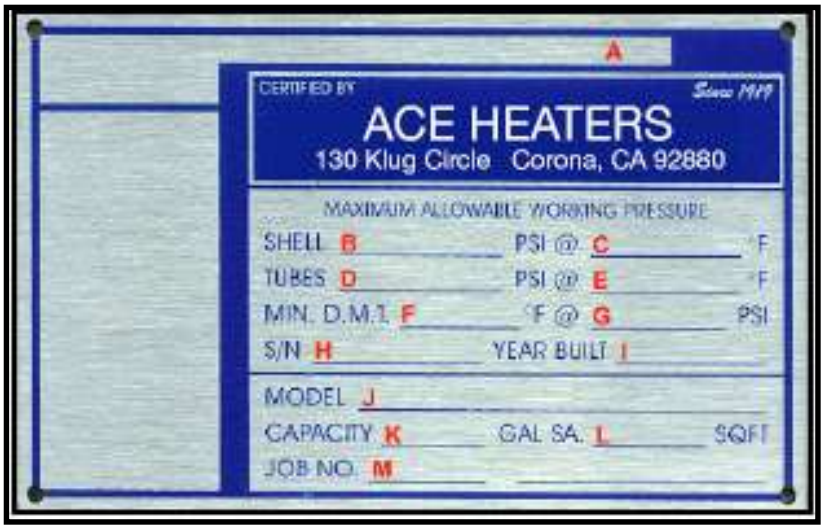
Experience in the field has proven that the Ace Packaged Storage Water Heater, if properly applied and maintained, will give many years of efficient, dependable and economical service.

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



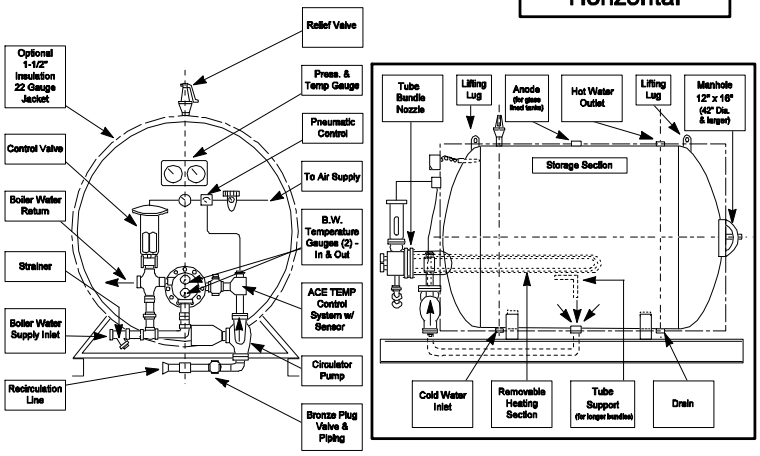
The Packaged Storage Water Heater Model Number

P H G 72 10 - G – 2. 1066 S A

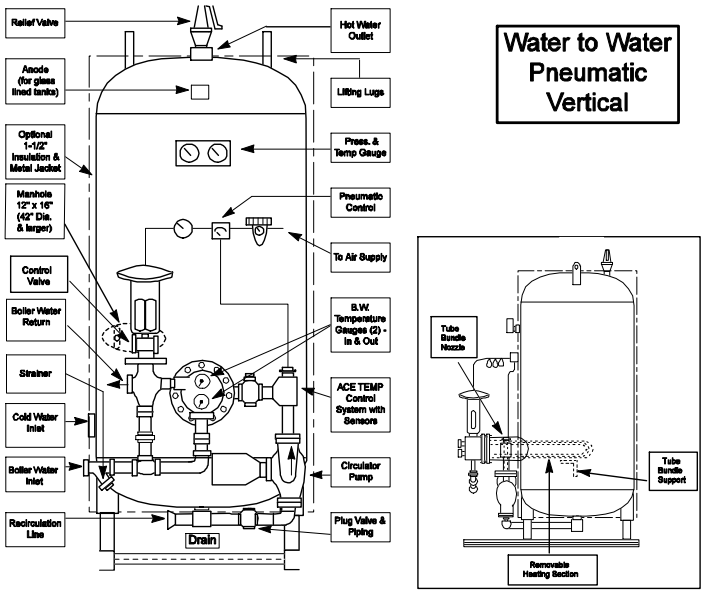
P = Packaged
H = Type (H = Horizontal, V = Vertical)
G = Tank Design Pressure (G = 125, J = 150)
72 = Tank Diameter
10 = Shell Length in feet
G = Lining Code (G = glass, K = pre-krete, U = unlined, C = cement, X = special, S = stainless)
2. = # of Passes
1066 = Coil model number (10 = diameter, 66 = 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)

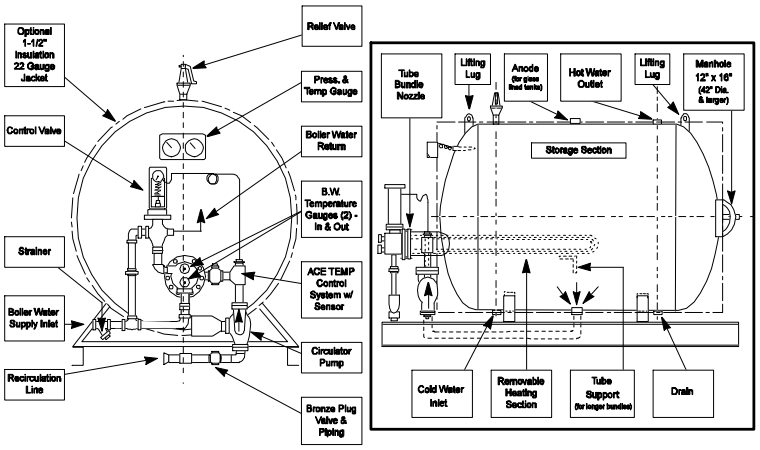
Water to Water Pneumatic Horizontal



Water to Water Pneumatic Vertical



Water to Water Self-Operating Horizontal



Water to Water Self-Operating Vertical

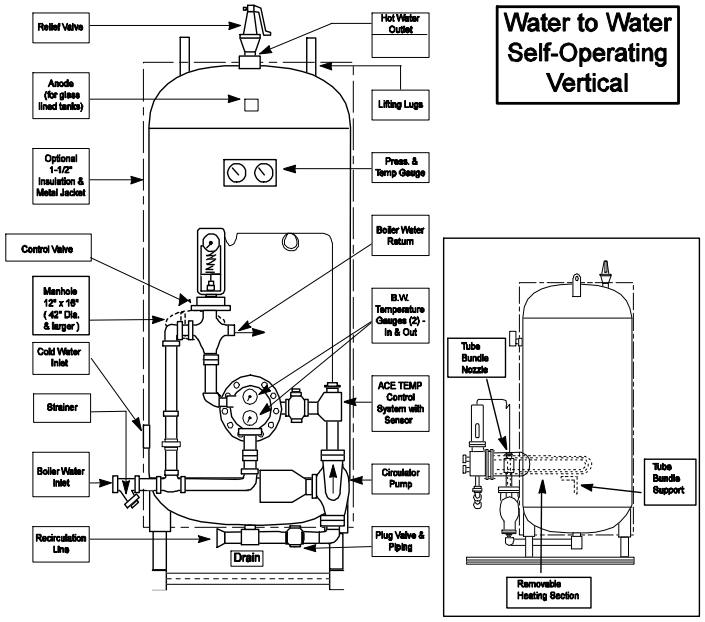


Diagram may vary from actual model

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 Heaters 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.lb	60 ft.lb
5/8"	90 ft.lb	120 ft.lb
3/4"	150 ft.lb	200 ft.lb
7/8"	240 ft.lb	320 ft.lb
1"	368 ft.lb	490 ft.lb
1 1/8"	533 ft.lb	710 ft.lb
1 1/4"	750 ft.lb	1000 ft.lb
1 1/2"	1200 ft.lb	1600 ft.lb

Notes:

* Spray each stud bolt and nut generously with penetrating oil before re-torque.

** Gasket thickness before compression. All partition gaskets are ⅛" 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.

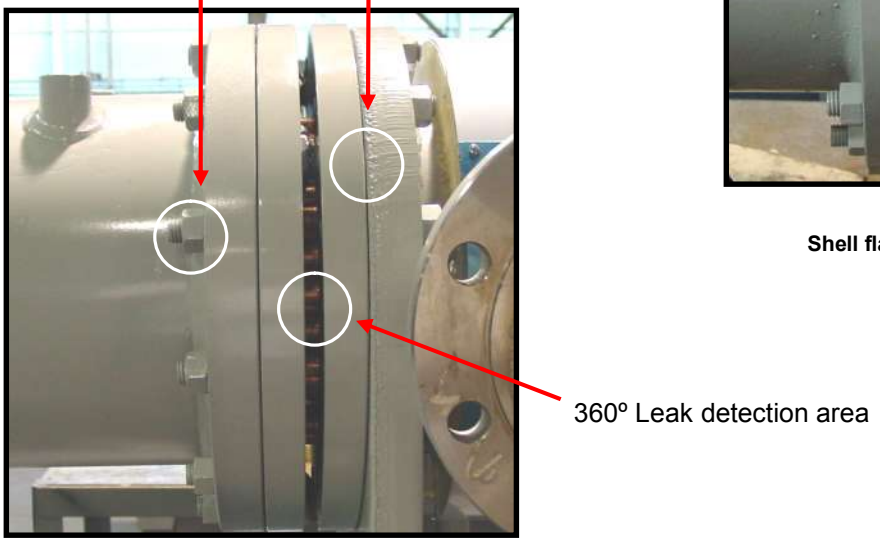


Figure 1.1
Shell flange to bonnet flange joint –
SW Tube Bundle

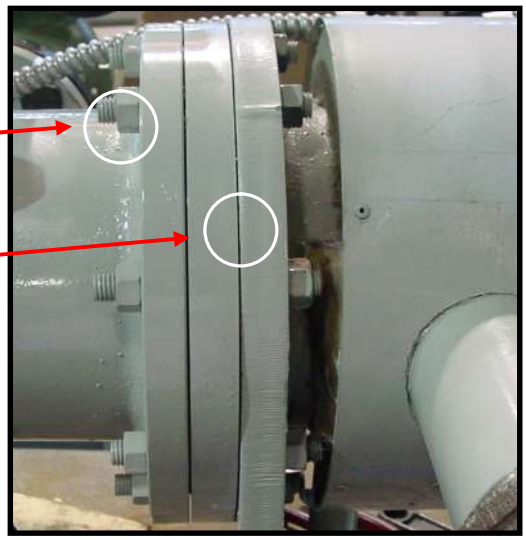


Figure 1.2
Shell flange to bonnet flange joint –
DW Tube Bundle

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 ackaged 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, water boiler, domestic water, instrument air, vents, drains and safety valve discharge lines. Prior to start-up inspect the strainer for any dirt, scale, welding particles or debris that may have accumulated during construction.
2. Make sure the power switch is in the “off” position.
3. Set the temperature on the Accritem pr valve to a minimal water temperature output, following instructions in the technical data sheet provided (factory does not preset).
4. If option is provided, adjust the high limit control 12º to 15ºF higher than the desired hot water outlet temperature.
5. Close the shut-off valve on the bonnet side (heating medium side). Slowly introduce domestic water to the unit by opening the shut-off valves at the inlet and outlet of the shell. This will allow water to circulate in the shell. Open the relief valve when filling to purge the trapped air from the unit.
6. Plant boiler water is used as the heating medium and is controlled by the control valve, which in turn receives its signal from the temperature controller. If pneumatic, connect the air supply to the filter/regulator (minimum 35psi supply to the air pressure regulator). The instrument air supply gauge on the pressure regulator should be regulated to 30psi to the Accritem. If the control valve is equipped with a valve positioned these pressures will still apply. The outlet pressure gauge on the Accritem should read 30psi when fully opened, and 0psi when fully closed. Under normal operating conditions the outlet gauge reading will fall within this range.
7. Set the temperature knob on the Accritem to its lowest temperature setting. If self-contained, adjust the temperature adjustment nut on the valve to its lowest setting.
8. Turn on the system by turning the control panel switch to the “ON” position (the manual boiler water supply valve should be closed at this time). The green light should come on. Make sure the circulator pump is running. (Please refer to the pump instruction manual for details.) If pneumatic, the solenoid on the control panel will energize, allowing air to the control valve actuator, which in turn will open the control valve.
9. Turn on a number of hot water fixtures to establish a steady 50% load if possible, with at least a flow of 8 to 10GPM for the initial startup. Make sure these stay on and there is not an additional load applied elsewhere during initial startup.
10. Manually open the main boiler water shut-off valve upstream of the control valve and SLOWLY allow boiler water to pass through the control valve. Continue until the shut-off valve is 100% open.
11. The storage water heater will now function automatically, reacting according to demand fluctuations and will stabilize once limits are met.
12. Slowly increase the system temperature output by adjusting the temperature knob on the Accritem or temperature adjustment nut. Watch the temperature gauge on the front of the unit and wait for the temperature to stabilize prior to turning it up again. Repeat this procedure slowly until the desired outlet temperature set point has been achieved. Please note that the temperature knob on the Accritem may not be accurate to the actual water temperature (see gauge on shell). Once you have achieved your set point, it is recommended to loosen the set screw on the knob and reposition as necessary to indicate the actual (gauge) temperature on the Accritem face plate.
13. Once stabilized, turn off the hot water fixtures one at a time and watch the temperature gauge on the unit. There should only be slight temperature fluctuations. With no hot water fixtures on, the temperature gauge should remain stable. Watch the temperature for 5 minutes to verify the valve has closed. If the temperature slowly creeps up, the valve is leaking hot water and may have debris on the seat or the valve requires “zeroing”. “Zeroing” the valve requires adjusting the stem length until the valve closes tightly.
14. If equipped with dual safety system, check the operation of the high limit safety control. Do this by rotating the temperature dial to its lowest setting and setting the Accritem control 20º above the high limit set point. Check that the temperature of the system matches the temperature set point of the high limit when it engages and shuts the control valve (the red high temp light will engage on the control panel as well). ***Caution*****:** Very hot water may splash as it is discharged;

take the necessary precautions to avoid contact. Return the temperature dial to the desired set point.

15 Observe the entire system over a period of variable loads to determine if any calibration is necessary on the Accritem temperature controller. The sensitivity of this controller is adjusted by turning the restriction screw.

16 After start-up, inspect the strainer for any dirt, scale, welding particles or debris that may have accumulated and remove as necessary; *any debris can damage the valve seat or obstruct it from full shut-off, resulting in possible over-temp conditions and/or scalding.*

17 Check the flange bolt section for leaks. Tighten only enough to stop leakage. *Never tighten more than necessary. Excessive tightening will shorten the life of the gasket and stretch the studs.*

Safety Features

1 The pneumatic hot water control valve is designed to fail safe (closed) in the event of a power failure.

2 The single safety solenoid (standard) closes the air line from the Accritem to the actuator upon an over-temp or power failure. The three-way valve also vents any air left in the actuator, thus ensuring full shut-off of the control valve.

3 The relief valve is designed to relieve the pressure in the system in the event the pressure gets too high.

4 The double safety solenoid is designed to dump the hot domestic water from the shell in the event that the water temperature exceeds the set point on the high limit control. This should be piped to a safe drain per local and state codes.

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 hot 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 2100ºF 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 baring 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 damage 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 over heats 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 ¼"	10,100lbs.
1 ½"	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 http://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 manufacteres 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 s 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.

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
a nudyne company

Ace Heaters. LLC
www.aceheaters.com

SIEMENS

Technical Instructions
Document No. CA1N4455E-P25
June 14, 2006

MXG461…U, MXF461…U Series

Modulating Control Valves with Magnetic Actuators

MXG461…U

MXF461…U

Description

Mixing or straight-through valves with magnetic actuators for modulating control of hot and chilled water systems in closed circuits.

Features

- Fast positioning time (one second), high-resolution stroke (1:1000).
- Linear or equal-percentage valve characteristic (user-defined).
- Switch-selectable control signal: 0 to 10 Vdc, 2 to 10 Vdc, or 4 to 20 mA.
- Wear-free inductive stroke measurement.
- Heavy-duty, no maintenance required.
- Fail-safe feature: A → AB closed when de-energized.
- Positioning control.
- Position feedback.
- Manual control.

Product Numbers

See Table 1.

Warning/Caution Notations

WARNING:	⚠	Personal injury or loss of life may occur if you do not follow the procedures as specified.
CAUTION:	⚠	Equipment damage or loss of data may occur if you do not follow the procedures as specified.

Application

The MXG461...U (screwed fitting) and MXF461...U (flange fitting) valves are mixing or straight-through valves with a factory calibrated and mounted magnetic actuator. The magnetic actuator incorporates an electronics module for position control and positioning feedback. Control path A → AB is closed when the valve is de-energized.

⚠ **CAUTION:**

The valve is suitable for straight-through normally closed or three-way applications and may be installed only in a mixing arrangement.
The direction of flow (A → AB) must be as indicated on the valve.

The fast positioning time, high resolution and high rangeability make these valves ideal for modulating control of chilled and hot water systems in closed circuits. Sturdy construction makes maintenance and regular servicing unnecessary and ensures a long service life.

Ordering

When using a 2-1/2 inch flanged valve in a straight-through application, a blanking flange is required for the third port. If required, order Z155/65 separately.

For screwed valves, no additional ordering is required. The components required to create a straight-through valve are included with the valve.

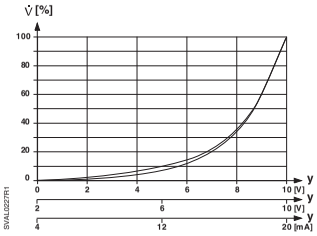
Principles/ Construction

Automatic Control

The control signal is converted by the microprocessor in the electronics module into an output signal that generates a magnetic field in the core. This causes the only moving part, the armature, to change its position in accordance with the interacting forces (magnetic field, counter-spring, hydraulics, and so on). The armature responds rapidly to any change in signal, transferring the corresponding movement directly to the control disc, enabling fast changes in load to be corrected quickly and accurately. The valve position is measured continuously. The positioning controller ensures an exactly proportional relationship between the control signal and the valve stroke.

Valve Characteristic

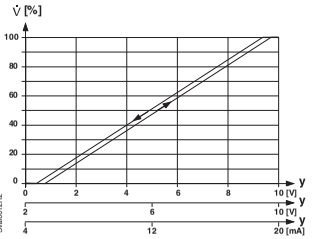
Volumetric flow



Control signal

Figure 1. Equal-percentage.

Volumetric flow



Control signal

Figure 2. Linear.

In the event of a power failure, or if the power is switched off, the spring force closes the valve automatically (control path ports A → AB normally closed).

Manual Control

The valve control path (ports A → AB) can be opened mechanically up to 95% of the full stroke by pressing the handwheel inward and turning it clockwise (to the MANUAL position). This disables the control signal from the controller.

To disable automatic control of the valve, press the handwheel inward and turn it counterclockwise (to the OFF position). The valve will close.

For automatic control, the handwheel must be set to the AUTO position (the handwheel will spring out).

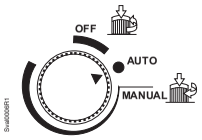


Figure 3. Selecting Automatic Control.

Sizing

Table 1. MX.461…U - Valves Sizing.

Product Numbers	Line Size	C_V	ΔP_{Vmax}		Maximum Close-off Pressure	P_{NA} [1]	P_{med} [1]	P_{NT} [1]	Wire Gauge			
									18	16	14	12
	(in)	(gpm)	(psi)	(bar)	(psi)	(VA)	(VA)	(VA)	Cable Length L (ft)			
MXG461.15-0.6U	1/2	0.7	44	3	72	22	4	38	108	213	361	525
MXG461.15-1.5U	1/2	1.7	44	3	72	22	4	38	108	213	361	525
MXG461.15-3.0U	1/2	3.5	44	3	72	22	4	38	108	213	361	525
MXG461.20-5.0U	3/4	5.8	44	3	43	22	4	38	108	213	361	525
MXG461.25-8.0U	1	9.3	44	3	43	22	4	38	108	213	361	525
MXG461.32-12U	1-1/4	14.0	44	3	43	22	4	38	108	213	361	525
MXG461.40-20U	1-1/2	23.0	44	3	43	36	7	60	66	118	197	328
MXG461.50-30U	2	35.0	44	3	43	36	9	60	66	118	197	328
MXF461.65-50U	2-1/2	58.0	44	3	43	45	12	75	49	98	164	262

Key:

ΔP_{vmax} = Maximum admissible pressure differential with valve closed

P_{NA} = Nominal power at 113°F (45°C)

P_{med} = Mean operating power

P_{NT} = Nominal transformer power

C_V = Flow rate to IEC534-2-4

Control path A → AB (normally closed): Tolerance ±5%
Control path B → AB (normally open): Tolerance ±10%

L = Maximum cable length. With four-wire connections, the maximum permissible length of the separate 16 AWG Cu (copper) signal cable is 656 feet. With three-wire connections, the maximum permissible cable length is reduced to 1/3 of the values shown in the table.

