



# **Package Unfired Steam Generator PSB-Series Steam-to-Steam**

## **Operating and Maintenance Manual**



*Designed and Manufactured in  
Accordance with  
ASME Code Section VIII Div. I*



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## Operating and Installation Instructions

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Congratulations on your purchase of a new Ace, Packaged Unfired Steam Boiler. 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 generator. Please read them carefully. They should be helpful in both the installation and service of this unit. Keep these instructions with the unit for future reference.

The Ace unfired steam boiler is of rugged construction, yet of simple design. The generator uses steam from a boiler to produce process, clean, or pure steam, whichever the unit is designed for. The unfired steam boiler construction and design provides a high quality, low maintenance and an extremely cost effective steam generating system.

The heat exchanger tubes are rolled and expanded into a tube sheet. Each unfired steam boiler is constructed and stamped in accordance with Section VIII Div-1 of the ASME Code, which is stamped on the nameplate with applicable markings.

Experience in the field has proven that the Ace Unfired Steam Boiler, if properly applied and maintained, will give many years of efficient, dependable and economical service.

## The Unfired Steam Boiler Nameplate And Model Number

### The Unfired Steam Boiler Nameplate

The following illustration is an accurate depiction of the nameplate found on the boiler.

- 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

MAXIMUM ALLOWABLE WORKING PRESSURE		
SHELL	B	PSI @ C
TUBES	D	PSI @ E
MIN. D.M.I.	F	°F @ G
S/N	H	YEAR BUILT I
MODEL	J	
CAPACITY	K	GAL. SA. L SQ. FT.
JOB NO.	M	

### The Unfired Steam Boiler Model Number

**PSB V 36 05 - B7 - S P 200**

- PSB = Packaged Unfired Steam Boiler
- V = Type (H = Horizontal, V = Vertical, M = Mini-pack style)
- 36 = Tank Style or Mini-Pack Style Vessel Diameter
- 05 = Shell Length
- B7 = Steam Quality (A6 = Pure Steam, B7 = Clean Steam, C5 = Process Steam)
- S = Steam
- P = Control Valve (A = Pneumatic – Warren, E = Electric, P = Pilot-operated – Spence )
- 200 = Control Valve size (200 = 2", etc.)

## **Parts of the Packaged Unfired Steam Boiler**

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**(See Attached Diagrams)**

*Diagram may vary from actual model*

## Receiving Your Packaged Unfired Steam Boiler

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**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, LLC 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, UL, ASHRAE, ABMA, etc.

**Placement:** The steam generator 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 unit is level, from side to side and front to back, to assure proper operation and draining. 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 should be piped to a safe drain.

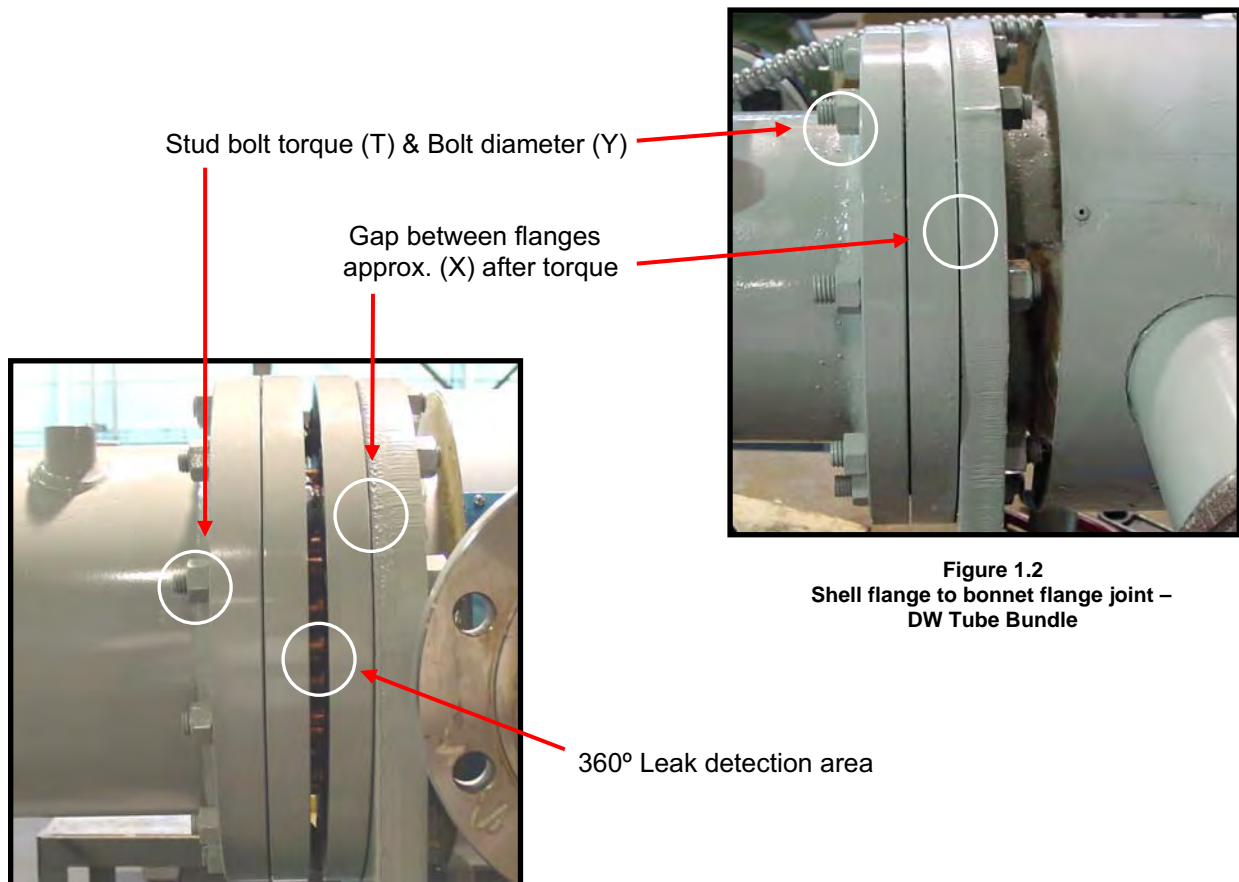
**Stud Nuts:** During shipment, the bonnet and shell flange nuts may loosen and should be re-tightened before start-up. Tighten these nuts to the torques specified later in this manual. After the unit has been in operation for a few days, check and retighten. Note: Bolting is independent on the bonnet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

**Torque's:** The following are recommended bolt torque requirements

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

**Notes:**

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



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

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

**Water Connections:** Pipe make-up water line to water make-up solenoid assembly. Pipe surface and bottom blow-off connections to drain.

**Steam Piping:** Check the steam supply pressure. The steam supply pressure should not exceed design pressure stated on List of Materials, which include design parameters. Connect steam supply line to control valve strainer. Connect product steam outlet of generator to system steam header.

**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. The unit's operating pressure cannot exceed that listed on the relief valve nameplate.

**Electrical:** Verify the electrical supply using a voltmeter. The voltage tie-in leads are indicated on the wiring diagram. Electrical power supplied through remote mounted electrical disconnect, supplied by others. This unit contains sensitive control components and it is recommended that a suitable commercial grade surge protection device be installed. The unit 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 Unfired Steam Boiler, wish to call to your attention the necessity for a sound approach to proper water treatment. The unit uses boiler steam 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 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. Also, note that proper and adequate blow down of unit effects quality of produced steam.

## Feed Water Treatment and Blow Down

Water treatment in the Unfired Steam Boiler is not as critical as in direct-fired boilers from the standpoint of generator failure. It must, however, be considered in every installation. Though water treatment frequently is unnecessary, it depends on the makeup water quality and its total solids content weighed against the percentage of makeup water added per pound of steam generated.

One situation that would require water treatment is the use of an unfired steam boiler for humidification only in a hard water region. Hard water is usually considered any water containing 200 ppm total hardness. It may have additional mineral and organic solid content, however, that may boost its total solids content beyond 250 ppm. In humidifier applications, there is 100 percent makeup to the unfired steam boiler. Every pound of water fed to the generator leaves its solids content concentrated in the generator boiler water. If the solids reach a concentration of 5,000 ppm or higher, moisture and solids maybe carried over with the steam, making it extremely difficult to control the humidifying equipment.

Often a suggested first treatment step is to soften the water. This converts insoluble calcium and magnesium salts to soluble salts. The soluble salts do not form hard scale on the tubes. They remain in solution in soft form to be discharged proportionately in the surface and bottom blow off.

One cautionary note, over-treatment can cause more harm than good. The treatment must be compatible with the tubing used in the steam generator. In addition, if the steam is to be used directly in food preparation or for sterilization and some water treatment is necessary, the water must be nontoxic.



It is possible for makeup water to be so hard and so high in total solids that complete demineralization would be the most economical approach. To determine the best type of treatment required for your system, call in a water treatment specialist.

Despite its value, water treatment alone is not sufficient. The key factor in effectively controlling solids concentration in the unfired steam boiler is a regular batch or continuous blow down from the generator shell. This should be combined with routine sample testing of the boiler water for total solids content. A formula for calculating rate of blow down follows:

### Permissible Solids Concentration in Boiler Water

Operating pressure (psig)	Solids (ppm)
Zero to 5	2,500
5 to 10	2,000
10 to 25	1,500
25 and up	1,000



**CAUTION:** *Prior to start-up, be certain that safety valve discharge and blow down valves are piped to a safe area to avoid possibility of injury to personnel or damage to property.*

## Start-up Instruction

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It is assumed that installation is complete and that all connections have been made, including: electrical, steam, water, instrument air, vents, drains and safety valve discharge lines.

1. **Make sure all adjustable settings are observed:**

- a) Steam control valve is to be set for the desired output. See pressure control manual within this booklet for fine-tuning. (Example: 15 psi)
- b) Steam Safety High Pressure Limit Switch (MERCROID) is to be set 10 psi above control valve set pressure. (Example: 25 psi)
- c) Pressure relief valves are factory set at 10 psi above high-pressure limit switch. (Example: 35 psi)

2. **Turn power on:** Turn on electrical system at manual Power-On switch on control panel. The On light (green), high-pressure light (red), feed water light (amber), and low water level light (red) should come on.

3. **Supply water to system:** The operator shall familiarize themselves with the valving and by-pass lines involved in the feed water lines. It will be observed that the feed water can be valved to by-pass the feed water valve by use of a three-valve by-pass around the feed water valve (not provided with unit). This is recommended for initial fill of tank.

The valving in the feed water circuit shall be set to allow the passage of feed water through the feed water valve and into the shell of the steam generator. The Low Water (red) and Feed Water (amber) lights will be on.

If feed water is now introduced to the unit, it will continue to fill the generator shell until the water level control de-energizes the feed water solenoid (on initial fill of tank operator will have to manually shut off by-pass). At this point, the gauge glass on the steam generator shell will indicate water at approximately the quarter point of the sight glass, the feed water low water alarm and light will be off. At the same time, open the top tri-cock (or isolation ball valve) to bleed the air out. Leave the tri-cock open until the feed water level starts to stabilize.

4. **Supplying plant steam to generator:**

A. **For Warren Pneumatic:**

- 1) Turn on the pneumatic system to the control making sure that 35 psi supply air is not exceeded.
- 2) Slowly open the manual shut-off valve to the control valve that passes the heating steam. Open this valve slightly and wait for the metal parts to heat up, then allow the control valve to slightly open to allow the coil and exchanger head to get hot. This is to ensure that the valve body and seat are not shocked, and that all connections to the valve are proved tight.
- 3) Then open the control valve completely; this will take about 15 to 30 seconds. You should notice the required steam pressure on the cap gauge. This pressure should not be higher than system design pressure noted in design parameters section.
- 4) Fine-tune Pressure Controller. Refer to Manual within this booklet.

**B. For Spence P14 and P15 pilot:**

- 1) Adjust the pilot wheel to the down position (zero pressure on spring).
  - 2) Slowly open the manual shut-off valve to the control valve that passes the heating steam. Open this valve slightly and wait for the metal parts to heat up. This is to ensure that the valve body and seat are not shocked, and that all connections to the valve are proved tight.
  - 3) Slowly turn the Spence pilot adjustment wheel until steam enters tube bundle. Let stabilize for one (1) minute, or until steam is observed exiting the tri-cock on the float assembly. If no steam is observed, turn pilot adjustment wheel in one quarter (1/4) turn increments with one (1) minute pauses until steam is observed. Close tri-cock, and observe steam pressure on shell pressure gauge.
  - 4) Continue adjusting pilot adjustment wheel with one (1) minute pauses until desired pressure output from generator is observed.
  - 5) Fine tune pilot. Refer to Manual within this booklet.
5. **Open product steam valve on steam outlet of unit.**
  6. **Test all safety controls to ensure they are operable.**
  7. **The steam generator will now function automatically under designed load.**

**Shut Down Instruction**

1. **Close off plant steam to generator:**
2. **De-energize all electrical power sources to the steam generator**
3. **Close air line supplying instrument air to generator (if applicable)**
4. **Shut valve for product steam**
5. **Drain water out of unit:** Open drain valve on unit. Pull lever on relief valve and leave open until unit has drained and cooled. Also, drain water out of sight glass assembly.
6. **Allow unit to cool down: Approximately 24 - 48 hours.**

**Emergency Safety Features**

1. **Control valve system:** The steam control valve system is designed to fail closed in the event of a power failure.
2. **Relief valve:** The relief valve is designed to relieve the pressure in the vessel in the event the pressure gets too high.
3. **Level controls:** Shell water level controls will shut off the steam control valve in case of low feed water level in the shell. At the same time, the low level alarm(s) will be triggered (red light) (audible or remote alarm).
4. **Mercoid pressure switch:** This high-pressure limit switch will shut off the steam control valve activating the high-pressure (red light) alarm.

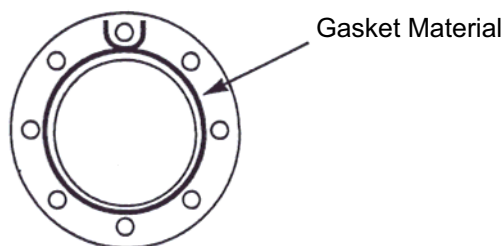
## Disassembly Instructions

1. **Controls and instrumentation:** Refer to the individual "Maintenance Instructions" sections for these components.
2. **Bundle removal:**
  1. Shut down unit. (See shut down instructions).
  2. Drain steam generator to sewer (after cool down period).
  3. Be certain plant steam is closed off completely.
  4. Disconnect flanged lines to tube bundle bonnet (stream inlet and condensate outlet).
  5. Remove nuts from the steam bonnet and shell nozzle.
  6. Steam bonnet can now be removed and tube bundle can be pulled out directly.

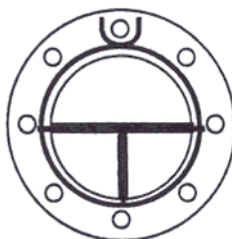
**Note:** *Tube bundle is supported inside the steam generator by a full length steel, or stainless steel, track. Care should be taken to remove bundle without damaging the tubes.*

## Tube Bundle and Cap Installation

1. **Flange and tube sheet preparation:** Gasket surfaces must be clean and even.
2. **Apply gaskets:** Install gasket material on stationary flange with adhesive side down.
  1. Overlap material at top of flange.
  2. Overlapped ends should protrude out of flange, with one end on each side of top bolt.
  3. Make sure gasket does not extend into bore.



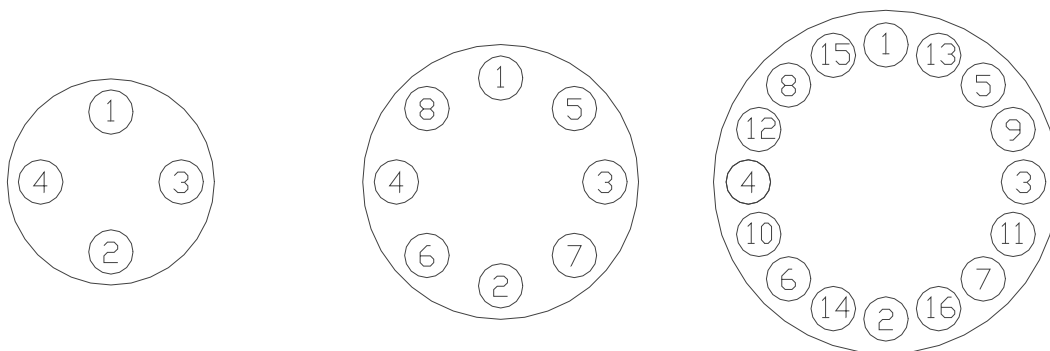
3. **Install heat exchanger bundle:** Bundle should be lifted or jacked to proper height before being pushed into gasket. Bundle should be left supported until installation is complete.
4. **Apply gasket material on channel cap:** Overlap gasket material around bolt hole as above. Apply gasket on divider sections as well. Overlap the divider gasket strips over the main gasket.



5. **Bolting cap and flange:** Place at least four (4) bolts thru stationary flange, double nut and thread thru tube sheet. Using jack or overhead support to lift cap into position, align with the bolts that are in place, level and slide cap against tube sheet. Remove second nut from tank side of bolt. Install nuts on bolts in place and tighten finger tight. Install remaining bolts and nuts, equal out bolts on tanks side and cap side, again tightening finger tight.
6. **Torque:** Unless otherwise specified, when using Goretex or spiral wound gaskets, use the following table to find recommended bolt tightening torque.

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

7. **Torque bolts:** Set torque wrench to half of recommended torque rating. Tighten bolts according to alternating crossover pattern. Do not over tighten any one bolt initially as this could crimp the gasket. The sequence is to lightly tighten the first bolt then move directly across the circle for the second bolt. Continue as illustrated below. Tighten each bolt in increments repeating the cycle until half torque ratings are reached. Reset torque wrench to full torque rating, and repeat tightening sequence in increments until full torque ratings are reached. Remember, for the gaskets to work properly, the flange faces must be kept parallel and the bolts tightened uniformly.



**Completion:** When bolt-tightening sequence is complete, remove the support from the tube sheet and the channel cap.

## Trouble-shooting Guide

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### a Banging or pinging:

1. Check for proper condensate drainage. Clean out all dirt and debris.
2. Check for backpressure in the condensate line.
3. Check steam trap(s) for proper operation.

### b Erratic temperature control:

1. Check for condensate lift.
2. Check for proper steam pressure. Make sure it is not more than what the steam generator is designed for.
3. Check steam trap(s) for proper operation.
4. On pneumatic valves, check control pressure to the actuator. Make sure it is not fluctuating.
5. Check for debris in valve or strainer.
6. Sticking valve stem. This can be caused by a bent valve stem or a valve stem not properly lubricated. A sticking valve stem can also be caused by the packing gland assembly being too tight. Loosen the packing gland assembly and lubricate.
7. Regulator is controlling at incorrect set point.
8. The sensitivity screw or wheel on the controller needs adjustment.

### c Poor recovery:

1. Shut unit down, remove bonnet and inspect coil for scale or fouling, restricting heat transfer. Clean with an approved chemical treatment.
2. Make sure the steam generator is not trying to supply more steam than it is designed for.
3. Check for fouling of steam pilot on pilot operated valves.
4. Check for proper air pressure to control valve on pneumatic valves.

### d Control Valve not closing:

1. The valve seat is worn or there is debris in the seat.
2. The packing gland assembly is too tight, locking the valve stem.
3. The temperature adjusting nut assembly is raised too high.
4. Increase the valve spring tension.

## Maintenance Instruction

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**KEEP TUBES CLEAN:** In order to maintain high efficiency, the steam generator tubes should be cleaned periodically. The frequency of cleaning the tubes depends on the characteristics of the water and the type of installation. Contact your local water treatment company for evaluation and recommendations.

**GASKETS:** Tighten gaskets during start up and periodically thereafter. Leaky gaskets can cause corrosion of the stud bolts. It is good practice to use a new gasket each time the tube bundle or cap is removed.

**STUDS:** Keep studs protected from corrosion with paint or oil. Keep stud bolts tight to prevent leaky gaskets. Stud bolts will not corrode if they are kept dry and protected. Use caution in removing and reinstalling the bonnet. The steam generator must be shut down and drained before attempting removal. Before removing the nuts, apply penetrating oil and allow it to set for a few minutes. Forcing the nut off could cause breakage. Use a torch to heat the nut and it will come off easier. If a torch is not available, take a cold chisel, place it across the flat of the nut, and strike several sharp blows with a heavy hammer. This should loosen the nut. If necessary, it is better to split the nut open and replace it than to break the stud off.

**CONTROLS:** Under normal conditions, controls furnished with the steam generator require very little service. It is important, however, that the controls be protected from moisture. All controls should be checked frequently to make sure that they are working properly.

**RELIEF VALVE:** The steam generator is equipped with a lever type relief valve of "ASME" rated capacity. To maintain the valve in good working condition, it should be manually opened once a month. The relief valve outlet should be piped directly to an open drain and the drain checked frequently for discharge. If the relief valve is leaking or does not operate freely, it should be replaced.

### Preventive Maintenance

#### Every 3 months:

1. Visually check for leaks from the valve body joints, piping, packing and stem areas.
2. Visually check for excessive corrosion on the regulator, bellows, capillary, bulb, bridge, and yoke.
3. Check for full valve travel. Less than full valve travel may indicate a leak in the bellows, capillary, or bulb.
4. Test the temperature adjusting nut assembly for freedom of movement.
5. Remove bulb from the steam generator and check for excessive corrosion or erosion.
6. Strainers should be inspected and cleaned. Damaged screens should be replaced.

### Annual Maintenance

1. The relief valve must be tripped to insure proper operation as a safety device.
2. Pull the tube bundle and clean the inside and outside of the tube bundle of scale. The frequency of tube cleaning will be determined after inspection. (Heavy scale will indicate more frequent cleaning is necessary). 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. The tube bundle should be cleaned with a tube brush and/or a muriatic pool acid solution.

### Replacement Parts

Ace Heaters maintains a complete equipment list for each Unfired Steam Boiler, filed by serial number. In order for us to give prompt service and to ensure that correct parts are supplied, please be sure and supply the model and serial number.

### **Material Safety Data Sheets**

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

If you do not know who your local Manufacturer's Rep is, you can find out by logging into the [www.aceheatingllc.com](http://www.aceheatingllc.com) website, and clicking on the Representative tab found in the table of contents.

**Ace Heaters, LLC**  
[www.aceheaters.com](http://www.aceheaters.com)





## FACTORY LIMITED WARRANTY POLICY

**The Ace Factory limited warranty provides assurance that all products are free from manufacturer 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 include:

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 architect, 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 terms and conditions of sale which is referenced in every quotation, on the back of sales order acknowledgements and invoices. It is legally correct and is an industry standard policy.

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# 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](http://www.aceheaters.com)

Ace Heaters, LLC

# WARNING

## PRODUCT SAFETY NOTICE

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

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

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



**Ace Heaters. LLC**  
[www.aceheaters.com](http://www.aceheaters.com)



## Bulletin E-90-BPC

# Series 4B, 8B, 16B and 32B Microprocessor Based Temperature Process Control

## Specifications - Installation and Operating Instructions



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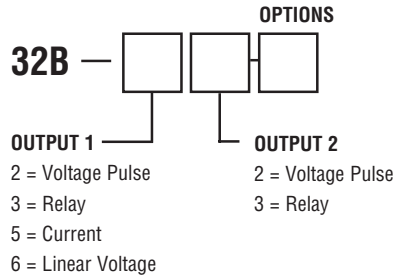
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## LOVE CONTROLS

A DIV. OF DWYER INSTRUMENTS INC.  
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46361, U.S.A.

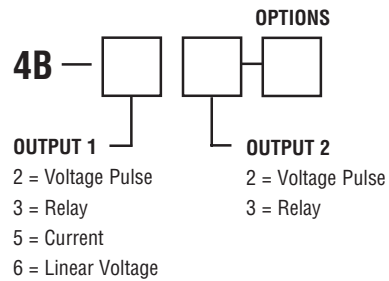
Phone: 219/879-8000 [www.love-controls.com](http://www.love-controls.com)  
Fax: 219/872-9057 e-mail: [love@love-controls.com](mailto:love@love-controls.com)

## MODEL NUMBER IDENTIFICATION



### OPTIONS

-LV = Low Voltage

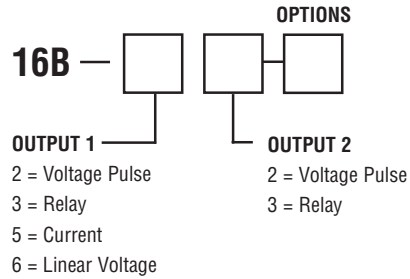


### OPTIONS

Blank = none  
1 = Event input  
2 = Current Transformer  
-LV = Low Voltage

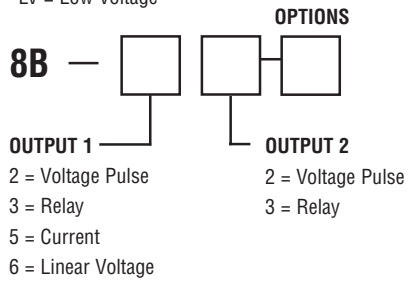
## GETTING STARTED

1. Install the control as described on page 4.
2. Wire your control following the instructions on pages 6-7. Please read the Precautions section located at the end of this manual before wiring the control.
3. For best results when programming changes are necessary, make all changes to the Initial Setting mode (Pages 20-22) before making changes to the Regulation Mode (Pages 17-19) or Operation Mode (Pages 15-16). If any error messages occur, check the Diagnostic Error Message Section (Page 26) for assistance.



### OPTIONS

Blank = none  
1 = Event input  
2 = Current Transformer  
-LV = Low Voltage



### OPTIONS

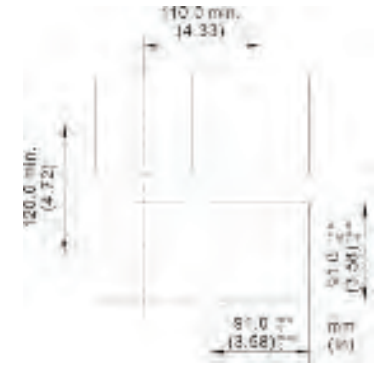
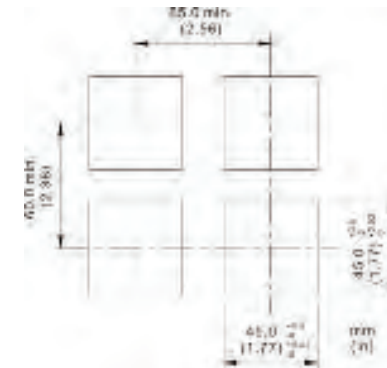
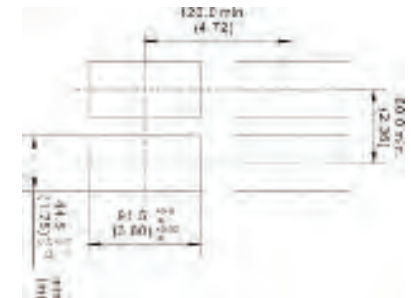
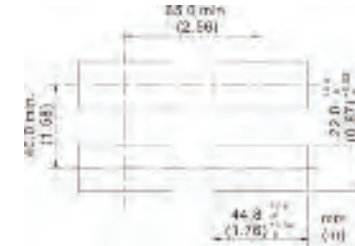
Blank = none  
1 = Event input  
2 = Current Transformer  
-LV = Low Voltage

## INSTALLATION

Mount the instrument in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.

Select the position desired for the instrument on the panel. Prepare the panel by cutting and deburring the required opening per the panel cut out dimensions listed below. Follow the mounting instructions listed on page 5. Lastly, wire the controller per the appropriate wiring diagram listed on page 6.