1 = All data relates to a 24 Vac supply.

Table 2. Water Flow Chart.

Product Number	Line Size (in)	ΔP_{V100}	PSI														
		C_{VS}	1	2	3	4	5	6	7	8	9	10	15	20	30	40	50
MXG461.15-0.6U	1/2	0.7	0.7	1	1.2	1.4	1.6	1.7	1.9	2.0	2.1	2.2	2.7	3.1	3.8	4.4	4.9
MXG461.15-1.5U	1/2	1.7	1.7	2.4	2.9	3.4	3.8	4.2	4.5	4.8	5.1	5.4	6.6	7.6	9.3	10.8	12
MXG461.15-30U	1/2	3.5	3.5	4.9	6.1	7	7.8	8.6	9.3	9.9	10.5	11	14	16	19	22	25
MXG461.20-50U	3/4	5.8	5.8	8.2	10	12	13	14	15	16	17	18	22	26	32	37	—
MXG461.25-8.0U	1	9.3	9.3	13	16	19	21	23	25	26	28	29	36	42	51	59	—
MXG461.32-12U	1-1/4	14	14	20	24	28	31	34	37	40	42	44	54	63	77	89	—
MXG461.40-20U	1-1/2	23	23	33	40	46	51	56	61	65	69	73	89	103	126	145	—
MXG461.50-30U	2	35	35	49	61	70	78	86	93	99	105	111	136	157	192	221	—
MXF461.65-50U	2-1/2	58	58	82	100	116	130	142	153	164	174	183	225	259	318	367	—

LED Indicators

The two-color LED display indicating operating status can be viewed by opening the cover of the electronics module.

Table 3. LED Display.

LED Display	Status	Description
LED green	On continuously	Automatic mode: Auto (normal, no faults)
	Flashing	– Mechanically set to MANUAL – Mechanically set to OFF – Currently in auto-calibration mode
LED red	On continuously	– General fault – General calibration fault – Microcontroller fault
	Flashing	– Faulty 24 Vac supply (that is, too low)
LED	Off	– No 24 Vac supply – Fault with electronics module

As a general rule, the LED can only assume the conditions in Table 3 (continuously red or green, flashing red or green, or off).

Mounting

Mounting and operating instructions are printed on the actuator and on the electronics module.

The valve is suitable only for straight-through or three-way applications and may be installed only in a mixing arrangement. In the case of the straight-through valve, strict observance of the direction of flow is essential.

Do not mount with actuator below horizontal position.

Access for Mounting

It is essential to maintain the specified minimum clearance above and to the side of the actuator and/or electronics module for servicing, installing and heat dissipation:

- 1/2-inch to 1-1/4 inches = 4 inches
- 1-1/2 inches to 2-1/2 inches = 6 inches

Also see *Dimensions*.

Mounting, Continued

Straight-through Valves

Only three-way MX.461...U valves are supplied. They may be used as straight-through normally closed valves by closing off port "B":

Port "B" can be sealed with a Z155/65 blanking flange and gasket.

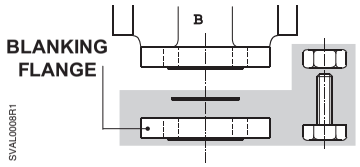


Figure 4. MXF461...U Flanged Valves in Straight-through Applications.

Port "B" can be sealed with the accessories supplied (blanking disk, gasket, and the nut).

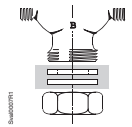


Figure 5. MXG461...U Screwed Valves in Straight-through Applications.

Installation

MXG461...U screwed valves are flat-faced to facilitate sealing with the gaskets supplied.

Do not use hemp, tape or thread-sealing compound.

Do not insulate the actuator.

For notes on electrical installation, see *Terminal Layout*.

Maintenance

The valves and actuators require no maintenance or service. The valve stem is sealed with a maintenance-free O-ring gland.

Should the valve electronics prove faulty, the electronics module should be exchanged for a replacement part, part number ASE1 (1/2-inch to 1-1/4 inches) or ASE2 (1-1/2 inches to 2-1/2 inches). Mounting instructions are enclosed (Ref. 35678).

WARNING:

Under operating conditions within the limits defined by the application data, the actuator will become hot, but this does not represent a fire risk. Always maintain the minimum clearance specified (see *Dimensions*).

Specifications

Electrical Interface	Power supply	Class 2
	Supply voltage – Maximum voltage tolerance	24 Vac, 50/60 Hz +20/–15%
	Control signal (user-selected)	0 to 10 Vdc, 2 to 10 Vdc, or 4 to 20 mA
	Software class	Class A
	Nominal power	See *Sizing*
	Position feedback: Output Maximum rating Non-linearity	 0 to 10 Vdc = 0 to 100% stroke 2 mA ±2% of full scale
Product Specific Data	Applications	To EN60730
	Nominal pressure	232 psi (16 bar)
	Operating pressure p_{emax}	145 psi (1 Mpa)(10 bar)
	Pressure differential ΔP_{vmax}	See *Sizing*
	Leakage at ΔP_v = 14.5 psi (0.1 Mpa) (1bar)	A → AB Max. 0.02 % k_{vs} (to IEC534-4) B → AB Depends on application data (<0.2% C_v)
	Admissible media	Water, or water/glycol mixtures with maximum 50% glycol
	Temperature of medium	36°F to 248°F (2°C to 120°C)
	Valve characteristic (stroke, k_{vs})	Linear or equal percentage (user-selected), optimized in low opening range (to IEC534-2-4)
	Stroke resolution $\Delta H/H_{100}$	1:1000 (H = stroke)
	Hysteresis	Typically 3%
	Type of operation	Modulating
	Manual adjustment	Yes, with handwheel
	Position with actuator de-energized	A → AB closed
	Orientation	Upright to horizontal Note that orientation affects protection standard
	Positioning time	≤1 second
Materials (valve body)	Housing parts	Cast iron
	Inner valve	CrNi Steel
	Seat	Brass
	Valve stem seal	EPDM (O-ring)
	Bellows	Tombac, bronze, CrNi steel
Electrical connection	Connection terminal Per terminal, with wire (no lug) Per terminal with wire	Screw terminals 2 × 16 AWG or 1 × 14 AWG 2 × 16 AWG or 1 × 12 AWG
Miscellaneous	Weight (including packaging) Dimensions	See *Dimensions* See *Dimensions*
Ambient conditions	Maximum ambient temperature	113°F (45°C)
Agency Approvals	UL listing	Per UL 873
	C-UL	Certified to Canadian Standard C22.2 No. 24 Suitable for use in air handling spaces NEMA Type 1

Wiring Terminals

WARNING:

Earth ground must be connected to the pipe work.

1	G0	⊥	24 Vac
2	G	~	24 Vac
3	Y		Control signal input
4	YM		Control signal reference voltage
5	X		0 to 10 Vdc stroke signal output (position feedback)
6	YF		Override control

Figure 6. Terminal Layout for Four-wire Connections.

Wiring Diagram

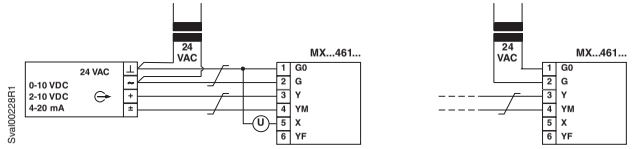


Figure 7. Connection to Controller with Four-wire Output.

(U) = Indication of valve position (only where required). 0 to 10 Vdc → 0 to 100% volumetric flow

If the cables for the 24 Vac supply and the control signal 0 to 10 Vdc (2 to 10 Vdc, 4 to 20 mA are routed separately, twisted pairs are not required for the 24 Vac cable).

Forced Control Feature (Input Terminal YF/6)

0 Vac (Bridge G0 – YF)	Control path A → AB closed
24 Vac (Bridge G – YF)	Control path A → AB open
1 to 9 Vdc at F	Continuously variable low limit control 10% to 90% volume flow (the higher value YF of Y takes priority). This function is available with valves with a manufacturing date of 990701 or later.

Configuration Switches

Switch	Off	On
1 Characteristic	Linear	Equal percentage*
2 Control signal	0 to 10 Vdc*	2 to 10 Vdc or 4 to 20 mA
3 Volts or mA	0(2) to 10 Vdc*	4 to 30 mA

* Factory setting: equal percentage valve characteristic, 0 to 10 Vdc control signal.

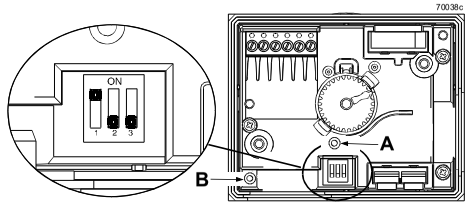


Figure 8. DIP Switches.

Calibration

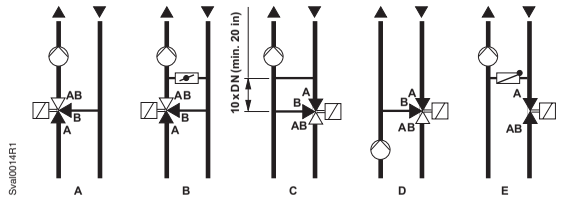
The MX…461…P magnetic valves are factory-calibrated at 0% and 100% stroke. When commissioning the valves (especially under extreme usage conditions) there may still be some leakage via control path A → AB with a 0% stroke control signal (0 Vdc, 4 mA or 2 Vdc). In this case, the valve can be recalibrated as follows (see Figure 8):

- Use a pin or paper clip to push the button in opening (A) in the terminal housing.
- During calibration, the LED light (B) in the electronics module will flash green for approximately 10 seconds. The valve will be briefly closed and fully opened.

Application Example

CAUTION:

This valve is suitable for straight-through normally closed or three-way applications only, and should only be installed in a mixing arrangement.



A Mixing circuit
B Mixing circuit with bypass (underfloor heating)
C Injection circuit
D Diverting circuit
E Injection circuit with straight-through valve

Figure 9. Hydraulic Circuits.

Service

CAUTION:

Do not disassemble the valve and actuator combination. This assembly is factory-calibrated, and should only be replaced by qualified personnel.

Dimensions

All dimensions in inches (millimeters)

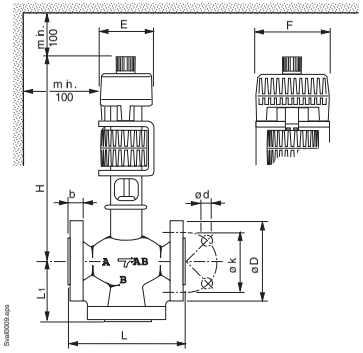


Table 4. MXF461…U – Flanged Valve with Electronics Module.

Product Number	L	L1	D	b	k	d 4X	H	E	F	lbs (kg)
MXF461.65-50U	11.42 (290)	4.92 (125)	7.00 (177.8)	0.88 (22.4)	5.50 (139.7)	0.75 (19.05)	15.43 (392)	3.15 (80)	3.94 (100)	63.1 (28.6)

NOTE: Installer must supply counterflanges.

lbs. (kg) = Weight (including packaging)

Dimensions, Continued

All dimensions in inches (millimeters)

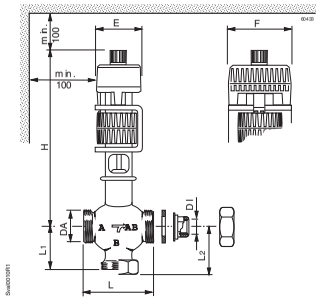


Table 5. MXG461…U –Valves with Electronics Module.

Product Number	DI	DA	L	L1	L2 *	H	E	F	lbs (kg)
MXG461.15-0.6U	1/2	1	3.15 (80)	1.67 (42.5)	2.01 (51)	9.45 (240)	3.15 (80)	3.94 (100)	8.4 (3.8)
MXG461.15-1.5U	1/2	1	3.15 (80)	1.67 (42.5)	2.01 (51)	9.45 (240)	3.15 (80)	3.94 (100)	8.4 (3.8)
MXG461.15-3.0U	1/2	1	3.15 (80)	1.67 (42.5)	2.01 (51)	9.45 (240)	3.15 (80)	3.94 (100)	8.4 (3.8)
MXG461.20-5.0U	3/4	1-1/4	3.74 (95)	2.07 (52.5)	2.40 (61)	10.24 (260)	3.15 (80)	3.94 (100)	9.3 (4.2)
MXG461.25-8.0U	1	1-1/2	4.33 (110)	2.22 (56.5)	2.56 (65)	10.63 (270)	3.15 (80)	3.94 (100)	10.4 (4.7)
MXG461.32-12U	1-1/4	2	4.92 (125)	2.66 (67.5)	2.99 (76)	11.22 (285)	3.15 (80)	3.94 (100)	12.3 (5.6)
MXG461.40-20U	1-1/2	2-1/4	5.51 (140)	3.17 (80.5)	3.70 (94)	12.60 (320)	3.94 (100)	4.72 (120)	20.5 (9.3)
MXG461.50-30U	2	2-3/4	6.69 (170)	3.68 (93.5)	4.29 (109)	13.39 (340)	3.94 (100)	4.72 (120)	26.2 (11.9)

* When used as a straight-through valve

lbs. (kg) = Weight (including packaging)

Information in this publication is based on current specifications. The company reserves the right to make changes in specifications and models as design improvements are introduced. Other product or company names mentioned herein may be the trademarks of their respective owners.
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Siemens Building Technologies, Inc.
1000 Deerfield Parkway
Buffalo Grove, IL 60089-4513
U.S.A.

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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

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

WARREN CONTROLS

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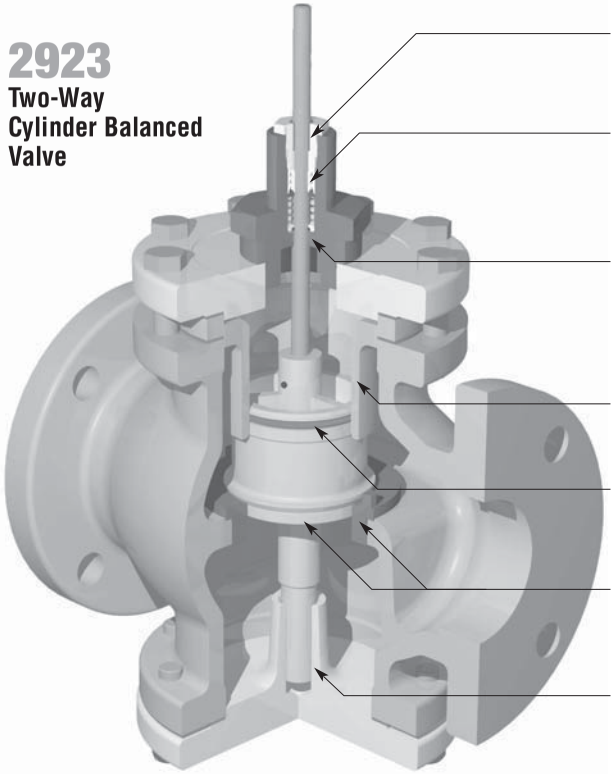
2923
Two-Way Cylinder Balanced Valve



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.

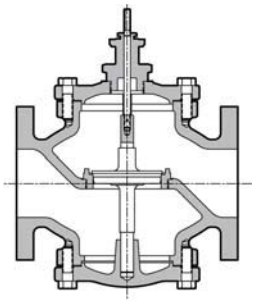
EPDM O-Ring or Fluoraz O-Ring (for higher temperatures)
maintains pressure balance seal.

Plug and Seat
in choice of Bronze, 300 SS, 17-4pH, or Alloy 6 provide Class IV shut off.

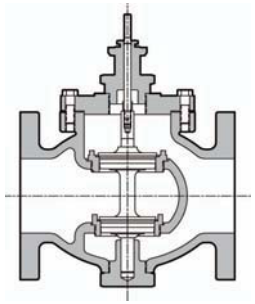
Bottom Post Guide
for additional stability, allowing higher pressure drop.

SERIES: 2900

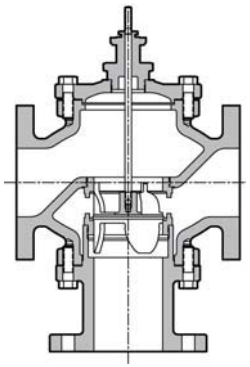
High Capacity
General Purpose Globe
Control Valves



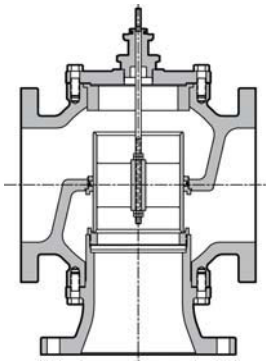
2920
Two-Way Single Seat Unbalanced Valve



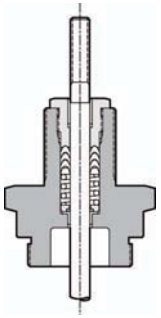
2922
Two-Way Double Seat Balanced Valve



2930
Three-Way Mixing Valve



2932
Three-Way Diverting/Mixing Valve



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

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 value 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.

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WARREN CONTROLS

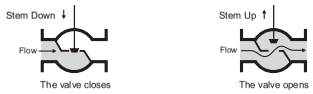
Body Style Versus Application

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:	EQ%, 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) +32 to 400°F (250 FLG)
Rangeability:	50:1



The valve closes — The valve opens

2922 Two-Way Double Seat Balanced Valve

A balanced valve that is an effective solution for sizes over 3" and for higher pressures. Its double seat design allows for dirtier fluids and requires less force to operate than unbalanced valves so smaller actuators can be used. It is limited to ANSI Class III shut-off.

Sizes:	2-1/2, 3, 4, 5, 6, 8, 10 inch
Body:	ANSI B16.1 Iron 125LB Flange or 250LB Flange
Trim:	EQ%, Bronze or 300 Series Stainless Steel
Packing:	Guided Low-Friction TFE V-Ring, Spring Loaded
Temperature:	+32 to 350°F (125 FLG) +32 to 400°F (250 FLG)
Rangeability:	50:1

The valve closes — The valve opens

2923 Two-Way Cylinder Balanced Valve

A balanced valve that is an effective solution for sizes over 3" and for higher pressures. It requires less force to operate than unbalanced valves so smaller actuators can be used. Its single seat o-ring seal design facilitates ANSI Class IV shut-off. It is limited to cleaner fluids.