## PANEL CUTOUT DIMENSIONS

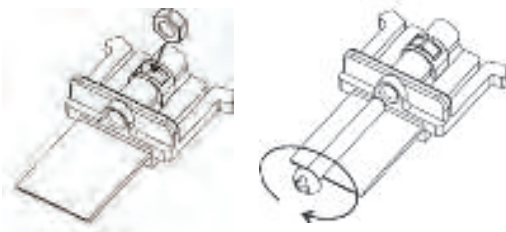




## MOUNTING METHOD

- Step 1: From the front of the panel, slide the controller housing through the cut out. The housing gasket should be against the housing flange before installing.
- Step 2: Insert the mounting brackets into the mounting grooves on the top and bottom of the controller (16B, 8B, and 4B). For the 32B, slide the mounting collar over the housing from the rear of the panel.
- Step 3: Push the mounting brackets forward until the bracket stops at the panel wall.
- Step 4: Insert and tighten the screws on the bracket to secure the controller in place. (The screw torque should be 0.8 kgf-cm).

### Mounting Bracket Installation



### 16B/4B/8B Mounting Method



### 32 Mounting Method



## WIRING

Do not run thermocouple or other class 2 wiring in the same conduit as power leads. Use only the type of thermocouple or RTD probe for which the control has been programmed. Maintain separation between wiring of sensor, auxiliary in or out, and other wiring. See the Initial Setting Menu for input selection.

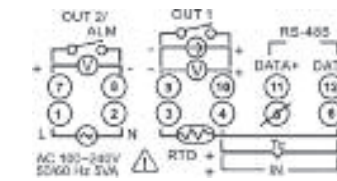
For thermocouple input always use extension leads of the same type designated for your thermocouple.

For supply connections use No. 16 AWG or larger wires rated for at least 75° C. Use conductors only. All line voltage output circuits must have a common disconnect and be connected to the same pole of the disconnect.

Input wiring for thermocouple, current, and RTD; and output wiring for current 14 VDC is rated CLASS 2.

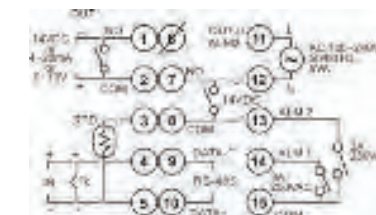
Control wiring as show below:

### Terminal Identification 32B



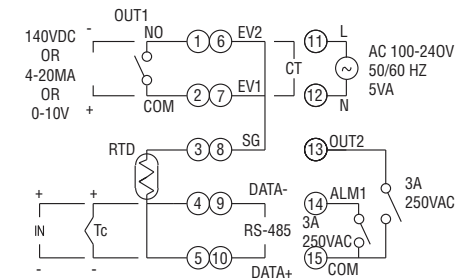
16B

AC

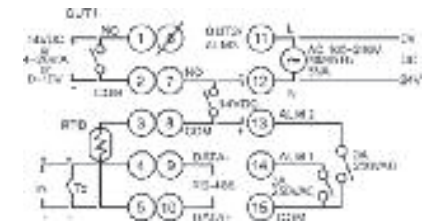


AC, No Event / CT Input

DC



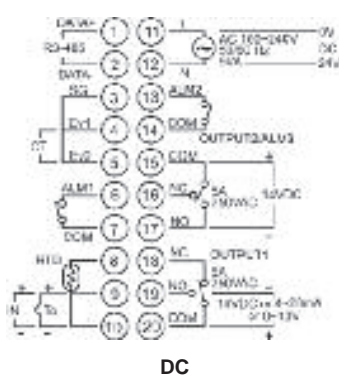
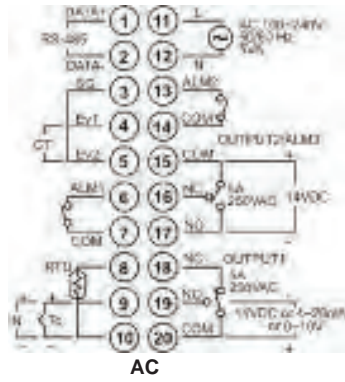
AC, Event / CT Input



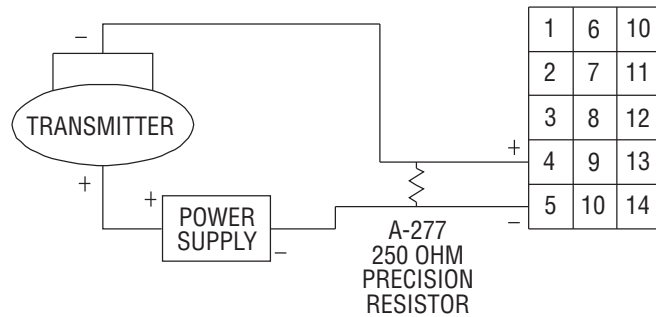
DC, No Event/CT Input

## Terminal Identification (Continued)

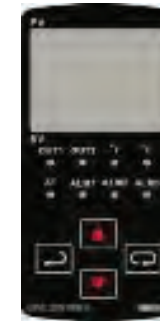
### 4B/8B



### Wiring for 4 to 20 mA Transmitter Inputs



Note: 16B terminal layout used in above example. Use appropriate terminal layout for selected controller.



### FRONT KEY FUNCTIONS

Key functions are as follows:



**INDEX:** Pressing the INDEX key advances the display to the next menu item.



**UP ARROW:** Increments a value or changes a menu item. If pressed during the **Operation Mode**, the set point value will be increased.



**DOWN ARROW:** Decrements a value or changes a menu item. If pressed during the **Operation Mode**, the set point value will be decreased.



**ENTER:** Stores the value or item change. If not pressed, the previously stored value or item will be retained. When pressed during the **Operation Mode**, the controller switches to the **Regulation Mode**. If held for more than 3 seconds during the **Operation Mode**, the controller switches to the **Initial Setting Mode**. If pressed during the **Regulation Mode** or **Initial Setting Mode**, the controller will return to the **Operation Mode**.

### SECURITY FEATURES

The B series controller has two built in security lock settings to prevent unauthorized personnel from changing parameter settings. These parameters are set in the **Operation Mode**.

The LoC1 setting affects all parameters in the controller. If LoC1 setting is enabled, the operator will have to unlock the controller to make any changes to the controller's parameters.

The LoC2 setting affects all parameters except the set point. If LoC2 setting is enabled, the only parameter that the operator will be able to change is the set point. In order to change any other parameters, the operator will have to unlock the control before making a change.

In order to unlock the control, the operator must depress the ENTER and INDEX key simultaneously.

## CONTROL OPERATION DESCRIPTION

The HOME display is the normal display while the control is operating. If no errors or functions are active, the HOME display will indicate the Process Variable (the temperature, pressure, flow, %RH, etc.) that is being measured on the top display and the Set Variable on the bottom display.

Items that can change the HOME display are the Ramp and Soak function and any error messages. Descriptions of these special displays follow.

If the Ramp and Soak feature is active, then bottom display will show the current execution pattern and current execution step. The UP and DOWN arrows can be pressed to change the bottom display to show the Set Point (SP) of the current execution step or the Time Remaining (r-ti) of the current execution step. After changing the bottom display to either the Time Remaining or the Set Point, the ENTER key must be pressed to display the values.

Error Messages are shown on page 26.

## OPTIONS

### Event Input

When the controller is ordered with the Event Input Option (See page 3 for ordering information), two event inputs are available. The event input is triggered by contact closure between event 1 (EV1) or event (EV2) contact terminal and signal ground (SG) contact terminal.

Event 1 controls the output operation of the control. When the event 1 contact terminals are open, the output is active. When the event 1 contact terminals are closed, the output is deactivated. The outputs can also be controlled via the Run/Stop parameter using the front keypad or by using the RS-485 communications.

Event 2 allows the user to switch between two temperature set points. Each temperature set point has independent control parameters.

### Current Transformer Alarm Function

The current transformer option allows the user to have an alarm contact trigger due to a loss of current or a surge in current to the control output. When using the current transformer input, the desired alarm contact should be set to alarm type 13 in the Initial Setting Menu (Page 21). The current transformer should be wired according to the appropriate wiring diagram on page 6 and page 7. The high and low alarm set points can be set from 0.5 to 30 Amps. The display resolution is 0.1 Amps and the accuracy is  $\pm 0.5$  Amps with the included current transformer.

## Heating, Cooling or Dual Loop Control

Temperature Control can be achieved by either heating or cooling. In the B series controllers, heating and cooling can be operated simultaneously using Dual Loop Output Control to maintain a temperature set point. When Dual Loop Output Control is used, control outputs must be connecting to the heating and cooling devices. Please refer to the following for the operation of each setting.

Control Modes are selected by changing the S-HC parameter in the Initial Setting Mode.

Select HEAt, for heating or reverse acting control for output 1. If selected, output 2 will become alarm 3.

Select Cool, for cooling or direct acting control for output 1. If selected, output 2 will become alarm 3.

Select H1C2 or C1H2 for Dual Loop Output Control for output 1 and 2. If H1C2 is selected, output 1 would be for heating or reverse acting control and output 2 would be for cooling or direct acting control. If C1H2 is selected, output 1 would be for cooling or direct acting control and output 2 would be for heating or reverse acting control.

Setting the control mode to PID when the controller is set for Dual Loop Output Control Activates the Proportional Band Coefficient (CoEF) parameter and the Dead Band (dead) parameter.

The Proportional Band Coefficient (CoEF) sets the Proportional band value for Output 2 based on the Proportional band of output 1. The Proportional Band of Output 2 would be equal to the Proportional Band (Pn) of Output 1 multiplied by the Proportional Band Coefficient (CoEF). The Integral Time (in) and the Derivative Time (dn) will be the same for both Outputs.

The Dead Band (dEAd) parameter sets an area in which the heating and cooling outputs are operating at 0% on. The Dead Band is centered on the Set Point in Dual Loop Output Control mode. Please see the Dead Band illustrated on page 19.



## RAMP/SOAK PROGRAMMING AND OPERATION

The ramp/soak feature offers a great deal of flexibility by allowing changes in the set point to be made over a predetermined period of time.

### Theory of Operation

The B series controls offer a very simple approach to programming a ramp function. Rather than requiring the operation to calculate an approach rate (usually in degrees per minutes), the B series does the calculation internally. Thus, the operator only needs to program the target set point and the time desired to reach that point. When the ramp segment is executed by the control, it calculates the ramp required to move the process from the starting value (current PV) to the desired value (programmed SP) in the time allowed.

Soaks (or dwells) are ramp segments where the target set point is the same as the beginning process value. This allows for multistage ramps without wasting intermediate soak steps. Care must be taken, however, that the process does actually reach the soak value before the soak time starts. If not, the next segment will calculate a slope from the starting PV to the target SP. Depending on your process requirements, this difference may be important. Make sure to test any program for desired results before running production material.

**Do not operate auto-tuning while a ramp function is operating. The ramp function will prevent self tune from operating properly. Make sure that all tuning is set up before operating ramp/soak.**

### Program Setup

All of the programming for the Ramp/Soak function is done in the Initial Setting Mode. You may wish to work out your program on paper before going into the programmer menu sequence.

In the Initial Setting Mode, go to the Control Mode (CtrlL) parameter. Set the parameter to ProG. Press INDEX to the Pattern Editing parameter (PAtn). Use the arrows to select the desired pattern to edit. By setting the Pattern Editing parameter to off, pressing the INDEX key brings up the next parameter in the Initial Setting mode. The Ramp and Soak function is supported by 8 different patterns (pattern numbers 0 to 7). Each pattern contains 8 steps (step numbers 0 to 7) for set point and execution times, one link pattern (Linn) parameter, one cycle parameter (CyCn), and one actual step parameter (PSYn).

The default of step 0 in pattern 0 is a soak function. The control should be programmed to reach the Set Point (SV) temperature, X, after the execution time, T. The unit will control the process temperature (PV) to reach temperature X and then keep the temperature at temperature X. The execution time T is determined by the execution time (ti00) for step number 0. The target set point (SP00) for step number 0 should equal the Set Point (SV) temperature.

After the first step, program SP01 and ti01 through SP07 and ti07 for the first pattern. The target set point value (SP0n) is in actual units just like your Set Point (SV). If the control is set for temperature, then the target set point displays are in temperature. If the control is programmed for some other engineering unit, the target set point displays will be set in that unit. The target execution time (ti0n) is in units of time, (hh.mm). The step parameters will be followed by the Actual Step parameter, Cycle parameter, and the Link parameter for each pattern.

The Actual Step parameter (PSYn) sets the last executable step for the current pattern. For example, if the Actual Step parameter is set to 2 for pattern 0, then the program will only run steps 0, 1, and 2 for pattern 0.

The Cycle parameter (CyCn) determines how many times the current pattern is repeated. For example, if the Cycle parameter for pattern 0 is set to 2, the steps in pattern 0 will be repeated twice before moving on to the next pattern.

The Link parameter (Linn) assigns the next pattern for the program to execute. For example, if the Link parameter is set to 3 for pattern 0, the program will skip patterns 1 and 2 and start executing pattern 3 after pattern 0 is complete. If the Link parameter is set to OFF, the program will stop after executing the current pattern and the temperature will be maintained at the set point of the last step executed.

### Execution

The execution of the ramp and soak feature is initiated through the Run/Stop parameter, (r-S) in the Operation Mode. The Run/Stop parameter has four possible values.

If the Run/Stop parameter is set to rUn, the program will start to execute in order from step 0 of the start pattern.

If the Run/Stop parameter is set to Program Stop (PStP), the program will stop and maintain the temperature of the last set point before the program was halted. When the Run/Stop parameter is restarted, the program will restart and execute from step 0 of the start pattern. The start pattern selection (Ptrn) is only available when the Run/Stop parameter is set to Program Stop.

If the Run/Stop parameter is set to Program Hold (PHod), the program will be paused and the temperature will be maintained at the set point temperature that was active prior to the program hold. Once the Run/Stop parameter is set back to run, the program will follow the step before the hold and start to execute through the rest of the program.

### Display

During ramp and soak program control, the SV default display is P-XX, where P indicates the current execution pattern and XX indicates the display item to Set Point Value (SP) or Residual Time (r-ti). The Set Point Value will display the temperature set point of the current execution step in the SV display. The Residual Time will display the remaining time of the current execution step in the SV display. After selecting the Set Point Value or Residual Time, the ENTER key must be pressed to accept the display change.

## PROGRAMMING AND OPERATION FOR PID

### Theory of Operation

The PID method of control is based on the individual tuning of proportional band values, integral time values, and derivative time values to help a unit automatically compensate for changes in a control system. The proportional band is the range around the set point in which the control's proportioning takes place. The control increases or decreases the output proportionately to the process temperature's deviation from the set point. The integral time eliminates undershoot and overshoot of the set point by adjusting the proportioning control based on the amount of deviation from the set point during steady state operation. The derivative time eliminates undershoot and overshoot by adjusting the proportioning control based on the rate of rise or fall of the process temperature. The integral deviation offset correction (ioFn) improves the speed in which the process value reaches the set point value. If this parameter is set to zero, the output will be zero when the process value is equal to the set point value. If the integral time parameter is used only to eliminate steady state error, it may take a long time to reach the set point because it needs time to accumulate the error. This parameter defines the default output level on start up. When the integral time is set at 0, then the proportional derivative offset correction (PdofF) would replace the integral deviation offset correction, but serves the same function.

### Program Set Up

In order to use the PID function in the B series controllers, the Control Mode will have to be set to PID in the Initial Setting Menu. After changing the Control Mode, the PID parameters can be accessed in the Regulation Menu. The PID parameters can either be programmed manually or they can be set by the controller using the auto tune function. The auto tune will use trial and error to tune the PID parameters to give the control the most precise control. Since the time to accurately tune the control may differ depending on the process, the controller can also be manually tuned to known PID values prior to running auto tune. The Run/Stop parameter must be set to run in order to start auto tuning.

The B series controller has four user-defined profiles (PID0 to PID3) of PID values along with an auto selection function (PID4). Each set of PID values includes a set point value (Svn), proportional band (Pn), integral time (in), derivative time (dn), and integral deviation setting (iofn). If PID4 is selected, the controller will pick which set of user defined parameters to use based on how close the set point value of the profile is to the current process value.

## DESCRIPTION OF MENU STRUCTURE

The programming for the controller is broken down into three menus (Operation, Regulation, and Initial Setting). Upon normal operation, control will be in the Operation Menu.

### OPERATION MENU

Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display, except for the set point which is displayed in the bottom display on the Home Display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

<i>1234</i>	Adjust the set point value - Can be any numerical value between the upper and lower limit of the temperature range.
<i>r-S</i>	Select Run - Stop Output Control.
<i>rUn</i>	Activates outputs and Starts Ramp/Soak.
<i>StoP</i>	De-activates outputs and Stops Ramp/Soak.
<i>PStP</i>	Halts Ramp/Soak program, outputs remain active. Only available during ramp/soak operation. Program restarts at Step 0 of Start Pattern.
<i>PHod</i>	Pauses Ramp/Soak program, outputs remain active. Only available during ramp/soak operation. Program restarts at step prior to program being held.
<i>Pttrn</i>	Set Start pattern for Ramp/Soak. Only available when r - S set to PStP.
<i>SP</i>	Number of digits to the right of the decimal. Decimal Point Position can be set for all Inputs except for B, S, and R type thermocouples.
<i>AL 1H</i>	Alarm 1 High Set Point. May not appear depending on ALA1 setting in Initial Setting Menu.

<i>AL 1L</i>	Alarm 1 Low Set Point. May not appear depending on ALA1 setting in Initial Setting Menu.
<i>AL2H</i>	Alarm 2 High Set Point. May not appear depending on ALA2 setting in Initial Setting Menu.
<i>AL2L</i>	Alarm 2 Low Set Point. May not appear depending on ALA2 setting in Initial Setting Menu.
<i>AL3H</i>	Alarm 3 High Set Point. May not appear depending on ALA3 setting in Initial Setting Menu.
<i>AL3L</i>	Alarm 3 Low Set Point. May not appear depending on ALA3 setting in Initial Setting Menu.
<i>LoC</i>	Set front panel security lock.
<i>LOC 1</i>	Lock all settings.
<i>LOC 2</i>	Lock all settings except the set point.
<i>out 1</i>	Display the % output value for output 1. In manual mode, this value can be changed using the up and down arrows.
<i>out 2</i>	Display the % output value for output 2. In manual mode, this value can be changed using the up and down arrows.

## REGULATION MENU

Press the ENTER key while at the Home Display in order to access the Regulation Menu. Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

<b>AutoTune</b>	Auto Tune. The controller will evaluate the process and select the PID values to maintain good control. Only available when the control mode is set to PID.
<b>on</b>	Start learning the process. After the process has been learned the menu will revert to oFF.
<b>oFF</b>	Disables Auto Tune.
<b>Pidn</b>	Selection of PID profile. The controller can store up to 4 PID profiles. The top display will show the PID profile and the bottom display will show the target set value for that profile. When Pid4 is selected, the controller will automatically select which PID profile to use based on the target set values. Only available when control mode is set to PID. See Programming and Operation of PID function for more information. (n = 0 to 4)
<b>SVn</b>	Target Set Value associated with each PID Profile. (n = 0 to 3).
<b>Pn</b>	Proportional Band Setting associated with each PID Profile. (n = 0 to 3).
<b>in</b>	Integral time (reset time) associated with each PID Profile. (n = 0 to 3).
<b>dn</b>	Derivative time (rate time) associated with each PID Profile. (n = 0 to 3).
<b>ioFn</b>	Integral Deviation Offset Correction associated with each PID Profile. (n = 0 to 4)

**PdoF** PD Offset Correction Setting. only available when control mode is set to PID and integral time = 0. See Programming and Operation of PID function for moving information.

**HtS** Heating Hysteresis (Differential) Setting. Sets the value for the amount of difference between the turn off point (set point) and the turn on point. Figure A shows the output behavior for a heating (reverse acting) application. Only available when control mode set to on/off control.

**CtS** Cooling Hysteresis (Differential) Setting. Sets the value for the amount of difference between the turn off point (set point) and the turn on point. Figure A shows the output behavior for a cooling (direct acting) application. Only available when control mode set to on/off control.

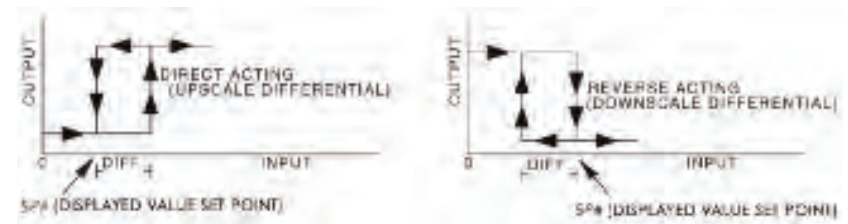


Figure A: Output behavior for Heating/Cooling On/Off Applications

**HtPd** Heating Control Cycle Setting. Defines the duration for one output period or cycle for output 1. Only available when control mode is set to PID or ProG and Output 1 is set for heating.

**CtPd** Cooling Control Cycle Setting. Defines the duration for one output period or cycle for output 1. Only available when control mode is set to PID or ProG and Output 1 is set for cooling.

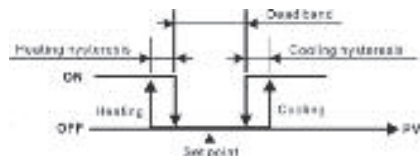
**HCPd** Control Cycle setting for output 2. Defines the duration for one output period or cycle for output 2. Only available when control mode is set to PID and Dual Loop Output Control.

**CoEF**

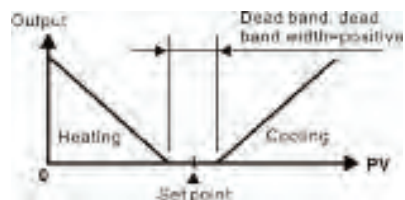
Proportional Band Coefficient. Sets the value of the proportional band for output 2. The proportional band of output 2 is equal to the proportional band of output 1 multiplied by the proportional band coefficient. This parameter is only available when the control mode is set to PID and Dual Loop Output Control.

**deAD**

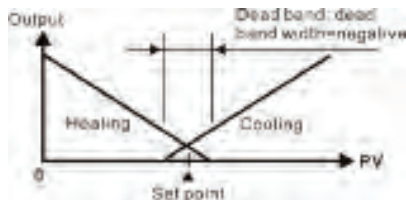
Dead Band. The zone centered on the set point in which the control is thought to be at the desired set level. The outputs will be turned off at this point unless there is an integral deviation offset or the dead band is negative. This parameter is only shown when the control is set to Dual Loop Output Control.



Output operation of ON/OFF control during dual loop output control.



PID control Dead Band is positive.



PID control, Dead Band is negative.

Figure B: Output Operation during dual loop control

**tPof**

Process Temperature Offset. This feature allows the input value to be changed to agree with an external reference or to compensate for sensor error.

**Crh**

Analog Output High Limit: Sets the actual upper limit of the analog output when the control's output is operating at 100%. Only available for analog output models.

**CrLo**

Analog Output Low Limit: Sets the actual lower limit of the analog output when the control's output is operating at 0%. Only available for analog output models.

## INITIAL SETTING MENU

Press and hold the ENTER key for at least 3 seconds while at the Home Display in order to access the Initial Setting Menu. Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

**inPt**

Input Selection. Select one of the following input types from the below table. For Current inputs, a 250 Ohm Resistor must be wired across the input terminals.

Input Temperature Sensor Type	LED Display	Temperature Range
Thermocouple TXK type	tXt	-328 ~ 1472°F (-200 ~ 800°C)
Thermocouple U type	U	-328 ~ 932°F (-200 ~ 500°C)
Thermocouple L type	L	-328 ~ 1562°F (-200 ~ 850°C)
Thermocouple B type	b	212 ~ 3272°F (100 ~ 1800°C)
Thermocouple S type	S	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple R type	r	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple N type	n	-328 ~ 2372°F (-200 ~ 1300°C)
Thermocouple E type	E	32 ~ 1112°F (0 ~ 600°C)
Thermocouple T type	t	-328 ~ 752°F (-200 ~ 400°C)
Thermocouple J type	J	-148 ~ 2192°F (-100 ~ 1200°C)
Thermocouple K type	K	-328 ~ 2372°F (-200 ~ 1300°C)
Platinum Resistance (Pt100)	Pt	-328 ~ 1112°F (-200 ~ 600°C)
Platinum Resistance (JPt100)	JPt	-4 ~ 752°F (-20 ~ 400°C)
0~50mV Analog Input	~ 0	-999 ~ 9999
0V ~ 10V Analog Input	0 10	-999 ~ 9999
0V ~ 5V Analog Input	0 5	-999 ~ 9999
4 ~ 20mA Analog Input	~ 4 4	-999 ~ 9999
0~20mA Analog Input	~ 0 0	-999 ~ 9999

**tPUu**

Temperature Units. This parameter is only available for thermocouple or RTD inputs.

**tP-H**

Scale High Limit. Sets the upper limit of the temperature range. If the process temperature exceeds this setting, the display will flash an error code.

**tP-L**

Scale Low Limit. Sets the lower limit of the temperature range. If the process temperature exceeds this setting, the display will flash an error code.

<i>Ctrl</i>	Control Mode. Select method of control operation. Can be set to PID, On-Off, Manual, or Ramp/Soak Programming.
<i>Patn</i>	Ramp/Soak Pattern Selection. Allows user to select which of the 8 ramp/soak patterns to program. Each pattern has 8 steps which gives a total of 64 possible steps in a single program. When finished programming all ramp and soak patterns, the parameter should be set to off. (n = 0 to 7)
<i>SPny</i>	Segment Set Point for pattern n and step y. For example the first step of the first pattern would be SP00. The last step would be SP77. (n = 0 to 7, y = 0 to 7)
<i>ti ny</i>	Segment Time for pattern n and step y. For example the first step of the first pattern would be ti00. The last step would be Ti77. The value of this parameter will be in HH:MM. (n = 0 to 7, y = 0 to 7)
<i>P5yn</i>	Last Step for pattern n. Sets the last step that will be performed in the current pattern. (n = 0 to 7)
<i>LYCn</i>	Pattern Loop Setting for pattern n. Sets the number of times that the current pattern will be repeated. (n = 0 to 7)
<i>Link</i>	Pattern Link for pattern n. Sets the next pattern that will be performed after the current pattern. When set to off, the program will end and maintain last set point. (n = 0 to 7)
<i>S-HC</i>	Heat/Cool Selection. Assigns output 1 and output 2 to be either heat or cool.  HEAt = Output 1 = Heating CooL = Output 1 = Cooling H1C2 = Output 1 = Heating; Output 2 = Cooling H2C1 = Output 1 = Cooling; Output 2 = Heating
<i>ALA1</i>	Alarm 1 Setting. Sets operation for Alarm 1. Please see selection on Alarm Outputs for description of the outputs.
<i>ALA2</i>	Alarm 2 Setting. Sets operation for Alarm 2. Please see selection on Alarm Outputs for description of the outputs.
<i>ALA3</i>	Alarm 3 Setting. Sets operation for Alarm 3. Please see selection on Alarm Outputs for description of the outputs. (not available for Dual Loop Output Control)

<i>SALA</i>	System Alarm Setting. Selects which of the alarm outputs is used if a system alarm occurs. The system alarms would be an input error or a process control failure. This feature can be disabled by turning this parameter to off.
<i>CoSH</i>	Communications Write Function Feature. Allows parameters to be changed via the RS-485 communications. Setting to oFF prevents any changes from remote users.
<i>C-SL</i>	Protocol Selection: Select whether to communicate using ASCII or RTU Protocol. This value must match the protocol used by the host computer.
<i>C-no</i>	Controller Address: Set from 1 to 247. This value must match the controller address used by the host computer.
<i>LEN</i>	Communication Data Length. Choose either 7 or 8. This value must match the communication data length of the host computer.
<i>Prty</i>	Communication Parity Bit. Set this value to even, odd, or none. This value must match the communication parity bit of the host computer.
<i>Stop</i>	Communication Stop Bit. Set this value to 1 or 2. This value must match the communication stop bit of the host computer.

## Alarm Output Configuration and Operation Table.

Set Value	Alarm Type	Alarm Output Operating
1	Alarm function disabled	Output is OFF
	Deviation upper- and lower-limit: This alarm output operates when PV value is higher than the setting value SV+(AL-H) or lower than the setting value SV-(AL-L).	
2	Deviation upper-limit: This alarm output operates when PV value is higher than the setting value SV+(AL-H).	
3	Deviation lower-limit: This alarm output operates when PV value is lower than the setting value SV-(AL-L).	
4	Reverse deviation upper- and lower-limit: This alarm output operates when PV value is in the range of the setting value SV+(AL-H) and the setting value SV-(AL-L).	
5	Absolute value upper- and lower-limit: This alarm output operates when PV value is higher than the setting value AL-H or lower than the setting value AL-L.	
6	Absolute value upper-limit: This alarm output operates when PV value is higher than the setting value AL-H.	
7	Absolute value lower-limit: This alarm output operates when PV value is lower than the setting value AL-L.	
8	Deviation upper- and lower-limit with standby sequence: This alarm output operates when PV value reaches set point (SV value) and the value is higher than the setting value SV+(AL-H) or lower than the setting value SV-(AL-L).	
9	Deviation upper-limit with standby sequence: This alarm output operates when PV value reaches set point (SV value) and the reached value is higher than the setting value SV+(AL-H).	
10	Deviation lower-limit with standby sequence: This alarm output operates when PV value reaches the set point (SV value) and the reached value is lower than the setting value SV-(AL-L).	
11	Hysteresis upper-limit alarm output: This alarm output operates if PV value is higher than the setting value SV+(AL-H). This alarm output is OFF when PV value is lower than the setting value SV+(AL-L).	
12	Hysteresis lower-limit alarm output: This alarm output operates if PV value is lower than the setting value SV-(AL-H). This alarm output is OFF when PV value is higher than the setting value SV-(AL-L).	
13	CT alarm output: This alarm operates when the current measured by transformer (CT) is lower than AL-L or higher than AL-H (This alarm output is available only for the controller with current transformer).	
14	When program control is end status, alarm output is ON.	
15	When RAMP UP status happens to PID program control, alarm output is ON.	
16	When RAMP DOWN status happens to PID program control, alarm output is ON.	
17	When SOAK status happens to PID program control, alarm output is ON.	
18	When RUN status happens to PID program control, alarm output is ON.	

(Note: AL-H and AL-L include AL1H, AL2H, AL3H and AL1L, AL2L, AL3L)

## Communication Register List

- Supporting transmission speed: 2400, 4800, 9600, 19200, 38400 bps.
- Non-supported formats: 7, N, 1 or 8, O, 2 or 8, E, 2.
- Communication protocol: Modbus (ASCII or RTU).
- Function code: 03H to read the contents of register (Max. 8 words). 06H to write 1 (one) word into register. 02H to read the bits data (Max. 16 bits). 05H to write 1 (one) bit into register.
- Address and Content of Data Register:

Address	Content	Explanation
1000H	Process value (PV)	Measuring unit is 0.1, updated one time in 0.4 second. The following reading value display indicates error occurs: 8002H : Initial process (Temperature value is not got yet) 8003H : Temperature sensor is not connected 8004H : Temperature sensor input error 8006H : Cannot get temperature value, ADC input error 8007H : Memory read/write error
1001H	Set point (SV)	Unit is 0.1, oC or oF
1002H	Upper-limit of temperature range	The data content should not be higher than the temperature range
1003H	Lower-limit of temperature range	The data content should not be lower than the temperature range
1004H	Input temperature sensor type and Temperature Range"	Please refer to the contents of the "Temperature Sensor Type
1005H	Control method	0: PID, 1: ON/OFF, 2: manual tuning, 3: PID program control
1006H	Heating/Cooling control selection	0: Heating, 1: Cooling, 2: Heating/Cooling, 3: Cooling/Heating
1007H	1st group of Heating/Cooling control cycle	0~99, 0:0.5 sec
1008H	2nd group of Heating/Cooling control cycle	0~99, 0:0.5 sec
1009H	PB Proportional band	0.1 ~ 999.9
100AH	Ti Integral time	0~9999
100BH	Td Derivative time	0~9999
100CH	Integration default 0~100%, unit is 0.1%	
100DH	Proportional control offset error value, when Ti = 0	0~100%, unit is 0.1%
100EH	The setting of COEF when Dual Loop output control are used	0.01 ~ 99.99
100FH	The setting of Dead band when Dual Loop output control are used	-999 ~ 9999
1010H	Hysteresis setting value of the 1st output group	0 ~ 9999
1011H	Hysteresis setting value of the 2nd output group	0 ~ 9999
1012H	Output value read and write of Output 1 mode only.	Unit is 0.1%, write operation is valid under manual tuning
1013H	Output value read and write of Output 2 mode only.	Unit is 0.1%, write operation is valid under manual tuning
1014H	Upper-limit regulation of analog linear output	1 Unit = 2.8uA(Current Output)=1.3mV(Linear Voltage Output)
1015H	Lower-limit regulation of analog linear output	1 Unit = 2.8uA(Current Output)=1.3mV(Linear Voltage Output)
1016H	Temperature regulation value	-999~+999, unit: 0.1
1017H	Analog decimal setting	0 ~ 3
101CH	PID parameter selection	0~4
101DH	SV value corresponded to PID value	Only valid within available range, unit: 0.1 scale
1020H	Alarm 1 type	Please refer to the contents of the "Alarm Outputs" for detail
1021H	Alarm 2 type	Please refer to the contents of the "Alarm Outputs" for detail
1022H	Alarm 3 type	Please refer to the contents of the "Alarm Outputs" for detail
1023H	System alarm setting	0 : None (default), 1~3 : Set Alarm 1 to Alarm 3
1024H	Upper-limit alarm 1	Please refer to the contents of the "Alarm Outputs" for detail
1025H	Lower-limit alarm 1	Please refer to the contents of the "Alarm Outputs" for detail



Address	Content	Explanation
1026H	Upper-limit alarm 2	Please refer to the contents of the "Alarm Outputs" for detail
1027H	Lower-limit alarm 2	Please refer to the contents of the "Alarm Outputs" for detail
1028H	Upper-limit alarm 3	Please refer to the contents of the "Alarm Outputs" for detail
1029H	Lower-limit alarm 3	Please refer to the contents of the "Alarm Outputs" for detail
102AH	Read LED status	b0 : Alm3, b1: Alm2, b2: F, b3: __, b4: Alm1, b5: OUT2, b6: OUT1, b7: AT
102BH	Read push button status	b0 : Set, b1 : Select, b2 : Up, b3 : Down. 0 is to push
102CH	Setting lock status	0 : Normal, 1 : All setting lock, 11 : Lock others than SV value
102FH	Software version	V1.00 indicates 0x100
1030H	Start pattern number	0 ~ 7
1040H~1047H	Actual step number setting inside the correspond pattern step N	0 ~ 7 = N, indicate that this pattern is executed from step 0 to
1050H~1057H	Cycle number for repeating the execution of the correspond pattern	0 ~ 99 indicate that this pattern has been executed for 1~100 times
1060H~1067H	Link pattern number setting of the correspond pattern	0 ~ 8, 8 indicates the program end. 0~7 indicates the next execution pattern number after executing the current pattern
2000H~203FH	Pattern 0~7 temperature set point setting Pattern 0 temperature is set to 2000H~2007H	-999 ~ 9999
2080H~20BFH	Pattern 0~7 execution time setting Pattern 0 time is set to 2080H~2087H	Time 0 ~ 900 (1 minute per scale)

6. Address and Content of Bit Register: ( First bit of reading will put into LSB, Write data = FF00H for bit set, 0000H for bit clear)

Address	Content	Explanation
0810H	Communication write-in selection	Communication write in disabled: 0 (default), Communication write in enabled: 1
0811H	Temperature unit display selection	oC / linear input (default) : 1 , oF : 0
0812H	Decimal point position selection	Except for the thermocouple B, S, R type, all the other thermocouple type are valid. (0 or 1)
0813H	AT setting	OFF: 0 (default), ON : 1
0814H	Control RUN/STOP setting	0 : STOP, 1 : RUN (default)
0815H	STOP setting for PID program control	0: RUN (default), 1: STOP
0816H	Temporarily STOP for PID program control	0: RUN (default), 1: Temporarily STOP

## DIAGNOSTIC ERROR MESSAGES

### Display Error Messages

Display		Description	Action Required
PV	b150	Display on Start Up	No Action Required
SV	rr		
PV	No	No Input Probe Connection	Verify that sensor is wired to proper terminals. Next, check that the controller is programmed for the correct input type. Most commonly seen when controller is programmed for a RTD, while a thermocouple is connected.
SV	Cont		
PV	Err	Input Error	Verify that the input is wired to the proper terminals. Next check to see if the input type is set to the proper value. Most commonly seen when controller is programmed for a 4 to 20 mA input and 0 to 20 mA signal is wired to the controller.
SV	inPt		
PV	2001	Process Value Flashes when outside of range	Input signals may normally go above or below range limits. If not check input and correct the process temperature or increase temperature range limits using tP-H and tP-L.
SV	0.0		
PV	Err	Error EEPROM	Attempt to reset the factory default settings using the instructions in the next section. If still has error, call customer service for a return goods authorization number to have the controller evaluated at the factory.
SV	Pron		



### Communication Error Messages

Error Status 102EH/4750H	PV read back 1000H/4700H	Error Status
0001H	N/A	PV Unstable
0002H	8002H	Re-initialize, no temperature at this time
0003H	8003H	Input sensor did not connect
0004H	8004H	Input Signal Error
0005H	N/A	Over Input Range
0006H	8006H	ADC fail
0007H	N/A	EEPROM read/write error

### Reset Factory Default Settings

Note: Resetting Factory Default Settings erases all of the values entered by the user. Record any necessary settings before proceeding.

Warning: Erasing the user entered values may result in a safety hazard and system malfunction.

The following instructions will reset the controller to the original factory default settings.

- Step 1. Press the INDEX KEY while at the Home Display until the controller reads LoC in the process display. Use the UP arrow to select LoC1. Press the ENTER KEY to save this value.
- Step 2. Press and hold the UP and DOWN arrows simultaneously for one second. Upon releasing the buttons, the display will read SHou in the PV display and oFF in the SV display.
- Step 3. Press the INDEX key once and the controller will read PASS in the PV display and a 4321 in the SV display. Adjust the value in the SV display to 1357 using the UP and DOWN arrows. Press the ENTER KEY to save the value.
- Step 4. Cycle the power on the controller. Upon power up, all of the user set values have been erased.

## SPECIFICATIONS


<b>Input Voltage</b>	100 to 240 VAC 50/60 Hz OR 24 VDC (depending on model)
<b>Operation Voltage Range</b>	85% to 110% of rated voltage.
<b>Power Consumption</b>	5VA max.
<b>Memory Protection</b>	EEPROM 4K bit (non-volatile memory (number of writes: 1000,000)).
<b>Display Method</b>	2 line x 4 character 7-segment LED display Process value (PV): Red color, Set point (SV): Green color.
<b>Sensor Type</b>	Thermocouple: K, J, T, E, N, R, S, B, L, U, TXK. 3-wire platinum RTD: Pt100, JPt100. Analog input 0 to 5 V, 0 to 10 V, 0 to 20 mA, 0 to 50 mV.
<b>Control Mode</b>	PID, ON/OFF, Manual or PID program control (Ramp/Soak control).
<b>Control Output</b>	Relay output: SPDT (SPST: 1/16 DIN and 1/32 DIN size), Max. load 250 VAC, 5 A resistive load. Voltage pulse output: DC 14 V, Max. output current 40 mA. Current output: DC 4 to 20 mA output (Load resistance: Max. 600Ω). Linear voltage output: 0 to 5 V, 0 to 10 V *(B Series only).
<b>Display Accuracy</b>	0 or 1 digit to the right of the decimal point (selectable).
<b>Sampling Range</b>	Analog input: 150 msec/per scan Thermocouple or Platinum RTD: 400 msec/per scan.
<b>RS-485 Communication</b>	MODBUS® ASCII/RTU communication protocol.
<b>Vibration Resistance</b>	10 to 55 Hz, 10 m/s <sup>2</sup> for 10 min, each in X, Y and Z directions.
<b>Shock Resistance</b>	Max. 300 m/s <sup>2</sup> , 3 times in each 3 axes, 6 directions.
<b>Ambient Temperature</b>	32°F to 122°F (0°C to +50°C).
<b>Storage Temperature</b>	-4°F to 150°F (-20°C to +65°C).
<b>Altitude</b>	2000 m or less.
<b>Relative Humidity</b>	35% tp 80% (non-condensing).

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Thermocouple Type and Temperature Range		
Input Temperature Sensor Type	LED Display	Temperature Range
Thermocouple TXK type	ℓℓℓ	-328 ~ 1472°F (-200 ~ 800°C)
Thermocouple U type	ℓ	-328 ~ 932°F (-200 ~ 500°C)
Thermocouple L type	ℓ	-328 ~ 1562°F (-200 ~ 850°C)
Thermocouple B type	ℓ	-212 ~ 3272°F (-100 ~ 1800°C)
Thermocouple S type	ℓ	-32 ~ 3092°F (0 ~ 1700°C)
Thermocouple R type	ℓ	-32 ~ 3092°F (0 ~ 1700°C)
Thermocouple N type	ℓ	-328 ~ 2372°F (-200 ~ 1300°C)
Thermocouple E type	ℓ	-32 ~ 1112°F (0 ~ 600°C)
Thermocouple T type	ℓ	-328 ~ 752°F (-200 ~ 400°C)
Thermocouple J type	ℓ	-148 ~ 2192°F (-100 ~ 1200°C)
Thermocouple K type	ℓ	-328 ~ 2372°F (-200 ~ 1300°C)
RTD Type and Temperature Range		
Input Temperature Sensor Type	LED Display	Temperature Range
Platinum Resistance (Pt100)	ℓℓ	-328 ~ 1472°F (-200 ~ 800°C)
Platinum Resistance (JPt100)	ℓℓℓ	-4 ~ 752°F (-20 ~ 400°C)
Voltage Input Type and Input Range		
Voltage Input Range	LED Display	Temperature Range
0~50mV Analog Input	ℓ ℓ	-999 ~ 9999
0V ~ 10V Analog Input	ℓ ℓℓ	-999 ~ 9999
0V ~ 5V Analog Input	ℓℓ	-999 ~ 9999
Current Input Type and Input Range		
Current Input Type	LED Display	Temperature Range
4 ~ 20mA Analog Input	ℓ ℓℓ	-999 ~ 9999
0~20mA Analog Input	ℓ ℓℓ	-999 ~ 9999

## PRECAUTIONS

### **⚠ DANGER Electric Shock!**

1. Do not touch the AC terminals while the power is supplied to the controller to prevent an electric shock.
2. Make sure power is disconnected while checking the unit inside.
3. The symbol  indicates that this Controller is protected throughout by DOUBLE INSULATION or REINFORCED INSULATION (equivalent to Class II of IEC 536).

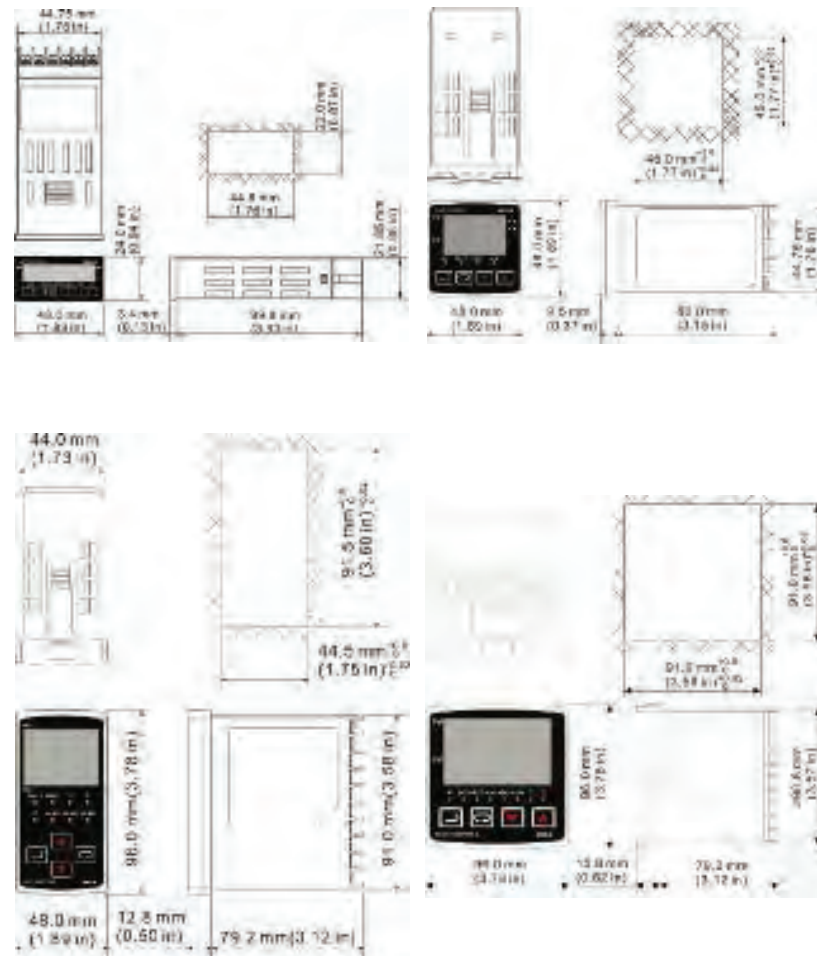
### **⚠ WARNING**

**Mount the controller in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.**

1. Always use recommended solder-less terminals: Fork terminals with isolation (M3 screw, width is 7.0mm (6.0mm for 32B Series), hole diameter 3.2mm). Screw size: M3 x 6.5 (With 6.8 x 6.8 square washer). Screw size for 32B Series: M3 x 4.5 (With 6.0 x 6.0 square washer). Recommended tightening torque: 0.4 N.m (4kgf.cm). Applicable wire: Solid/twisted wire of 2 mm<sup>2</sup>, 12AWG to 24AWG. Please be sure to tighten them properly.
2. Do not allow dust or foreign objects to fall inside the controller to prevent it from malfunctioning.
3. Never modify or disassemble the controller.
4. Do not connect anything to the "No used" terminals.
5. Make sure all wires are connected to the correct polarity of terminals.
6. Do not install and/or use the controller in places subject to: Dust or corrosive gases and liquid, high humidity and high radiation, vibration and shock, high voltage and high frequency.
7. Power must be off when wiring and changing a temperature sensor.
8. Be sure to use compensating wires that match the thermocouple types when extending or connecting the thermocouple wires.
9. Please use wires with resistance when extending or connecting a platinum resistance sensor (RTD).
10. Please keep the wire as short as possible when wiring a platinum resistance sensor (RTD) to the controller and please route power wires as far as possible from load wires to prevent interference and induce noise.
11. This controller is an open-type unit and must be placed in an enclosure away from high temperature, humidity, dripping water, corrosive materials, airborne dust and electric shock or vibration.
12. Please make sure power cables and signals from instruments are all installed properly before energizing the controller, otherwise serious damage may occur.
13. Please do not use acid or alkaline liquids for cleaning. Please use a soft, dry cloth to clean the controller.
14. Wait at least one minute after power is disconnected to allow capacitors to discharge, and please do not touch any internal circuit within this period.
15. This instrument is not furnished with a power switch or fuse. Therefore, if a fuse or power switch is required, install the protection close to the instrument. Recommended fuse rating: Rated voltage 250 V, Rated current 1 A. Fuse type: Time-lag fuse.
16. Note: This controller does not provide overcurrent protection. Use of the product requires that suitable overcurrent protection device(s) must be added to ensure compliance with all relevant electrical standards and codes. (Rated 250 V, 15 Amps max). A suitable disconnecting device should be provided near the controller in the end-use installation.

## External Dimensions

Dimensions are in millimeter (inch)



## LOVE CONTROLS

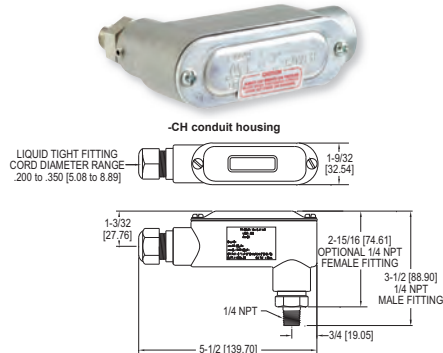
A DIV. OF DWYER INSTRUMENTS INC.  
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46361, U.S.A.

Phone: 219/879-8000 [www.love-controls.com](http://www.love-controls.com)  
Fax: 219/872-9057 e-mail: [love@love-controls.com](mailto:love@love-controls.com)



## Series 626 & 628 Pressure Transmitters

### Specifications - Installation and Operating Instructions



The **Series 626 & 628 Pressure Transmitters** converts a single positive pressure into a standard 4-20 mA output signal. The Series 626 and 628 can be used to accurately measure compatible gases and liquids; Series 626 full scale accuracy is 0.25%; Series 628 full scale accuracy is 1.0% (see specifications). Designed for industrial environments with a NEMA 4X (IP66) housing, this transmitter resists most effects of shock and vibration.

**CAUTION** Do not exceed specified supply voltage ratings. Permanent damage not covered by warranty will result. This device is not designed for 120 or 240 V AC operation. Use only on 13-30 VDC.

PRESSURE RANGES		
Pressure Range	Maximum Pressure	Over Pressure
0-15 psia	30 psia	45 psia
15-0 psia	30 psia	45 psia
0-30 psia	60 psia	90 psia
0-50 psia	100 psia	150 psia
0-100 psia	200 psia	300 psia
0-200 psia	400 psia	600 psia
0-300 psia	600 psia	900 psia
0-5 psig	10 psig	50 psig
0-15 psig	30 psig	150 psig
0-30 psig	60 psig	300 psig
0-50 psig	100 psig	300 psig
0-100 psig	200 psig	500 psig
0-150 psig	300 psig	750 psig
0-200 psig	400 psig	1000 psig
0-300 psig	600 psig	1500 psig
0-500 psig	1000 psig	2500 psig
0-1000 psig	2000 psig	5000 psig
0-1500 psig	3000 psig	5000 psig
0-2000 psig	4000 psig	5000 psig
0-3000 psig	6000 psig	7500 psig
0-5000 psig	7500 psig	10000 psig
0-8000 psig	10000 psig	12000 psig

#### SPECIFICATIONS

**Service:** Compatible gases and liquids.  
**Wetted Materials:** Type 316 SS.

**Accuracy:** 626: 0.25% FS, 0.20% RSS; 628: 1.0% FS, 0.5% RSS; 626 absolute ranges: 0.5% FS, 0.35% RSS. (Includes linearity, hysteresis, and repeatability).  
**Temperature Limit:** 0 to 200°F (-18 to 93°C).

**Compensation Temperature Range:** 0 to 175°F (-18 to 79°C).

**Thermal Effect:** 626: ±0.02% FS/°F. 628: ±0.04% FS/°F (Includes zero and span).

**Pressure Limits:** See table.

**Power Requirements:** 10-30 VDC (for 4-20 mA, 0-5, 1-5, 1-6 VDC outputs); 13-30 VDC (for 0-10, 2-10 VDC outputs); 5 VDC ±0.5 VDC (for 0.5-4.5 VDC ratio-metric output).

**Output Signal:** 4-20 mA, 0-5 VDC, 1-5 VDC, 0-10 VDC, or 0.5-4.5 VDC.  
**Response Time:** 300 ms.

**Loop Resistance:** 0-1000 Ω max.  
R max = 50 (Vps-10) Ω (4 to 20 mA output), 5K Ω (0-5, 1-5, 1-6, 0-10, 2-10, 0.5-4.5 VDC output).

**Current Consumption:** 38 mA maximum (for 4-20 mA output); 10 mA maximum (for 0-5, 1-5, 1-6, 0-10, 2-10, 0.5-4.5 VDC output); 140 mA maximum (for all 626/628/629-CH with optional LED).

**Electrical Connections:** Conduit Housing (-CH): terminal block, 1/2" female NPT conduit; General Purpose Housing (-GH): cable DIN EN 175801-803-C.

**Process Connection:** 1/4" male or female NPT and BSPT.

**Enclosure Rating:** NEMA 4X (IP66).  
**Mounting Orientation:** Mount in any position.

**Weight:** 10 oz (283 g).  
**Agency Approvals:** CE.

#### INSTALLATION

- Location:** Select a location where the temperature of the transmitter will be between 0 and 175°F (-18 to 79°C). Distance from the receiver is limited only by total loop resistance. The tubing or piping supplying pressure to the unit can be practically any length required but long lengths will increase response time slightly.
- Position:** The transmitter is not position sensitive. However all standard models are originally calibrated with the unit in a position with the pressure connection downward. Although they can be used at other angles, for best accuracy it is recommended that units be installed in the position calibrated at the factory.
- Pressure Connection:** Use a small amount of plumber's tape or other suitable sealants to prevent leaks. Be sure the pressure passage inside the port is not blocked.
- Electrical Connections**

**Wire Length** - The maximum length of wire connecting the transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of the receiver resistance to total loop resistance. For extremely long runs (over 1000 feet), choose receivers with higher resistance to minimize the size and cost of connecting leads. Where wiring length is under 100 feet, wire as small as 22 AWG can be used.

#### CURRENT (4-20 mA) OUTPUT OPERATION

An external power supply delivering 10-30 VDC with minimum current capability of 40 mA DC (per transmitter) is required to power the control loop. See Figure A for connection of the power supply, transmitter and receiver. The range of appropriate receiver load resistance (RL) for the DC power supply voltage available is expressed by the formula:

$$R_L \text{ Max} = \frac{V_{ps} - 10}{20 \text{ mA DC}}$$

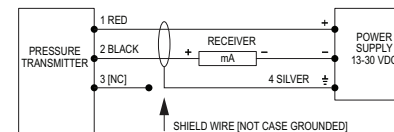


Figure A: Current output connection

**Conduit Housing with 4-20 mA Output (-CH)** Electrical connections to the pressure transmitters are made to the terminal block located inside the housing. Remove the screws and lift off the cover. Wire as shown in Figure A, B or C. Use Figure A for current output connection. Use Figure B for current output with optional LED display. Use Figure C for current output with optional LED display using two power supplies.

If ordering optional pre-wired cable, black wire is negative [-] and red wire is positive [+].

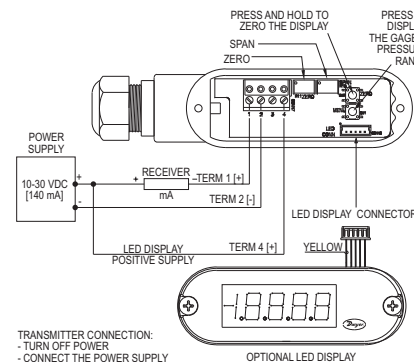
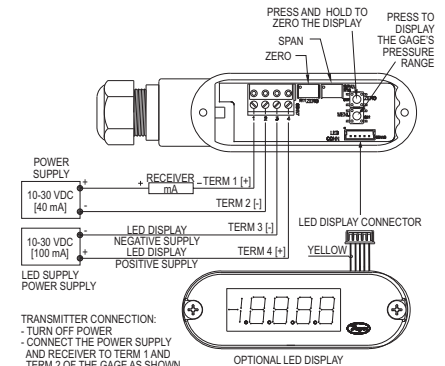


Figure B: Current output with optional LED display connection



**TRANSMITTER CONNECTION:**  
- TURN OFF POWER  
- CONNECT THE POWER SUPPLY AND RECEIVER TO TERM 1 AND TERM 2 OF THE GAGE AS SHOWN  
- CONNECT LED POWER SUPPLY [-] TO TERMINAL 3  
- CONNECT LED POWER SUPPLY [+] TO TERMINAL 4  
- INSTALL THE DISPLAY'S CONNECTOR  
- TURN ON POWER

Figure C: Current output with optional LED display using two power supplies

**Hirschman DIN Connector with 4-20 mA** When using cable version of -GH General Purpose Housing, black wire is negative [-] and red wire is positive [+]. When using optional Hirschman DIN Plug, remove top-center screw and lift off the terminal block assembly. Wire to terminals shown below in Figure D. For optional 4-pin M-12 connector, wire to pins as shown in Figure E.