Sizes:	2-1/2, 3, 4, 5, 6 inch
Body:	ANSI B16.1 Iron 125LB Flange or 250LB Flange
Trim:	EQ%, Bronze, 300 Series Stainless Steel, 17-4 PH Hardened Stainless Steel, or Alloy 6.
Packing:	Guided Low-Friction TFE V-Ring, Spring Loaded
O-Ring:	EPDM (BRZ) Fluoraz 797 (300 SSTrim, 17-4 pH or Alloy 6 Trim)
Temperature:	+32 to 300°F (BRZ) +32 to 350°F (125 FLG w/ 300 SSTrim, 17-4 PH or Alloy 6 Trim) +32 to 400°F (250 FLG w/ 300 SSTrim, 17-4 PH or Alloy 6 Trim)
Rangeability:	50:1

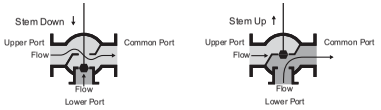
The valve closes — The valve opens

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) +32 to 400°F (250 FLG)
Rangeability:	50:1

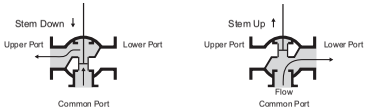


The upper port opens and the lower port closes — The upper port closes and the lower port opens

2932 Three-Way Diverting/Mixing Valve

Designed as a diverting valve with one inlet and two outlets with ANSI Class II shutoff. 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) +32 to 150°F (6 & 8)
Rangeability:	50:1



The upper port opens and the lower port closes — The upper port closes and the lower port opens

Body Pressure-Temperature Ratings:		
Temperature (F)	125 FLG	250 FLG
+32° To 150°	175	400
175°	170	385
200°	165	370
225°	157	355
250°	150	340
275°	145	325
300°	140	310
350°	125	280
375°	-	265
400°	-	250

Pressure ratings are PSIG

For applications below 32° consult factory

Trim Materials	Flowing Differential Pressure Limit
Bronze	50 PSID
300 Series Stainless Steel	100 PSID
17-4 pH Hardened Steel	200 PSID
Alloy 6	300 PSID

PS 2900 C 0305

Flow Coefficients (Cv) Versus Travel

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

Valve		2920 Flow Coefficients (Cv) Two-Way Single Seat Unbalanced Valve									
Valve	Trim	%Travel									
Size (IN)	Style	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
2-1/2	EQ%	65.0	55.6	43.8	29.8	15.4	8.07	5.67	4.11	2.81	1.49
3	EQ%	90.0	83.6	75.1	63.8	49.2	31.6	12.9	4.75	3.37	1.99
4	EQ%	170	159	143	122	95.1	62.9	31.3	15.6	9.89	4.11
5	EQ%	280	258	230	194	150	102	54.7	23.1	14.0	6.40
6	EQ%	360	333	298	255	203	144	83.6	34.1	14.6	7.10
8	EQ%	450	386	318	250	186	130	81.9	44.6	18.3	2.92
10	EQ%	650	556	457	359	267	186	117	64.1	26.5	4.87

Valve		2922 Flow Coefficients (Cv) Two-Way Double Seat Balanced Valve									
Valve	Trim	%Travel									
Size (IN)	Style	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
2-1/2	EQ%	70.0	59.5	45.9	30.2	15.7	8.60	6.36	4.12	3.44	2.75
3	EQ%	100	87.6	71.2	50.8	28.7	12.2	8.54	6.58	4.60	3.27
4	EQ%	200	180	155	126	91.0	53.3	17.8	8.36	6.07	4.54
5	EQ%	260	239	212	178	138	100	74.3	53.8	32.2	9.86
6	EQ%	350	323	286	238	178	113	63.2	44.8	27.5	9.83
8	EQ%	680	619	557	475	370	246	118	43.9	29.0	14.2
10	EQ%	960	886	796	689	574	474	383	285	181	72.3

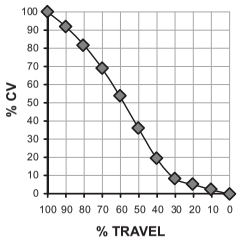
Valve		2923 Flow Coefficients (Cv) Two-Way Cylinder Balanced Valve									
Valve	Trim	%Travel									
Size (IN)	Style	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
2-1/2	EQ%	65.0	55.6	43.8	29.8	15.4	8.07	5.67	4.11	2.81	1.49
3	EQ%	90.0	83.6	75.1	63.8	49.2	31.6	12.9	4.75	3.37	1.99
4	EQ%	170	159	143	122	95.1	62.9	31.3	15.6	9.89	4.11
5	EQ%	280	258	230	194	150	102	54.7	23.1	14.0	6.40
6	EQ%	360	333	298	255	203	144	83.6	34.1	14.6	7.10

3-Way Valves (Control of Liquids)

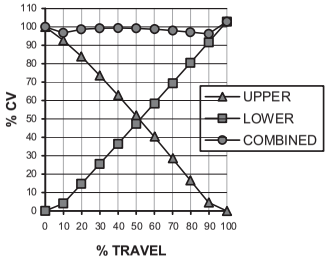
Valve		2930 Flow Coefficients (Cv) Three-Way Mixing Valve
Valve	Trim	Travel
Size (IN)	Style	100%
2-1/2	LINEAR	69
3	LINEAR	86
4	LINEAR	156
5	LINEAR	270
6	LINEAR	347
8	LINEAR	450

Valve		2932 Flow Coefficients (Cv) Three-Way Diverting/Mixing Valve	
Valve	Trim	Travel 100%	
Size (IN)	Style	Upper	Lower
2-1/2	LINEAR	68	75
3	LINEAR	85	95
4	LINEAR	160	180
5	LINEAR	195	220
6	LINEAR	270	300
8	LINEAR	425	510

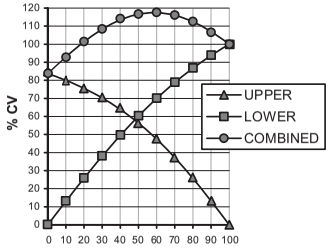
2-WAY VALVE
TYPICAL FLOW CURVE



2930
TYPICAL FLOW CURVE



2932
TYPICAL FLOW CURVE



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WARREN CONTROLS

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	952	1159
25	266	130	236	934	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	1202
300	422	217	399	805	1204
400	448	231	438	778	1216
500	470	243	453	752	1205
600	489	254	475	729	1204

Rectangular Tank Capacity in Gallons

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

or

Gallons = H x W x L (Ft.) x 7.5

Circular Tank Storage Capacity in Gallons

Storage = $6D^2$ x L (Gallons)

Where:
D = Tank Diameter in Feet
L = Length in Feet

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 PSI =	27.7 Inches of Water
1 U.S. Gallon Water =	231 Cubic Inches
1 U.S. Gallon Water =	8.33 Lbs.

Heating Water with Steam

Quick Method

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

Accurate Method

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

Heating or Cooling Water with Water

$$GPM_1 = GPM_2 \times \frac{\text{°F water}_2 \text{ temp. rise or drop}}{\text{°F water}_1 \text{ temp. rise or drop}}$$

Heating or Cooling Water

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

Heating Oil with Steam

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

Heating Air with Water

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

Heating Liquids with Steam

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

Heating Liquids in Steam Jacketed Kettles

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

General Liquid Heating

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

Heating Air with Steam

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

PS 2900 C 0305

Shut-Off ΔP and Cv Ratings

Valve			Actuator		Shut-Off ΔP Two-Way Single Seat Unbalanced 2920							
					Maximum Shut-off ΔP in PSI							
					Fail Closed Reverse Acting				Fail Open Direct Acting			
					Air Signal to Actuator				Air Signal to Actuator			
Valve Size (IN)	Cv Rating	Plug Travel (IN)	Pneumatic Actuator	Spring Range	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
2 1/2	65	3/4	DL49	Low	N/A	N/A	N/A	N/A	20	40	170	N/A
				Full	N/A	N/A	10	N/A	N/A	N/A	130	N/A
				High	30	50	60	N/A	N/A	10	140	N/A
			DL84	Low	N/A	N/A	12	N/A	63	97	319	N/A
				Full	N/A	N/A	12	N/A	N/A	N/A	217	N/A
				High	63	97	114	N/A	N/A	N/A	217	N/A
			DL84XR	Xtra-High	114	148	165	N/A	N/A	N/A	N/A	N/A
			DL115	Low	N/A	5	28	28	98	145	400	400
				Full	N/A	5	28	28	N/A	5	309	400
				High	98	145	169	169	N/A	5	309	400
			DL115XR	Xtra-High	N/A	N/A	400	400	N/A	N/A	N/A	N/A
3	90	3/4	DL49	Low	N/A	N/A	N/A	N/A	10	23	113	N/A
				Full	N/A	N/A	3	N/A	N/A	N/A	86	N/A
				High	16	30	37	N/A	N/A	3	93	N/A
			DL84	Low	N/A	N/A	4	N/A	39	63	217	N/A
				Full	N/A	N/A	4	N/A	N/A	N/A	146	N/A
				High	39	63	75	N/A	N/A	N/A	146	N/A
			DL84XR	Xtra-High	75	99	110	N/A	N/A	N/A	N/A	N/A
			DL115	Low	N/A	N/A	15	15	64	96	308	400
				Full	N/A	N/A	15	15	N/A	N/A	210	373
				High	64	96	113	113	N/A	N/A	210	373
			DL115XR	Xtra-High	N/A	N/A	285	285	N/A	N/A	N/A	N/A
4	170	1 1/4	DL84	Low	N/A	N/A	N/A	N/A	17	30	117	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	77	N/A
				High	17	30	37	N/A	N/A	N/A	77	N/A
			DL115	Low	N/A	N/A	3	3	31	49	168	260
				Full	N/A	N/A	3	3	N/A	N/A	113	205
				High	31	49	58	58	N/A	N/A	113	205
			DL115XR	Xtra-High	N/A	N/A	140	140	N/A	N/A	N/A	N/A
5	280	1 1/2	DL84	Low	N/A	N/A	N/A	N/A	8	16	72	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	46	N/A
				High	8	16	21	N/A	N/A	N/A	46	N/A
			DL115	Low	N/A	N/A	N/A	N/A	17	29	105	163
				Full	N/A	N/A	N/A	N/A	N/A	N/A	70	128
				High	17	28	34	34	N/A	N/A	70	128
			DL115XR	Xtra-High	N/A	N/A	81	81	N/A	N/A	N/A	N/A
6	360	1 1/2	DL84	Low	N/A	N/A	N/A	N/A	3	9	48	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	30	N/A
				High	3	9	12	N/A	N/A	N/A	30	N/A
			DL115	Low	N/A	N/A	N/A	N/A	9	17	70	111
				Full	N/A	N/A	N/A	N/A	N/A	N/A	46	87
				High	9	17	21	21	N/A	N/A	46	87
			DL115XR	Xtra-High	N/A	N/A	54	54	N/A	N/A	N/A	N/A
8	450	2	DL115	Low	N/A	N/A	N/A	N/A	9	16	67	106
				Full	N/A	N/A	N/A	N/A	N/A	N/A	44	83
				High	9	16	20	20	N/A	N/A	44	83
			DL115XR	Xtra-High	N/A	N/A	44	44	N/A	N/A	N/A	N/A
10	650	2 1/2	DL115	Low	N/A	N/A	N/A	N/A	3	7	37	60
				Full	N/A	N/A	N/A	N/A	N/A	N/A	23	46
				High	3	7	10	10	N/A	N/A	23	46
			DL115XR	Xtra-High	N/A	N/A	20	20	N/A	N/A	N/A	N/A

NOTES:

1) 2920 Seat closure ANSI Class IV.

2) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

3) 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.

4) 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

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

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

Shut-Off ΔP and Cv Ratings

NOTES:

1) 2922 Seat closure ANSI Class III.

2) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

3) 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.

4) 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

5) Do Not Use DL115 Actuators on Valves With Bronze Trim.

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

Valve			Actuator		Shut-Off ΔP Two-Way Double Seat Balanced 2922							
					Maximum Shut-off ΔP in PSI							
					Fail Closed Reverse Acting				Fail Open Direct Acting			
					Air Signal to Actuator				Air Signal to Actuator			
Valve Size (IN)	Cv Rating	Plug Travel (IN)	Pneumatic Actuator	Spring Range	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
2 1/2	70	3/4"	DL49	Low	N/A	N/A	113	N/A EXCEEDS DL49 AND DL84 ACTUATORS' MAXIMUM AIR PRESSURE	388	400	400	N/A EXCEEDS DL49 AND DL84 ACTUATORS' MAXIMUM AIR PRESSURE
				Full	N/A	113	250		N/A	113	400	
				High	400	400	400		N/A	250	400	
			DL84	Low	N/A	34	270		400	400	400	
				Full	N/A	34	270		N/A	34	400	
				High	400	400	400		N/A	34	400	
3	100	3/4"	DL49	Low	N/A	N/A	39		267	400	400	
				Full	N/A	39	153		N/A	39	400	
				High	381	400	400		N/A	153	400	
			DL84	Low	N/A	N/A	169		400	400	400	
				Full	N/A	N/A	169		N/A	N/A	400	
				High	400	400	400		N/A	N/A	400	
4	200	3/4"	DL49	Low	N/A	N/A	N/A		117	287	400	
				Full	N/A	N/A	32		N/A	N/A	400	
				High	202	372	400		N/A	32	400	
			DL84	Low	N/A	N/A	44		400	400	400	
				Full	N/A	N/A	44		N/A	N/A	400	
				High	400	400	400		N/A	N/A	400	
5	260	1 1/4"	DL84	Low	N/A	N/A	N/A		340	400	400	
				Full	N/A	N/A	N/A		N/A	N/A	400	
				High	340	400	400		N/A	N/A	400	
6	350	1 1/4"	DL84	Low	N/A	N/A	N/A		242	400	400	
				Full	N/A	N/A	N/A		N/A	N/A	400	
				High	242	400	400		N/A	N/A	400	
8	680	1 1/2"	DL84	Low	N/A	N/A	N/A		85	232	400	
				Full	N/A	N/A	N/A		N/A	N/A	400	
				High	85	232	305		N/A	N/A	400	
10	960	1 1/2"	DL84	Low	N/A	N/A	N/A		13	134	400	
				Full	N/A	N/A	N/A		N/A	N/A	400	
				High	13	134	195		N/A	N/A	400	

Shut-Off ΔP and Cv Ratings

Valve			Actuator		Shut-Off ΔP Two-Way Cylinder Balanced 2923							
					Maximum Shut-off ΔP in PSI							
					Fail Closed Reverse Acting				Fail Open Direct Acting			
Valve Size (IN)	Cv Rating	Plug Travel (IN)	Pneumatic Actuator	Spring Range	Air Signal to Actuator				Air Signal to Actuator			
					3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
2 1/2	65	3/4	DL49	Low	N/A	N/A	N/A	N/A	124	288	400	N/A
				Full	N/A	N/A	42	N/A	N/A	42	400	N/A
				High	206	370	400	N/A	N/A	N/A	N/A	N/A
			DL84	Low	N/A	N/A	53	N/A	400	400	400	N/A
				Full	N/A	N/A	53	N/A	N/A	N/A	400	N/A
				High	400	400	400	N/A	N/A	N/A	400	N/A
3	90	3/4	DL49	Low	N/A	N/A	N/A	N/A	53	193	400	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	N/A
				High	123	263	333	N/A	N/A	N/A	400	N/A
			DL84	Low	N/A	N/A	N/A	N/A	353	400	400	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	N/A
				High	353	400	400	N/A	N/A	N/A	400	N/A
4	170	1 1/4	DL84	Low	N/A	N/A	N/A	N/A	182	369	400	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	N/A
				High	182	369	400	N/A	N/A	N/A	400	N/A
			DL115	Low	N/A	N/A	N/A	N/A	343	400	400	400
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	400
				High	343	400	400	400	N/A	N/A	400	400
5	280	1 1/2	DL84	Low	N/A	N/A	N/A	N/A	79	230	400	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	N/A
				High	79	230	306	N/A	N/A	N/A	400	N/A
			DL115	Low	N/A	N/A	N/A	N/A	219	400	400	400
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	400
				High	219	400	400	400	N/A	N/A	400	400
6	360	1 1/2	DL84	Low	N/A	N/A	N/A	N/A	N/A	127	400	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	N/A
				High	N/A	127	192	N/A	N/A	N/A	400	N/A
			DL115	Low	N/A	N/A	N/A	N/A	124	290	400	400
				Full	N/A	N/A	N/A	N/A	N/A	N/A	400	400
				High	124	290	373	373	N/A	N/A	400	400
			DL115XR	Xtra-High	N/A	N/A	400	400	N/A	N/A	N/A	N/A

NOTES:

1) 2923 Seat closure ANSI Class IV.

2) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

3) 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.

4) 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

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

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

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Shut-Off ΔP and Cv Ratings

NOTES:

1) 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.

2) 2930 Seat closure ANSI Class IV.

3) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

4) 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.

5) 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

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

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

Valve			Actuator		Shut-Off ΔP Three-Way Mixing 2930							
					Maximum Shut-off ΔP in PSI							
					Upper Port Closed Direct Acting				Lower Port Closed Direct Acting			
Valve Size (IN)	Cv Rating	Plug Travel (IN)	Pneumatic Actuator	Spring Range	Air Signal to Actuator				Air Signal to Actuator			
					3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
2 1/2	69	3/4"	DL49	Low	N/A	N/A	N/A	N/A	11	31	161	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	121	N/A
				High	10	30	40	N/A	N/A	N/A	131	N/A
			DL84	Low	N/A	N/A	12	N/A	54	88	310	N/A
				Full	N/A	N/A	12	N/A	N/A	N/A	208	N/A
				High	63	97	114	N/A	N/A	N/A	208	N/A
			DL84XR	Xtra-High	114	148	165	N/A	N/A	N/A	208	N/A
			DL115	Low	N/A	5	28	28	82	129	400	400
				Full	N/A	5	28	28	N/A	N/A	293	400
				High	98	145	169	169	N/A	N/A	293	400
			DL115XR	Xtra-High	N/A	N/A	400	400	N/A	N/A	129	363
3	86	3/4"	DL49	Low	N/A	N/A	N/A	N/A	3	17	107	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	79	N/A
				High	3	16	23	N/A	N/A	N/A	86	N/A
			DL84	Low	N/A	N/A	4	N/A	33	57	211	N/A
				Full	N/A	N/A	4	N/A	N/A	N/A	140	N/A
				High	39	63	75	N/A	N/A	N/A	140	N/A
			DL84XR	Xtra-High	75	99	110	N/A	N/A	N/A	140	N/A
			DL115	Low	N/A	N/A	15	15	53	85	296	400
				Full	N/A	N/A	15	15	N/A	N/A	199	362
				High	64	96	113	113	N/A	N/A	199	362
			DL115XR	Xtra-High	N/A	N/A	285	285	N/A	N/A	85	248
4	156	1 3/8"	DL84	Low	N/A	N/A	N/A	N/A	14	27	114	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	74	N/A
				High	17	30	37	N/A	N/A	N/A	74	N/A
			DL115	Low	N/A	N/A	3	3	25	43	162	253
				Full	N/A	N/A	3	3	N/A	N/A	107	198
				High	31	49	58	58	N/A	N/A	107	198
			DL115XR	Xtra-High	N/A	N/A	136	136	N/A	N/A	43	134
5	270	1 3/8"	DL84	Low	N/A	N/A	N/A	N/A	5	14	70	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	44	N/A
				High	8	16	21	N/A	N/A	N/A	44	N/A
			DL115	Low	N/A	N/A	N/A	N/A	13	24	100	159
				Full	N/A	N/A	N/A	N/A	N/A	N/A	65	124
				High	17	28	34	34	N/A	N/A	65	124
			DL115XR	Xtra-High	N/A	N/A	84	84	N/A	N/A	24	83
6	347	1 3/8"	DL84	Low	N/A	N/A	N/A	N/A	2	8	46	N/A
				Full	N/A	N/A	N/A	N/A	N/A	N/A	28	N/A
				High	3	9	12	N/A	N/A	N/A	28	N/A
			DL115	Low	N/A	N/A	N/A	N/A	7	15	67	108
				Full	N/A	N/A	N/A	N/A	N/A	N/A	43	84
				High	9	17	21	21	N/A	N/A	43	84
			DL115XR	Xtra-High	N/A	N/A	56	56	N/A	N/A	15	55
8	450	2 1/2"	DL115	Low	N/A	N/A	N/A	N/A	6	14	64	103
				Full	N/A	N/A	N/A	N/A	N/A	N/A	41	80
				High	9	16	20	20	N/A	N/A	41	80
			DL115XR	Xtra-High	N/A	N/A	38	38	N/A	N/A	14	53

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Shut-Off ΔP and Cv Ratings

Valve			Actuator		Shut-Off ΔP Three-Way Diverting/Mixing 2932							
					Maximum Shut-off ΔP in PSI							
					Upper Port Closed Direct Acting				Lower Port Closed Direct Acting			
Valve Size (IN)	Cv Rating	Plug Travel (IN)	Pneumatic Actuator	Spring Range	Air Signal to Actuator				Air Signal to Actuator			
					3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
2 1/2	68/75	3/4"	DL49	HIGH	N/A	106	108	N/A	N/A	N/A	110	N/A
			DL84	HIGH	106	108	110	N/A	N/A	N/A	115	N/A
3	85/95	3/4"	DL49	HIGH	N/A	104	106	N/A	N/A	N/A	108	N/A
			DL84	HIGH	104	106	108	N/A	N/A	N/A	113	N/A
4	160/180	3/4"	DL49	HIGH	N/A	N/A	104	N/A	N/A	N/A	106	N/A
			DL84	HIGH	102	104	106	N/A	N/A	N/A	111	N/A
			DL115	HIGH	106	108	111	111	N/A	N/A	113	115
5	195/220	1-1/4"	DL84	HIGH	99	102	104	N/A	N/A	N/A	108	N/A
			DL115	HIGH	104	106	108	108	N/A	N/A	111	113
6	270/300	1-3/8"	DL84	HIGH	97	99	102	N/A	N/A	N/A	106	N/A
			DL115	HIGH	101	104	106	106	N/A	N/A	108	110
8	425/510	1-1/5"	DL115	HIGH	99	101	104	104	N/A	N/A	106	108

NOTES:

1) 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 Acuators used with the 2932 are direct acting. The upper port fails closed on loss of air pressure to the actuator.

2) 2932 Seat closure ANSI Class II.

3) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

4) 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.