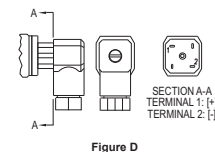


Figure D

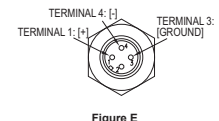


Figure E

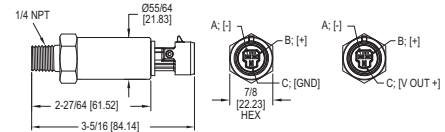


Figure F: Packard connection

DWYER INSTRUMENTS, INC.

P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.

Phone: 219-879-8000

Fax: 219-872-9057

www.dwyer-inst.com

e-mail: info@dwyermail.com

#### VOLTAGE (0-5, 1-5, 0-10, 1-6 or 2-10 VDC) OUTPUT OPERATION

(Other outputs contact the factory) See Figure G for connection of the power supply, transmitter and receiver.

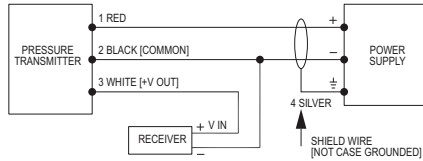


Figure G: Voltage output connection

**Conduit Housing (-CH)** Electrical connections to the pressure transmitters are made to the terminal block located inside the housing. Remove the screws and lift off the cover. Wire as shown in Figure G or Figure H. Use Figure G for voltage output connection. Use Figure H for voltage output with optional LED display connection. If ordering optional pre-wired cable, black wire is negative [-], red wire is positive [+] and white wire is +Vout.

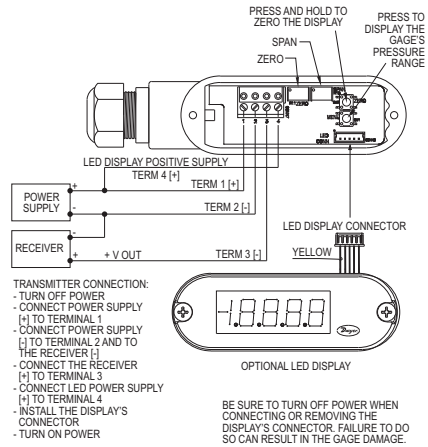


Figure H: Voltage output with optional LED display connection

**Hirschman DIN Connector with Voltage Output** When using cable version of -GH General Purpose Housing, black wire is negative [-], red wire is positive [+] and white wire is output. When using optional Hirschman DIN Plug, remove top-center screw and lift off the terminal block assembly. Wire to terminals shown below in Figure I. For optional 4-pin M-12 connector, wire to pins as shown in Figure J. If utilizing optional A-164 cable for M-12 connection, brown wire corresponds to pin #1, white #2, blue #3, and black #4.

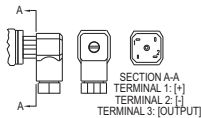


Figure I

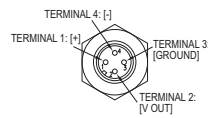


Figure J

#### RATIOMETRIC (0.5-4.5 VDC) OUTPUT OPERATION

(Other outputs contact the factory) See Figure K for connection of the power supply, transmitter and receiver.

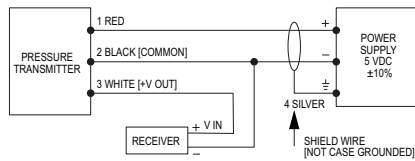


Figure K: Voltage output connection

**General Purpose Housing with Ratiometric Output** When using cable version of -GH General Purpose Housing, black wire is negative [-], red wire is positive [+] and white wire is output. When using optional Hirschman DIN Plug, remove top-center screw and lift off the terminal block assembly. Wire to terminals shown below in Figure L. For optional 4-pin M-12 connector, wire to pins as shown in Figure M. If utilizing optional A-164 cable for M-12 connection, brown wire corresponds to pin #1, white #2, blue #3, and black #4.

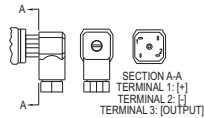


Figure L

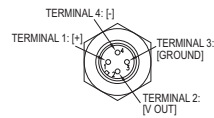


Figure M

**Deutsche Connector with Voltage Output, Ratio Metric and 4-20 mA** When using this cable version see Figure N for voltage output and ratio metric terminal connections. See Figure P for 4-20 mA terminal connections.

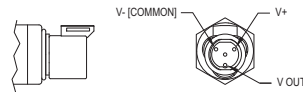


Figure N

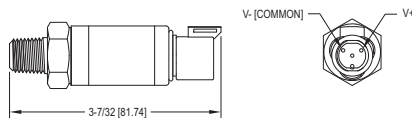


Figure P: Deutsche connection

#### MAINTENANCE

After final installation of the pressure transmitter and its companion receiver, no routine maintenance is required. A periodic check of system calibration is suggested. The Series 626 and 628 transmitters are not field repairable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.



**Note:** Please do not cover or insert objects into vent hole.



## R.E.V. OPERATING MANUAL



*Product of: Valve Pro*

*Contact Information: Phone: (909)464-9227*

*Website: [www.valvepro.biz](http://www.valvepro.biz) Email: [sales.valvepro@hotmail.com](mailto:sales.valvepro@hotmail.com)*

*\*Valve Pro, division of Control Pro, Inc.*

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## 1. Operational Safety

**General Information** This operating manual is an integral part of the actuators and must be kept available to operators at any time.

All safety notes and information contained in this manual must be followed.

Please note that in case of unintended use and/or inappropriate operation the manufacturer is released from all liabilities.

The chapter on Operational Safety contains some fundamental safety instructions to be strictly observed when working with the actuators.

In addition to this, further safety instructions concerning individual action steps can be found in various sections of this manual. These are highlighted by special warning signs.

**Issue** Issue 2  
21.06.2007  
Upon receipt of this operating manual, all manuals bearing an earlier date of issue and having been supplied prior to this issue become void.

### Safety Notes



**Danger!**  
...warns of hazards due to electric current within buildings or when using machines or tools.



**Caution!**  
...warns of dangerous spots. Contains information, instructions and interdictions to avoid injuries or damage.



**Danger!**  
... warns of hazards posing a risk to health. Ignoring these instructions can lead to injuries.

---

### Dangers resulting from non-observance of safety notes

Each actuator is set-up for the valve it's on. Do not attach to other valve bodies (damage will occur). The actuators may however cause dangers if not operated by trained and instructed personnel. Safety of operation can only be guaranteed for intended and appropriate use.

Non-observance of these guidelines can:

- result in dangers to health and life of operators or third persons
- damage the actuator and other assets of the user
- pose risks to the actuator's efficient functioning.

In the interest of your personal safety, please pay attention to these instructions before installation, commissioning, operation, maintenance and repair. Any person in charge of the tasks mentioned above must have read and fully understood the contents of this manual, especially the sections relevant to safety.

**Safe Operation** The actuators may only be operated by trained and authorized personnel.

Prior to repair work on the actuator, voltage must be disconnected. Repair work on the unit shall only be executed when the actuator is at rest.

To ensure a safe operation, it is necessary to check whether the unit is free from visible damage or defects. Disturbances of its operating performance must be localised and eliminated immediately.



**Beware of mechanical hazards due to electrically powered actuator components!**

**With the actuator powered electrically, operating the unit holds the danger of crushing your fingers.**

During the installation of the actuator and the valve, the unit must not be powered electrically.

Previous to maintenance and adjustment work, voltage must be disconnected from the actuator. The unit must also be safeguarded against unintentional restarting.

**Upgrade and accessory parts** Upgrading and operating the actuator with accessory parts requires observance of the respective operating manuals.

---

## 2. Usage as per Specification

The linear actuators are exclusively designed for the use as electric valve actuators. They are destined for the assembly with valves and for their motor actuation. The actuators must not be operated outside the limits specified in data sheets and catalogues.

Any other usage is assumed to be prohibited. The manufacturer is not liable for any damage resulting thereof. Furthermore, unpredictable situations of danger may result from prohibited usage.

Usage as per specification also comprises observance of operating, maintenance and repair processes as stipulated by the manufacturer.

To avoid dangers in normal operation:

- ☐ Only employ trained personnel for all types of work.
- ☐ Observe accident prevention regulations.
- ☐ Observe any internal working, operating and safety instructions that may exist.



### 3. Installation Conditions

**Storage** Storage requirements to be observed:

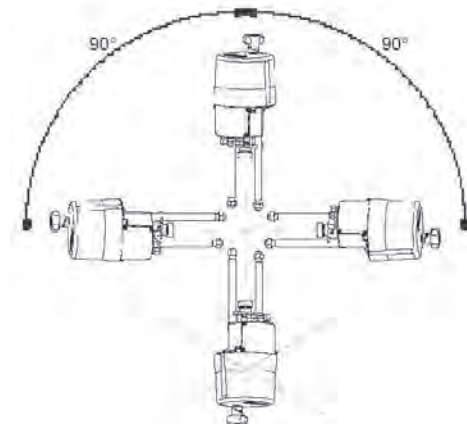
- Only store the actuators in well ventilated and dry spaces.
- Only store them on shelves, wooden grids etc. to ensure protection against rising moisture.
- Protect from dust and dirt using a plastic foil.
- Protect the actuators against mechanical damage.

**Operating conditions** Ambient temperature 32°F to +140°F

(actuator specific values to be  
from relevant data sheet)

Degree of protection IP 67

**Mounting position** Any mounting position allowed except „cap pointing down“.



**Installation dimensions** The actuators must be built in with a sufficient clearance to facilitate the removal of the cap. (see figure below).

### 4. Operating principle

**Operating principle** The linear actuators are designed for the use as electric valve actuators. Mounting to the valve is done via the actuator pillars. Depending on the valve design, a lantern or a special mounting plate will be required.

The motor torque is transmitted via a multi-step spur gear to a trapezoidal thread spindle. The spindle itself converts the induced torque into an axial force via a spindle nut. The spindle nut's resulting linear vertical motion is self-locking and is transmitted via a coupling piece to the valve stem.

During power failure and adjustment work the actuators can be emergency-operated via the hand wheel (see chapter 5/Manual Operation), except when using the fail-safe unit .

### 5. Manual Operation

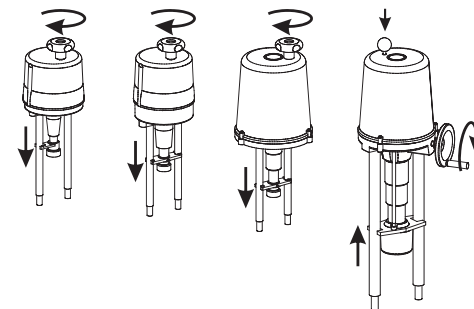
**Manual operation** A hand wheel is provided to operate the actuator in case of power failure or for valve adjustment. If a fail-safe unit type (option) is installed, this has to be disconnected to enable the actuator to be operated by hand wheel. .

At actuators of the series REV the hand wheel is tuning during motor operation. The actuators are equipped with a declutchable hand wheel, that is standing still during motor operation. To operate these actuators manually, the knob at the top of the cover must be depressed and held down.



**Caution!**

The hand wheel should not be used in ongoing operation, as, the actuator tries to compensate the deviation in position, depending on the operating mode.



Manual operation

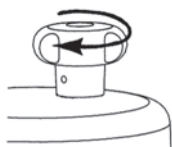


If a fail-safe device (option) is fitted to the actuator, this has to be disconnected electrically to allow to drive the actuator by hand wheel. Open the cover of the and disconnect the cable from the minus terminal, see picture below. There is safety-low voltage (24V) present.

## 6. Mechanical Mounting

### 6.1. Safety note

**Safety note** Beware of mechanical hazards due to electrically powered actuator components!  
With the actuator powered electrically, operating the unit holds the danger of crushing your fingers, damaging the actuator and/or the valve.



*Note: All mentioned items refer to the itemisation as shown on the page after page 24.*

During adjustment work, the actuator may be operated by means of the hand wheel only. Do not operate electrically!

### 6.2. Mounting to the valve

#### How to mount the actuator



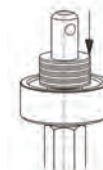
Unscrew the locking nut (item 10) from the spindle nut (item 9).



Check whether the coupling piece (item 15) is drilled as per the valve stem's end (item 11). If necessary, re-machine.



Place the locking nut (item 10) over the valve stem (item 11).



Place the disc springs (item 16) over the valve stem.

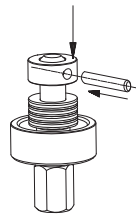
Observe the various arrangements for the disc springs! (see next figure).

The arrangement of the disc springs varies according to the type of valve. There are three versions:

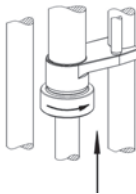
A: Arrangement for two-way valves with closing direction „valve stem retracting“

B: Arrangement for two-way valves with closing direction „valve stem extending“

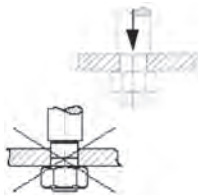
### C: Arrangement for three-way Valves



Screw the coupling piece (item 15) onto the valve stem, drill the semi-drilled hole completely through and secure with the pin (item 14).



Insert the assembly of valve stem, coupling piece and disc springs into the spindle nut. Re-adjust its position accordingly with the hand wheel. Screw the locking nut on and tighten it with the wrench supplied with the actuator.



Introduce the pillars (item 12) into the bore holes at the valve bonnet and tighten them with the nut (item 13).



Before tightening the nut, both pillars must be fed completely into the bore holes at the valve bonnet. If necessary, the spindle nut's position has to be adjusted with the hand wheel.  
Non-observance may cause damage to the actuator!

## 7. Electrical Connection

### 7.1. Safety Note

**Safety note** When performing electric work on this unit, the local accident prevention regulations must be followed.



Electric supply lines must be dimensioned for the peak current of the unit and comply with IEC 227 and IEC 245. See relevant data sheet.

Yellow-and-green coded cords may only be used for connection to protective earth.

When leading wires through the cable glands on the actuator, their minimum bending radius has to be considered.

The electric actuators are not fitted with an internal electric isolator, hence a switching device or circuit breaker must be integrated in the facility. It should be installed close to the actuator and should be easy to access for the user. It is important to mark the circuit breaker as this actuator's isolator.



Electric installations and over-current protection devices must conform to the standard IEC 364-4-41, protective class I.

## 7.2. Wiring Diagram

### Wiring Diagram

Electric terminals are provided in a terminal box at the actuator

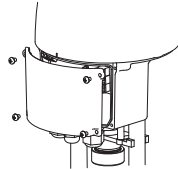
[illegible]

### 7.3. Mains supply

#### Mains supply

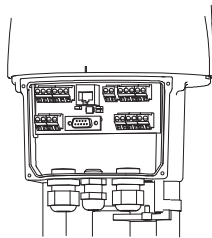


Isolate the power supply.  
Safeguard the line against  
unauthorized and unintended  
restarting.



Open the terminal box.

The terminal box provides  
terminals to accommodate rigid  
and flexible cables of wire widths  
of 0.14 mm<sup>2</sup> to 2.5 mm<sup>2</sup> as well  
as a PE screw on the housing.



**Caution:** Please observe the  
supply voltage and the maximum  
power consumption of the  
actuator as indicated on the  
actuator's tag plate!

Connect supply and control lines  
to terminals (as indicated in the  
wiring diagram).

### 7.4. Interfaces

**Interfaces** The actuator has several interfaces inside the terminal box  
which can be configured by the parameterising software or  
by the control box (see relevant manuals).



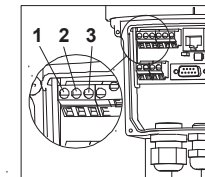
#### 7.4.1. Communication Interface

For communication and parameterisation with a PC or a hand-held  
device, connect the communication cable to the RJ45-connector  
(item 4). Actuator parameters can be set using the software  
or the control box (see relevant manuals).

**FACTORY CONFIGURED ONLY**

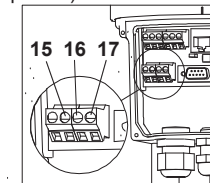
#### 7.4.2. Input Terminals

##### 7.4.2.1. Galvanically isolated Set-Value



Terminals 1 through 3 are used  
to receive a parameterisable  
modulating set-value for control  
operation within the range of 0-  
20 mA or 0-10V.

##### 7.4.2.2. Sensor Feedback for Process Controller (optional)



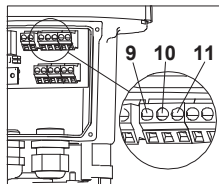
Terminals 15 through 17 are  
used to receive a process  
sensor's feedback to the -  
optional - process controller, in  
the parameterisable range of 0-  
20 mA oder 0-10 V.



#### **Caution!**

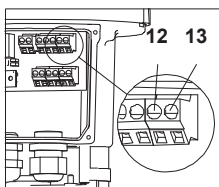
The following binary inputs (7.4.2.3 & 7.4.2.4) have priority over the  
modulating set-value. If the actuator is parameterised for  
modulating service, these set-value settings are disregarded in the  
case a binary signal is applied. Only after disconnection of the  
binary signal the actuator will reposition according to the set-value  
applied.

#### 7.4.2.3. Galvanically Isolated Binary Input



Terminals 9 through 11 are for binary open/close signals. Standard voltage level is 24 V, see wiring plan. The actuator is then driven in 3-point service.

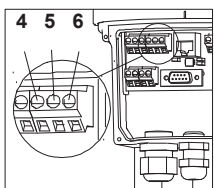
#### 7.4.2.4. Fail-safe port for Binary Input (optional)



The fail-safe port (terminals 12 and 13) allows to drive the actuator to a parameterised safety position by applying a voltage of 24 V.

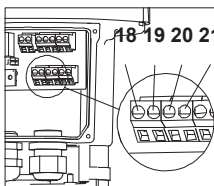
### 7.4.3. Output Terminals

#### 7.4.3.1. Active Position Feedback



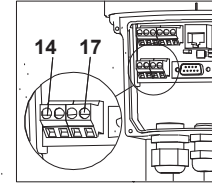
Terminals 4 through 6 are giving active position feedback, parameterisable within the range of 0-20mA or 0-10V. See also "9.1 Cut-off in end positions"!

#### 7.4.3.2. Additional Position Switches (optional)



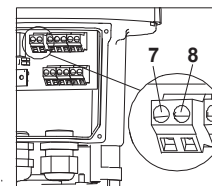
The activation points of the optionally available position switches are freely adjustable via cams. Terminals 18/19 and 20/21 provide potential-free opening or closing contacts. The standard switches are rated to 230VAC/5A. Special switches with gold plated contacts are available for low power (up to 100 mA and 30V).

#### 7.4.3.3. Voltage feed to Process Sensor (optional)



Terminals 14 and 17 provide an unregulated output voltage of 24 to 30 VAC at maximum 100 mA to feed an external process sensor.

#### 7.4.3.4. Fault Indicating Relay (optional)



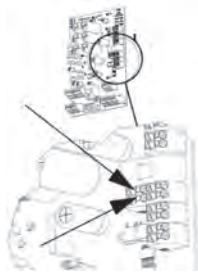
This potential-free normally-open relay contact (terminals 7 and 8) allows to display parameterisable fault indication to the control room. See instruction manual for software.

---

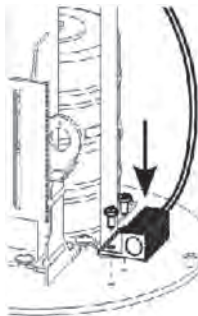
## 7.5. Accessories

### Space Heater 7.5.1. Space Heater (optional)

Actuators can be fitted with a space heater. When using actuators in environments with high temperature fluctuations or high humidity, we suggest a heating resistor be fitted to prevent the build-up of condensation within the enclosure.



In actuators the space heater is powered via the power supply of the actuator, so it does not have to be fed separately. For retro-fitting the heating resistor, wiring of the two cables has to be made to the terminals on the main board as per the picture on the left.

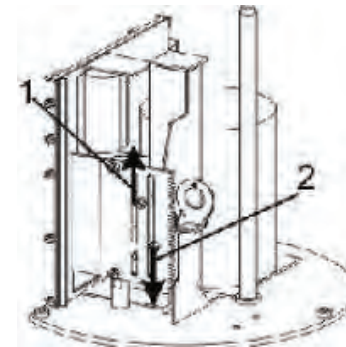


Mounting of the space heater has to be made to the indicated place on the base plate by using the screws provided. Route the cables in a way to prevent them from being squashed by the main cover, and from being touched by moving parts inside the actuator.

### 7.5.2. Adjusting Additional Position Switches (optional)

#### Position Switches

Two switches for position feedback are available as factory-mounted option. They are either normally-closed or normally-open contacts, potential-free. They are available with silver contacts (for currents between 10 mA and 5 A at maximum 230 V) or with gold-plated contacts (for currents between 0,1 mA and 30 mA at maximum 30 V). Connection goes to terminals 18/19 and 20/21.



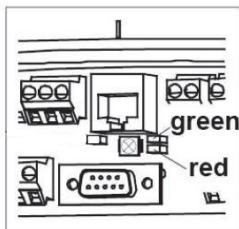
The cams for closing the switches are located on the switch plate, and are adjustable with a small screwdriver. Cam 1 is for retracting the spindle nut, while cam 2 is for extending the spindle nut out of the actuator.

---

## 8. Status display / Operating element

### 8.1. LEDs inside terminal box

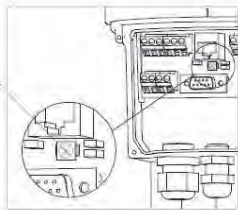
#### LEDs inside terminal box



A red and a green LED on top of each other (item 7) inside the terminal box indicate the status of the actuator.

### 8.2. Commissioning button

#### Commissioning button



The commissioning button (item 6) for starting the automatic commissioning run (to adjust the actuator to the valve) is located inside the terminal box, below the communication port. -> See chapter 9.1 "Cut-off in end positions"

---

## 9. Operation

All internal parameters, like required motor torque, actual position, functional status, etc., are being permanently monitored during operation of the actuator. This ensures that the actuator positions with optimum accuracy, and closes the valve always tight. Deviations can be read out via communication software or via local control (see respective instruction manuals), or can be displayed to the control room using the optional fault indication relay. This provides maximum safety of the process.

### 9.1. Cut-off in End Positions

**Cut-off in End Positions** Cut-offs of the actuators can be adjusted to meet the valve function in an optimum way by using the communication software (using a special interface cable, or optionally Bluetooth connection). This will result in different behaviour of the actuator. In case a position is surpassed or not reached, this can be read out via the optional Fault Indication Relay or via the communication software.

#### 9.1.1. Cut-Off by Force / Torque

The actuator delivers the programmed maximum force / torque each time when driving to this end position. If the closing point inside the valve dislocates, e.g. when a seat gasket wears, then the actuator will drive further in its possible actuation range to try to reach the programmed force / torque.

#### 9.1.2. Cut-Off by Position automatically

In normal operation, the actuator will stop at the position which was found at a mechanical stop in the valve or the actuator during Automatic Commissioning. If the closing point inside the valve dislocates, the actuator will NOT follow this dislocation but it will always stop at the point initially found.

#### 9.1.3. Cut-Off by Position

In normal operation, the actuator will stop at the point which was defined by Manual Commissioning. This position is not depending on any mechanical stop inside valve or actuator.

## 10. Commissioning

The actuator is shipped commissioned to the valve body it's on. Do not attach to other valve body or damage will occur.

Depending on the type of cut-offs programmed (see 9.), there are two ways to do commissioning:

- **Automatic** commissioning is done if at least one of the cut-offs is set to be "by force/torque" or "by position automatically".

### Caution!

Electrical operation of the actuator is allowed only after mounting to a valve!



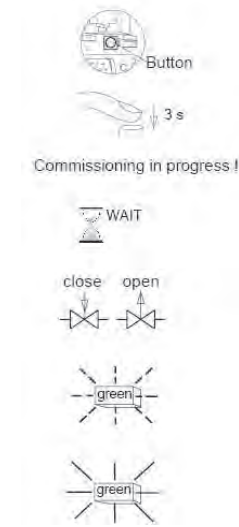
### 10.1. Automatic commissioning

**Automatic commissioning** This is performed if at least one of the cut-offs is set to be "by force/torque" or "by position automatically".

During automatic commissioning the actuator goes through the full programmed valve stroke / angle automatically. Parameters specific to the valve are being measured and calculated values are permanently stored in the actuator. At the same, set value and position feedback range are scaled.

To enable Automatic Commissioning, a mechanical stop is required in at least one end position (usually the closed position) of the valve. This mechanical stop can be either given by design of the valve, or it may be adjusted by the stop screws of the actuator (only when cut-off "by position automatically" is programmed). (THIS IS FACTORY PROGRAMMED)

### Procedure:



a.) Mount the actuator to a valve, wire it and switch the power on, according to these instructions. Press the button (item 6) inside the terminal box for at least 3 seconds.

b.) The automatic commissioning run starts and the actuator moves through the whole valve stroke. The green LED flashes quickly during this commissioning run.

c.) After finishing the automatic commissioning, the actuator is ready for use. The green LED is glowing permanently.

### Note

If the actuator is stalled during the automatic commissioning run BEFORE reaching a desired position-dependent cut-off, it will then store the so-obtained stroke.

### Note

If, as a result of automatic commissioning, no force/torque limit is found, or if a stroke below the minimum allowed stroke (5 mm in standard version) is found, the commissioning run will be aborted. The actuator returns to the "not commissioned" condition (i.e. green LED flashing slowly), even if the actuator had been initialized correctly before that.



### Caution!

If the LEDs display other types of signals than "flashing green" or "glowing green permanently", please refer to the chapter on "Fault messages".



### Caution!

The mains supply must not be interrupted during the commissioning run!



## 11. Status messages

### 11.1. Fault indicator relay

**Fault indicator relay** Fault messages can be transmitted to control boards with a maximum load of 24 VDC/100 mA via an optionally available closing contact at terminals 7 and 8. The messages can be parameterised via software or control box. -> See relevant manuals

### 11.2. Tracing faults

For explanation of the blinking codes of the status-LEDs, call Valve Pro at (909)464-9227

## 12. Maintenance and repair

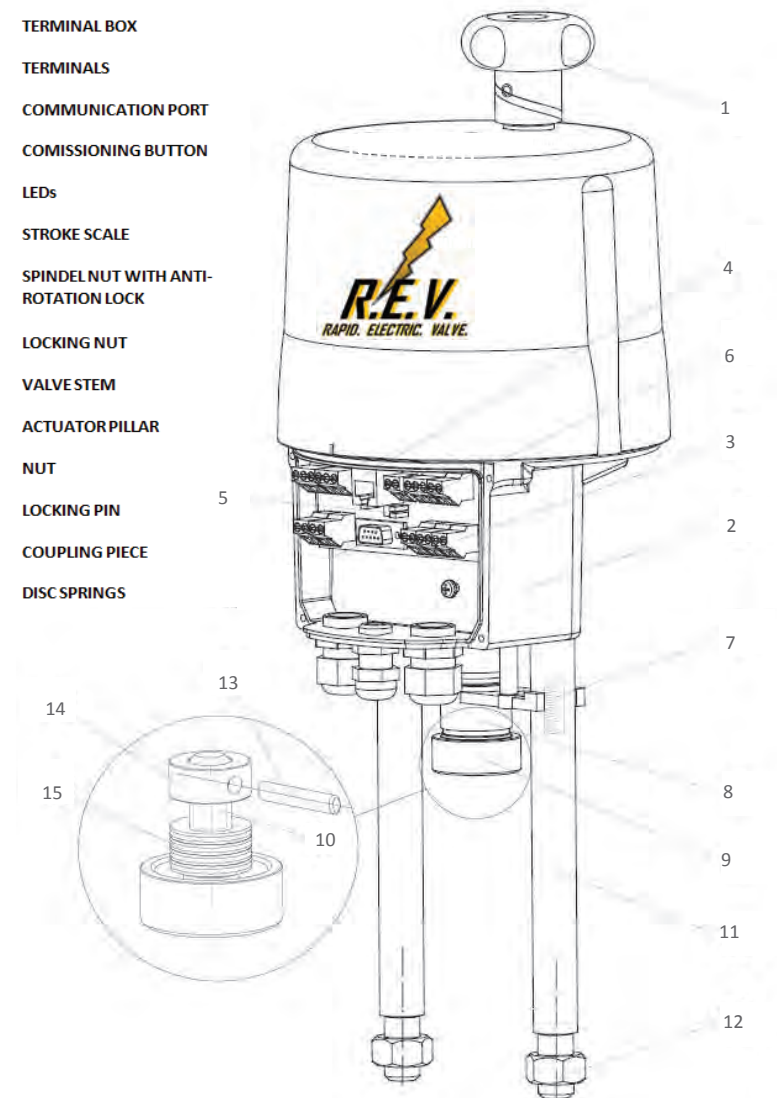
Under the conditions of use as per specification as lined out in the data sheet, the actuators are free of maintenance. All gears are lubricated for their service life and do not require to be re-lubricated.

**Cleaning** Clean the actuators with a dry soft cloth and do not use any cleaning agent. Do not use any coarse or abrasive materials.

## 13. Safety on Transportation

For transportation and storage all cable glands and connection flanges have to be closed to prevent ingress of moisture and dirt. A suitable method of packaging is required for transporting to avoid damage of coating and any external parts of the actuator.

- 1 HANDWHEEL
- 2 TERMINAL BOX
- 3 TERMINALS
- 4 COMMUNICATION PORT
- 5 COMISSIONING BUTTON
- 6 LEDs
- 7 STROKE SCALE
- 8 SPINDEL NUT WITH ANTI-ROTATION LOCK
- 9 LOCKING NUT
- 10 VALVE STEM
- 11 ACTUATOR PILLAR
- 12 NUT
- 13 LOCKING PIN
- 14 COUPLING PIECE
- 15 DISC SPRINGS



*Product of: Valve Pro*

*Contact Information: Phone: (909)464-9227*

*Website: [www.valvepro.biz](http://www.valvepro.biz) Email: [sales.valvepro@hotmail.com](mailto:sales.valvepro@hotmail.com)*

*\*Valve Pro, division of Control Pro, Inc.*

## Installation Operation and Maintenance Instructions for ARIA electric actuators



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## FUNCTION

The ARIA Series actuators are designed as Spring-Fail-Safe upon Loss of- Power, or Loss-of-Signal. The actuator is mounted onto the control valve via pillars and mounting base and attached via a yoke locknut. The actuator stem and valve stem are connected as well.

Based on a brushless DC motor (BLDC) the generated torque is transmitted via a multi-stage spur gear onto a spindle nut. The

spindle nut transmits the input torque into an axial thrust force via a spindle. The linear stroke is transmitted to the valve spindle by a coupling piece.

The stroke is measured and controlled by a linear 12 Bit Hall sensor. In case of mains power loss, the stroke movement is in OPEN or CLOSE direction by spring force. Electrical wiring is terminated at a terminal block under the actuator cover.

## SYMBOLS AND SAFETY

### GENERAL DANGERS OF NON-COMPLIANCE WITH SAFETY REGULATIONS

ARIA Series actuators are built at state-of the art technology and are safe to operate. Despite of this, the actuators may be hazardous if operated by personnel that has not been sufficiently trained or minimum instructed, and if the actuators are handled improperly, or not used as per specification.

### THIS MAY

- cause danger to life and limb of the user or a third party,
- damage the actuator and other property belonging to the owner,
- reduce safety and function of the actuator.

To prevent such problems, please ensure that these operating instructions and this chapter in particular have been read and understood by all personnel involved in the installation, commissioning, operation, maintenance and repair of the actuators.

### BASIC SAFETY NOTES

- The actuators may only be operated by skilled and authorized operating personnel.
- Make sure to follow all security advice mentioned in this manual, any national rules for accident prevention, as well as the owner's instructions for work, operation and safety.
- The isolating procedures specified in these operating instructions must be followed for all work pertaining to the installation, commissioning, operation, change of operating conditions and modes, maintenance, inspection, repair and installation of accessories.
- Areas that can be under voltage have to be isolated before working on them.
- Ensure that the actuators are always operated in faultless condition. Any damage or faults, and changes in the operational characteristics that may affect safety, must be reported at once.

## DANGER SIGNS



**CAUTION!** There is a general risk of damage related to health and/or properties.



**DANGER!** Electrical voltages are present that may lead to death. Life threatening risks may occur due to electrical voltages!



**DANGER!** This sign warns of hazards posing a risk to health. Ignoring these instructions can lead to injuries.

### OTHER NOTES

- The motor surface temperature may rise when maintaining, inspecting and repairing the actuator immediately after operation. There is a danger of burning the skin!
- Always consult the relevant operating instructions when mounting ARIA accessories or operating the actuator with ARIA accessories.
- Connections for signal in- and output are double isolated from circuits that can be under dangerous voltage

## USAGE AS PER SPECIFICATION

- ARIA Series actuators are exclusively designed to be used as electric valve actuators for rising stem globe control valves. They are meant to be mounted on Warren Controls, control valves in order to run their motors.
- Any other use is considered to be non-compliant and the manufacturer cannot be held liable for any damage resulting from it.
- The actuators can only be used within the limits laid out in the data sheets, catalogues and other documents. Otherwise, the manufacturer cannot be held liable for any resulting damage.
- Usage as per specification includes the observance of the operating, service and maintenance conditions laid down by the manufacturer.
- Read this document in its entirety as special precautions need to be taken before mounting and adjusting the actuator as well as servicing!
- The actuators may only be used, serviced and repaired by personnel that is familiar with them and informed about potential hazards. The specific regulations for the prevention of accidents have to be observed.
- Damages caused by unauthorized modifications carried out on the actuators are excluded from the manufacturer's liability.
- Supply voltage may only be switched on after the proper closure of the main cover or terminal box.

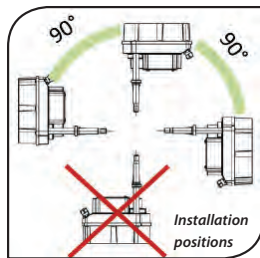
## ARIA SERIES BASIC SPECIFICATIONS

MAX Thrust:	455 Lbf (2kN)
MAX Stroke:	1.38 in. (35mm)
Manual Override (electric):	via 2 push buttons when powered
Power Supply:	24 VAC/DC, optionally wide range PS (100-240 VAC)
Motor protection:	Electronic motor current monitoring with safety cut-off
Duty cycle as per IEC 60034-1,8:	S2 30 min/ S4 1200c/h-50% ED
Permitted ambient temperature:	-4°F to 140°F (-20°C to +60°C)
Internal fault monitoring:	Thrust, Control Signal, Temperature, Power Supply
Binary control:	24-230- VAC for ON/OFF service
Control Signal and Feedback:	0-20 mA, 4-20 mA, 0-10 V, 2-10 V selectable, plus split range
Mounting Position:	Any position, except cover pointing downwards
Conduit entries:	2 pcs. M 20 x 1.5 / 1 pc. M 16 x 15
Enclosure Rating, to EN 60529:	IP67
Fuse - HV Power Supply:	2 AMP, 5 x 20 mm, 250 VAC, Slow Blow

POWER CONSUMPTION 25 WATTS, MAX CURRENT
1.8 A at 24 VAC / DC
0.36 A at 115 VAC
0.18 A at 230 VAC

	Spring-Fail ARIA
Stroke Speed	12 Secs/In., (2 mm/sec.), Fixed. Spring-Fail Speed: 2.3 mm/sec.
What happens under the condition of Loss of Power, under voltage or over voltage.	Actuator engages Spring Fail, to Open or Close, Depending on model.
What happens under the condition of Loss of Control Signal.	Actuator engages Spring Fail, to Open or Close, Depending on model. With control by binary inputs, actuator stops in position when event occurs.

## OPERATING CONDITIONS AND INSTALLATION POSITION



- Standard actuators may be operated at ambient temperatures according to the ARIA Series basic specifications.
- Operating modes correspond to IEC 60034-1, 8: S2 for short cycle and S4 for modulating operation.
- For protection against moisture and dust, the enclosure rating is IP65 according to EN 60529.
- When installing the actuators, leave enough space to allow cover removal.
- The actuator can be installed vertically or horizontally or any position in between. The actuator must not be installed with the cover pointing downwards.



**Outdoor usage:** When using the actuators in environments with high temperature fluctuations or high humidity, we recommend using the optional heating resistor. IP67

## REMOVING / CLOSING THE COVER

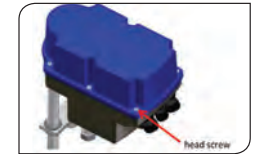
**OPEN:** Loosen the screws by using a screwdriver and unscrew them entirely out of the gear casing. The screws are captivated. Open the cover only in a dry environment.

**CLOSE:** Put the cover on the gear casing and press down slightly. Tighten the screws gently and then crosswise for even tightening.

**DO NOT OVERTIGHTEN**

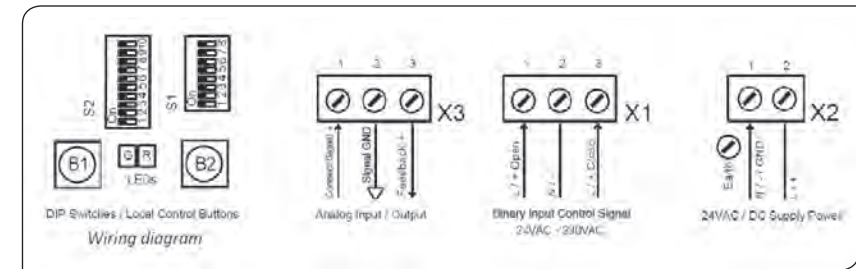


Open the cover only in a dry environment.



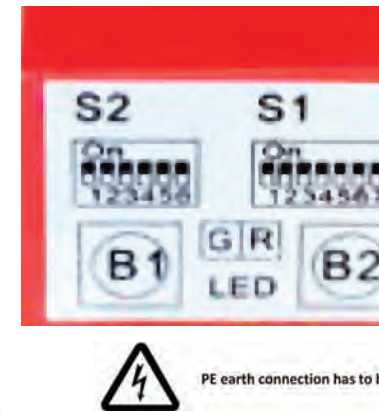
## WIRING DIAGRAM

Wiring diagram indicates the electrical connections for standard actuators. The wiring diagram inside the actuator is binding for the specific actuator wiring. For any optional accessories, see the separate wiring diagram in the corresponding installation instructions, at the end of this document.

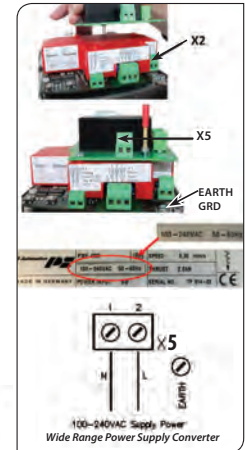


## HIGH VOLTAGE POWER SUPPLY

**Terminal overview wiring diagram for the Wide Range Power Supply Converter**



Disconnect the 24 VAC/VDC power (X2), if connected. Remove the screws of the protective cover but don't remove the cover. Put the power supply board converter with the connecting pins carefully through the opening of the protective cover and fix it with the screws. Wire the 100-240 VAC source to the power supply (X5) terminations as shown. On the high voltage power supply. Take the provided label "100-240VAC 50-60Hz" and stick it on the type plate of the actuator as shown in figure to the bottom left.





Before connecting to the mains, ensure that the mains supply is isolated and secured against an accidental switching-on.

Remove the cover of the actuator in order to connect the electric supply.

The mains connecting cables must be suitably dimensioned to accept the max. current requirement of the actuator. The yellow-green colored cables may only be used for connecting to earth. When you insert the cable through the drive cable connector, ensure that the max. bending radius of the cable is observed.

ARIA Series electric actuators do not have an internal electrical power



Please protect all of the power supply and control cables in front of the terminals mechanically by using suitable measures against unintentional loosening. Never install the power supply and the control cables together in one line but instead please always use two different lines.

## ELECTRIC SUPPLY

switch. A switch or power mains switch must be provided in the building installation. It should be positioned closely to the device and be easily accessible for the user and shall be labelled as the mains isolator switch for the actuator. The building installation must also provide power surge trips or fuses corresponding to standard IEC 60364-4-41 with protection class I resp. protection class III (24 VAC / 24 VDC) for the actuator connections. The high voltage power supply has it's own fuse.

## MOUNTING ADDITIONAL POSITION SWITCHES MECHANICAL & RELAYS

1



ADDITIONAL POSITION SWITCHES RELAY 1

1 relay board, 1 connecting cable, 3 plastic screws, 3 spacers

2

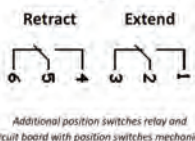


CIRCUIT BOARD WITH POSITION SWITCHES MECHANICAL 2

1 pre-assembled bracket with limit switch board, switching cams and lever, 1 ball pin, 3 screws

Standard switches 2WE: silver/nickel contacts, current: 0,1 A to 10 A, voltage: 24 V to 230 V. Optional 2WE gold: gold contacts, current 0,1 mA to 100 mA, voltage: 5 V to 24 V

X6



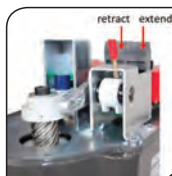
Terminal overview wiring diagram for the Additional Position Switches



[1] Screw the ball pin in the drilled hole of the magnet holder by using an open-end wrench (size 5,5 mm).



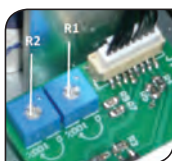
[2] Place the bracket with the lever over the ball pin and screw it tight.



[3] Connect the limit switches as NO or NC. Switch on power supply. Drive the actuator in manual operation until the required switch position is reached. Turn the switching cams with a screwdriver (blade width 4 mm) until the microswitches are heard to click. The operating directions "Extend" respectively "Retract" refer to the actuator stem.



[4] Clip the relay board with the spacers in the locating holes. Connect the main board with the connection cable. Connect according to the wiring diagram.



[5] Switch on power supply. Adjust the switch positions with the trimmers R1 (Retract) and R2 (Extend). The relay is switching when the switching position is reached or passed. The switching point can be adjusted from 0 to 100 %. The actuator doesn't need to be re-calibrated. X6: The operating directions "Extend" respectively "Retract" refer to the actuator stem.

## DIP SWITCH FUNCTIONS & SETTINGS

S1 Dip Switches • Function	1	2	3	4	5	6	7	8
SIGNALS	Control Signal				Position Feedback			
Voltage (DC)	ON	ON	OFF	OFF	OFF	ON	OFF	ON
Milliamp (DC)	OFF	OFF	ON	ON	ON	OFF	ON	OFF

S2 Dip Switches • Function		1	2	3	4	5	6	7	8	9	10
ONLY RELEVANT WHEN AUTO - COMMISSIONING IS OPEN WITH STROKE	Cut Off by Force if the valve stem is up/out of the valve.	ON									
	Cut Off by Force if the valve stem is down/into the valve. <Default>	OFF									
Control Type	Control via Analog Control Signal. <Default>						ON				
	Control via Binary Inputs						OFF				
Control Action	Valve Stem Up and Out of Valve with Increasing Control Signal. <Default>					ON					
	Retract Valve Stem with Increasing Set Value					OFF					
Automatic Commissioning	Close with Force / Open with Force. <Default>			ON	ON					OFF	
	Close with Force / Open with Stroke			ON	OFF					ON	
	Close with Force / Open with 20 mm Stroke			OFF	ON					ON	
	Close with Force / Open with 30 mm Stroke			OFF	OFF					ON	
	Close with Force / Open with 40 mm Stroke			ON	ON					ON	
Short Stroke Commissioning	Close with Force / Open with Required Stroke			ON	ON					ON	
Control Signal Ranges	Control Signal Range: 0-10V / 0-20 mA		ON						ON	ON	
	Control Signal Range: 2-10V / 4-20 mA. <Default>		OFF						ON	ON	
	Split Range HIGH Control Signal: 5-10 V / 10-20 mA		ON						ON	OFF	
	Split Range HIGH Control Signal: 6-10 V / 12-20 mA		OFF						ON	OFF	
	Split Range LOW Control Signal: 0-5V / 0-10 mA		ON						OFF	ON	
	Split Range LOW Control Signal: 2-6 V / 4-12 mA		OFF						OFF	ON	
Signal vs Travel	Travel is LINEAR with Signal. <Default>										ON
	Travel is Quick Opening with Signal										ON
< FACTORY DEFAULTS >		OFF	OFF	ON	ON	ON	ON	ON	ON	OFF	ON

1) "Open with force" refers **solely** to automatic **commissioning**. During operation the actuator will stop at the found position (see PG 13. Operation)

2) After changing the switches S2.3 and S2.4, perform re-calibration to activate the new operating mode.

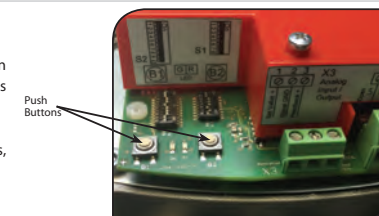
3) Switch S2.6 Off (control via binary inputs) switch S2.5 on (Default)

## MANUAL OPERATION (ELECTRICALLY)

Two push buttons are available to drive the actuator for installation work such as mounting onto a valve, or setting the limit switches positions or manual mode troubleshooting.

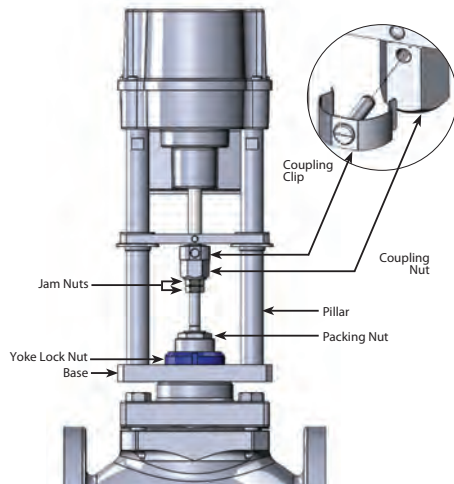
This function is available in both Spring-Fail or Fail-In-Place Models, only for when power is applied.

See: "MANUAL OPERATION PUSH BUTTON" on Page 9.





## ACTUATOR PARTS IDENTIFICATIONS



## ACTUATOR REMOVAL INSTRUCTIONS

### STEP 1A:

*(If the actuator is still functional, can accept power and stroke with either the control signal or manual commissioning push buttons, go to Step 1B)*

For when the actuator is in complete failure, this model has the actuator spring providing the full force on the valve plug loaded into the valve seat. It is important to reduce this load before removing the coupling clip.

With the valve secure in the piping or in a vise, use a hammer and cold chisel to loosen the Yoke Lock Nut (counterclockwise) while making sure a partner holds on to the actuator in-place to prevent it from rotating (or this will score the plug and seat, ruining the valve trim).

### STEP 1B:

Assuming the actuator is still functional, can accept power and stroke with either the control signal or manual commissioning push buttons, reposition the actuator that it is roughly at midstroke.

At this point, you should be able to work the Coupling Clip off of the Coupling Nut with your hand.

With the valve secure in the piping or in a vise, use a hammer and cold chisel to loosen the Yoke Lock Nut (counterclockwise).

As the yoke lock nut is loosened all the way off the bonnet threads, attempt to lift the actuator straight upwards as the actuator's base will bind some on the bonnet threads when you do. Once this base is moved up at least  $\frac{1}{4}$ ", you should be able to work the Coupling Clip off of the Coupling Nut with your hand. With the clip removed, you should be able to lift the actuator completely off the valve.

Proceed to the ARIA Series IOM, Page 8, The Step called 'Third' (Spring Extend Actuator). Follow wiring instructions. Use commissioning buttons to reposition the actuator midstroke. Mount the actuator with the yoke lock nut, doing all steps from before in reverse.

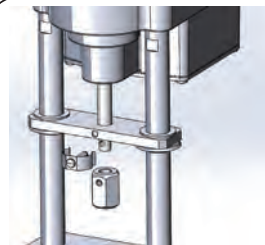
**Proceed to 'Final Steps' bottom of page 8.**

As the yoke lock nut is loosened all the way off the bonnet threads, attempt to lift the actuator straight upwards as the actuator's base will bind some on the bonnet threads when you do. With the clip removed, you should be able to lift the actuator completely off the valve.

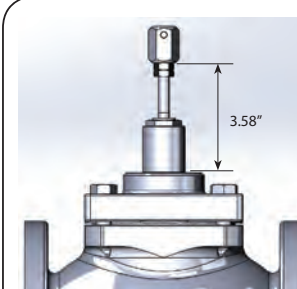
Proceed to the ARIA IOM, Page 8, The Step called 'Third' (Spring Extend Actuator). Follow wiring instructions. Use commissioning buttons to reposition the actuator midstroke. Mount the actuator with the yoke lock nut, doing all steps from before in reverse.

**Proceed to 'Final Steps' bottom of page 8.**

## REMOVAL / REPLACING OF ACTUATOR



**FIRST:** Remove coupling nut from actuator by removing coupling clip. (In conjunction with Page 7)

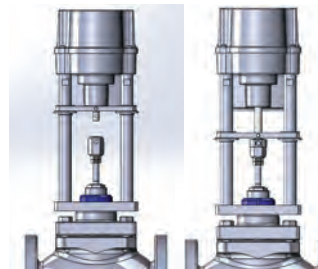


### SECOND:

Push valve stem down into valve so plug is seated. Tighten the two Jam Nuts together to the distance shown ( $3.58" \pm 0.02"$ ).

Then proceed to thread on and tighten the coupling nut as shown.

### THIRD: (follow the steps for your CORRECT Actuator)

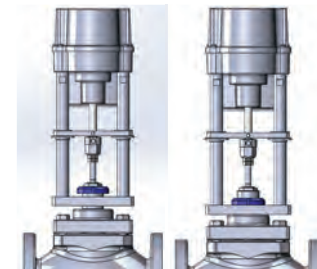


#### SPRING - FAIL-UP (Spring Retract Actuator)

Mount Actuator onto Valve as shown. Thread yoke nut onto the valve bonnet and fasten in place.

Connect the actuator to an electrical supply. (ref "ELECTRICAL SUPPLY", "WIRING DIAGRAM", Page 4&5")

Manually drive actuator stem to align holes for the connecting pin. Insert connecting pin. (ref "MANUAL OPERATION PUSH BUTTON" page 11)



#### SPRING - FAIL-DOWN (Spring Extend Actuator)

Mount Actuator onto Valve as shown. Begin to thread yoke nut onto the valve bonnet. Align the holes for the connecting pin. Insert connecting pin.

Connect the actuator to an electrical supply. (ref "ELECTRICAL SUPPLY" "WIRING DIAGRAM" Page 4&5")

Manually drive the actuator stem to seat the base of the actuator on the valve bonnet (ref "MANUAL OPERATION PUSH BUTTON" page 11)

Tighten Yoke lock nut

## FINAL STEPS

Set the Dip switches as per requirements. Ref "SIGNALS / FUNCTIONS" page 6.  
Complete automatic commissioning as per "COMMISSIONING / OPERATION" page 11.  
Once commissioning is complete and successful the actuator is ready for operation.

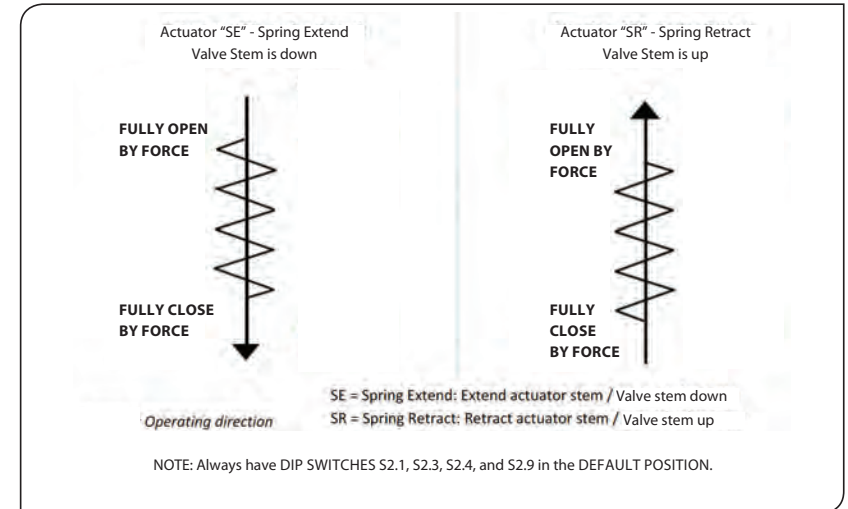
## OPERATOR PUSH BUTTON

Function	Action	Push button B1	Push button B2	LED sequence
Manual operation	Activate	Push > 3 seconds	Push > 3 seconds	Both LED's are flashing alternately
	Valve stem Down/ Into Valve	Push		Green LED is flashing
	Valve stem UP/ Out of Valve		Push	Red LED is flashing
	Stop			Both LED's are flashing alternately
	Exit	Push 3 seconds	Push 3 seconds	Red or green LED is on (actuator is commissioned), Red LED flashing quickly (actuator is not commissioned)
Automatic Commissioning	Start		Push 7 seconds	Both LED's are on
	Commissioning finished			Green LED is flashing 7x (if commissioning is successful), green LED is flashing quickly (if commissioning failed)
	Exit	Push 1x		Red or green LED is on

## SPECIAL COMMISSIONING PROCEDURE FOR SHORT-STROKING A VALVE

Function	Action	Push button B1	Push button B2	LED sequence
Short Stroke Commissioning	Activate	Push 7 seconds		Both LED's are flashing alternately
	Valve stem Down/ Into Valve	Push		Green LED is flashing
	Valve stem UP/ Out of Valve to Desired Stroke		Push	Red LED is flashing
	Start	Push 3 seconds	Push 3 seconds	Both LED's are on
	Exit	Push 1 x		Red or green LED is on

## OPERATING DIRECTION



## STATUS DISPLAY

STATUS	GREEN LED	RED LED
Actuator not commissioned	Off	is flashing quickly
Normal operation/ actuator running	On	Off
Normal operation/ actuator stationary	Off	On
Manual mode active	is flashing alternately	is flashing alternately
Manual mode: valve stem UP/ Out of Valve	Off	is flashing
Manual mode: valve stem Down/ Into Valve	is flashing	Off
Automatic commissioning running	On	On
Automatic and manual commissioning successful	is flashing 7x - 1.5 seconds off	On
Automatic commissioning failed	is flashing quickly	On
Overvoltage	is flashing 1 x -1.5 seconds off	On
Undervoltage	is flashing 2 x -1.5 seconds off	On
Memory error	is flashing 3 x -1.5 seconds off	On
Control Signal error (<1 V, < 2 mA)	is flashing 4 x -1.5 seconds off	On
Torque error	is flashing 5 x -1.5 seconds off	On
Under-/ Overtemperature	is flashing 6 x -1.5 seconds off	On

## COMMISSIONING / OPERATION



### WARNING

Actuator must be commissioned anytime the connection between the valve stem and actuator stem is changed. Failure to do so may result in damage to the actuator, voiding the warranty!

### CAUTION

PRESSING B2 for only 4 seconds will invoke the speed change procedure when done on the FAIL-In-PLACE MODEL

#### AUTOMATIC COMMISSIONING

- Ensure secure connection between valve and actuator.
- To start the automatic commissioning push button B2 minimum 7 seconds. The actuator will automatically drive to the final open valve position via force, and back to the final closed valve position.
- After successful commissioning, the green LED is flashing 7 times.
- Push button B1 to return to normal operation.
- After successful commissioning, check the found or adjusted stroke by comparing the control signal and the valve position.
- In case of unsuccessful commissioning the green LED is flashing quickly. Please check valve mounting.
- For commissioning a stroke of at least 1 mm in direction "close with force" is required before the actuator has reached its mechanical stop. Furthermore, the actuator must be able to perform a stroke of at least 5 mm.