5) 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

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

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Dimensions & Weights

Component 2920		Dimension (IN) by Valve Size (IN)						
Variable		2-1/2	3	4	5	6	8	10
A	125FLG	9	10	13	15-3/4	17-3/4	16-1/4	20
	250FLG	9-5/8	10-3/4	13-5/8	16-5/8	18-5/8	16-1/4	21-3/8
B		4-3/4	5-3/8	6-3/8	7-3/8	8	8-7/8	9-7/8
C	DL49 Direct*	17-5/8	18-1/2	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
	DL84 Direct*	21-5/8	22-1/2	23-1/2	24-1/8	24-3/4	N/A	N/A
	DL84 or 84XR Reverse	21	21-7/8	22-7/8	23-1/2	24-1/8	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
	DL115 or 115XR Reverse	CF	CF	CF	CF	CF	CF	CF
H	DL49	4-1/4	5	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
	DL115 or 115XR Direct	11-1/8	11-7/8	13	13-5/8	14-1/4	15-1/2	16
	DL115 or 115XR Reverse	CF	CF	CF	CF	CF	CF	CF
Item		**Weight (LB) by Valve Size (IN)**						
Variable		2-1/2	3	4	5	6	8	10
125FLG		55	72	119	134	175	270	417
250FLG		64	77	131	166	233	360	510

Component 2923		Dimension (IN) by Valve Size (IN)				
Variable		2-1/2	3	4	5	6
A	125FLG	9	10	13	15-3/4	17-3/4
	250FLG	9-5/8	10-3/4	13-5/8	16-5/8	18-5/8
B		4-3/4	5-3/8	6-7/8	7-7/8	8-1/2
C	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
	DL84 Direct*	22-1/8	23	24-1/8	24-5/8	25-1/4
	DL84 Reverse	21-1/2	22-3/8	23-1/2	24	24-5/8
	DL115 or 115XR Direct*	N/A	N/A	36-1/2	37	37-5/8
	DL115 or 115XR Reverse	N/A	N/A	CF	CF	CF
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	13-1/2	14-1/8	14-3/4
	DL115 or 115XR Reverse	N/A	N/A	CF	CF	CF
Item		**Weight (LB) by Valve Size (IN)**				
Variable		2-1/2	3	4	5	6
125FLG		57	75	127	149	197
250FLG		66	80	139	181	256

Component 2922		Dimension (IN) by Valve Size (IN)						
Variable		2-1/2	3	4	5	6	8	10
A	125FLG	7-3/4	9	11-3/8	12	14-1/8	16-1/4	20
	250FLG	8-3/8	9-3/4	12	12-7/8	14-1/2	16-1/4	21-3/8
B		4-1/8	4-3/8	5	6-7/8	7-5/8	8-7/8	9-7/8
C	DL49 Direct*	17-1/4	17-1/2	19	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
	DL84 Direct*	21-1/4	21-1/2	23	24	24-7/8	26	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
H	DL49	3-3/8	4	5-5/8	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	10-7/8
Item		**Weight (LB) by Valve Size (IN)**						
Variable		2-1/2	3	4	5	6	8	10
125FLG		32	42	77	124	169	290	435
250FLG		42	54	96	162	220	380	540

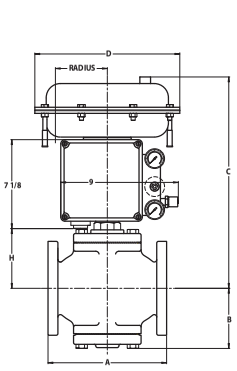
* Includes 1-3/8 inch for air fitting
H = Centerline of pipe to bottom of positioner
CF = Consult factory
N/A = Not Available

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

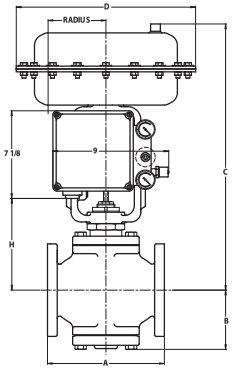
Face to face dimensions conform to historical Warren Controls standard and are **NOT** ANSI/ISA compatible.

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

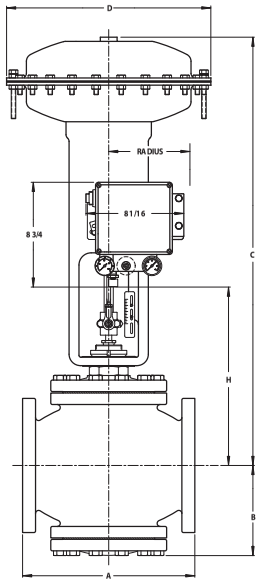
Positioner Removal Clearance
Allow 3-1/4 Inch beyond 760 for cover removal/service.



2-WAY w/DL49
& 760 Positioner



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



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

PS 2900 C 0305

Component 2930		Dimension (IN) by Valve Size (IN)					
Variable		2-1/2	3	4	5	6	8
A	125FLG	9	10	13	15-3/4	17-3/4	16-1/4
	250FLG	9-5/8	10-3/4	13-5/8	16-5/8	18-5/8	16-1/4
B	125FLG	7-1/8	8	9-7/8	9-1/4	9-7/8	11-7/8
	250FLG	7-3/8	8-3/8	10-1/4	10-3/8	11	12-3/8
C	DL49 Direct*	17-5/8	18-1/2	N/A	N/A	N/A	N/A
	DL84 or 84XR Direct*	21-5/8	22-1/2	23-1/2	22-3/8	23-1/8	N/A
	DL115 or 115XR Direct*	34	34-7/8	35-7/8	34-3/4	35-1/2	38-3/8
H	DL49	4-1/4	5	N/A	N/A	N/A	N/A
W/760	DL84 or 84XR	6	6-7/8	7-7/8	6-3/4	7-1/2	N/A
	DL115 or 115XR Direct	11-1/8	11-7/8	13	11-7/8	12-5/8	15-1/2
Item		**Weight (LB) by Valve Size (IN)**					
Variable		2-1/2	3	4	5	6	8
125FLG		64	83	139	157	202	306
250FLG		73	94	157	211	283	398

Component 2932		Dimension (IN) by Valve Size (IN)					
Variable		2-1/2	3	4	5	6	8
A	125FLG	9	10	13	12	14-1/8	16-1/4
	250FLG	9-5/8	10-3/4	13-5/8	12-7/8	14-1/2	16-1/4
B	125FLG	7-1/8	8	9-7/8	10-1/2	11-1/8	11-7/8
	250FLG	7-3/8	8-3/8	10-1/4	11	11-1/2	12-3/8
C	DL49 Direct*	17-5/8	18-1/2	19-1/4	N/A	N/A	N/A
	DL84 or 84XR Direct*	21-5/8	22-1/2	23-1/4	23-7/8	N/A	N/A
	DL115 or 115XR Direct*	N/A	N/A	35-5/8	36-1/4	36-7/8	38
H	DL49	4-1/4	5	5-7/8	N/A	N/A	N/A
W/760	DL84 or 84XR	6	6-7/8	7-7/8	8-1/4	8-7/8	10
	DL115 or 115XR Direct	N/A	N/A	12-3/4	13-5/8	14	15
Item		**Weight (LB) by Valve Size (IN)**					
Variable		2-1/2	3	4	5	6	8
125FLG		59	78	140	154	203	316
250FLG		73	94	166	215	284	407

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

Actuator		Dimension (IN)
D	DL49	11
	DL84 or 84XR	13-7/8
	DL115 or 115XR	16-3/4
RADIUS	DL49	7-7/8
W/760	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

Actuator Removal Clearance
Above DL49, 84, or 84XR allow 5-5/8 IN
Above DL115 or 115XR allow 6-1/8 IN

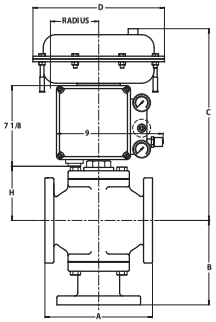
Consult factory for drawings, weights, and dimensions of configurations not shown.

Actual shipping weights may vary.

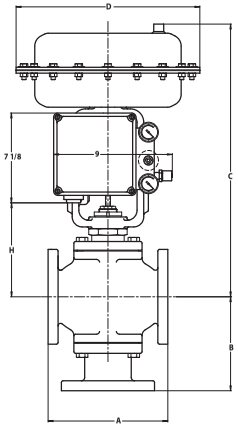
Face to face dimensions conform to historical Warren Controls standard and are **NOT** ANSI/ISA compatible.

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

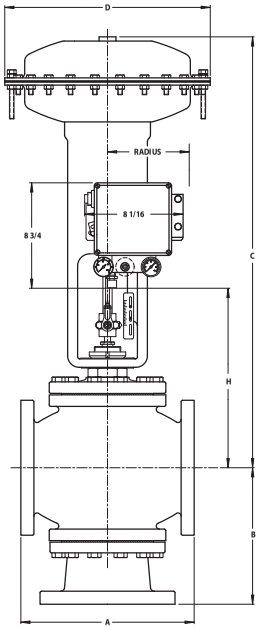
Positioner Removal Clearance
Allow 3-1/4 Inch beyond 760 for cover removal/service.



3-WAY w/DL49
& 760 Positioner



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



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

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

WARREN CONTROLS

Actuators

Actuator		Spring Range (PSI)			
Size	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 & DL115	Direct	3-9	3-15	9-15	N/A
DL84 & DL115	Reverse	3-9	3-15	9-15	N/A
DL84XR &DL115XR	Direct	N/A	N/A	N/A	See Note
DL84XR & DL115XR	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/P's 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
Diaphragm: Buna-N Fabric Reinforced
Diaphragm Chambers: Steel
Yoke: DL49, 84 & 84XR Ductile Iron
DL115 & 115XR Aluminum
Stem: 300 Series Stainless Steel
Finish: DL49 Epoxy-Coated
DL84, 84XR, 115, & 115XR Acrylic Enamel
Ambient Temperature: DL49 -20 to 160°F
DL84, 84XR, 115 & 115XR -40 to 180°F
Mounting: Vertical Above or Below Valve
Handwheel: Available on DL84, 84XR, 115 & 115XR
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:

BLX 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, 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: 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:
FM Intrinsically Safe: Class I II III, Div 1, Groups A,B,C,D,E,F,G.
CSA Intrinsically Safe: Class I, Div 1, Groups A, B, C, D.
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, 0.28 SCFM at 40 PSIG

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Positioners (Continued)

BLX Electro-Pneumatic Explosion Proof

Models: BFX_: Full Range Signal (4-20 mA)
BLX_: Low Range Signal (4-12 mA)
BHX_: High Range Signal (12-20 mA)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Approvals & Ratings:
FM Intrinsically Safe: Class I II III, Div 1, Groups A,B,C,D,E,F,G.
Non-Incendive: Class I, Div 2, Groups A,B,C.
Explosion Proof: Class I, Div 1, Groups B,C,D.
Class I II III, Div 1, Groups E,F,G.
CSA Intrinsically Safe: Class I, Div 1, Groups A,B,C,D.
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.
Explosion Proof: Class I, Div 1, Groups B,C,D.
Class II, Div 1, 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

BLX Electro-Pneumatic Fail Freeze

Models: BFF_: Full Range Signal (4-20 mA)
BLF_: Low Range Signal (4-12 mA)
BHF_: High Range Signal (12-20 mA)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Supply Pressure: 20 to 100 PSIG Max **Not to exceed actuator rating**
Air Consumption: 0.21 SCFM at 30 PSIG, 0.28 SCFM at 40 PSIG

All Models:

Construction: Aluminum Housing with Polyester Powder Coat
Action: Direct or Reverse
Media: Clean Dry Oil Free Air Filtered to 5 micron
Air Connections: 1/4 NPT
Flow Capacity: 9.8 SCFM at 30 PSIG, 13.1 SCFM at 40 PSIG
Electrical Connection: 1/2 NPT
Gauges: Input 0-30 PSIG, Output 0-60 PSIG, Supply 0-60 PSIG, Housing Black Steel Case with Chrome Ring
Ambient Temperature: -40 to 185°F (Except Fail Freeze –4 to 158°F)
Mounting: Yoke Mounted
Limit Switches and Feedback Options are NEMA 4X, IP66 only, and are not suitable for hazardous locations.

Moore 760 Models:

760P Pneumatic

Models: 76P_: Full Range Signal (3-15 PSIG)
Options Limit Switches, 4-20 mA Feedback *(Reduced feedback span for valves with less than 1 inch travel – Call factory for details)*

760E Electro-Pneumatic

Models: 76E_: Full Range Signal (4-20 mA)
Options Limit Switches, 4-20 mA Feedback *(Reduced feedback span for valves with less than 1 inch travel – Call factory for details)*
Approvals & Ratings:
FM Intrinsically Safe: Class I, Div 1, Groups A,B,C,D.
Class II, Div 1, Groups E,F,G.
Class III, Div 1.
Non-Incendive: Class I, Div 2, Groups A,B,C,D.
Suitable for: Class II, Div 2, Groups F,G.
Class III, Div 2.

760E Electro-Pneumatic (Continued)

CSA Intrinsically Safe: Class I, Div 1, Groups A,B,C,D.
Class II, Div 1, Groups E,F,G.
Class III, Div 1.
Suitable for: Class I, Div 2, Groups A,B,C,D.
Class II, Div 2, Groups E,F,G.
Class III, Div 2.

All Models:

Construction: Aluminum Housing with Epoxy/Polyester Powder Coat
Ingress & Corrosion Protection: NEMA 4, 4X, IP65
Action: Direct or Reverse
Supply Pressure: 150 PSIG Max **Not to exceed actuator rating**
Media: Clean Dry Oil Free Air Filtered to 3 micron
Flow Capacity: 9.0 SCFM
Air Consumption: 0.5 SCFM Typical
Air Connections: 1/4 NPT
Electrical Connection: 3/4 NPT
Gauges: Input 0-30 PSIG, Output 0-60 PSIG, Housing Black Steel Case with Chrome Ring
Ambient Temperature: 760P -40 to 180°F, 760E –40 to 167°F
Mounting: Yoke Mounted

Westlock ICoT Models:

Electro-Pneumatic

Models: 510_: Full Range Signal (4-20 mA)
Options 2SPDT Limit Switches

Intelligent with Keypad

Models: 520_: Full Range Signal (4-20 mA)
Calibration 3 Button Keypad
Options 2SPDT Limit Switches, 4-20 mA Feedback

Intelligent with HART

Models: 530_: Full Range Signal (4-20 mA)
Calibration 3 Button Keypad & HART
Options 2SPDT Limit Switches, 4-20 mA Feedback

Intelligent with Foundation Fieldbus

Models: 540_: Full Range Signal (4-20 mA)
Calibration 3 Button Keypad & Foundation Fieldbus
Options 2SPDT Limit Switches, 4-20 mA Feedback

All Models:

Construction: Engineered Resin Housing
Ingress & Corrosion Protection: NEMA 4, 4X
Approvals & Ratings: Non-Incendive Groups A-G, Div 2
Action: Direct or Reverse
Supply Pressure: 15 to 45 PSIG **Not to exceed actuator rating**
Media: Clean Dry Oil Free Air Filtered to 40 micron
Flow Capacity: 8.0 SCFM at 25 PSIG
Air Consumption: 0.003 SCFM at 20 PSIG
Air Connections: 1/4 NPT
Electrical Connection: 1/2 NPT
Gauges: Supply 0-60 PSIG, Output1 0-60 PSIG, Housing Black Steel Case with Chrome Ring
Ambient Temperature: -40 to 180°F
Mounting: Yoke Mounted

Actuators, Positioners, & Accessories

Position Indication Switches

Proximity Mark 1

Models: 2 SPDT Switches
4 SPDT Switches
6 SPDT Switches
2 SPDT Switches w/ 2K Potentiometer
2 SPDT Switches w/ 4-20 mA Feedback
Construction: Aluminum Housing, Hard Anodized
Locations: NEMA 1, 2, 3, 3R, 3S
Ambient Temperature: -40 to 180°F
Electrical Connection: 3/4 NPT, Terminal Strip
Mounting: Yoke Mounted

I/P's

Type 500X

Locations: NEMA 3
Construction: Zinc Alloy Base with Aluminum Bonnet, Epoxy Painted
Ranges: 3-9, 9-15, 3-15, 1-17, or 6-30 PSI
Supply Pressure: Minimum 3 PSIG Above Maximum Output
Maximum 100 PSIG **Not to Exceed Actuator Rating**
Flow Capacity: 4.5 SCFM at 25 PSIG,12 SCFM at 100 PSIG
Air Consumption: 0.05 SCFM Midrange Typical
Ambient Temperature: -20 to 140°F

Type 550X

Locations: NEMA 4X (IP65)
Construction: Chromate-treated Aluminum with Epoxy Paint
Ranges: 0-30, or 0-60 PSI
Supply Pressure: Minimum 5 PSIG Above Maximum Output
Maximum 100 PSIG **Not to Exceed Actuator Rating**
Flow Capacity: 12 SCFM at 100 PSIG
Air Consumption: 6.0 SCFH Midrange Typical
Ambient Temperature: -20 to 150°F

Type 950X

Locations: NEMA 4X (IP65), Explosion proof
Construction: Chromate-treated Aluminum with Epoxy Paint
Ranges: 3-15 PSI
Supply Pressure: Minimum 5 PSIG Above Maximum Output
Maximum 100 PSIG **Not to Exceed Actuator Rating**
Flow Capacity: 4.5 SCFM at 25 PSIG
Air Consumption: 3.0 SCFH Midrange Typical.
Ambient Temperature: -40 to 160°F

I/P's (Continued)

All Models:

Input: 4-20 mA
Field Reversible
Air Connections: 1/4 NPT
Electrical Connection: 1/2 NPT, Pigtail Leads
Media: Clean Dry Oil Free Air Filtered to 40 micron
Mounting: Yoke Mounted

Air Filter Regulators

Models: Type 300, Type 350SS
Output Ranges: Type 300, 0-30 or 0-60 PSIG
Type 350SS, 0-100 PSIG
Supply Pressure: Type 300, 250 PSIG Maximum
Type 350SS, 290 PSIG Maximum
Construction: Type 300, Die-Cast Aluminum with Irridite and Baked Epoxy Paint
Type 350SS, 316 Stainless Steel
Gauge: Type 300, Output, Housing Steel Painted
Type 350SS,Output, Housing Stainless Steel
Air Connections: 1/4 NPT
Filter: Type 300, 40 micron. Type 350SS, 25 micron
Mounting: Chamber Mounted

Solenoids

Models: 8320G184, EF8320G184, 8320G202, EF8320G202
Construction: (EF)8320G184, 3-Way Brass
(EF)8320G202, 3-Way Stainless Steel
Locations: 83206G184 & 8320G202, Watertight, Types 1, 2, 3, 3S, 4 & 4X
EF8320G184 & EF8320G202, Explosion proof and Watertight, Types 3, 3S, 4, 4X 6, 6P, 7 & 9
Supply: 120VAC
Ambient Temperature: +32 to 125°F
Air Connections: 1/4 NPT
Electrical Connection: 1/2 NPT, Pigtail Leads
Approvals: CSA, UL, CE
Mounting: Chamber Mounted

Air Tubing

Standard: Copper
Optional: Stainless Steel

Factory Default Settings

Positioners

Valve Type	Actuator Action	Input Signal: Pneumatic	Input Signal: Electro-Pneumatic	Input Signal: Increasing Signal	Failure Modes: Loss of Signal[1] Valve Fails…	Failure Modes: Loss of Supply Valve Fails…
2920, 22 & 23	Direct	3-15 PSI	4-20 mA	Closes Valve	Open	Open
	Reverse	3-15 PSI	4-20 mA	Opens Valve	Closed	Closed
2930 & 32	Direct	3-15 PSI	4-20 mA	Closes Lower Port/ Opens Upper Port	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open

[1] Valves with Fail Freeze Positioners Fail in Last Position on Loss of Signal.

Positioner Feedback

Valve Type	Actuator Action	Feedback Signal[2]	Signal Increases as
2920, 22 & 23	Direct	4-20 mA	Valve Closes
	Reverse	4-20 mA	Valve Opens
2930 & 32	Direct	4-20 mA	Lower Port Closes/ Upper Port Opens

[2] Reduced feedback span for valves with 760 and less than 1 inch travel.

Positioner Limit Switches

Valve Type	Position	Settings: Switch 1	Settings: Switch 2
2920, 22 & 23	Valve Closed	Closed	Open
	Valve Open	Open	Closed
2930 & 32	Upper Port Closed	Closed	Open
	Lower Port Closed	Open	Closed

I/P's

Valve Type	Actuator Action	Input Signal	Increasing Signal	Failure Modes: Loss of Signal Valve Fails…	Failure Modes: Loss of Air Supply Valve Fails…
2920, 22 & 23	Direct	As Required For Shut-off	Closes Valve	Open	Open
	Reverse	As Required For Shut-off	Opens Valve	Closed	Closed
2930 & 32	Direct	As Required For Shut-off	Closes Lower Port/ Opens Upper Port	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open

SOLENOIDS (without Positioners or I/P's)

Valve Type	Actuator Action	Solenoid Energized	Failure Modes: Loss of Signal Valve Fails…	Failure Modes: Loss of Air Supply Valve Fails…	Failure Modes: Solenoid De-energized Valve Fails…
2920, 22 & 23	Direct	Closes Valve	Open	Open	Open
	Reverse	Opens Valve	Closed	Closed	Closed
2930 & 32	Direct	Closes Lower Port/ Opens Upper Port	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open

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

Valve Type	Actuator Action	Feedback Signal: Potentiometer[3]	Feedback Signal: mA	Feedback Signal Increases as
2920, 22 & 23	Direct	0-350 ohm	4-20 mA	Valve Closes
	Reverse	0-350 ohm	4-20 mA	Valve Opens
2930 & 32	Direct	0-350 ohm	4-20 mA	Lower Port Closes/ Upper Port Opens

[3] Span varies from approx 155 to 350 ohm depending on actuator and travel.