#### SHORT-STROKE COMMISSIONING

- Ensure secure connection between valve and actuator.
- To activate the individual commissioning push button B1 for minimum 7 seconds.
- For manual operation use push buttons B1 and B2 until the required open valve position is reached.
- Start commissioning of both positions and store them by simultaneously pushing the buttons B1 & B2 for minimum 3 seconds.
- After successful commissioning, the green LED is flashing 7 times.
- Push button B1 to return to normal operation.
- After successful commissioning, check the found or adjusted stroke by comparing the control signal and the valve position.
- In case of unsuccessful commissioning the green LED is flashing quickly. Please check valve mounting.
- For commissioning, a stroke of at least 1 mm in direction "close with force" is required before the actuator has reached its mechanical stop. Furthermore, the actuator must be able to perform a stroke of at least 5 mm.

#### MANUAL OPERATION PUSH BUTTON

- Push button B1 and B2 simultaneously for minimum 3 seconds to change to manual operation mode.
- Push button B1 to position valve stem down into valve.
- Push button B2 to position valve stem up out of valve.
- Push button B1 and B2 simultaneously for minimum 3 seconds to exit from manual operation mode.

## COMMISSIONING / OPERATION

#### OPERATION

All internal parameters, like required motor torque, actual position, functional status, etc., are being permanently monitored during operation for the actuator. This ensures that the actuator positions with optimal accuracy, and always closes the valve tightly.

#### CUT-OFF IN END POSITIONS

During operation the cut-off in end positions is realized for the one end position at the position found/chosen and for the other end position via force depending on the settings for the DIP switch S2.1 (see page 6).

**FAIL-IN-PLACE  
MODEL  
ONLY**

## COMMISSIONING



- Open the cover put the actuator on the valve, connect the electric supply.
- Perform automatic or manual commissioning.
- Close the cover.

## MAINTENANCE



#### CAUTION!

During maintenance and repair the actuator must not be operated electrically.

The actuators are maintenance-free if used under the operating conditions as designated in the data sheet. The gearboxes are lubricated for life and do not require further lubrication.

#### CLEANING

The actuators should be cleaned dry. Do not use abrasive cleaning agents or cleaning products containing solvents as the labelling of the safety stickers and the type plate might become illegible. Do not operate the actuator during the cleaning process.



#### MAINTENANCE

Spring Fail actuators have a pre-tensioned spring inside, the gearbox housing must not be opened. Defective actuators should be returned to our plant, or to our representatives, to be checked for damages and their possible causes.

#### SPARE PARTS

Damaged actuators should be returned to our plant, or to our representatives, to be checked for damages and their possible causes.

## DECOMMISSIONING AND DISPOSAL

- Disconnect the mains supply and ensure that it is secured against an accidental switching-on.
- Open the cover.
- Remove external electrical connections.
- Take off the actuator from the valve, page 7.



#### DISPOSAL

For its disposal, the product should be treated as waste containing electrical and electronic equipment and should not be disposed of as household waste. The actuators have a pre-tensioned spring inside. For disassembly please contact our plant.

## USAGE AND STORAGE

### ARIA SERIES

#### USAGE

- ARIA Series actuators are exclusively designed to be used as electric valve actuators. They are meant to be mounted on Warren Controls, control valves in order to run their motors.
- Any other use is considered to be non-compliant and the Warren Controls cannot be held liable for any damage resulting from it.
- The actuators can only be used within the limits laid out in the data sheets, catalogues and other documents. Otherwise, the manufacturer cannot be held liable for any resulting damage.
- Usage as per specification includes the observance of the operating, service and maintenance conditions laid down by the Warren Controls.
- Not to be regarded as usage as per specification are mounting and adjusting the actuator as well as servicing. Special precautions have to be taken while doing this!
- The actuators may only be used, serviced and repaired by personnel that is familiar with them and informed about potential hazards. The specific regulations for the prevention of accidents have to be observed.
- Damages caused by unauthorized modifications carried out on the actuators are excluded from the manufacturer's liability.
- Supply voltage may only be switched on after the proper closure of the main cover or terminal box.

#### STORAGE

For appropriate storage, the following instructions have to be met:

- Only store the actuators in ventilated, dry rooms.
- Store the actuators on shelves, wooden boards, etc., to protect them from soil moisture.
- Cover the actuators with plastic foil to protect them from dust and dirt.
- Protect the actuators against mechanical damage.

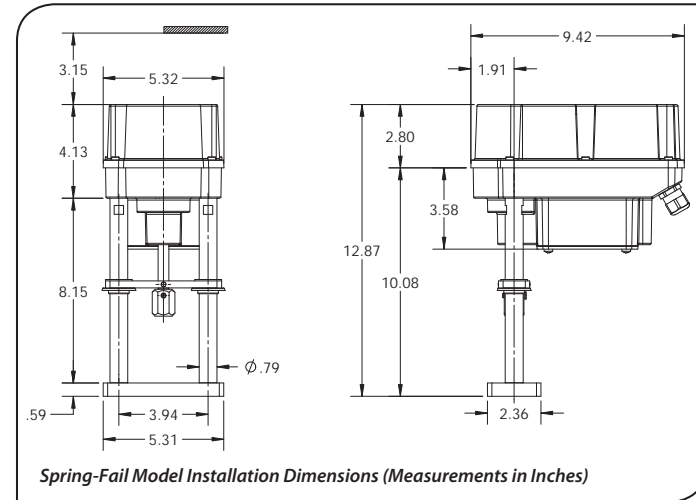
## ACCESSORIES OPTIONS

Various options are available in order to adapt the actuators to the various service conditions.

For technical data, please refer to the respective data sheets.

				AVAILABILITY
ACCESSORIES/OPTIONS	Position signal switches, mechanical	2WE	2 potential-free position switches, mechanical, with silver-plated changeover contacts 24V to 230 V AC/DC @ 0.1A- 5A	STOCKED
	Position signal switches gold, mechanical	2WE gold	2 potential-free position switches, mechanical, with gold-plated changeover contacts 5V to 30 V AC/DC @ 1mA- 100mA; contact resistance 30 mOhm	NOT STOCKED
	Position signal relays		2 position signal relays with changeover contacts, calibrated automatically to valve stroke 24V to 230 V AC/DC @ 0.1A- 1A Switching point adjustable 0-100 % of the stroke using potentiometers	NOT STOCKED
	Heating resistor	HR	Heating resistor to prevent condensation	STOCKED
	Wide range power supply		For 100-240 VAC 1~ supply voltage	STOCKED

## DIMENSIONAL DATA





## DECLARATION

The Warren Controls, ARIA F-Series Actuators comply with the requirements of the following directives.

<b>2014/30/EU</b>	Electromagnetic Compatibility (EMC)
<b>2006/95/EC</b>	Low Voltage (LVD) (valid until 05/19/2016)
<b>2014/35/EU</b>	Low Voltage (LVD) (valid from 05/20/2016)

and have been successfully tested in accordance with the following harmonized standards

<b>EN 61000-6-2: 2005</b>	Electromagnetic compatibility (EMC), Generic standards-Immunity for industrial environments
<b>EN 61000-6-3: 2007</b>	Electromagnetic compatibility (EMC), Generic standards-Emission standard for residential, commercial and light-industrial environments
<b>EN 61010-1: 2010</b>	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use

## TROUBLESHOOTING TIPS

- Actuator has power but does not operate as expected.
  - Open Cover, observe LED's and See page 10 for status display conditions.
- If the Actuator won't calibrate
  - Start by checking the jam nut height (see page 8)
  - If this didn't work, check dip switches (see page 6)
- Control signal is correct but actuator is not stroking.
  - Check DIP Switch Block "SW1" Settings on Page 6
  - Check wiring diagram connections on Page 4.



ARIA\_IOM\_RevD\_0519  
92500143 RevD



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SPENCE ENGINEERING COMPANY, INC.  
Walden, New York

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS  
for  
TYPE EP14 SERIES CONSTANT PRESSURE PUMP GOVERNORS

INTENDED PURPOSE

Type EP Series Pump Governors are designed to control the steam supply to a pump so as to maintain a constant, adjustable pump discharge pressure.

These instructions cover main valve Types E, E3 and E5 used with pilot Types P14, P13, P15 and P32.

INSTALLATION

Locate the governor as near the pump as possible. Install the main valve in a straight run of horizontal pipe with diaphragm chamber down and arrow on the body pointing in the direction of flow to the pump. Carefully clear the piping system of foreign matter at assembly. Provide a 3-valve by-pass to facilitate inspection of the governor without interrupting service. Avoid damaging effects of scale and dirt in pipe lines by using a SPENCE strainer ahead of the governor.

Mount the pilot on either side of the main valve, connecting it to the  $\frac{1}{4}$ " pipe tap on the inlet end with the nipple and union provided. Assemble the auxiliary fittings and tubing as shown on the connection drawing. Bleedport fitting #4A and Restriction elbow #5A contain orifices which must not be obstructed.

The pump discharge pressure control pipe should be as short as practical and must enter the pipe line at a point of minimum turbulence. Avoid a control point near a turn. See connection drawing for proper location of pressure snubber.

Insulation may be applied to the upper portion (globe and flanges) of the Main Valve. Do not insulate the diaphragm chamber, condensation chamber (if used) or any part of the Pilot.

OPERATION

On starting up, proceed as follows:

1. Use the by-pass valve to put the pump in operation at desired discharge pressure.
2. Open valve in control pipe.
3. Open outlet stop valve wide. Open inlet stop valve gradually and choke down on the by-pass until the governor is on the line.

Pressure Adjustment - Compressing the pilot adjusting spring increases the pump discharge pressure. Turn the handwheel slowly until the desired pressure is reached.

MAINTENANCE

Complete dismantling at regular intervals for inspection and repair is not recommended. Under normal conditions, if kept relatively free of dirt, a governor will function year after year with a minimum of maintenance attention. The following service points are suggested:

After the first few days of operation, and thereafter twice a year:

1. Inspect for dirt collected at -
  - a. No. 4A Bleedport orifice - screwed into outlet end of main valve.
  - b. No. 5A Restriction orifice - screwed into underside of main valve.

c. Inlet screen in Pilot - remove square bottom cap to drop out.

2. Inspect all joints for leakage. Tighten all bolts. Never allow a leak to persist.

Pilot Stem Seal:

If steam blows out around stem, the bellows seal is defective and must be replaced. Proceed as follows:

1. Remove set screw in stem and four bolts holding bonnet to body.
2. Remove top-works and bonnet from body.
3. Fit 11/16" deep socket on nut at the end of bellows assembly and remove it from body.
4. Replacement of bellows assembly in bonnet:
  - a. This joint should be made up with Copaltite, Permatex, or equal plastic gasket compound.
  - b. Remove all compound from bonnet with a wire brush. Apply new compound sparingly to both parts (bellows and bonnet) threads and shoulders. Let stand until tacky before assembling.
5. Be sure bellows stem fits into coupling on temperature stem and tighten set screw.

Dismantling, Valve Grinding:

To take main valve apart, begin by removing top flange. Next, connect a source of air (water, steam) pressure which can be adjusted by hand to the underside of the diaphragm. Apply 30 psi to jack the valve wide open. The friction of the pressure plate against stops in the base will prevent the stem from turning while removing the stem nuts.

To dismantle the pilot, take out four bolts on bonnet and remove topwork from body. Lift disc out of seat to inspect.

To grind in either main valve or pilot disc, use extremely fine (grit 400) compound with light pressure to avoid tearing the metal. Clean all parts with kerosene or carbon tetrachloride before reassembling.

TROUBLE SHOOTING PROCEDURE

Failure to Open -

1. Remove tubing bend at No. 4A bleedport fitting which contains a 3/32" orifice. This orifice may have been omitted or misplaced.
2. Remove tubing bend at No. 5A Restriction fitting. This orifice may be clogged.
3. Close the control pipe valve and break the union between it and the pilot diaphragm chamber to relieve the pressure.
4. Crack open the inlet stop valve. Steam should issue from open No. 8B tee at pilot outlet. If there is little or no flow, remove square bottom cap on pilot and clean the inlet screen. Also, tap the lower end of the disc to check its freedom to lift in the seat ring.
5. Make sure there is adequate pressure at the main valve inlet.
6. Inspect main valve diaphragm.

Failure to Close -

1. Remove tubing bend at No. 4A bleedport fitting, as in (1) above, and observe if orifice is clogged.

2. Check control pipe and pressure snubber at pilot diaphragm chamber to see that neither is clogged.
3. Run pump on the by-pass leaving only the control pipe valve open. Remove bleedport tubing bend and slack off on the adjusting spring.
4. Crack open the inlet stop valve;
  - a. If steam issues from No. 8B tee, the pilot has an obstruction between its seat and disc.
  - b. If the leakage is from the No. 4A bleedport, the main valve is held open.
  - c. To inspect either valve seat, see "Maintenance" sub-paragraph on dismantling.

Erratic Operation -

1. Omission of pressure snubber at pilot diaphragm chamber. No. 1 snubber for a reciprocating pump governor has a #60 drill orifice for water and light oils, 1/16" orifice for heavy oil. Special snubbers are supplied for turbine-driven pumps.
2. Hunting at light loads - drill out No. 4A bleedport orifice to  $\frac{1}{8}$ " diameter.
3. Sticking or binding of parts - look for deposits of compound or other foreign matter on the valve stems or the guiding flutes of the pilot disc.



TYPE P14 PILOT

#### APPLICATION DATA

- Steam Driven Pump Control
- Steam Generated Output Control

#### RATINGS (Maximum Inlet Conditions)

Construction	Pressure PSIG (bar)	Temperature °F (°C)
Cast Iron	250 (17.2) @	450 (232)
Cast Steel	600 (41.4) @	750 (400)

#### SPRING PRESSURE RANGES (PSIG)

P13	100-300		
P14	5-30	20-100	40-150
P15	3-10	5-25	
P32	200-450	400-600	

Canadian Registration # OC 0591.9C

SIZING INFO  
PAGE 120

## TYPE P SERIES PILOTS PUMP GOVERNOR PILOTS

CONTROLS 3 to 600 PSIG

- Self Contained
- Spring Operated
- Normally Open
- ANSI/FCI 70-2 Class IV Shutoff
- Packless Construction
- Accurate to  $\pm 1$  psi
- Three Adjustable Spring Ranges
- Steam Applications
- Constant Average Discharge Pressure
- Accurate Regulation Unaffected by Service Conditions
- Easy In-line Maintenance

#### OPTIONS

- Adjustment Indicator
- Integral Mount

#### MODELS

- **TYPE P13** features a spring for controlling pressures 100 to 300 PSI.
- **TYPE P14** features three spring ranges for controlling pressures 5 to 150 PSI.
- **TYPE P15** features two spring ranges for controlling pressures 3 to 25 PSI.
- **TYPE P32** is piston driven and features three spring ranges for controlling pressures 200 to 2000 PSI.

#### TYPICAL CONFIGURATIONS

STEAM PUMP CONTROL .....TYPE EP  
STEAM PUMP CONTROL.....TYPE E2P  
STEAM PUMP CONTROL.....TYPE E5P

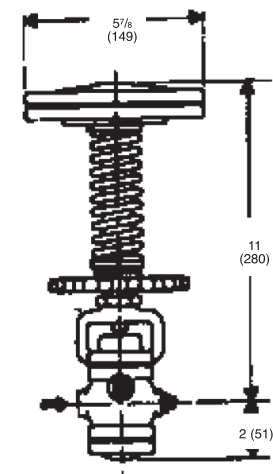
## TYPE P SERIES PILOTS PUMP GOVERNOR PILOTS

#### SPECIFICATION

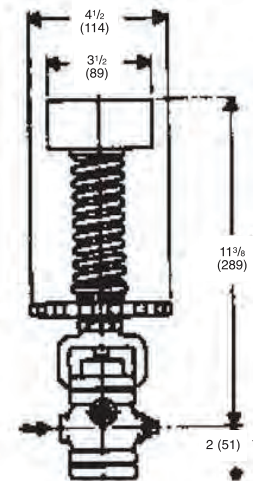
The Pilot shall be separate from the main valve and connected to it with a male union. The Pilot shall be normally open design with packless construction. A strainer screen shall be built into the Pilot inlet. The Pilot shall be interchangeable on all sizes of main valves. The pilot shall automatically adjust pump discharge pressures within the spring range to maintain a constant average pressure.

#### MATERIALS OF CONSTRUCTION

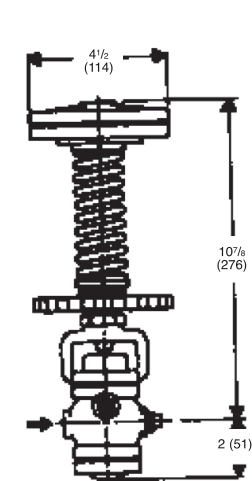
Body, Cast Iron .....ASTM A126 CI B  
Body, Cast Steel .....ASTM A216 GR. WCB  
Stern .....2024-T4 ASTM B211-75  
Disc .....440 St. St. ASTM A276-75 COND A  
Seat .....420 St. St. ASTM A276 COND A  
Gasket .....Non-Asbestos  
Diaphragm .....301 St. St. MIL-5-5059C  
Spring .....Steel ASTM A231



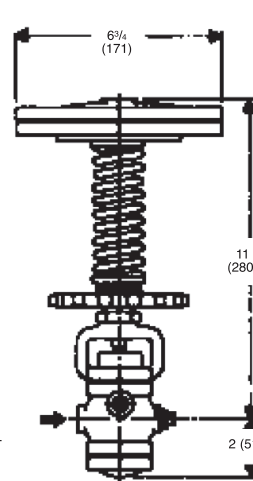
TYPE P14 PILOT  
13 LBS.  
(5.9 KG)



TYPE P32 PILOT  
10 LBS.  
(4.5 KG)



TYPE P13 PILOT  
11 LBS.  
(5 KG)



TYPE P15 PILOT  
15 LBS.  
(6.8 KG)

†For Integral Mount Pilot, this dimension is 1 1/8" (27).



# Installation & Maintenance Instructions

## 2-WAY INTERNAL PILOT OPERATED SOLENOID VALVES NORMALLY CLOSED OPERATION — STEAM SERVICE 1/4", 3/8", OR 1/2" NPT — 3/8" ORIFICE

### SERIES

8222

Form No.V5433R3

**NOTICE:** See separate solenoid installation and maintenance instructions for information on: Wiring, Solenoid Temperature, Cause of Improper Operation, Coil and Solenoid Replacement.

### DESCRIPTION

Series 8222 valves are 2-way internal pilot-operated solenoid valves designed for steam service. These valves are made of brass with ethylene propylene elastomers.

### OPERATION

**Normally Closed:** Valve is closed when solenoid is de-energized; open when energized.

**IMPORTANT:** Minimum operating pressure differential is 1 psi.

### INSTALLATION

Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

### Future Service Considerations

Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

### Temperature Limitations

For maximum valve ambient and fluid temperatures, see chart below.

Catalog Numbers	Class of Insulation	Maximum Ambient Temp. °F	Maximum Fluid Temp. °F
8222A64, 8222A66 8222A68	F	85	324
8222A70, 8222A74 8222A76	H	85	353
8222G64, 8222G66 8222G68	F	125	324
8222G70, 8222G74 8222G76	H	140	353

### Positioning

This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub-assembly area.

### Mounting

For mounting bracket (optional feature) see Figure 1.

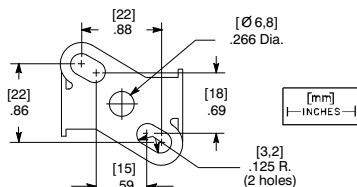


Figure 1. Mounting dimension of optional mounting bracket.

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### Piping

Connect piping or tubing to valve according to markings on valve body.

**CAUTION:** This valve is equipped with ethylene propylene elastomers which can be attacked by oils and greases. Wipe the pipe threads clean of cutting oils.

Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

**CAUTION:** To protect the solenoid valve, install a strainer or filter, suitable for the service involved, in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.

### MAINTENANCE

**WARNING:** To prevent the possibility of personal injury or property damage, turn off electrical power, depressurize valve, and vent fluid to a safe area before servicing the valve.

**NOTE:** It is not necessary to remove the valve from the pipeline for repairs.

### Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise, or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to open or close. Clean strainer or filter when cleaning the valve.

### Preventive Maintenance

- Keep medium flowing through the valve as free from dirt and foreign material as possible.
- While in service, the valve should be operated at least once a month to ensure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

### Causes of Improper Operation

- Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
- Excessive Leakage:** Disassemble valve and clean all parts. If parts worn or damaged, install a complete ASCO Rebuild Kit.

### Valve Disassembly

- Disassemble valve in an orderly fashion. Use exploded views for identification and placement of parts.
- Remove solenoid, see separate instructions.
- Unscrew solenoid base sub-assembly from valve body. Then remove core with core spring, bonnet gasket and retainer from valve body.

**CAUTION:** Do not damage center hole (pilot orifice) in piston assembly. Damage will cause valve malfunction.

- Insert a wire, bent paper clip or similar tool into the bleed hole on top of the piston assembly. Pull piston assembly, with piston ring attached, from the valve body.
- All parts are now accessible for cleaning or replacement. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

### Valve Reassembly

- Lubricate bonnet gasket with DOW CORNING® 200 Fluid lubricant or an equivalent high-grade silicone fluid.
- Replace piston assembly, refer to Figure 1. A flexible plastic sheet (Form No. V5661) is provided in the Rebuild Kit for installation of the piston assembly. Wrap piston assembly with plastic sheet; be sure one edge of the sheet is even with the top of the piston assembly. Then compress piston ring with plastic sheet and slide piston assembly into cavity.

**CAUTION:** Do not damage piston ring or force piston assembly into valve body cavity. Damage to piston assembly will cause valve malfunction.

When piston assembly is installed, remove and discard plastic sheet, Form No. V5661.

- Replace retainer with shouldered side up, bonnet gasket seats on retainer shoulder. Install bonnet gasket, core with core spring and solenoid base sub-assembly. Torque solenoid base sub-assembly to 175 ± 25 in-lbs [19.8 ± 2.8 Nm].
- Install solenoid, see separate instructions. Then make electrical hookup to solenoid.

**WARNING:** To prevent the possibility of personal injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.

- Restore line pressure and electrical power supply to valve.
- After maintenance is completed, operate the valve a few times to be sure of proper operation. A metallic click signifies the solenoid is operating.

### ORDERING INFORMATION FOR ASCO REBUILD KITS

Parts marked with an asterisk (\*) in the exploded view are supplied in Rebuild Kits. When Ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate. If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.

### Torque Chart

Part Name	Torque Value Inch-Pounds	Torque Value Newton-Meters
Solenoid Base Sub-Assembly	175 ± 25	19.8 ± 2.8

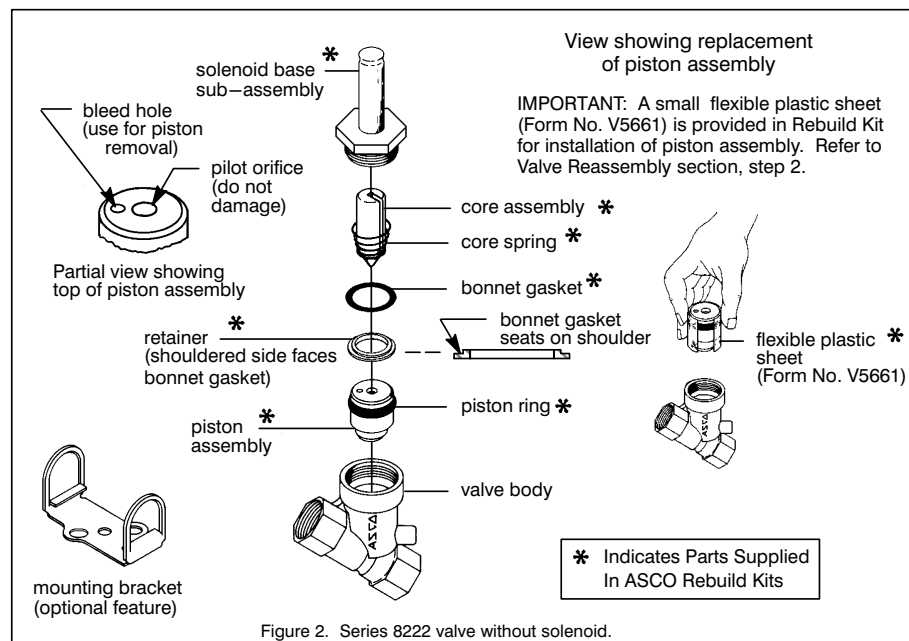


Figure 2. Series 8222 valve without solenoid.

**Torque Chart**

Part Name	Torque Value In-lbs	Torque Value Nm
Solenoid base sub-assembly & adapter	175 ± 25	19,8 ± 2,8

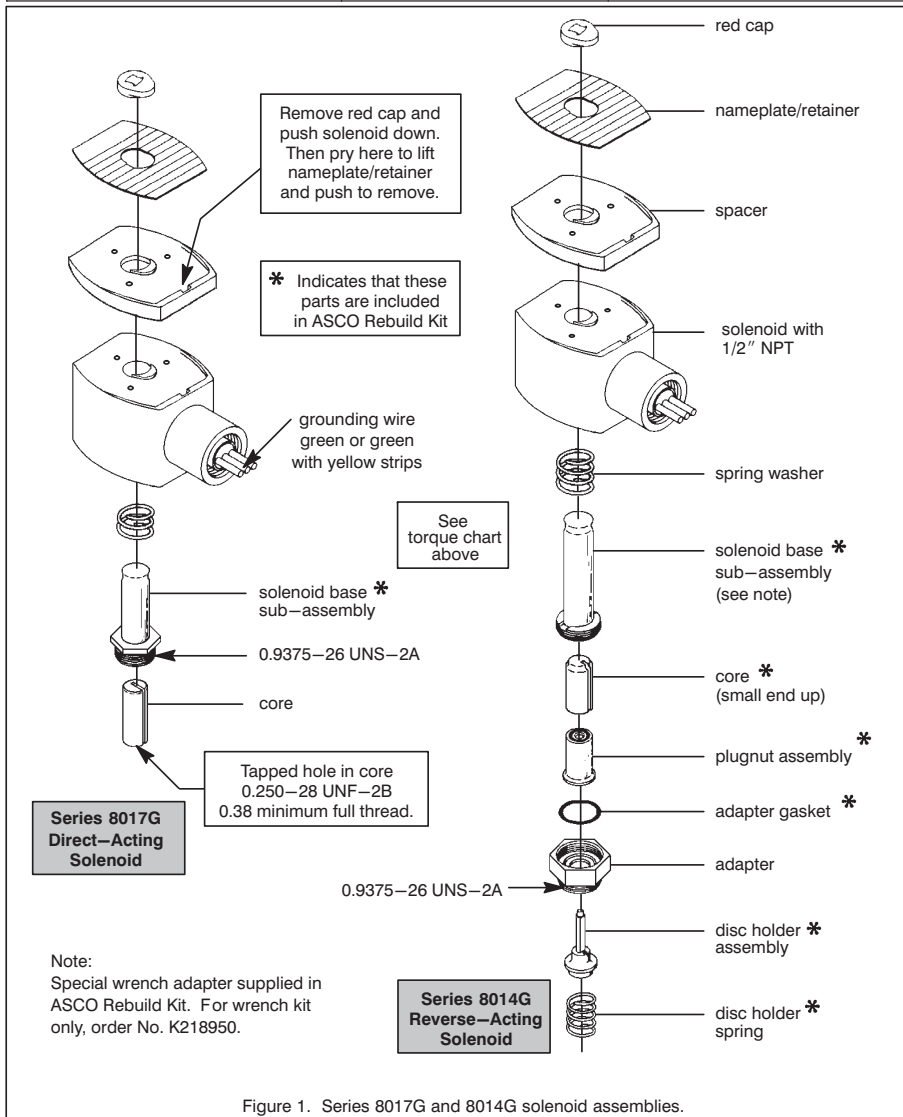


Figure 1. Series 8017G and 8014G solenoid assemblies.