Limit Switches

Valve Type	Position	Settings: Switch 1, 3, 5	Settings: Switch 2, 4, 6
2920, 22 & 23	Valve Closed	Closed	Open
	Valve Open	Open	Closed
2930 & 32	Upper Port Closed	Closed	Open
	Lower Port Closed	Open	Closed

Air Filter Regulators

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

Configurations

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

29□ – □□ □□□ R □ □ □ □ □ □

2. OPTIONS

VALVE BODY

Model	Valve Type	Size	Body Material	End Connection	Trim Style	Trim Material	Trim Cv		Packing Type
29N 49" or 84" Pneumatic **291** 115" Pneumatic	**20** 2-Way Single Seat **22** 2-Way Double Seated **23** 2-Way Cylinder Bal. **30** 3-Way Mixing **32** 3-Way Diverting	**250** 2-1/2 inch **300** 3 inch **400** 4 inch **500** 5 inch **600** 6 inch **800** 8 inch **010** 10 inch	**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 **6** Alloy 6 Wrapped	**F** Full Port		**T** Teflon **G** Graphite *Graphite Packing Used for Temp up to 500F where Body Pressure/Temp is not Violated!*

NOTE: Valve Type 22 is Only Used with 29N Body & DL49/DL84 Actuators.

VALVE TYPE / TRIM MATERIAL COMBINATIONS:

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

VALVE TYPE / ACTUATOR COMPATIBILITY:

VALVE STYLE	VALVE SIZES	ACTUATORS
Type 20	2-1/2" & 3"	DL49 & DL84XR
Type 20	2-1/2" – 6"	DL84
Type 20	2-1/2" – 10"	DL115 & DL115XR
Type 22	2-1/2" – 4"	DL49 & DL84
Type 22	5" – 10"	DL84
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 & DL84XR
Type 30	2-1/2" – 6"	DL84
Type 30	2-1/2" – 8"	DL115 DL115XR
Type 32	2-1/2" – 4"	DL49
Type 32	2-1/2" – 6"	DL84
Type 32	4" – 8"	DL115

ACTUATOR

Actuator Series	Action	Spring Range	Handwheel
00 None DIAPHRAGMS: **49** DL49 (49 Sq.In.) **84** DL84 (84 Sq.In.) **8X** DL84XR (84 Ext. Rng.) **15** DL115 (115 Sq.In.) **5X** DL115XR *NOTE : 5X & 8X Only in Xtra-High Spring Range, Reverse Acting*	**0** None **R** Reverse Stem Fail Down **D** Direct Stem Fail Up	**0** None **L** Low 4-10psi 49R ; 3-9psi 49D, 84R/D, 115R/D **F** Full 5-14psi 49R ; 4-13psi 49D; 3-15psi 84R/D, 115R/D **H** High 9-15 psi 84; 115 10-14 psi 49R 8-12 psi 49D **X** Xtra-High DL84XR & DL115XR	**0** None **R** Reverse **D** Direct *NOTE : DL84; DL115; DL84XR & DL115XR only - Must match action.*

FAILURE MODES:

MODE	VALVE TYPE	ACTUATOR ACTION
Closed	20/22	Reverse
Open	20/22	Direct
Upper Closed*	30/32	Direct
Upper Open	30/32	Reverse

*Standard

ACCESSORIES

Positioners, I/P's & Limit Switches	Air Filter Regulators	ASCO Solenoids	Special Options
0000 None POSITIONERS: **BxP_** BLX Pneumatic **BxE_** BLX ElectroPneumatic **BxI_** BLX ElectroPneu. Intrn. Safe **BxX_** BLX ElectroPneu. Exp. Proof **BxF_** BLX ElectroPneu. Fail Freeze **76P_** Moore760 Pneumatic **76E_** Moore760 Electro-Pneumatic **510_** Westlock ICoT Electro-Pneumatic **520_** Westlock ICoT Intelligent-Keypad **530_** Westlock ICoT Intelligent-Hart **540_** Westlock ICot Found.Fieldbus PROXIMITY SWITCHES: **PX11** Mark 1 Series - 2 ea. SPDT **PX12** Mark 1 Series - 2 ea. SPDT w/2k Pot. **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 I/P's *Use with Diaphragm Only* **MAP1** Type 500X I/P, 3-9 PSI **MAP2** Type 500X I/P, 9-15 PSI **MAP3** Type 500X I/P, 3-15 PSI **MAP4** Type 500X I/P, 1-17 PSI **MAP5** Type 500X I/P, 6-30 PSI **MAP6** Type 550X I/P, 0-30 PSI **MAP7** Type 550X I/P, 0-60 PSI-*For 15 or 5X only* **MAP9** Type 950X I/P, 3-15 EXP	**0** None **A** Type 300, 0-30 PSI **B** Type 300, 0-60 PSI **D** Type 350SS, 0-100 PSI	**0** None **A** 8320G184 3-Way Brass **B** 8320G202 3-Way SS **L** EF8320G184 3-Way EXP Br. **M** EF8320G202 3-Way EXP SS *120 VAC Coils*	**0** None **S** Special Opts or Set-up **T** SS Tubing **G** SS Tagging **B** SS Tubing and Tagging

x digit spec.
- **F** Full Range Signal, 3-15 PSI or 4-20mA
- **L** Low of Split Range, 3-9 PSI or 4-12mA
- **H** High of Split Range, 9-15 PSI or 12-20mA

4th digit spec.
- **0** No Additions
- **L** w/Mech. Lmt Swtch's
- **F** w/4-20 Feedback
- **B** w/Switch's & Feedback

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

ACTUATOR / BODY COMPATIBILITY:

DIAPHRAGM	BODY
49 49 Sq.In. (DL49)	For 29N Bodies
84 84 Sq.In. (DL84)	For 29N Bodies
8X DL84XR	For 29N Bodies
15 115 Sq.In. (DL115)	For 291 Bodies
5X DL115XR	For 291 Bodies

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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: • 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.	**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 flg	**ends** Buttweld, NPT	**ends** Flange	**ends** 150,300 RF flg	**ends** 150,300 RF flg
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 II, III, IV	**shutoff** class IV, VI	**shutoff** class IV, VI
rangeability 50:1	**rangeability** 50:1	**rangeability** 50:1	**rangeability** 100:1	**rangeability** 50:1
• Heavy Duty • Severe Service • High Pressure Differentials • Corrosive Materials, Liquids, Gases & Steam • Modulating or On/Off Control	• Economical • Precision Control • Suited for Gases, Steam, or Liquids that are Not Viscous or Solids Bearing	• High Capacity • General Purpose • Moderate Pressure Drops • Compatible Liquids and Gas, Steam & Water • Modulating or On/Off Control	• 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

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

PS.2900.C.0305

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

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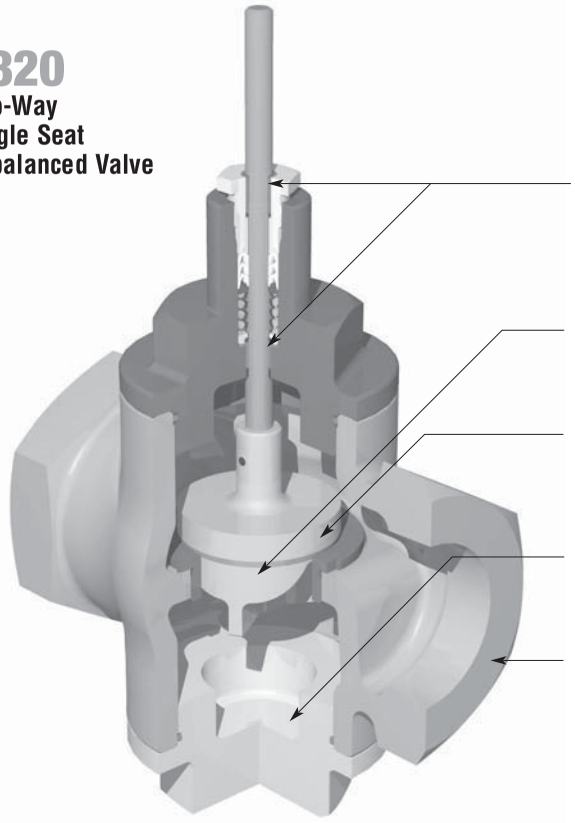
2820
Two-Way
Single Seat
Unbalanced Valve



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 hysterisis and optimum control.

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

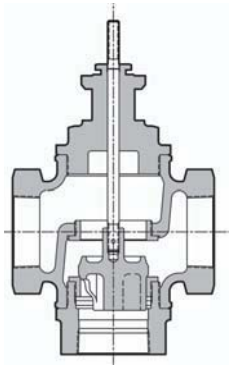
Port Guided Plug Assembly
provides stability and desired equal percentage flow characteristic.

Lower Plug
offers easy access for inspection and clean out.

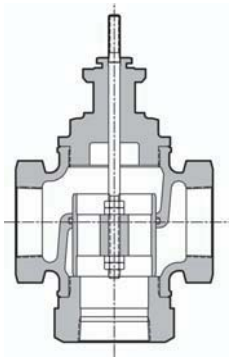
Rugged Body
with a selection of port reductions.

SERIES: 2800

Precision Globe Control Valves

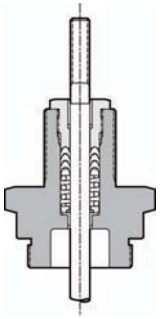


2830
Three-Way Mixing Valve Bronze Body

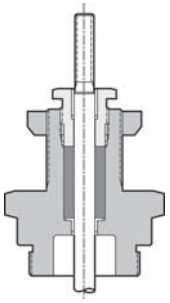


2832
Three-Way Diverting/Mixing Valve Bronze Body

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



Guided Low-Friction TFE V-Ring Packing Spring Loaded



Adjustable Graphite Packing

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
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WARREN CONTROLS

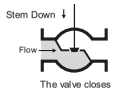
Body Style Versus Application

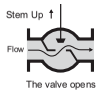
2-Way Valves (Control of Liquids, Gases, and Steam)

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 inch
Body:	ANSI B16.15 Bronze 250LB Threaded (NPT) or 316 Stainless Steel 300LB Threaded (NPT)
Trim:	EQ% 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) +32 to 450°F (316 Stainless Steel 300LB 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	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

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

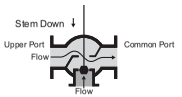
Pressure ratings are PSIG
For applications below 32° consult factory.
For applications above 375°, 300 THD Stainless Steel Body is recommended.

3-Way Valves (Control of Liquids)

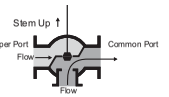
2830 Three-Way Mixing Valve

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 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



The upper port opens and the lower port closes

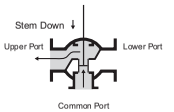


The upper port closes and the lower port opens

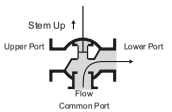
2832 Three-Way Diverting/Mixing Valve

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 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



The upper port opens and the lower port closes



The upper port closes and the lower port opens

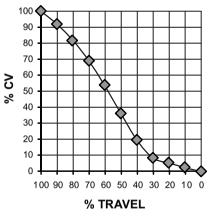
PS 2800 C 0305

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

Valve — 2820 Flow Coefficients (Cv) — Two-Way Single Seat Unbalanced Valve

Valve Size(IN)	Trim Style	Trim Size(IN)	Port Size	%Travel 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	1.92	0.95	0.69	0.43	0.17
		0.626	1SR	3.20	3.16	2.29	1.61	1.19	0.75	0.51	0.39	0.26	0.13
		0.626	2SR	1.50	1.44	0.96	0.72	0.52	0.42	0.31	0.21	0.10	0.06
	LINEAR	0.876	FULL	6.00	5.40	4.80	4.20	3.60	3.00	2.40	1.80	1.20	0.60
3/4	EQ%	0.876	FULL	7.20	7.09	5.53	3.51	2.53	1.73	1.24	0.88	0.52	0.27
		0.876	1SR	5.50	5.31	3.73	2.64	1.95	1.21	0.96	0.70	0.43	0.17
		0.626	2SR	3.30	3.30	2.34	1.63	1.20	0.75	0.51	0.39	0.26	0.13
		0.626	3SR	1.50	1.45	0.96	0.73	0.52	0.42	0.31	0.21	0.10	0.06
	LINEAR	0.876	FULL	7.20	6.48	5.76	5.04	4.32	3.60	2.88	2.16	1.44	0.72
1	EQ%	1.126	FULL	10.0	9.70	6.52	4.40	2.82	2.04	1.36	0.81	0.55	0.30
		0.876	1SR	8.60	8.38	6.09	3.64	2.58	1.74	1.25	0.89	0.52	0.27
		0.876	2SR	6.00	5.79	3.88	2.70	1.97	1.22	0.96	0.70	0.43	0.17
		0.626	3SR	3.40	3.41	2.38	1.64	1.20	0.75	0.51	0.39	0.26	0.13
		0.626	4SR	1.50	1.46	0.97	0.73	0.53	0.42	0.31	0.21	0.10	0.06
	LINEAR	1.126	FULL	10.0	9.00	8.00	7.00	6.00	5.00	4.00	3.00	2.00	1.00
1-1/4	EQ%	1.438	FULL	16.0	15.5	10.4	7.04	4.51	3.26	2.18	1.30	0.88	0.48
		1.126	1SR	10.0	9.70	6.52	4.40	2.82	2.04	1.36	0.81	0.55	0.30
		0.876	2SR	8.60	8.38	6.09	3.64	2.58	1.74	1.25	0.89	0.52	0.27
		0.876	3SR	6.00	5.79	3.88	2.70	1.97	1.22	0.96	0.70	0.43	0.17
		0.626	4SR	3.40	3.41	2.38	1.64	1.20	0.75	0.51	0.39	0.26	0.13
	LINEAR	1.676	FULL	17.2	15.5	13.8	12.0	10.3	8.60	6.88	5.16	3.44	1.72
1-1/2	EQ%	1.676	FULL	24.0	22.5	19.7	15.1	10.3	7.30	4.90	3.20	1.90	0.90
		1.438	1SR	16.0	15.5	10.4	7.04	4.51	3.26	2.18	1.30	0.88	0.48
		1.126	2SR	10.0	9.70	6.52	4.40	2.82	2.04	1.36	0.81	0.55	0.30
		0.876	3SR	8.60	8.38	6.09	3.64	2.58	1.74	1.25	0.89	0.52	0.27
		0.876	4SR	6.00	5.79	3.88	2.70	1.97	1.22	0.96	0.70	0.43	0.17
	LINEAR	1.676	FULL	18.0	16.2	14.4	12.6	10.8	9.00	7.20	5.40	3.60	1.80
2	EQ%	2.126	FULL	40.0	37.1	33.1	27.3	19.8	13.2	8.50	5.30	2.80	1.10
		1.676	1SR	24.0	22.5	19.7	15.1	10.3	7.30	4.90	3.20	1.90	0.90
		1.438	2SR	16.0	15.5	10.4	7.04	4.51	3.26	2.18	1.30	0.88	0.48
		1.126	3SR	10.0	9.70	6.52	4.40	2.82	2.04	1.36	0.81	0.55	0.30
		0.876	4SR	8.60	8.38	6.09	3.64	2.58	1.74	1.25	0.89	0.52	0.27
	LINEAR	2.126	FULL	37.0	33.3	29.6	25.9	22.2	18.5	14.8	11.1	7.40	3.70

2-WAY VALVE
TYPICAL FLOW CURVE

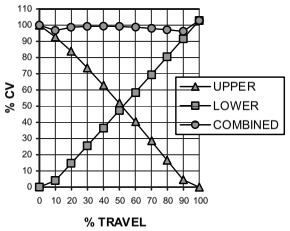


3-Way Valves (Control of Liquids)

Valve — 2830 Flow Coefficients (Cv) — Three-Way Mixing Valve

Valve Size(IN)	Trim Style	Trim Size(IN)	Port Size	Travel 100%	Valve Size(IN)	Trim Style	Trim Size(IN)	Port Size	Travel 100%
1/2	LINEAR	1.126	FULL	6.30	1-1/4	LINEAR	1.676	FULL	18.5
		0.876	1SR	4.00			1.126	1SR	10.0
		0.626	2SR	2.00	1-1/2	LINEAR	1.676	FULL	20.0
		0.626	3SR	1.00			1.126	1SR	10.0
3/4	LINEAR	1.126	FULL	8.20	2	LINEAR	2.126	FULL	40.0
		0.876	1SR	4.00			1.676	1SR	20.0
		0.626	2SR	2.00					
		0.626	3SR	1.00					
1	LINEAR	1.126	FULL	10.0					
		0.876	1SR	4.00					
		0.626	2SR	2.00					
		0.626	3SR	1.00					

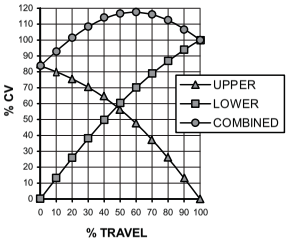
2830
TYPICAL FLOW CURVE



Valve — 2832 Flow Coefficients (Cv) — Three-Way Diverting/Mixing Valve

Valve Size(IN)	Trim Style	Travel 100% Upper	Lower
1	LINEAR	12	15
1-1/2	LINEAR	22	26
2	LINEAR	40	47

2832
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	952	1159
25	266	130	236	934	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	1202
300	422	217	399	805	1204
400	448	231	438	778	1216
500	470	243	453	752	1205
600	489	254	475	729	1204

Rectangular Tank Capacity in Gallons

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

or

Gallons = H x W x L (Ft.) x 7.5

Circular Tank Storage Capacity in Gallons

Storage = $6D^2$ x L (Gallons)

Where:
D = Tank Diameter in Feet
L = Length in Feet

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 PSI =	27.7 Inches of Water
1 U.S. Gallon Water =	231 Cubic Inches
1 U.S. Gallon Water =	8.33 Lbs.

Heating Water with Steam

Quick Method

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

Accurate Method

$$\text{Lbs./Hr.} = \frac{\text{GPM x 500 x } \Delta T}{h_o}$$

Heating or Cooling Water with Water

$$GPM_1 = GPM_2 \times \frac{°F\ water_2\ temp.\ rise\ or\ drop}{°F\ water_1\ temp.\ rise\ or\ drop}$$

Heating or Cooling Water

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

Heating Oil with Steam

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

Heating Air with Water

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

Heating Liquids with Steam

$$\text{Lbs./Hr.} = \frac{\text{GPM x 60 x Cp x W}}{h_o} \times \Delta T$$

Heating Liquids in Steam Jacketed Kettles

$$\text{Lbs./Hr.} = \frac{\text{GPM x Cp x S x 8.33}}{h_o \times t} \times \Delta T$$

General Liquid Heating

$$\text{Lbs./Hr.} = \frac{\text{W x Cp}}{h_o \times t} \times \Delta T$$

Heating Air with Steam

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

Shut-Off ΔP Ratings

2820 Two-Way, Single Seat Unbalanced

Maximum Shut-off ΔP in PSI

Valve Trim Size (IN)	Valve Size (IN)	Plug Travel (IN)	Actuator Pneumatic Actuator	Actuator Spring Range	Fail Closed Reverse Acting Air Signal to Actuator 3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	Fail Open Direct Acting Air Signal to Actuator 3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
0.626	1/2	3/4	DL49	Low	N/A	226	386	N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure	704	720	720	N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure
	thru			Full	67	386	545		67	386	720	
	1-1/4			High	720	720	720		226	545	720	
0.876	1/2	3/4	DL49	Low	N/A	90	171		333	496	720	
	thru			Full	8	171	252		8	171	720	
	2			High	415	577	659		90	252	720	
1.126	1	3/4	DL49	Low	N/A	38	88		186	284	720	
	thru			Full	N/A	88	137		N/A	88	720	
	2			High	235	334	383		38	137	720	
			DL84	Low	N/A	60	144		397	566	720	
				Full	N/A	60	144		N/A	60	720	
				High	397	566	650		N/A	60	720	
1.438	1-1/4	3/4	DL49	Low	N/A	11	42		102	162	555	
	thru			Full	N/A	42	72		N/A	42	434	
	2			High	132	193	223		11	72	464	
			DL84	Low	N/A	24	76		231	335	720	
				Full	N/A	24	76		N/A	24	697	
				High	231	335	386		N/A	24	697	
			DL84XR	Xtra-High	386	490	542		N/A	N/A	N/A	
1.676	1-1/4	3/4	DL49	Low	N/A	N/A	24		68	113	401	
	thru			Full	N/A	24	46		N/A	24	313	
	2			High	91	135	157		N/A	46	335	
			DL84	Low	N/A	11	49		163	240	720	
				Full	N/A	11	49		N/A	11	506	
				High	163	240	278		N/A	11	506	
			DL84XR	Xtra-High	278	354	392		N/A	N/A	N/A	
2.126	2	3/4	DL49	Low	N/A	N/A	7		34	62	242	
				Full	N/A	7	21		N/A	7	186	
				High	48	76	90		N/A	21	200	
			DL84	Low	N/A	N/A	23		94	141	449	
				Full	N/A	N/A	23		N/A	N/A	307	
				High	94	141	165		N/A	N/A	307	
			DL84XR	Xtra-High	165	212	236		N/A	N/A	N/A	

NOTES:

1) 2820 Seat closure ANSI Class IV (Stainless Steel and Alloy 6 Trim), ANSI Class VI (TFE and PEEK Trim).

2) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

3) 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.

4) 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 & 84XR…30 PSIG

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

Shut-Off ΔP Ratings

2830 Three-Way Mixing

Maximum Shut-off ΔP in PSI

Trim Size (IN)	Valve Size (IN)	Plug Travel (IN)	Actuator Pneumatic Actuator	Actuator Spring Range	Upper Port Closed Direct Acting Air Signal to Actuator 3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	Lower Port Closed Direct Acting Air Signal to Actuator 3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
0.626	1/2	9/16	DL49	Low	N/A	67	226	N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure	560	720	720	N/A Exceeds DL49 and DL84 Actuator's Maximum Air Pressure
	thru			Full	N/A	226	386		N/A	242	720	
	1			High	545	720	720		83	401	720	
0.876	1/2	9/16	DL49	Low	N/A	8	90		260	423	720	
	thru			Full	N/A	90	171		N/A	98	720	
	1			High	252	415	496		16	179	720	
1.126	1/2	9/16	DL49	Low	N/A	N/A	38		142	240	720	
	thru			Full	N/A	38	88		N/A	43	683	
	2			High	137	235	284		N/A	92	720	
1.676	1-1/4	3/4	DL49	Low	N/A	N/A	2		48	93	381	
	thru			Full	N/A	2	24		N/A	4	293	
	2			High	46	91	113		N/A	26	315	
			DL84	Low	N/A	11	49		140	223	715	
				Full	N/A	11	49		N/A	N/A	486	
				High	163	240	278		N/A	N/A	486	
2.126	2	3/4	DL49	Low	N/A	N/A	N/A		22	50	229	
				Full	N/A	N/A	N/A		N/A	N/A	174	
				High	21	48	62		N/A	8	188	
			DL84	Low	N/A	N/A	23		81	129	436	
				Full	N/A	N/A	23		N/A	N/A	58	
				High	94	141	165		N/A	N/A	294	
			DL84XR	Xtra-High	165	212	236		N/A	N/A	294	

NOTES:

1) 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 2930 are direct acting. The upper port fails closed on loss of air pressure to the actuator.

2) 2830 Seat closure ANSI Class IV.

3) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

4) 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.

5) 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

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

2832 Three-Way Diverting/Mixing

Maximum Shut-off ΔP in PSI

Valve Size (IN)	Plug Travel (IN)	Actuator Pneumatic Actuator	Actuator Spring Range	Upper Port Closed Direct Acting Air Signal to Actuator 3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI	Lower Port Closed Direct Acting Air Signal to Actuator 3-15 PSI	1-17 PSI	0-30 PSI	0-40 PSI
1	3/4	DL49	High	110	113	115	N/A Exceeds Actuator Rating	N/A	N/A	115	N/A Exceeds Actuator Rating
		DL84	High	113	115	118		N/A	N/A	120	
1-1/2	3/4	DL49	High	N/A	110	113		N/A	N/A	113	
		DL84	High	110	113	115		N/A	N/A	118	
2	3/4	DL49	High	N/A	N/A	110		N/A	N/A	111	
		DL84	High	108	110	113		N/A	N/A	115	

1) 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.

2) 2832 Seat closure ANSI Class III.

3) Inlet pressure **cannot** exceed Body Pressure-Temperature Rating.

4) 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.

5) 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.

Component 2820		Dimension (IN) by Valve Size (IN)		
Variable		1/2, 3/4, 1	1-1/4 & 1-1/2	2
A	250THD	4-7/8	5-3/4	6-1/2
	300THD	5	6-1/8	6-1/2
B	250THD	2-3/4	3-1/4	3-5/8
	300THD	3	3-1/2	3-7/8
C	DL49 Direct*	15-1/4	15-7/8	16-1/8
	DL49 Reverse	14-5/8	15-1/4	15-1/2
	DL84 Direct*	19-1/4	19-7/8	20-1/8
	DL84 or 84XR Reverse	18-5/8	19-1/4	19-1/2
H	DL49	1-3/4	2-3/8	2-3/4
(W/760)	DL84 or 84XR	3-5/8	4-1/4	4-1/2
Item		**Weight (LB) by Valve Size (IN)**		
Variable		1/2, 3/4, 1	1-1/4 & 1-1/2	2
	250THD	8-1/2	14-1/2	18-1/2
	300THD	8	15-1/2	19

Component 2830		Dimension (IN) by Valve Size (IN)		
Variable		1/2, 3/4, 1	1-1/4 & 1-1/2	2
A	250THD	4-7/8	5-3/4	6-1/2
	300THD	5	6-1/8	6-1/2
B	250THD	2-3/4	3-3/4	4
	300THD	2-3/4	3-3/8	3-3/4
C	DL49 Direct*	15-1/4	15-7/8	16-1/8
	DL84 or 84XR Direct*	N/A	19-7/8	20-1/8
H	DL49	1-3/4	2-3/8	2-3/4
(W/760)	DL84 or 84XR	N/A	4-1/4	4-1/2
Item		**Weight (LB) by Valve Size (IN)**		
Variable		1/2, 3/4, 1	1-1/4 & 1-1/2	2
	250THD	9	15-1/2	20
	300THD	8	15	18-1/2

Component 2832		Dimension (IN) by Valve Size (IN)		
Variable		1	1-1/2	2
A	250THD	4-7/8	5-3/4	6-1/2
	300THD	5	6-1/8	6-1/2
B	250THD	3-1/2	3-3/4	4
	300THD	2-3/4	3-3/8	3-3/4
C	DL49 Direct*	15-1/4	15-7/8	16-1/8
	DL84 Direct*	19-1/4	19-7/8	20-1/8
H	DL49	1-3/4	2-3/8	2-3/4
(W/760)	DL84	3-5/8	4-1/4	4-1/2
Item		**Weight (LB) by Valve Size (IN)**		
Variable		1	1-1/2	2
	250THD	9	16-1/2	21
	300THD	8	15	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

Allow 4-7/8 inch clearance above actuator for removal.

Actual shipping weights may vary.

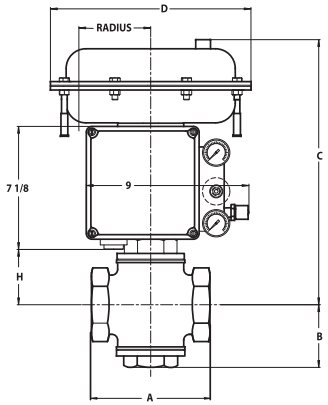
Consult factory for drawings, weights, and dimensions of configurations not shown.

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

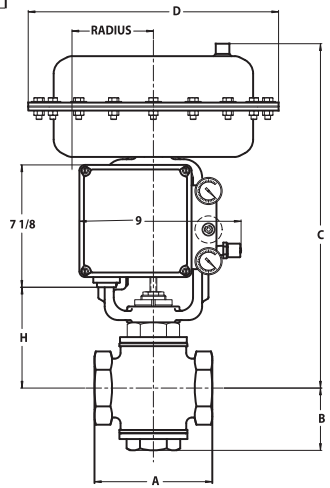
Actuator	Weight (LB)
DL49	24-1/2
DL84 84XR	48-1/2

Positioner	Weight (LB)
760	10

Dimension (IN)		
D	DL49	11
	DL84 or 84XR	13-7/8
Radius	DL49	7-7/8
(W/760)	DL84 or 84XR	8-1/8



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



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

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.

Actuators

Actuator		Spring Range (PSI)			
Size	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/P's 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
Yoke: Ductile Iron
Stem: 300 Series Stainless Steel
Finish: DL49 Epoxy-Coated
DL84, 84XR Acrylic Enamel
Ambient Temperature: DL49 -20 to 160°F
DL84, 84XR -40 to 180°F
Mounting: Vertical Above or Below Valve
Handwheel: Available on DL84 & 84XR
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 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:
FM Intrinsically Safe: Class I II III, Div 1, Groups A,B,C,D,E,F,G.
CSA Intrinsically Safe: Class I, Div 1, Groups A, B, C, D.
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

Positioners (Continued)

BLX Electro-Pneumatic Explosion Proof

Models: BFX_: Full Range Signal (4-20 mA)
BLX_: Low Range Signal (4-12 mA)
BHX_: High Range Signal (12-20 mA)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Approvals & Ratings:
FM Intrinsically Safe: Class I II III, Div 1, Groups A,B,C,D,E,F,G.
Non-Incendive: Class I, Div 2, Groups A,B,C.
Explosion Proof: Class I, Div 1, Groups B,C,D.
Class I II III, Div 1, Groups E,F,G.
CSA Intrinsically Safe: Class I, Div 1, Groups A,B,C,D.
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.
Explosion Proof: Class I, Div 1, Groups B,C,D.
Class II, Div 1, Groups E,F,G.
Supply Pressure: 30 to 145 PSIG **Not to exceed actuator rating**
Air Consumption: 0.21 SCFM at 30 PSIG

BLX Electro-Pneumatic Fail Freeze

Models: BFF_: Full Range Signal (4-20 mA)
BLF_: Low Range Signal (4-12 mA)
BHF_: High Range Signal (12-20 mA)
Options 2SPDT Limit Switches, 4-20 mA Feedback
Ingress & Corrosion Protection: NEMA 4X, IP66
Supply Pressure: 20 to 100 PSIG Max **Not to exceed actuator rating**
Air Consumption: 0.21 SCFM at 30 PSIG

All Models:

Construction: Aluminum Housing with Polyester Powder Coat
Action: Direct or Reverse
Media: Clean Dry Oil Free Air Filtered to 5 micron
Air Connections: 1/4 NPT
Flow Capacity: 9.8 SCFM at 30 PSIG
Electrical Connection: 1/2 NPT
Gauges: Input 0-30 PSIG, Output 0-60 PSIG, Supply 0-60 PSIG, Housing Black Steel Case with Chrome Ring
Ambient Temperature: -40 to 185°F (Except Fail Freeze –4 to 158°F)
Mounting: Yoke Mounted
Limit Switches and Feedback Options are NEMA 4X, IP66 only, and are not suitable for hazardous locations.

Moore 760 Models:

760P Pneumatic

Models: 76P_: Full Range Signal (3-15 PSIG)
Options Limit Switches, 4-20 mA Feedback *(Reduced feedback span for valves with less than 1 inch travel – Call factory for details)*

760E Electro-Pneumatic

Models: 76E_: Full Range Signal (4-20 mA)
Options Limit Switches, 4-20 mA Feedback *(Reduced feedback span for valves with less than 1 inch travel – Call factory for details)*
Approvals & Ratings:
FM Intrinsically Safe: Class I, Div 1, Groups A,B,C,D.
Class II, Div 1, Groups E,F,G.
Class III, Div 1.
Non-Incendive: Class I, Div 2, Groups A,B,C,D.
Suitable for: Class II, Div 2, Groups F,G.
Class III, Div 2.

760E Electro-Pneumatic (Continued)

CSA Intrinsically Safe: Class I, Div 1, Groups A,B,C,D.
Class II, Div 1, Groups E,F,G.
Class III, Div 1.
Suitable for: Class I, Div 2, Groups A,B,C,D.
Class II, Div 2, Groups E,F,G.
Class III, Div 2.

All Models:

Construction: Aluminum Housing with Epoxy/Polyester Powder Coat
Ingress & Corrosion Protection: NEMA 4, 4X, IP65
Action: Direct or Reverse
Supply Pressure: 150 PSIG Max **Not to exceed actuator rating**
Media: Clean Dry Oil Free Air Filtered to 3 micron
Flow Capacity: 9.0 SCFM
Air Consumption: 0.5 SCFM Typical
Air Connections: 1/4 NPT
Electrical Connection: 3/4 NPT
Gauges: Input 0-30 PSIG, Output 0-60 PSIG, Housing Black Steel Case with Chrome Ring
Ambient Temperature: 760P -40 to 180°F, 760E –40 to 167°F
Mounting: Yoke Mounted

Westlock ICoT Models:

Electro-Pneumatic

Models: 510_: Full Range Signal (4-20 mA)
Options 2SPDT Limit Switches

Intelligent with Keypad

Models: 520_: Full Range Signal (4-20 mA)
Calibration 3 Button Keypad
Options 2SPDT Limit Switches, 4-20 mA Feedback

Intelligent with HART

Models: 530_: Full Range Signal (4-20 mA)
Calibration 3 Button Keypad & HART
Options 2SPDT Limit Switches, 4-20 mA Feedback

Intelligent with Foundation Fieldbus

Models: 540_: Full Range Signal (4-20 mA)
Calibration 3 Button Keypad & Foundation Fieldbus
Options 2SPDT Limit Switches, 4-20 mA Feedback

All Models:

Construction: Engineered Resin Housing
Ingress & Corrosion Protection: NEMA 4, 4X
Approvals & Ratings: Non-Incendive Groups A-G, Div 2
Action: Direct or Reverse
Supply Pressure: 15 to 45 PSIG **Not to exceed actuator rating**
Media: Clean Dry Oil Free Air Filtered to 40 micron
Flow Capacity: 8.0 SCFM at 25 PSIG
Air Consumption: 0.003 SCFM at 20 PSIG
Air Connections: 1/4 NPT
Electrical Connection: 1/2 NPT
Gauges: Supply 0-60 PSIG, Output1 0-60 PSIG, Housing Black Steel Case with Chrome Ring
Ambient Temperature: -40 to 180°F
Mounting: Yoke Mounted

Actuators, Positioners, & Accessories

Position Indication Switches

Proximity Mark 1

Models: 2 SPDT Switches
4 SPDT Switches
6 SPDT Switches
2 SPDT Switches w/ 2K Potentiometer
2 SPDT Switches w/ 4-20 mA Feedback
Construction: Aluminum Housing, Hard Anodized
Locations: NEMA 1, 2, 3, 3R, 3S
Ambient Temperature: -40 to 180°F
Electrical Connection: 3/4 NPT, Terminal Strip
Mounting: Yoke Mounted

I/P's

Type 500X

Locations: NEMA 3
Construction: Zinc Alloy Base with Aluminum Bonnet, Epoxy Painted
Ranges: 3-9, 9-15, 3-15, 1-17, or 6-30 PSI
Supply Pressure: Minimum 3 PSIG Above Maximum Output
Maximum 100 PSIG **Not to Exceed Actuator Rating**
Flow Capacity: 4.5 SCFM at 25 PSIG
Air Consumption: 0.05 SCFM Midrange Typical
Ambient Temperature: -20 to 140°F

Type 550X

Locations: NEMA 4X (IP65)
Construction: Chromate-treated Aluminum with Epoxy Paint
Ranges: 0-30 PSI
Supply Pressure: Minimum 5 PSIG Above Maximum Output
Maximum 100 PSIG **Not to Exceed Actuator Rating**
Flow Capacity: 12 SCFM at 100 PSIG
Air Consumption: 6.0 SCFH Midrange Typical
Ambient Temperature: -20 to 150°F

Type 950X

Locations: NEMA 4X (IP65), Explosion proof
Construction: Chromate-treated Aluminum with Epoxy Paint
Ranges: 3-15 PSI
Supply Pressure: Minimum 5 PSIG Above Maximum Output
Maximum 100 PSIG **Not to Exceed Actuator Rating**
Flow Capacity: 4.5 SCFM at 25 PSIG
Air Consumption: 3.0 SCFH Midrange Typical.
Ambient Temperature: -40 to 160°F

I/P's (Continued)

All Models:

Input: 4-20 mA
Field Reversible
Air Connections: 1/4 NPT
Electrical Connection: 1/2 NPT, Pigtail Leads
Media: Clean Dry Oil Free Air Filtered to 40 micron
Mounting: Yoke Mounted

Air Filter Regulators

Models: Type 300, Type 350SS
Output Ranges: Type 300, 0-30, 0-60 PSIG
Type 350SS, 0-100 PSIG
Supply Pressure: Type 300, 250 PSIG Maximum
Type 350SS, 290 PSIG Maximum
Construction: Type 300, Die-Cast Aluminum with Irridite and Baked Epoxy Paint
Type 350SS, 316 Stainless Steel
Gauge: Type 300, Output, Housing Steel Painted
Type 350SS,Output, Housing Stainless Steel
Air Connections: 1/4 NPT
Filter: Type 300, 40 micron. Type 350SS, 25 micron
Mounting: Chamber Mounted

Solenoids

Models: 8320G184, EF8320G184, 8320G202, EF8320G202
Construction: (EF)8320G184, 3-Way Brass
(EF)8320G202, 3-Way Stainless Steel
Locations: 83206G184 & 8320G202, Watertight, Types 1, 2, 3, 3S, 4 & 4X
EF8320G184 & EF8320G202, Explosion proof and Watertight, Types 3, 3S, 4, 4X 6, 6P, 7 & 9
Supply: 120VAC
Ambient Temperature: +32 to 125°F
Air Connections: 1/4 NPT
Electrical Connection: 1/2 NPT, Pigtail Leads
Approvals: CSA, UL, CE
Mounting: Chamber Mounted

Air Tubing

Standard: Copper
Optional: Stainless Steel

Factory Default Settings

Positioners

Valve Type	Actuator Action	Input Signal: Pneumatic	Input Signal: Electro-Pneumatic	Input Signal: Increasing Signal	Failure Modes: Loss of Signal[1] Valve Fails...	Failure Modes: Loss of Supply Valve Fails...
2820	Direct	3-15 PSI	4-20 mA	Closes Valve	Open	Open
	Reverse	3-15 PSI	4-20 mA	Opens Valve	Closed	Closed
2830 & 32	Direct	3-15 PSI	4-20 mA	Closes Lower Port/ Opens Upper Port	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open

[1] Valves with Fail Freeze Positioners Fail in Last Position on Loss of Signal.

Positioner Feedback

Valve Type	Actuator Action	Feedback Signal[2]	Signal Increases as
2820	Direct	4-20 mA	Valve Closes
	Reverse	4-20 mA	Valve Opens
2830 & 32	Direct	4-20 mA	Lower Port Closes/ Upper Port Opens

[2] Reduced feedback span for valves with 760 and less than 1 inch travel.

Positioner Limit Switches

Valve Type	Position	Settings: Switch 1	Settings: Switch 2
2820	Valve Closed	Closed	Open
	Valve Open	Open	Closed
2830 & 32	Upper Port Closed	Closed	Open
	Lower Port Closed	Open	Closed

I/P's

Valve Type	Actuator Action	Input Signal	Increasing Signal	Failure Modes: Loss of Signal Valve Fails...	Failure Modes: Loss of Air Supply Valve Fails...
2820	Direct	As Required For Shut-off	Closes Valve	Open	Open
	Reverse	As Required For Shut-off	Opens Valve	Closed	Closed
2830 & 32	Direct	As Required For Shut-off	Closes Lower Port/ Opens Upper Port	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open

SOLENOIDS (without Positioners or I/P's)

Valve Type	Actuator Action	Solenoid Energized	Failure Modes: Loss of Signal Valve Fails...	Failure Modes: Loss of Air Supply Valve Fails...	Failure Modes: Solenoid De-energized Valve Fails...
2820	Direct	Closes Valve	Open	Open	Open
	Reverse	Opens Valve	Closed	Closed	Closed
2830 & 32	Direct	Closes Lower Port/ Opens Upper Port	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open	Upper Port Closed/ Lower Port Open

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

Valve Type	Actuator Action	Feedback Signal Potentiometer[3]	Feedback Signal mA	Feedback Signal Increases as
2820	Direct	0-350 ohm	4-20 mA	Valve Closes
	Reverse	0-350 ohm	4-20 mA	Valve Opens
2830 & 32	Direct	0-350 ohm	4-20 mA	Lower Port Closes/ Upper Port Opens

[3] Span varies from approx 155 to 350 ohm depending on actuator and travel.