**Torque Chart**

Part Name	Torque Value in Inch-Pounds	Torque Value in Newton-Meters
terminal block screws	10 ± 2	1,1 ± 0,2
socket head screw	15 – 20	1,7 – 2,3
center screw	5 ± 1	0,6 ± 0,1

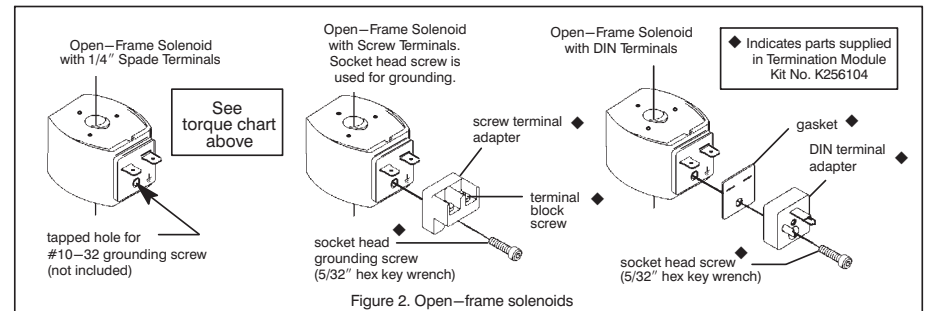


Figure 2. Open-frame solenoids

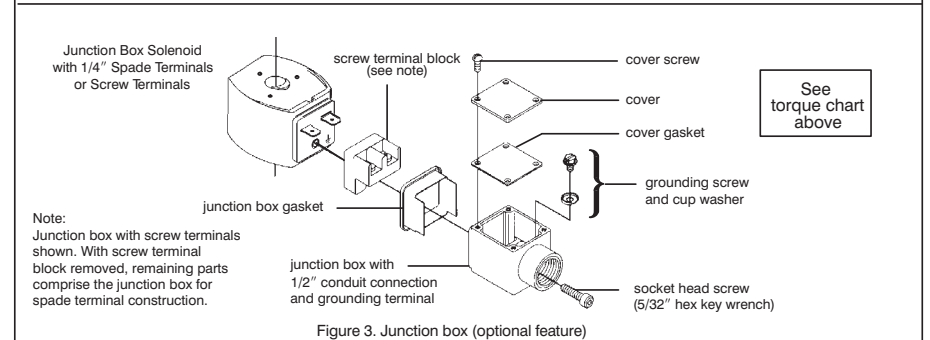


Figure 3. Junction box (optional feature)

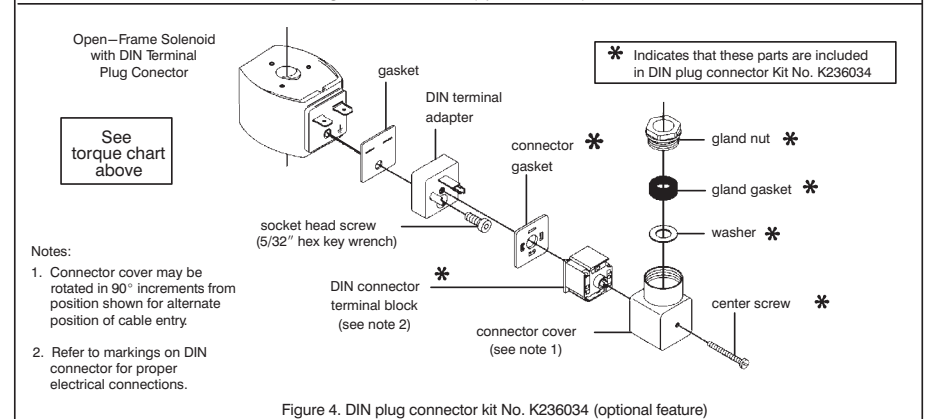


Figure 4. DIN plug connector kit No. K236034 (optional feature)

# Installation & Maintenance Instructions



OPEN—FRAME, GENERAL PURPOSE, WATERTIGHT/EXPLOSIONPROOF SOLENOIDS

## SERIES

8017G  
8014G

I&M No.V7221R3

**NOTICE:** See separate valve installation and maintenance instructions for information on: Operation, Positioning, Mounting, Cleaning, Preventive Maintenance, Causes of Improper Operation, Disassembly and Reassembly of basic valve.

## DESCRIPTION

Series 8017G and 8014G are epoxy encapsulated solenoids. The green solenoid with lead wires and 1/2" conduit connection is designed to meet Enclosure Type 1—General Purpose, Type 2—Dripproof, Types 3 and 3S—Raintight, and Types 4 and 4X—Watertight. The black solenoid on catalog numbers prefixed "EF" is designed to meet Enclosure Types 3 and 3S—Raintight, Types 4 and 4X—Watertight, Types 6 and 6P—Submersible, Type 7 (A, B, C & D) Explosionproof Class I, Division 1 Groups A, B, C, & D and Type 9 (E & F)—Dust—Ignitionproof Class II, Division 1 Groups E & F. See *Temperature Limitations* section for solenoid identification and nameplate/retainer for service. When Series 8017G is installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250—28 UNF—2B tapped hole, 0.38 minimum full thread.

Catalog Nos. 8017G1 and 8017G2 are pull type direct—acting solenoids, while Catalog Nos. 8014G1 and 8014G2 are push type reverse—acting solenoids.

General purpose solenoids (green) are available in open—frame construction. This construction may be supplied with 1/4" spade, screw or DIN terminals (Refer to Figure 2).

## Optional Features For Type 1 — General Purpose Construction Only

- **Junction Box:** This junction box construction meets Enclosure Types 2,3,3S,4, and 4X. Only solenoids with 1/4" spade or screw terminals may have a junction box. The junction box provides a 1/2" conduit connection, grounding and spade or screw terminal connections within the junction box (See Figure 3).
- **DIN Plug Connector Kit No. K236034:** Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 4).

## OPERATION

**Series 8017G** — When the solenoid is energized, the core is drawn into the solenoid base sub—assembly. **IMPORTANT:** When the solenoid is de—energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force is 1 pound, 12 ounces.

**Series 8014G** — When the solenoid is energized, the disc holder assembly seats against the orifice. **IMPORTANT:** Initial return force for the disc or disc holder assembly, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force is 1 pound, 12 ounces. When the solenoid is de—energized, the disc holder assembly returns.

## INSTALLATION

Check nameplate for correct catalog number, service, and wattage. Check front of solenoid for voltage and frequency.

**▲ WARNING: Electrical hazard from the accessibility of live parts. To prevent the possibility of death, serious injury or property damage, install the open—frame solenoid in an enclosure.**

## FOR BLACK ENCLOSURE TYPES 7 AND 9 ONLY

**▲ CAUTION: To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 180° C.**

**NOTE:** These solenoids have an internal non—resettable thermal fuse to limit solenoid temperature in the event that extraordinary conditions occur which could cause excessive temperatures. These conditions include high input voltage, a jammed core, excessive ambient temperature or a shorted solenoid, etc. This unique feature is a standard feature only in solenoids with black explosionproof/dust—ignitionproof enclosures (Types 7 & 9).

**▲ CAUTION: To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.**

## Temperature Limitations

For maximum valve ambient temperatures, refer to chart. The temperature limitations listed, only indicate maximum application temperatures for field wiring rated at 90°C. Check catalog number prefix and watt rating on nameplate to determine maximum ambient temperature. See valve installation and maintenance instructions for maximum field temperature. **NOTE:** For steam service, refer to *Wiring* section, *Junction Box* for temperature rating of supply wires.

Temperature Limitations For Series 8017G or 8014G Solenoids for use on Valves Rated at 16.1 or 20.1 Watts			
Watt Rating	Catalog Number Coil Prefix	Class of Insulation	Maximum † Ambient Temp.
16.1	None, KF, KP SD, SF, & SP,	F	125°F (52°C)
20.1	FB, KF, KP SD, SF, & SP	F	104°F (40°C)
16.1	None, KB, KH, SS, ST & SU	H	140°F (60°C) ----- 125°F (52°C) For Steam Service
20.1	HB, KH, SS, ST, SU & SV	H	140°F (60°C) ----- Not for Steam Service

† Minimum ambient temperature —40° F (—40° C).

## Positioning

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub—assembly area.

## Wiring

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2" conduit connection. To facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

**▲ CAUTION: Cryogenic Applications — Solenoid lead wire insulation should not be subjected to cryogenic temperatures. Adequate lead wire protection and routing must be provided.**

## Additional Wiring Instructions For Optional Features:

- **Open—Frame solenoid with 1/4" spade terminals.**

For solenoids supplied with screw terminal connections use #12—18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to 10 ± 2 in—lbs [1.0 ± 1.2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10—32 machine screw. Torque grounding screw to 15 — 20 in—lbs [1.7 — 2.3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 — 20 in—lbs [1.7 — 2.3 Nm] with a 5/32" hex key wrench.

- **Junction Box**

The junction box is used with spade or screw terminal solenoids only and is provided with a grounding screw and a 1/2" conduit connection. Connect #12—18 AWG standard copper wire only to the screw terminals. Within the junction box use field wire that is rated 90°C or greater for connections. For steam service use 105°C rated wire up to 50 psi or use 125°C rated wire above 50 psi. After electrical hookup, replace cover gasket, cover, and screws. Tighten screws evenly in a crisscross manner.

- **DIN Plug Connector Kit No.K236034**

1. The open—frame solenoid is provided with DIN terminals to accommodate the plug connector kit.
  2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.
  3. Use #12—18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4" for installation in socket terminals. The use of wire—end sleeves is also recommended for these socket terminals. Maximum length of wire—end sleeves to be approximately 1/4". Tinning of the ends of the lead wires is not recommended.
  4. Thread wire through gland nut, gland gasket, washer and connector cover.
- NOTE:** Connector housing may be rotated in 90° increments from position shown for alternate positioning of cable entry.
5. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.
  6. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in—lbs [0.6 ± 1.1 Nm].

## Installation of Solenoid

Solenoids may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid.

## Solenoid Temperature

Standard solenoids are designed for continuous duty service. When the solenoid is energized for a long period, the solenoid becomes hot and can be touched by hand only for an instant. This is a safe operating temperature.

## MAINTENANCE

**▲ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize solenoid operator and/or valve, and vent fluid to a safe area before servicing.**

## Cleaning

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the solenoid is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

## Preventive Maintenance

- Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
- While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any worn or damaged parts.

## Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* signifies that the solenoid is operating. Absence of the *click* indicates loss of power supply. Check for loose or blown fuses, open—circuited or grounded solenoid, broken lead wires or splice connections.
- **Burned—Out Solenoid:** Check for open—circuited solenoid. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate/retainer and marked on the solenoid. Check ambient temperature and check that the core is not jammed.
- **Low Voltage:** Check voltage across the solenoid leads. Voltage must be at least 85% of rated voltage.

## Solenoid Replacement (Refer to Figure 1)

1. Disconnect conduit, coil leads, and grounding wire.

**NOTE:** Any optional parts attached to the old solenoid must be reinstalled on the new solenoid. For removal or assembly of optional parts, see Figure 2, 3 or 4.

2. Snap off red cap from top of solenoid base sub—assembly.
3. Push down on solenoid. Then using a suitable screwdriver, insert blade between solenoid spacer and nameplate/retainer. Pry up slightly and push to remove.
4. Remove solenoid spacer and solenoid from solenoid base sub—assembly.
5. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.

## Disassembly and Reassembly of Solenoids

1. Remove solenoid, see *Solenoid Replacement*.
2. Remove spring washer from solenoid base sub—assembly.
3. Unscrew solenoid base sub—assembly from valve body. For Series 8014G solenoids a special wrench adapter for the solenoid base sub—assembly is supplied in the ASCO Rebuild Kit. For wrench adapter only, order Wrench Kit No. K218950.
4. Remove internal solenoid parts for cleaning or replacement. Use exploded views for identification and placement of parts.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.
7. Torque solenoid base sub—assembly and adapter to 175±25 in—lbs [19,8±2,8 Nm].

## ORDERING INFORMATION FOR ASCO SOLENOIDS

When Ordering Solenoids for ASCO Solenoid Operators or Valves, order the number stamped on the solenoid. Also specify voltage and frequency.



50 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

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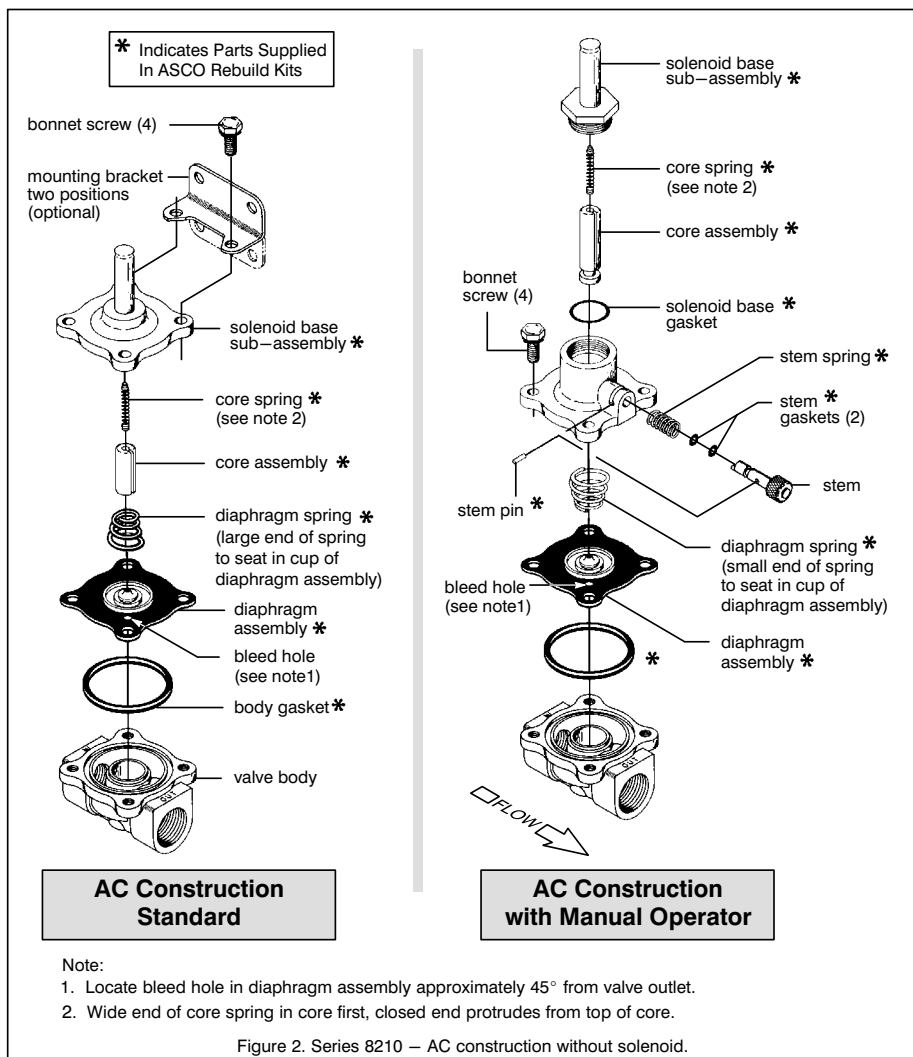


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I&M No.V7221R3

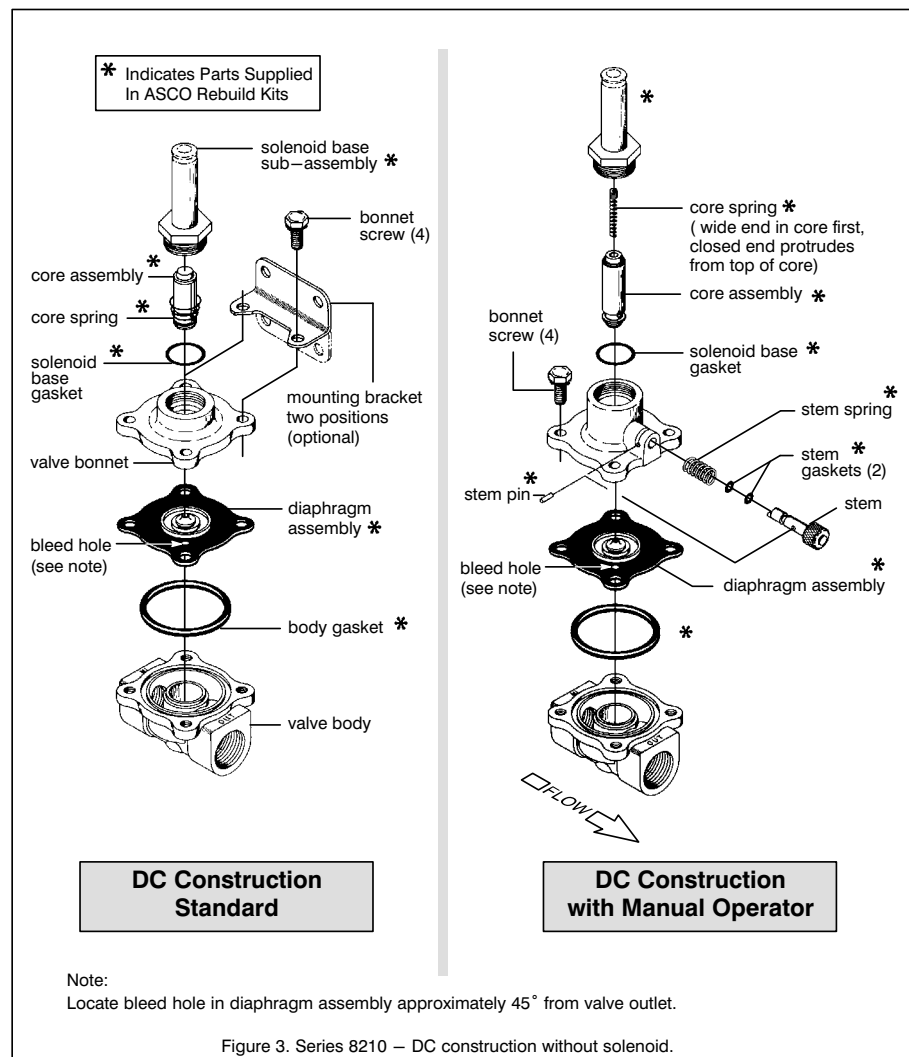
### Torque Chart

Part Name	Torque Value Inch—Pounds	Torque Value Newton—Meters
Solenoid base sub—assembly	175 ± 25	19,8 ± 2,8
Bonnet screws	95 ± 10	10,7 ± 1,1



### Torque Chart

Part Name	Torque Value Inch—Pounds	Torque Value Newton—Meters
Solenoid base sub—assembly	175 ± 25	19,8 ± 2,8
Bonnet screws	95 ± 10	10,7 ± 1,1





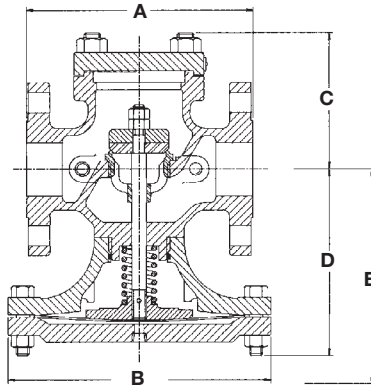


# SPENCE ENGINEERING COMPANY, INC. Technical Data

SD 3001F

A Division of CH2M International, Inc.

150 Goldenham Road, Walden, New York 12586-2035 • Phone (845) 778-5566 • Fax: (845) 778-1072 • www.spenceengineering.com



TYPE E MAIN VALVE

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

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

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

### CAST IRON RATINGS (Maximum Inlet Conditions)

Valve Ends	Pressure	(Temperature)
□ ANSI NPT Screwed.....	250 PSIG.....	(450°F)
□ ANSI 125 Flanged.....	125 PSIG.....	(450°F)
□ ANSI 250 Flanged.....	250 PSIG.....	(450°F)

### CAST STEEL RATINGS (Maximum Inlet Conditions)

Valve Ends	Pressure	(Temperature)
□ ANSI NPT Screwed.....	300 PSIG.....	(600°F)*
□ ANSI 150 Flanged.....	150 PSIG.....	(600°F)
□ ANSI 300 Flanged.....	300 PSIG.....	(600°F)*
□ ANSI 600 Flanged.....	600 PSIG.....	(600°F)*

\*750°F construction available on request.

### DIMENSIONS (inches) AND WEIGHTS (pounds)

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

### RATED FLOW COEFFICIENTS (Cv)

SEAT FACTOR	REGULATOR SIZE											
	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
Full	1.5	2.8	5.4	8.8	14.1	19.8	31	44	74	109	169	248
Full 75 %	—	2.1	4.0	6.6	10.6	14.8	23.3	33	56	82	127	186
Full 50 %	—	1.4	2.7	4.4	7.0	9.9	15.5	22	37	55	85	124
Normal	.65	1.5	4.8	7.5	10.4	14.6	17.6	24	43	78	115	151
Normal 75 %	—	—	—	—	—	—	—	18	33	59	87	114
Normal 50 %	—	—	—	—	—	—	—	12	22	39	58	76

## OPERATING PRINCIPLE

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

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

## RECOMMENDED INSTALLATION

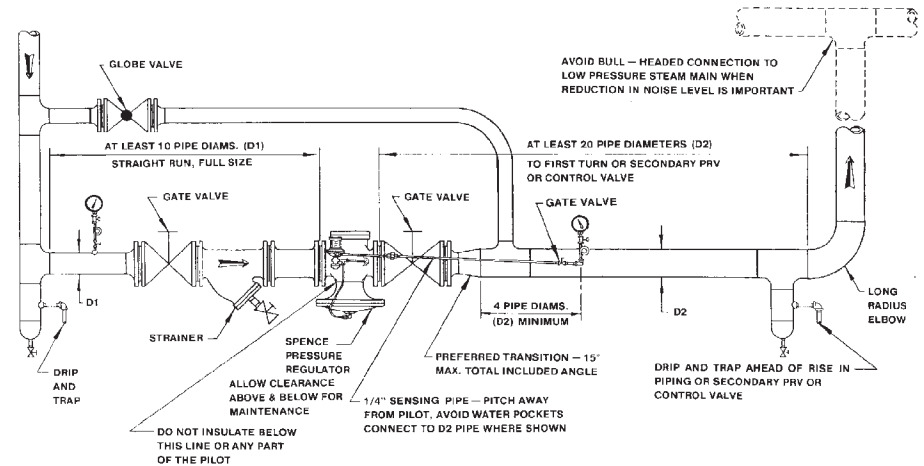


FIGURE 1A - Typical Installation

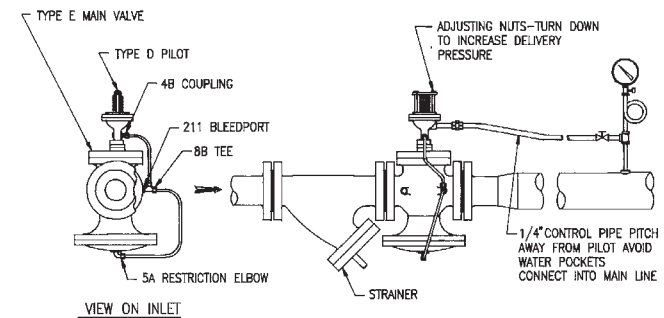


FIGURE 1B - Installation of Integrally Mounted Pilot

## INSTALLATION

### PLANNING

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

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

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

### MAIN VALVE

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

### PILOT

FOR SIDE MOUNT CONSTRUCTION: Mount the pilot on either side of the main valve by means of 1/4" nipple and

union provided. Make this connection on the 1/4" pipe tap at the inlet of the main valve as shown in Figure 2.

FOR INTEGRAL MOUNT CONSTRUCTION: Remove blind flange on pilot and mount on blind flange of main valve using provided bolt.

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

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

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

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

### CONTROL PIPE

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

## START-UP AND SETTING

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

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

### HYDROSTATIC TEST PROCEDURE

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

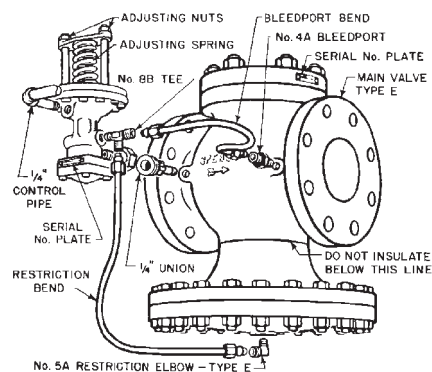


FIGURE 2

## TROUBLE SHOOTING

### FAILURE TO OPEN OR SAGGING DELIVERY PRESSURE

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

### FAILURE TO CLOSE OR OVER-RIDING DELIVERY PRESSURE

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

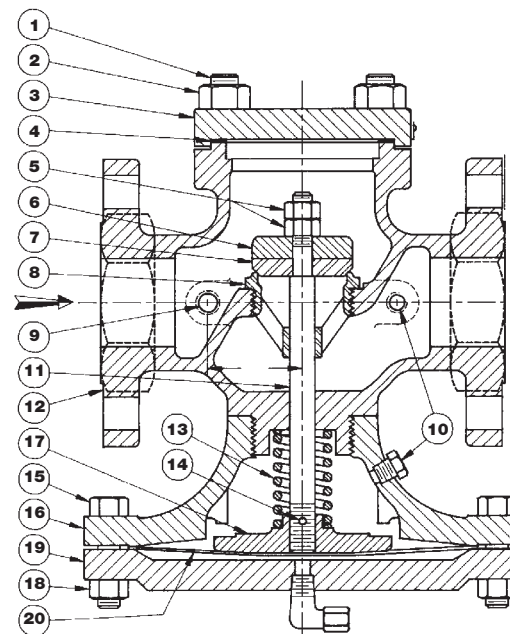
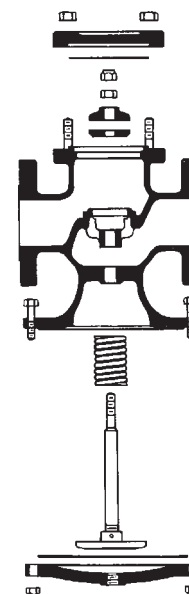


FIGURE 3



## MAINTENANCE

### INSPECTION

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

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

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

### DISMANTLING MAIN VALVE

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

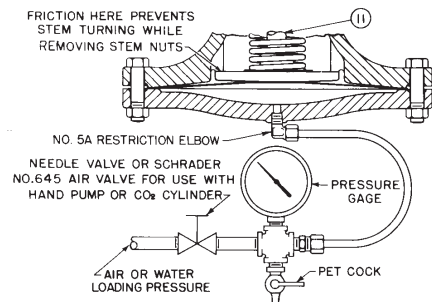


FIGURE 4

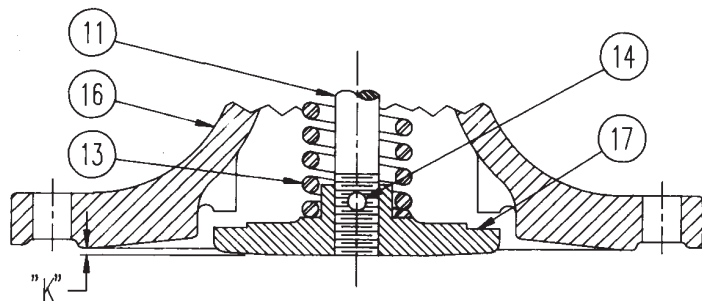


FIGURE 5

### REPLACING SEAT RINGS

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

### GRINDING IN

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

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

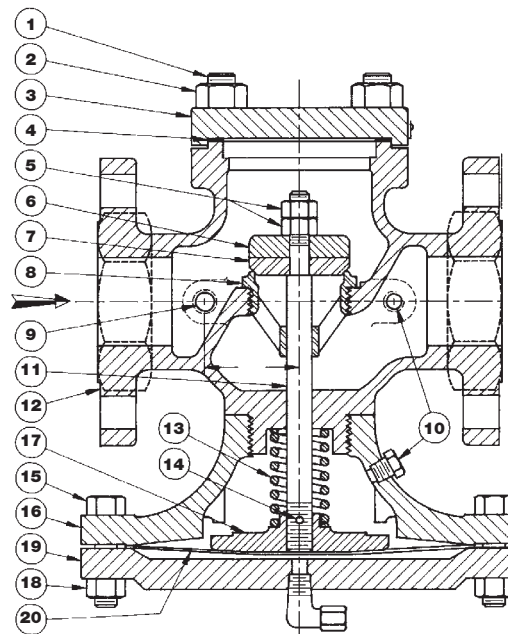
After grinding, disassemble and clean all parts.