Limit Switches

Valve Type	Position	Settings: Switch 1, 3, 5	Settings: Switch 2, 4, 6
2820	Valve Closed	Closed	Open
	Valve Open	Open	Closed
2830 & 32	Upper Port Closed	Closed	Open
	Lower Port Closed	Open	Closed

Air Filter Regulators

Actuator	Output Pressure
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

WARREN CONTROLS

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

Model	Valve Type	Size	Body Material	End Connection	Trim Style	Trim Material	Trim Cv	Packing Type
	20 2-Way Single Seat **30** 3-Way Mixing **32** 3-Way Diverting	**050** 1/2 inch **075** 3/4 inch **100** 1 inch **125** 1-1/4 inch **150** 1-1/2 inch **200** 2 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 **6** Alloy 6 **H** 17-4 PH **T** Teflon **P** PEEK	**F** Full Port **1** 1st Port Reduction **2** 2nd 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 Bodies come standard w/PEEK bearings. Used for Temp. up to 500°F.*

VALVE TYPE/TRIM MATERIAL COMBINATIONS:

SIZE	TRIM MATERIAL: S 316 SS	B Bronze	6 Alloy 6	H 17-4 PH	T Teflon	P PEEK
050 1/2 inch	20, 30	N/A	20	20	20	20
075 3/4 inch	20, 30	N/A	20	20	20	20
100 1 inch	20, 30, 32SS	32 BRZ	20	20	20	20
125 1-1/4 inch	20, 30	N/A	20	20	20	20
150 1-1/2 inch	20, 30, 32SS	32 BRZ	20	20	20	20
200 2 inch	20, 30, 32SS	32 BRZ	20	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"	DL84XR
Type 30	1/2" - 2"	DL49
Type 30	1-1/4" - 2"	DL84
Type 30	2"	DL84XR
Type 32	1/2" - 2"	DL49 & DL84

See Shut-Off ΔP Ratings for details.

ACTUATOR

Actuator Series	Action	Spring Range	Handwheel
00 None DIAPHRAGMS: **49** DL49 (49 Sq.In.) **84** DL84 (84 Sq.In.) **8X** DL84XR (84 Ext. Rng.) *NOTE: 8X Only in Xtra-High Spring Range*	**0** None **R** Reverse Stem Fail Down **D** Direct Stem Fail Up	**0** None **L** Low 4-10 PSI 49R ; 3-9 PSI 49D, 84R/D **F** Full 5-14 PSI 49R ; 4-13 PSI 49D; 3-15 PSI 84R/D **H** High 9-15 PSI 84 10-14 PSI 49R 8-12 PSI 49D **X** Xtra-High DL84XR	**0** None **R** Reverse **D** Direct *NOTE: DL84 or DL84XR only - Must match action.*

ACCESSORIES

Positioners, I/P's & Limit Switches	Air Filter Regulators	ASCO Solenoids	Special Options
0000 None POSITIONERS: **BxP_** BLX Pneumatic **BxE_** BLX ElectroPneumatic **BxI_** BLX ElectroPneu. Intrn. Safe **BxX_** BLX ElectroPneu. Exp. Proof **BxF_** BLX ElectroPneu. Fail Freeze **76P_** Moore 760 Pneumatic **76E_** Moore 760 Electro-Pneumatic **510_** Westlock ICoT Electro-Pneumatic **520_** Westlock ICoT Intelligent-Keypad **530_** Westlock ICoT Intelligent-Hart **540_** Westlock ICoT Found.Fieldbus PROXIMITY SWITCHES: **PX11** Mark 1 Series - 2 ea. SPDT **PX12** Mark 1 Series - 2 ea. SPDT w/2k Pot. **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 I/P's *Use with Diaphragm Only* **MAP1** Type 500X I/P, 3-9 PSI **MAP2** Type 500X I/P, 9-15 PSI **MAP3** Type 500X I/P, 3-15 PSI **MAP4** Type 500X I/P, 1-17 PSI **MAP5** Type 500X I/P, 6-30 PSI **MAP6** Type 550X I/P, 0-30 PSI **MAP9** Type 950X I/P, 3-15 EXP	**0** None **A** Type 300, 0-30 PSI **B** Type 300, 0-60 PSI **D** Type 350SS, 0-100 PSI	**0** None **A** 8320G184 3-Way Brass **B** 8320G202 3-Way SS **L** EF8320G184 3-Way EXP Br. **M** EF8320G202 3-Way EXP SS *120 VAC Coils*	**0** None **S** Special Opts or Set-up **T** SS Tubing **G** SS Tagging **B** SS Tubing and Tagging

x digit spec.
- **F** Full Range Signal, 3-15 PSI or 4-20mA
- **L** Low of Split Range, 3-9 PSI or 4-12mA
- **H** High of Split Range, 9-15 PSI or 12-20mA

4th digit spec.
- **0** No Additions
- **L** w/Mech. Lmt Switch's
- **F** w/4-20 Feedback
- **B** w/Switch's & Feedbck

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

FAILURE MODES:

MODE	VALVE TYPE	ACTUATOR ACTION
Closed	20	Reverse
Open	20	Direct
Upper Closed*	30/32	Direct
Upper Open	30/32	Reverse

*Standard

ACTUATOR/BODY COMPATIBILITY:

DIAPHRAGMS	BODY
49 49 Sq.In. (DL49)	For 28N Bodies
84 84 Sq.In. (DL84)	For 28N Bodies
8X (DL84XR)	For 28N Bodies

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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: • 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.	**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 flg	**ends** Buttweld, NPT	**ends** Flange	**ends** 150,300 RF flg	**ends** 150,300 RF flg
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 II, III, IV	**shutoff** class IV, VI	**shutoff** class IV, VI
rangeability 50:1	**rangeability** 50:1	**rangeability** 50:1	**rangeability** 100:1	**rangeability** 50:1
• Heavy Duty • Severe Service • High Pressure Differentials • Corrosive Materials, Liquids, Gases & Steam • Modulating or On/Off Control	• Economical • Precision Control • Suited for Gases, Steam, or Liquids that are Not Viscous or Solids Bearing	• High Capacity • General Purpose • Moderate Pressure Drops • Compatible Liquids and Gas, Steam & Water • Modulating or On/Off Control	• 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

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PS.2800.C.0305

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 (air or water)
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
Stainless Steel no. 744-082 ..... 1125 psi (7756 kPa)
Copper no. 744-111 ..... 525 psi (3619 kPa)
Well Dimensions ..... *See page 5*

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

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.

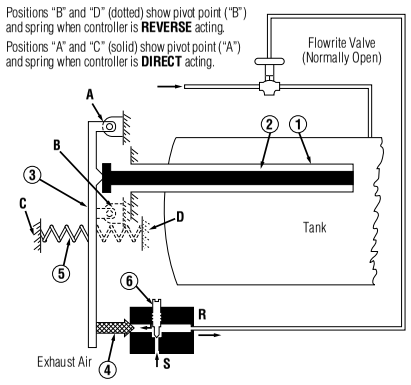


Figure 1.

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 controller 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).*

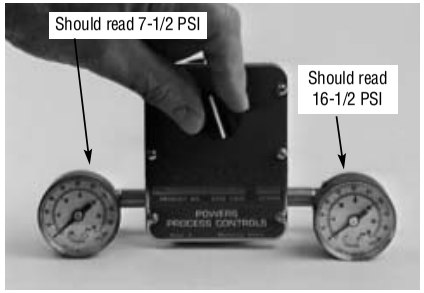


Figure 3. *Turn adjusting knob until 52 kPa (7-1/2 psi) control pressure shows on gauge. Read temperature at bulb with an accurate thermometer.*

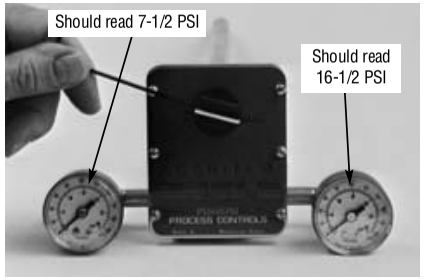


Figure 4. *Loosen set screw and turn adjusting knob to indicate temperature at bulb. Tighten set screw. Set controller for desired control temperature.*

INSTALLATION (GENERAL INSTRUCTIONS)

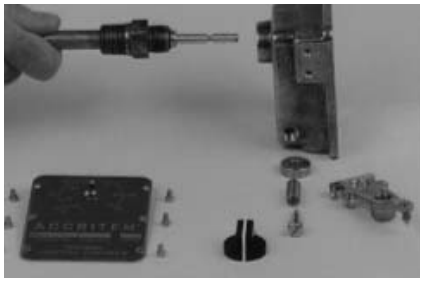


Figure 5.

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. Remover 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.

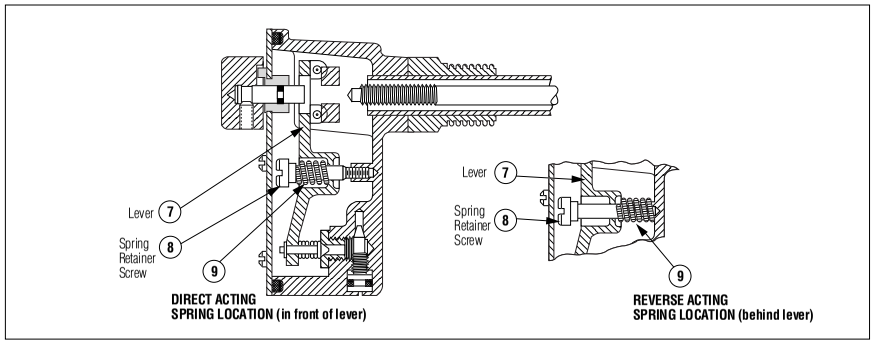


Figure 6.

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.

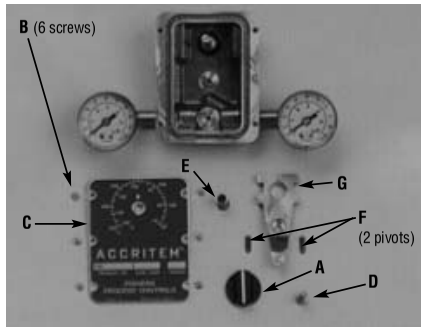


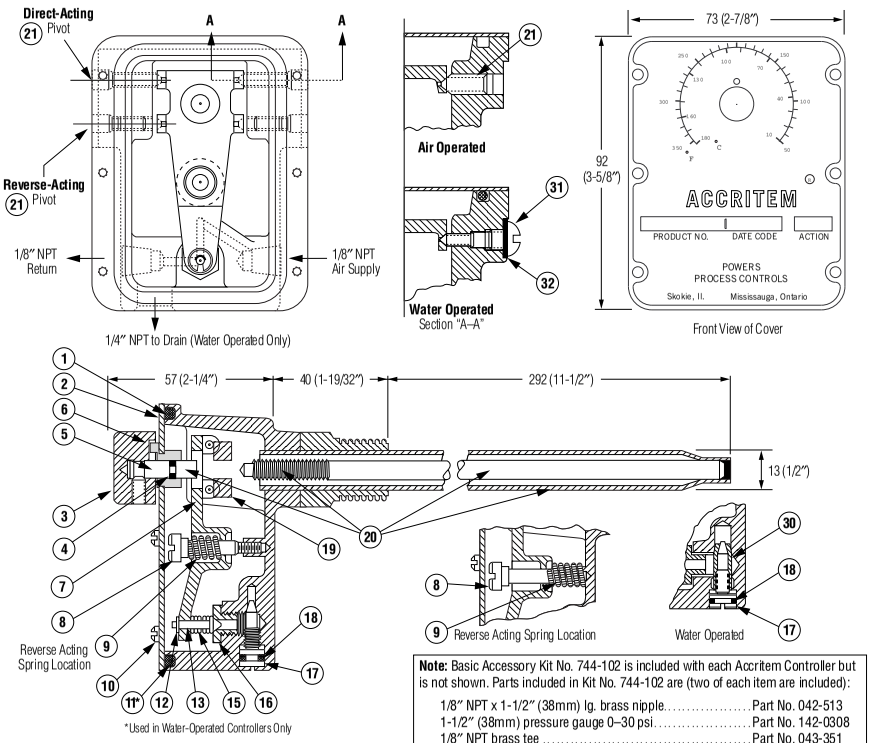
Figure 7.

3. Install screws (㉛) and gaskets (㉜) 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 (⑲) 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)



Note: Basic Accessory Kit No. 744-102 is included with each Accritem Controller but is not shown. Parts included in Kit No. 744-102 are (two of each item are included):

1/8″ NPT x 1-1/2″ (38mm) lg. brass nipple.....Part No. 042-513
1-1/2″ (38mm) pressure gauge 0–30 psi.....Part No. 142-0308
1/8″ NPT brass tee .....Part No. 043-351

PARTS LIST

Item	Part Name	Part Numbers Air or Gas	Part Numbers Water	No. Req'd	Material
1	Body	—	—	1	Brass
2	Cover Plate	744-170D	744-170D	1	—
3	Adjusting Knob w/ Set Screw	744-234	744-234	1	—
4	Quad Ring	—	047-043	1	—
5	Adjustment Screw	744-175	744-175	1	Brass
6	Stop Pin	744-061	744-061	1	Brass
7	Lever	—	—	1	Brass
8	Spring Retainer Screw	744-124	744-124	1	Brass
9	Lever Spring	225-073	430-021◆	1	Stainless Steel
10	Cover Screw	030-041	030-041	6	Brass
11	O-Ring	Not used	047-050	1	Silicone Rubber
12	Retaining Ring	100-124*	100-124**	1	Phos. Bronze
13	Valve	744-155*	744-163**	1	Phos. Bronze
15	Valve Spring	744-075*	744-075**	1	Phos. Bronze
16	Valve Seat	744-063*	744-131**▲	1	Phos. Bronze
17	Restriction Screw†	744-072	744-134▲	1	Brass
18	O-Ring	047-049●	047-045	1	Buna-N
19	Thrust Collar	—	—	1	Brass
20	Sensitive Tube Assembly	744-172	744-172	1	—
21	Lever Pivot	744-154	744-154	2	Stainless Steel
30	Insert	—	—	1	Stainless Steel
31	Sealing Screw	—	030-895	4	Stainless Steel
32	Gasket	—	744-083	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.

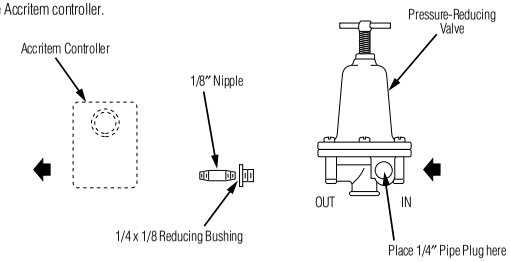
Valve and Seat Kit for Model 3 (Air-Operated Accritem).....744-168
Valve and Seat Kit for Model 3 (Water-Operated Accritem).....744-169

ACCESSORIES

Dimensions: Millimeters (Inches)

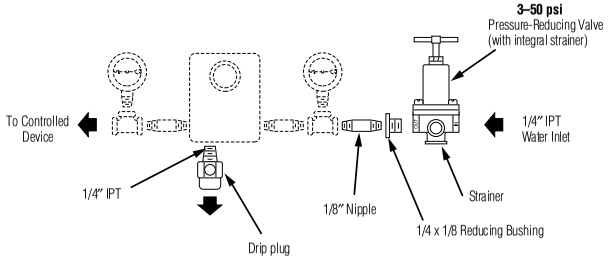
AIR
Accessory Kit No. 744-107
(Dotted line item not included)

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



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

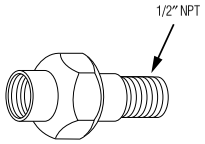
Kit provides materials necessary to convert the Accritem ***from*** air operation ***to*** water operation.



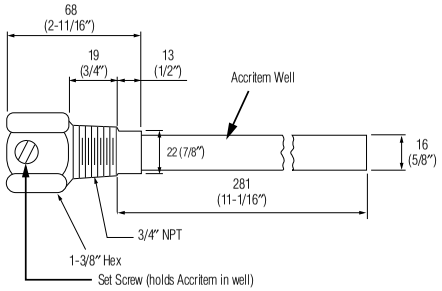
Supply gauge may also be installed in extra outlet of PRV.

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.



Well Dimensions
mm (inches)



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

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.wattsind.com/prop65

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 or galvanic action. This express warranty is in lieu of and excludes all other warranties, guarantees, or representations, express or implied. There are no implied warranties of merchantability or of fitness for a particular purpose. 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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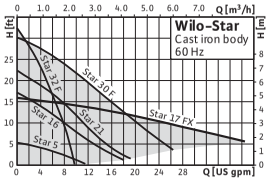
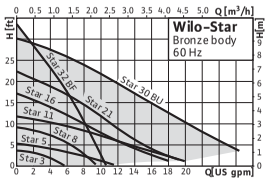
Range: Wilo-Star

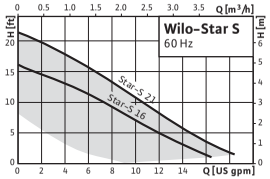




>Maintenance free single-head circulators
>Pipe connection:
- flange
- flange rotated 90°
- unions
- internal sweat

>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



>Maintance 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

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**	**30 F**	**32 F**
Approved fluids (other fluids on request)								
Heating water	•	•	•	•	•	•	•	•
Water/glycol mixtures (max. 1:1; 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	33
Max. delivery head [m]	1.7	4.9	4.9	5.2	6.4	6.4	9.1	10.1
Max. volume rate of flow [USGPM]	12	16.5	16.5	50	19	19	26	10.5
Max. volume rate of flow [m³/h]	2.7	3.7	3.7	11.4	4.3	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	–	–	–	–	–	–	–	–
Ambient temperature range	104 °F (+40 °C)							
Max. working pressure p_{max} [psi]	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
Power frequency [Hz]	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
Non overload motor	•	•	•	•	•	•	•	•
Insulation class	F	F	F	F	F	F	F	F

• = available, – = not available

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**	**32 F**
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	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
230 °F (110 °C)	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5

• = available, – = not available

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**
Approved fluids (other fluids on request)				
Heating water	•	•	•	•
Water/glycol mixtures (max. 1:1; mixtures with more than 20 % glycol require reassessment of the hydraulic criteria)	•	•	•	•
Domestic hot water	–	–	–	–
Performance				
Max. delivery head [ft]	16	16	21	21
Max. delivery head [m]	4.9	4.9	6.4	6.4
Max. volume rate of flow [USGPM]	16.5	16.5	19	19
Max. volume rate of flow [m^3/h]	3.7	3.7	4.3	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)	104 °F (+40 °C)
Max. working pressure p_{max} [psi]	140	140	140	140
Pipe connections				
Flange	•	–	•	–
Flange rotated 90°	–	•	–	•
Union connection	–	–	–	–
Internal sweat	–	–	–	–
Electrical connections				
Power supply 1~ [V]	115	115	115	115
Power frequency [Hz]	60	60	60	60
Wilo's quick connection with spring clips	•	•	•	•
Motor/Electronics				
Number of speed steps	3	3	3	3
Non overload motor	•	•	•	•
Insulation class	F	F	F	F

• = 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**	**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

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**
Approved fluids (other fluids on request)									
Heating water	•	•	•	•	•	•	•	•	•
Water/glycol mixtures (max. 1:1; 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 [m^3/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
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
Power frequency [Hz]	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
Non overload motor	•	•	•	•	•	•	•	•	•
Insulation class	F	F	F	F	F	F	F	F	F

• = 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**
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	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

Circulating Pumps
Product review: Wilo-Star/Star S

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

	Wilo-Star S... (Bronze body)	
	S 16 BFX	**S 21 BFX**
Approved fluids (other fluids on request)		
Heating water	•	•
Water/glycol mixtures (max. 1:1; 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

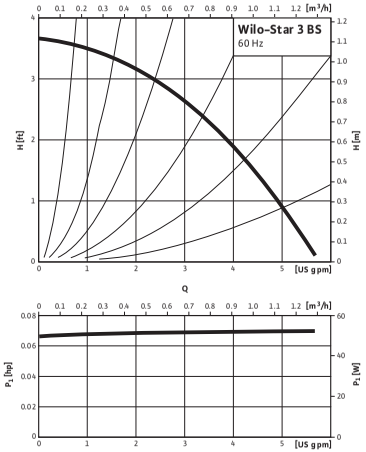
Function, Equipment & Technical data Wilo-Star S (Bronze body)

	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

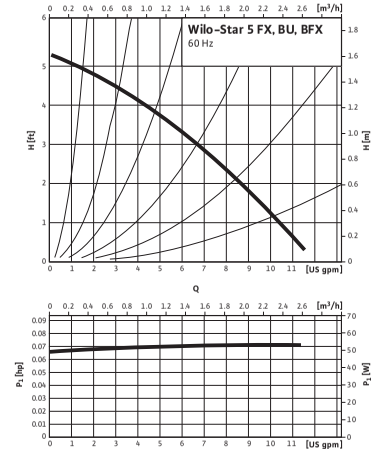
• = available, – = not available

Pump curves Wilo-Star

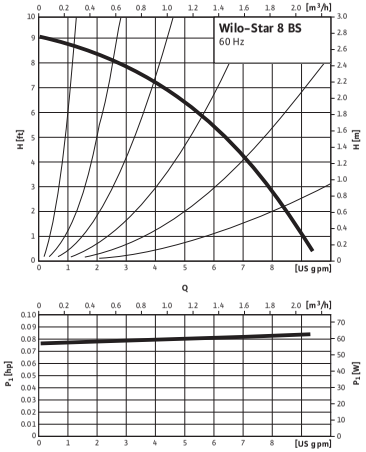
Wilo-Star 3 BS



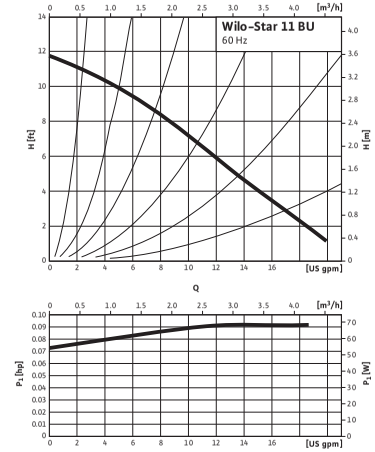
Wilo-Star 5 FX, BU, BFX



Wilo-Star 8 BS

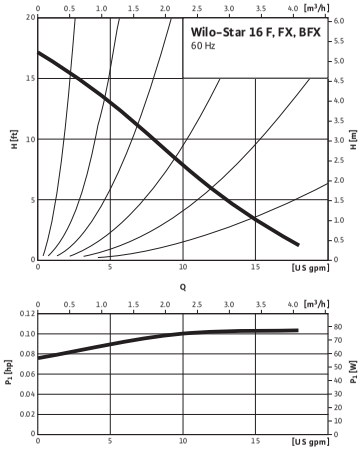


Wilo-Star 11 BU

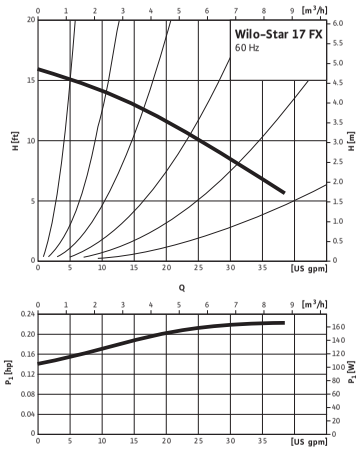


Pump curves Wilo-Star

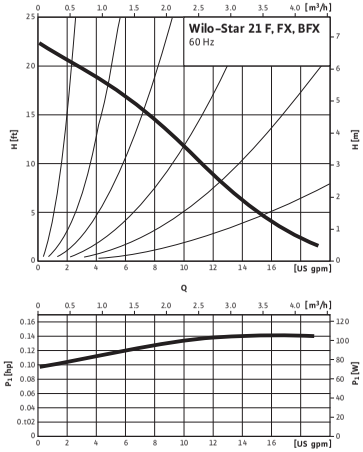
Wilo-Star 16 F, FX, BFX



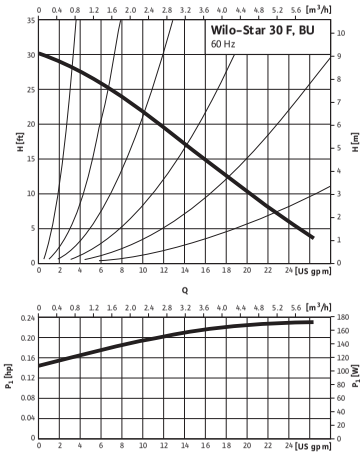
Wilo-Star 17 FX



Wilo-Star 21 F, FX, BFX



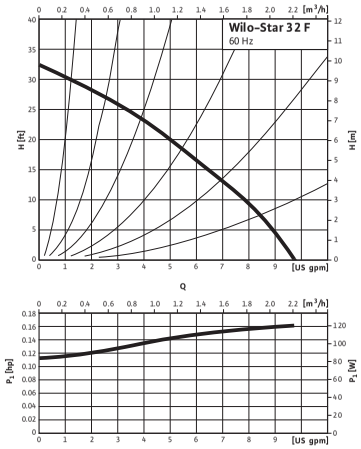
Wilo-Star 30 F, BU



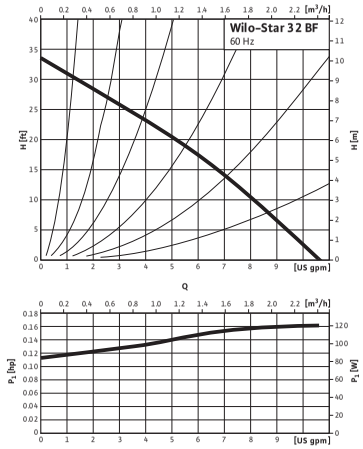
Circulating Pumps
Wilo-Star/Star S

Pump curves Wilo-Star

Wilo-Star 32 F

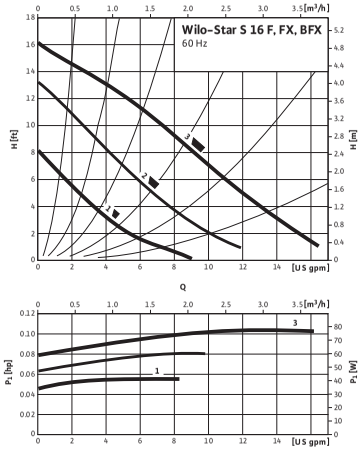


Wilo-Star 32 BF

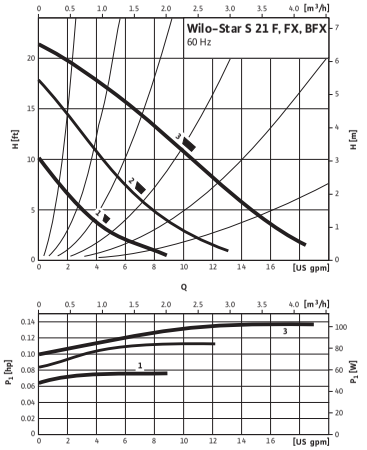


Pump curves Wilo-Star S

Wilo-Star S 16 F, FX, BFX

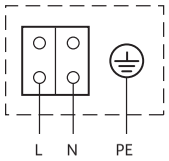


Wilo-Star S 21 F, FX, BFX



Wiring diagramms, motor data

Wiring diagramm



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

Motor data Wilo-Star

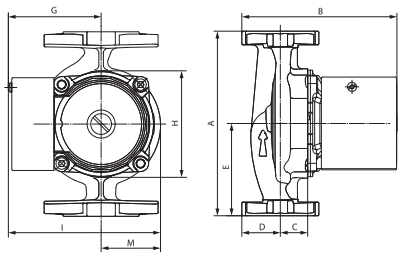
Wilo-Star...	Rated Power		Speed	Power consumption		Current 1~115 V, 60 Hz	Motor protection	Capacitor
	P_2		n	P_1		I	–	–
	[hp]	[W]	[rpm]	[hp]	[W]	[A]	–	[µF]
Star 3...	0.03	20	3400	0.07	50	0.49	not necessary (blocking-current-proof)	7
Star 5...	0.03	20	2700	0.07	50	0.49		7
Star 8...	0.03	20	3000	0.09	64	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		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...

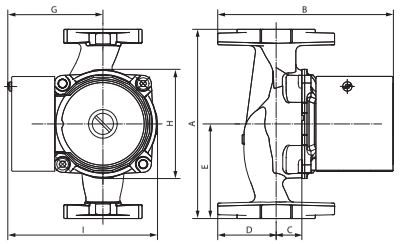
Wilo-Star S...	Rated Power		Speed	Power consumption		Current 1~115 V, 60 Hz	Motor protection	Capacitor
	P_2		n	P_1		I	–	–
	[hp]	[W]	[rpm]	[hp]	[W]	[A]	–	[µF]
Star S 16...	0.05	35	max. 2700	0.10	80	0.66	not necessary (blocking-current-proof))	7
			2200	0.08	60	0.55		
			min. 1600	0.05	41	0.38		
Star S 21...	0.05	40	max. 2700	0.13	110	0.92		9
			2100	0.10	83	0.75		
			min. 1300	0.07	56	0.52		

Dimension, weights

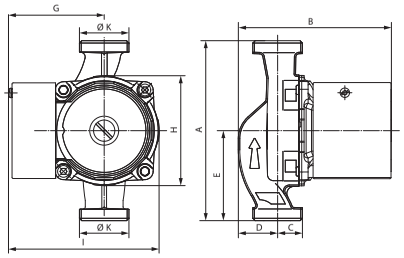
Wilo-Star, Drawing no.: 1



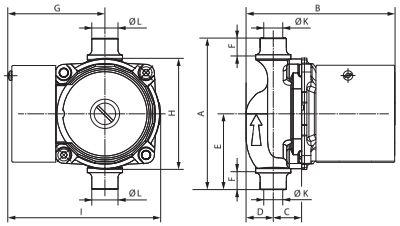
Wilo-Star, Drawing no.: 2



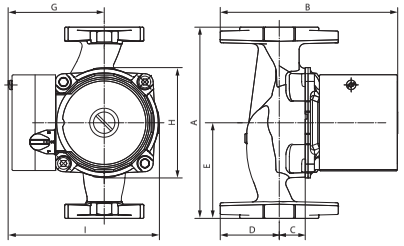
Wilo-Star, Drawing no.: 3



Wilo-Star, Drawing no.: 4



Wilo-Star S, Drawing no.: 5



Circulating Pumps
Wilo-Star/Star S

Dimension, weights

inch

Wilo-Star...	A	B	C	D	E	F	G	H	I	Ø K	Ø L	M	Weight approx.	Drawing No.
	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[lbs]	
Star 3 BS 5	5	4 15/16	15/16	7/8	2 4/8	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 4/8	9/16	3 3/16	3 11/16	5 1/16	7/8	1 1/8	–	5.3	4
Star 5 BU	6	5 1/8	11/16	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 4/8	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 4/8	9/16	3 3/16	3 11/16	5 1/16	7/8	1 1/8	–	5.3	4
Star 11 BU	6	5 1/8	11/16	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 2/7	2 3/16	4 1/4	–	3 2/9	3 7/9	5 1/8	–	–	–	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 1/8	–	–	–	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	1
Star 32 BF	6 3/8	5 3/8	1/16	1 5/16	3 3/16	–	3 3/16	3 11/16	5 1/16	–	–	2 1/16	7.7	1
Star 32 F	6 3/8	5 3/8	15/16	1 5/16	3 3/16	–	3 3/16	3 11/16	5 1/16	–	–	2 1/16	6.7	1
Star S 16 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 S 16 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 S 16 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 S 21 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 S 21 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 S 21 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

metric

Wilo-Star...	A	B	C	D	E	F	G	H	I	Ø K	Ø L	M	Weight approx.	Drawing No.
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	
Star 3 BS 5	127	125	24	23	64	15	81	93.5	128	16	22	–	3.0	4
Star 3 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

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: ¾" 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 ¾" to 2" (20 to 50mm).

Series 374A

Iron body with forged bronze inlet, 550,000 BTU/hr rating. Size ¾" (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 boilers 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.

Series 174A

Series 740

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 obligation to make such changes and modifications on Watts products previously or subsequently sold.

A LEADER IN VALVE TECHNOLOGY
WATTS® REGULATOR
Since 1874 — Watts Industries, Inc.
Water Products Division • Safety & Control Valves

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

HV NB ASME

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

Set Pressure psi	Set Pressure bars	¾" x ¾" 20 x 20mm Model M3	1" x 1" 25 x 25mm Model M1	1¼" x 1¼" 32 x 32mm Model M1	1½" x 1½" 40 x 40mm Model M	2" x 2" 50 x 50mm Model M
30	2.07	650,000	1,005,000	1,682,000	2,020,000	3,815,000
33	2.27	695,000	1,075,000	1,788,000	2,150,000	4,080,000
35	2.41	725,000	1,125,000	1,877,000	2,250,000	4,250,000
36	2.48	740,000	1,145,000	1,916,000	2,310,000	4,344,000
40	2.76	800,000	1,240,000	2,071,000	2,490,000	4,690,000
45	3.10	875,000	1,355,000	2,265,000	2,720,000	5,130,000
50	3.45	950,000	1,470,000	2,459,000	2,950,000	5,575,000
55	3.79	1,025,000	1,590,000	2,653,000	3,190,000	6,010,000
60	4.13	1,100,000	1,702,000	2,847,000	3,425,000	6,450,000
65	4.58	1,170,000	1,820,000	3,041,000	3,660,000	6,890,000
70	4.82	1,245,000	1,935,000	3,235,000	3,890,000	7,330,000
75	5.17	1,320,000	2,055,000	3,429,000	4,125,000	7,770,000
80	5.51	1,400,000	2,166,000	3,605,000	4,360,000	8,215,000
85	5.86	1,470,000	2,285,000	3,817,000	4,590,000	8,650,000
90	6.60	1,545,000	2,400,000	4,011,000	4,825,000	9,090,000
95	6.55	1,620,000	2,520,000	4,205,000	5,060,000	9,530,000
100	6.89	1,695,000	2,635,000	4,399,000	5,290,000	9,970,000
105	7.23	1,770,000	2,750,000	4,593,000	5,525,000	10,410,000
110	7.58	1,845,000	2,865,000	4,787,000	5,760,000	10,850,000
115	7.92	1,920,000	2,980,000	4,981,000	5,990,000	11,290,000
120	8.27	1,995,000	3,100,000	5,175,000	6,225,000	11,730,000
125	8.61	2,070,000	3,215,000	5,370,000	6,460,000	12,170,000
130	8.96	2,145,000	3,330,000	5,564,000	6,690,000	12,610,000
135	9.30	2,220,000	3,445,000	5,758,000	6,925,000	13,050,000
140	9.65	2,295,000	3,565,000	5,952,000	7,160,000	13,490,000
145	9.99	2,370,000	3,680,000	6,146,000	7,390,000	13,930,000
150	10.34	2,445,000	3,795,000	6,340,000	7,630,000	14,370,000

Series 740

Set Pressure psi	Set Pressure bars	¾" x 1" 20 x 25mm Model M3	1" x 1¼" 25 x 32mm Model M1	1¼" x 1½" 32 x 40mm Model M1	1½" x 2" 40 x 50mm Model M	2" x 2½" 50 x 65mm Model M
30	2.07	925,000	1,300,000	2,105,000	2,900,000	5,250,000
33	2.27	989,000	1,390,000	2,250,000	3,100,000	5,613,000
35	2.41	1,032,000	1,450,000	2,345,000	3,235,000	5,855,000
36	2.48	1,053,000	1,480,000	2,395,000	3,300,000	5,975,000
40	2.76	1,139,000	1,600,000	2,590,000	3,569,000	6,461,000
45	3.10	1,245,000	1,750,000	2,830,000	3,903,000	7,067,000
50	3.45	1,352,000	1,899,000	3,075,000	4,237,000	7,672,000
55	3.79	1,459,000	2,049,000	3,315,000	4,572,000	8,277,000
60	4.13	1,566,000	2,200,000	3,560,000	4,907,000	8,883,000
65	4.58	1,672,000	2,349,000	3,800,000	5,241,000	9,488,000
70	4.82	1,779,000	2,499,000	4,045,000	5,575,000	10,093,000
75	5.17	1,886,000	2,649,000	4,285,000	5,909,000	10,700,000

DIMENSIONS - WEIGHTS

Series 174A

No.	Size (Dn) in.	Size (Dn) mm	Model	Height in.	Height mm	Length in.	Length mm	Weight lbs.	Weight kg.
374A	¾ x ¾	20 x 20	–	3⅝	92	2½	64	1.13	.5
174A	¾ x ¾	20 x 20	M3	5⅛	130	2½	64	1.50	.7
174A	1 x 1	25 x 25	M1	5¾	146	3	76	3.13	1.4
174A	1¼ x 1¼	32 x 32	M1	8⅜	213	4¾	121	6.25	2.8
174A	1½ x 1½	40 x 40	M	9	229	4⅞	124	7.25	3.3
174A	2 x 2	50 x 50	M	11⅝	295	6¼	159	13.75	6.2

Series 740

740	¾ x 1	20 x 25	M1	5⅝	143	3	76	1.88	.9
740	1 x 1¼	25 x 32	M	7¼	184	3½	89	3.13	1.4
740	1¼ x 1½	32 x 40	M	8¼	222	4⅜	117	6.13	2.8
740	1½ x 2	40 x 50	M	9¼	235	5¼	133	7.50	3.4
740	2 x 2½	50 x 65	M	11⅝	295	6¾	171	16.50	7.5

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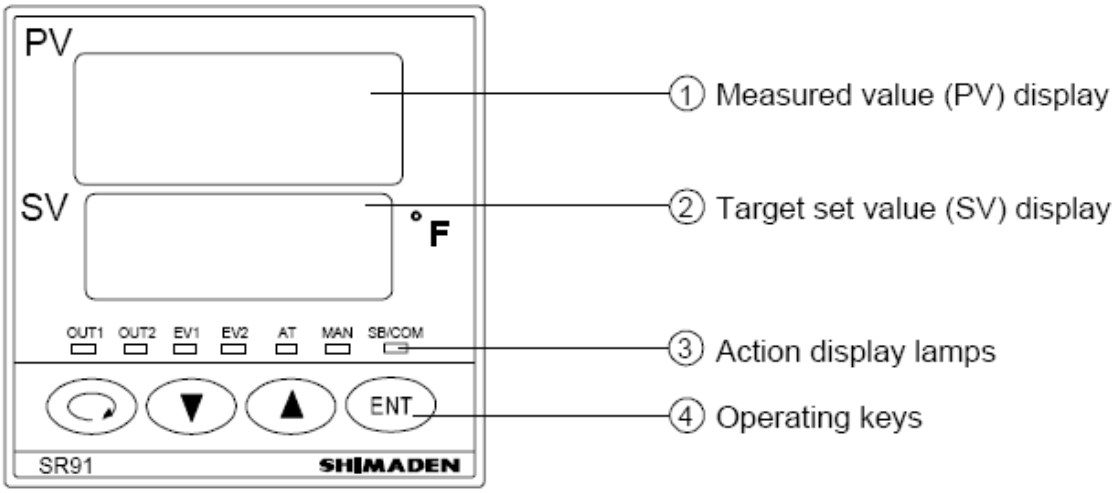
ACE Mini-Pack/SWH Digital Panel (Water)
ACE USB Digital Panel (Steam)



	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_ň	Hd	High deviation alarm
E1_d	5.0 (Water) **3.0 (Steam)	High alarm differential
E1_i	1	High alarm event standby action
E2_ ň	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 I**E2Ld**I 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)

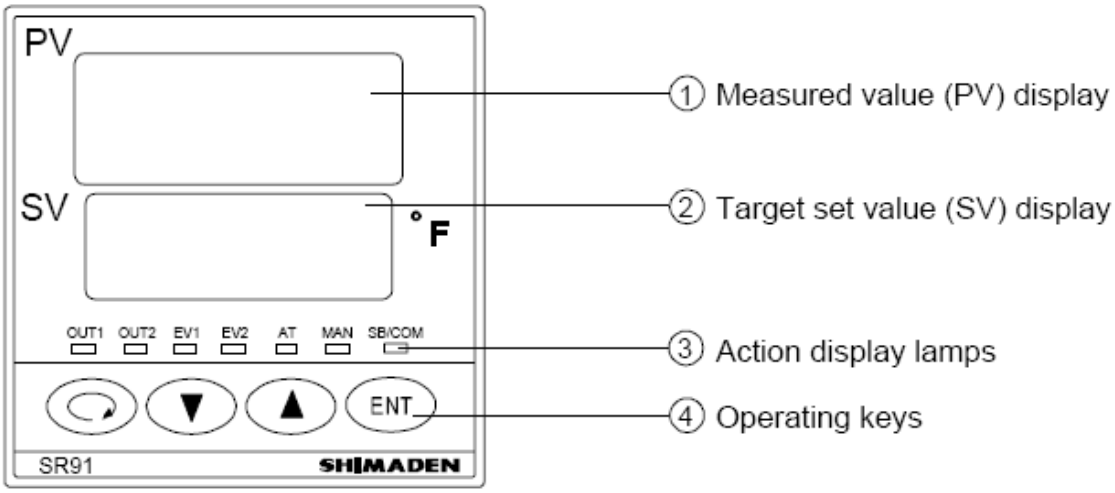
Change Setpoint

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 ENT 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_ň	Hd	High deviation alarm
E1_d	5.0 (Water) **3.0 (Steam)	High alarm differential
E1_i	1	High alarm event standby action
E2_ ň	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
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30) Fill out the **Safety System Test Check Sheet**.

N O T I C E

This owners & operation manual provides warnings of risk of harm from improper installation, operation and/or maintenance of Ace Products. Ace Heaters, LLC used ordinary care and complied with UL and ASME Standards in the design and manufacture of Ace Products. Proper installation, operation and maintenance are covered in the manual supplied with the product. All equipment must comply with local codes.

W A R N I N G

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

Ace Heaters, LLC
www.aceheaters.com

SO # _____

Serial No. _____

Model No. _____

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ACE
a nudyne company

Aceheaters.com
130 Klug Circle
Corona, CA 92878

(951) 738-2230