### VALVE SETTING

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

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

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



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

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

Specify complete part number when ordering.

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

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE							
			3/8	1/2	3/4	1	1 1/4	1 1/2	2	
1	Stud	Steel	05-05518-00	04-05518-00	04-05518-00	04-10118-00	05-05507-00	04-05443-00	04-10119-00	
2	Nut	Steel	05-02847-00	05-02847-00	05-02847-00	05-02851-00	05-02854-00	05-02856-00	05-02860-00	
3	Blind Flange	Cast Iron	04-02213-01	04-02213-01	04-02171-01	04-02173-00	04-02176-00	04-02178-00	04-02180-00	
4	Gasket	Non-Asbestos	05-02361-01	05-02361-01	05-02381-01	05-02362-01	05-02382-01	05-02365-01	05-02366-01	
5	Stem Nut	Steel	05-02968-00	05-02968-00	05-02969-00	05-02970-00	05-02970-00	05-02971-00	05-02971-00	
6	Muffling Plate	Cast Iron	—	—	—	—	—	—	04-03550-01	
7	Disc	Stainless Steel	04-01790-02	04-01800-02	04-01813-02	04-01832-02	04-01850-02	04-01870-02	04-01888-02	
8	Seat Ring	Stainless Steel	04-04109-01	04-04066-01	04-04075-01	04-04084-01	04-04092-01	04-04496-01	04-11544-00	
9	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	
10	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	
11	Stem	Stainless Steel	04-05306-01	04-05306-01	04-05233-01	04-05237-02	04-05248-01	04-05251-02	04-05262-01	
12	NPT Body	Cast Iron	—	—	—	—	—	—	—	
125	Body	Cast Iron	—	—	—	—	—	—	—	
250	Body	Cast Iron	—	—	—	—	—	—	—	
13	HP Spring	Steel	05-09106-00	05-09106-00	05-09107-00	05-09108-01	05-09110-00	05-09110-00	05-09368-02	
14	LP Spring	Steel	05-05000-01	05-05000-01	05-04987-01	05-04979-01	05-05010-01	05-05010-01	05-04989-01	
15	Dowel Pin	Steel	05-03243-00	05-03243-00	05-03245-00	05-03245-00	05-03248-00	05-03248-00	05-03248-00	
16	Diaphragm Bolt	Steel	05-04771-00	05-04771-00	05-04774-00	05-04774-00	05-04774-00	05-04775-00	05-04780-00	
17	Base	Cast Iron	04-00475-00	04-00475-00	04-00467-00	04-00476-00	04-00468-00	04-00472-00	04-00469-00	
18	Pressure Plate	Cast Iron	04-03695-00	04-03695-00	04-03579-00	04-03580-00	04-03582-00	04-03581-00	04-03584-01	
19	Diaphragm Nut	Steel	05-02872-00	05-02872-00	05-02874-00	05-02874-00	05-02874-00	05-02874-00	05-02877-00	
20	Hood	Cast Iron	04-02569-00	04-02569-00	04-02572-00	04-02573-00	04-02576-00	04-02577-00	04-02580-01	
20	Diaphragm	Stainless Steel	04-01629-01	04-01629-01	04-01662-00	04-01632-00	04-01664-00	04-01635-00	04-01638-00	
Repair Kit - High Pressure			07-07746-00	07-07747-00	07-07748-00	07-07749-00	07-07750-00	07-07751-00	07-07752-00	
Repair Kit - Low Pressure			—	—	20112	08-11978-00	08-11979-00	08-09124-00	08-11981-00	

\*These parts furnished in Repair Kit

### CAST IRON PARTS LIST – 2½" to 8"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE					
			2½"	3	4	5	6	8
1	Stud 125	Steel	04-10119-00	04-05443-00	04-10119-00	04-10120-00	04-10120-00	04-10120-00
	Stud 250	Steel	04-05448-00	04-10119-00	04-05448-00	04-05449-00	04-05449-00	04-05455-00
2	Nut 125	Steel	05-02860-00	05-02856-00	05-02860-00	05-02877-00	05-02860-00	05-02860-00
	Nut 250	Steel	05-02862-00	05-02860-00	05-02862-00	05-02862-00	05-02862-00	05-02862-00
3	Blind Flange 125	Cast Iron	04-02185-00	04-02157-00	04-02158-00	04-02160-00	04-02165-00	04-02167-00
	Blind Flange 250	Cast Iron	04-02183-00	04-02186-00	04-02159-00	04-02161-00	04-02163-00	05-02166-00
4	*Gasket	Non-Asbestos	05-02367-01	05-02369-01	05-02371-01	05-02372-01	05-02374-01	05-02375-01
5	*Stem Nut	Steel	05-02972-00	05-02973-00	05-02974-00	04-02975-00	04-02976-00	04-02977-00
6	Muffling Plate	Cast Iron	04-03515-00	04-03516-00	04-03518-00	04-03519-00	04-03520-00	04-03524-00
7	*Disc	Stainless Steel	04-01906-01	04-01918-00	04-01931-00	04-01938-00	04-01995-00	04-01691-00
8	*Seat Ring	Stainless Steel	04-11539-00	04-11484-00	04-11565-00	04-11700-01	04-15142-00	04-15144-00
9	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
10	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
11	*Stem	Stainless Steel	04-05260-02	04-05279-01	04-05282-02	04-05285-01	04-05288-01	04-05292-01
12	125 Body	Cast Iron	—	—	—	—	—	—
	250 Body	Cast Iron	—	—	—	—	—	—
13	*HP Spring	Steel	05-08257-02	05-09112-02	05-09114-02	05-09115-02	05-09116-01	05-09118-01
	LP Spring	Stainless Steel	05-05021-01	05-05057-01	05-12267-00	05-12268-00	05-12269-00	05-12270-00
14	*Dowel Pin	Steel	05-03252-00	05-03254-00	05-03254-00	05-03258-00	05-03258-00	05-03261-00
15	Diaphragm Bolt	Steel	05-04779-00	05-04780-00	05-04782-00	05-04782-00	05-04786-00	05-04788-00
16	Base	Cast Iron	04-00471-00	04-00470-00	04-00473-01	04-00478-00	04-00479-00	04-00474-00
17	*Pressure Plate	Cast Iron	04-03583-00	04-03585-01	04-03587-00	04-03588-01	04-03589-02	04-03591-00
18	Diaphragm Nut	Steel	05-02877-00	05-02877-00	05-02877-00	05-02877-00	05-02881-00	05-02881-00
19	Hood	Cast Iron	04-02581-00	04-02584-00	04-02588-01	04-02591-00	04-02593-00	04-02595-00
20	*Diaphragm	Stainless Steel	04-01641-00	05-02038-00	05-01647-00	05-01649-00	05-01651-00	05-01653-00
Repair Kit - High Pressure			08-08148-01	08-08567-01	08-08568-01	08-09738-01	08-09720-00	22800
Repair Kit - Low Pressure			—	20113	20114	—	—	—

\*These parts furnished in Repair Kit

### CAST STEEL PARTS LIST – 3/8" to 2"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE					
			3/8	1/2	3/4	1	1½	2
1	Stud NPT, 150, 300	Steel	05-05518-00	05-05518-00	05-05518-00	05-05506-00	05-05507-00	05-05509-00
	Stud 600	Steel	—	—	—	05-05507-00	05-05484-00	05-05501-00
2	Nut NPT, 150, 300	Steel	05-02848-00	05-02848-00	05-02848-00	05-02852-00	05-02855-00	05-02857-00
	Nut 600	Steel	—	—	05-02855-00	05-02855-01	05-02859-00	05-02863-00
3	Blind Flange NPT, 150, 300	Steel	04-02188-00	04-02188-00	04-02190-00	04-02192-00	04-02194-00	04-02196-00
	Blind Flange 600	Steel	—	—	04-02191-00	04-02193-00	05-02195-00	04-02196-00
4	*Gasket	Non-Asbestos	05-02361-01	05-02361-01	05-02381-01	05-02362-01	05-02382-01	05-02365-01
5	*Stem Nut	Steel	05-02968-00	05-02968-00	05-02969-00	05-02970-00	05-02971-00	05-02971-00
6	Muffler Plate	Cast Iron	—	—	—	—	—	04-03550-01
7	*Disc	Stainless Steel	04-01790-02	04-01800-02	04-01813-02	04-01832-00	04-01850-02	04-01870-02
8	*Seat Ring	Stainless Steel	04-04109-01	04-04066-01	04-04075-01	04-04084-01	04-04092-01	04-04496-01
9	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
10	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
11	*Stem	Stainless Steel	04-05306-01	04-05306-01	04-05233-01	04-05237-02	04-05248-01	04-05251-02
12	Body/Base NPT	Steel	—	—	—	—	—	—
	Body/Base 150	Steel	—	—	—	—	—	—
	Body/Base 300	Steel	—	—	—	—	—	—
	Body/Base 600	Steel	—	—	—	—	—	—
13	*Spring	Steel	05-09106-00	05-09106-00	05-09107-00	05-09108-01	05-09110-00	05-09368-02
14	*Dowel Pin	Stainless Steel	05-03244-00	05-03244-00	05-03245-00	05-03245-00	05-03248-00	05-03248-00
15	Diaphragm Stud	Steel	05-05480-00	05-05480-00	05-05481-00	05-05481-00	05-05481-00	05-05486-00
16	Base	Steel	(w/Body)	(w/Body)	(w/Body)	(w/Body)	(w/Body)	(w/Body)
17	*Pressure Plate	Cast Iron	04-03695-00	04-03695-00	04-03579-00	04-03580-00	04-03582-00	04-03581-00
18	Diaphragm Nut	Steel	05-02848-00	05-02848-00	05-02852-00	05-02852-00	05-02852-00	05-02857-00
19	Hood	Steel	04-02570-00	04-02570-00	04-02574-00	04-02575-00	04-02578-00	04-02579-00
20	*Diaphragm	Stainless Steel	04-01629-01	04-01629-01	04-01662-00	04-01632-00	04-01664-00	04-01635-00
Repair Kit			24140	24141	24142	24144	24146	24148

\*These parts furnished in Repair Kit

### CAST STEEL PARTS LIST – 2½" to 8"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE					
			2½"	3	4	5	6	8
1	Stud NPT, 150, 300	Steel	05-05510-00	05-05509-00	05-05509-00	05-05511-00	05-05519-00	05-05519-00
	Stud 600	Steel	05-05478-00	05-05478-00	05-05485-00	05-05475-00	05-05475-00	05-05476-00
2	Nut NPT, 150, 300	Steel	05-02861-00	05-02857-00	05-02857-00	05-02861-00	05-02861-00	05-02861-00
	Nut 600	Steel	05-02861-00	05-02861-00	05-02863-00	05-02865-00	05-02865-00	05-02865-00
3	Blind Flange NPT, 150, 300	Steel	04-02184-00	04-02201-00	04-02204-00	04-02207-00	04-02209-00	04-02211-00
	Blind Flange 600	Steel	04-02200-00	04-02202-00	04-02205-00	04-02208-00	04-02210-00	04-02212-00
4	*Gasket	Non-Asbestos	05-02367-01	05-02369-01	05-02371-00	05-02372-01	05-02374-01	05-02375-01
		Non-Asbestos	NPT, 150#, 300#	NPT, 150#, 300#	300#	150#, 300#	150#, 300#	150#, 300#
5	*Stem Nut	Steel	05-02367-01	05-02369-01	05-02369-00	05-02379-01	04-04628-01	04-04630-01
			600#	600#	600#	600#	600#	600#
6	Muffler Plate	Cast Iron	05-02972-00	05-02973-00	05-02974-00	05-02975-00	05-02976-00	05-02977-00
7	*Disc	Stainless Steel	04-03515-00	04-03516-00	04-03518-00	04-03519-00	04-03520-00	04-03524-00
8	*Seat Ring	Stainless Steel	04-01906-01	04-01918-00	04-01931-00	04-01938-00	04-01995-00	04-01691-00
9	Pipe Plug 1/4"	Steel	04-11539-00	04-11484-00	04-11565-00	04-11700-01	04-15142-00	04-15144-00
10	Pipe Plug 1/8"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
11	*Stem	Stainless Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
12	Body 150	Steel	04-05260-02	04-05279-01	04-05282-02	04-05285-01	04-05288-01	04-05292-01
	Body 300	Steel	—	—	—	—	—	—
	Body 600	Steel	—	—	—	—	—	—
			—	—	—	—	—	—
13	*Spring	Steel	05-08257-02	05-09112-02	05-09114-02	05-09115-02	05-09116-01	05-09118-01
14	*Dowel Pin	Stainless Steel	05-03252-00	05-03254-00	05-03254-00	05-03258-00	05-03258-00	05-03261-00
15	Diaphragm Stud	Steel	05-05486-00	05-05486-00	05-05487-00	05-05487-00	05-05483-00	05-05483-00
16	Base	Steel	04-00488-00	04-00487-00	04-00487-00	04-00490-00	04-00495-00	04-00491-00
17	*Pressure Plate	Cast Iron	04-03583-00	04-03585-01	04-03587-00	04-03588-01	04-03589-02	04-03591-00
18	Diaphragm Nut	Steel	05-02857-00	05-02857-00	05-02857-00	05-02857-00	05-02861-00	05-02861-00
19	Hood	Steel	04-02646-00	04-02586-00	04-02589-00	04-02592-00	04-02594-00	04-02596-00
20	*Diaphragm	Stainless Steel	04-01641-00	05-02038-00	05-01647-00	05-01649-00	05-01651-00	05-01653-00
Repair Kit			24152	24158	24155	—	24157	—

\*These parts furnished in Repair Kit

### DIAPHRAGM TABLE

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

### SEAT RING TOOLS PART NUMBERS

SIZE	Description: Port	Part # of Complete Wrench
2" E	New: Full and Normal	08-05691-00
2½" E	New: Full and Normal	08-10111-00
3" E	New: Full and Normal	08-09715-00
4" E	New: Full and Normal	08-10113-00
5" E	New: Full and Normal	08-10304-00
5" E	Old: Full	08-00575-00
5" E	Old: Normal	08-00587-00
6" E	New/Old: Full	08-03948-00
6" E	New/Old: Normal	08-00567-00
8" E	New/Old: Full	08-00518-00
8" E	New/Old: Normal	08-03949-00

Old = Used on any valve made prior to 1984

**WARNING:** This product operates in pipelines or with equipment that carries fluids and/or gasses at elevated temperatures and pressures. Caution should be taken to make sure that the equipment is installed correctly and inspected regularly. Caution should also be taken to protect personnel from fluid or gas leakage."

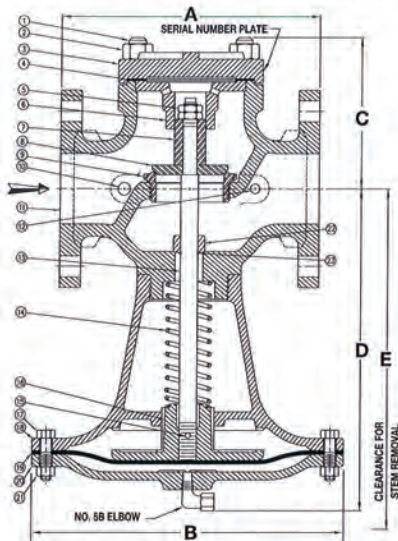




# SPENCE ENGINEERING COMPANY, INC. Technical Data

SD 3002B

A subsidiary of CH2M HILL, Inc.  
150 Goldenham Road, Walden, New York 12586-2035 • Phone (845) 778-5566 • Fax: (845) 778-1072 • www.spenceengineering.com



TYPE E2 MAIN VALVE

## TYPE E2 Main Valve Sizes 3/4" through 10"

The Spence Type E2 Main Valve is of normally closed, single seat design featuring packless construction, HyCar diaphragm and protected main spring.

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

### CAST IRON RATINGS (Maximum Inlet Conditions)

Valve Ends Pressure (Temperature)

□ ANSI NPT Screwed .....15 PSIG .....(250°F)

□ ANSI 125 Flanged .....15 PSIG .....(250°F)

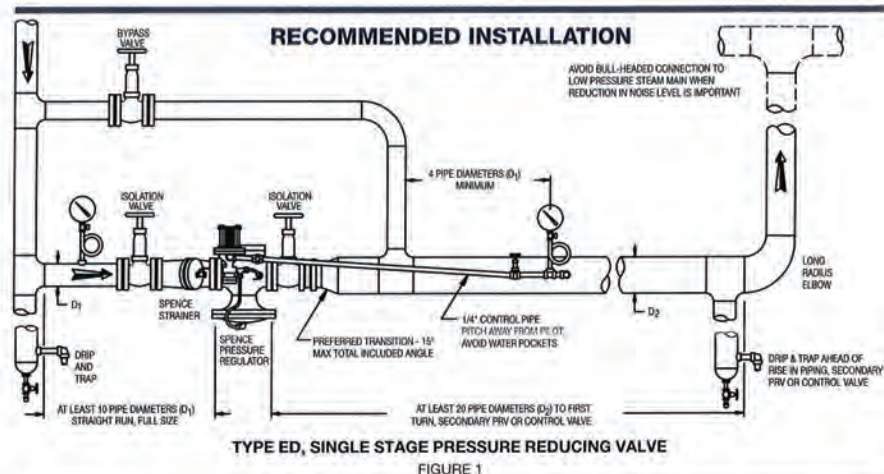
### DIMENSIONS (inches), WEIGHTS (pounds) AND RATED FLOW COEFFICIENTS (Cv)

SIZE	A		OTHER DIMENSIONS				APPROX. WT.		Cv
	CI ANSI NPT	CI ANSI 125	B	C	D	E	CI ANSI NPT	CI ANSI 125	
3/4	4 1/4	—	8	2 1/4	7 1/4	11 1/2	18	—	7.6
1	5 1/4	5 1/2	8	3 3/4	8 1/4	12 1/2	19	21	11.7
1 1/4	6 1/2	6 1/4	9	4 1/4	8 1/4	12 1/2	30	33	18.9
1 1/2	7 1/4	6 7/8	9 1/4	4 3/4	8 1/4	13 1/4	36	40	27.4
2	7 1/2	8 1/2	10 1/2	5 1/4	10	15 1/4	50	57	44
2 1/2	—	9 1/4	10 1/2	5 1/4	11 1/2	17 1/4	—	70	68
3	—	10	11 1/4	6 1/4	12 1/4	19 1/4	—	98	96
4	—	11 1/4	13 1/2	6 1/4	13 3/4	21 1/4	—	135	143
5	—	13 1/4	14 1/4	7 1/2	15	23	—	185	202
6	—	15 1/4	16	7 1/4	16 1/4	26	—	250	255
8	—	19	20	9 1/2	19 1/4	30 1/2	—	415	465
10	—	23 3/4	24	10 1/4	23 1/2	38 1/2	—	690	748

## OPERATING PRINCIPLE

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

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



TYPE ED, SINGLE STAGE PRESSURE REDUCING VALVE

FIGURE 1

## INSTALLATION

### PLANNING

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

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

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

### MAIN VALVE

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

### PILOT

#### For side mount construction:

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

#### For integral mount construction:

Remove blind flange on pilot and mount on blind flange of main valve using provided bolt.

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

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

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

Connect tubing bends as illustrated in Fig. 2.

### CONTROL PIPE (Not required with T14 & T52)

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

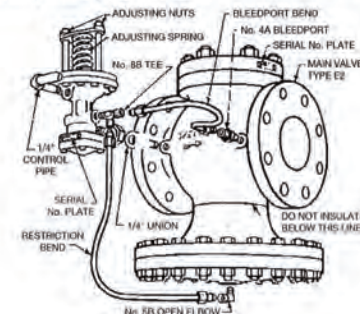


FIGURE 2



## MAINTENANCE

### INSPECTION

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

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

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

### DISMANTLING MAIN VALVE

Connect a source of air or water pressure which can be adjusted by hand to the No. 5B elbow. Apply pressure to jack valve open and prevent stem from turning while removing stem nuts. Usually 30 psi will suffice. Use penetrating oil on the threads.

### REPLACING SEAT RINGS

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

### GRINDING IN

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

Main stem (13) is slotted for rotation with a screwdriver. Valve spring (14) is omitted from the assembly during grinding. Slip the stem into its normal position. Apply compound to the disc, place it on the stem and guide plug, tighten with stem nut.

After grinding, disassemble and clean all parts.

### VALVE SETTING

VALVE SIZE	TYPE E2	
	HOOD (K)	TOTAL
3/4	1/8	1/4
1	3/16	5/16
1 1/2	7/32	3/8
2	1/4	7/16
2 1/2	9/32	11/16
3	13/32	13/16
4	15/32	15/16
5	17/32	1 1/8
6	19/32	1 1/4
8	25/32	1 5/8
10	31/32	1 7/8

Valve setting is gaged at K to establish correct stem length and diaphragm position. Dimension K is supplied with each replacement stem.

To install new stem (13), fasten disc (8) and guide plug firmly on stem with stem nut. Insert stem and disc assembly in valve and screw on pressure plate (16). Omit spring (14) for this operation. Hold disc on seat and adjust position of pressure plate until valve setting K is reached. Push pressure plate against stops in base (18). Remove disc, drop out pressure plate and stem, drill and insert dowel pin (15) to lock the joint. Grind off stem projection flush with face of pressure plate.

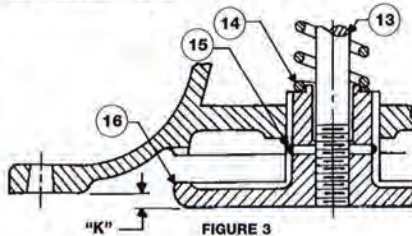


FIGURE 3

## START-UP AND SETTING

On pressure reducing valves like the E2D, use by-pass to fill the delivery system and raise pressure to slightly below normal required. Close pilot by releasing compression on adjusting spring. See Figure 2. Open 1/4" control pipe valve. Crack outlet stop valve. Crack inlet stop valve. Blow down strainer. **Caution:** Never open a reducing valve without positive indication that the high side is clear of condensate.

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

## TROUBLE SHOOTING

### FAILURE TO OPEN OR SAGGING DELIVERY PRESSURE

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

### FAILURE TO CLOSE OR OVER-RIDING DELIVERY PRESSURE

1. Adjusting spring on pilot may have been tampered with.
2. Orifice in bleedport No. 4A may be plugged.

3. By-pass valve may be leaking.

4. On pressure regulators like the E2D, the main valve or pilot may be held open by foreign matter in seat. To determine which valve leaks, first close inlet stop valve and 1/4" control pipe valve. Then remove bleedport bend so pilot will exhaust to atmosphere. Crack inlet stop valve. Steam will issue from No. 8B tee. Release compression on adjusting spring to see if pilot closes tight. Open and close several times to wash seat. Steam blowing back from bleedport means main valve disc is held open by foreign matter. Steam may wash the obstruction from the seat if the valve is made to open wide. This can be accomplished, even at light loads, if the control point is beyond the outlet stop valve. Reassemble bleedport bend and place regulator in operation. Then, slowly open and close outlet stop valve.

## CAST IRON PARTS LIST - 3/4" to 3"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE					
			3/4	1	1 1/4	1 1/2	2	2 1/2
1	Blind Flange Stud	Steel	05-0518-00	04-10118-00	05-05507-00	04-05443-00	04-10119-00	04-10119-00
2	Blind Flange Nut	Steel	05-02847-00	05-02851-00	05-02854-00	05-02856-00	05-02860-00	05-02856-00
3	Blind Flange	Cast Iron	04-02171-00	04-02173-00	04-02176-00	04-02178-00	04-02180-00	04-02185-00
4	*Gasket	Non-Asbestos	05-02381-01	05-02382-01	05-02382-01	05-02386-01	05-02386-01	05-02387-01
5	*Stem Nut	Steel	05-02969-00	05-02970-00	05-02970-00	05-02971-00	05-02971-00	05-02972-00
6	Disc Guide Plate	Cast Iron	04-03576-00	04-03479-00	04-03480-00	04-03478-00	04-03500-00	04-03509-00
7	Guide Plug	Stainless Steel	—	—	—	04-03751-01	04-03750-00	04-03754-00
8	*Integral Disc	Stainless Steel	04-01813-02	04-01832-02	04-01850-02	04-01870-02	04-01888-02	04-01906-01
9	*Seat Ring	Stainless Steel	04-04075-01	04-04084-01	04-04092-01	04-04496-01	04-11593-00	04-11593-00
10	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00	04-03772-00
11	NPT Body	Cast Iron	—	—	—	—	—	—
12	125 Body	Cast Iron	—	—	—	—	—	—
12	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00	04-03769-00
13	*Stem	Stainless Steel	04-05241-02	04-05254-02	04-05254-02	04-05325-01	04-05247-02	04-05324-02
14	*Main Spring	Steel	05-05093-02	05-05093-02	05-05094-01	05-05096-01	05-05097-01	05-05098-01
15	*Groove Pin	Steel	05-03247-00	05-03247-00	05-03247-00	05-03251-00	05-03251-00	05-03253-00
16	*Pressure Plate	Cast Iron	04-03700-00	04-03700-00	04-03622-00	04-03623-01	04-03624-00	04-03625-00
17	Diaphragm Bolt	Steel	05-04770-00	05-04770-00	05-04773-00	05-04773-00	05-04773-00	05-04774-00
18	Base	Cast Iron	—	—	—	—	—	—
19	*Diaphragm	Hycar	05-01668-00	05-01668-00	05-01669-00	05-01670-00	05-01671-00	05-01672-00
20	Hood	Cast Iron	04-02571-00	04-02571-00	04-02605-00	04-02606-00	04-02607-00	04-02608-00
21	Diaphragm Nut	Steel	05-02872-00	05-02872-00	05-02874-00	05-02874-00	05-02874-00	05-02874-00
22	Stem Washer	Stainless Steel	04-06130-00	04-06131-00	04-10048-00	04-06132-00	04-12291-00	04-06248-00
23	Retaining Ring	Stainless Steel	05-09382-00	05-09383-00	05-09383-00	05-09384-00	05-09382-00	05-09385-00
24	Top Flange	Cast Iron	04-02248-00	04-02248-00	04-02250-00	04-02252-00	04-02253-00	04-02259-00
	Repair Kit		08-07940-00	08-07941-00	08-07942-00	08-07943-00	08-07944-01	08-07945-01

\*These parts furnished in Repair Kit

## CAST IRON PARTS LIST - 4" to 10"

ITEM NO.	PART NAME	MATERIAL	VALVE SIZE			
			4	5	6	10
1	Blind Flange Stud	Steel	04-05443-00	04-10119-00	04-10120-00	04-10120-00
2	Blind Flange Nut	Steel	05-02856-00	05-02860-00	05-02860-00	05-02860-00
3	Blind Flange	Cast Iron	04-02157-00	04-02158-00	04-02162-00	04-02167-00
4	*Gasket	Non-Asbestos	05-02369-01	05-02371-01	05-02397-01	05-02375-01
5	*Stem Nut	Steel	05-02973-00	05-02947-00	04-02975-00	04-02976-00
6	Disc Guide Plate	Cast Iron	04-03496-00	04-03504-00	04-03473-00	04-03474-00
7	Guide Plug	Stainless Steel	04-03756-00	04-03757-00	04-03742-00	04-03743-00
8	*Integral Disc	Stainless Steel	04-01922-00	04-01931-00	04-01940-00	04-01951-00
9	*Seat Ring	Stainless Steel	04-11758-00	04-11666-00	04-15802-00	07-43794-00
10	Pipe Plug 1/4"	Steel	04-03772-00	04-03772-00	04-03772-00	04-03772-00
11	125 Body	Cast Iron	—	—	—	—
12	Pipe Plug 1/8"	Steel	04-03769-00	04-03769-00	04-03769-00	04-03769-00
13	*Stem	Stainless Steel	04-05266-02	04-05268-02	04-05269-02	04-05272-01
14	*Main Spring	Steel	05-05099-01	05-05100-01	05-05101-01	05-05103-01
15	*Groove Pin	Steel	05-03256-00	05-03257-00	05-03259-00	05-03260-00
16	*Pressure Plate	Cast Iron	04-03627-00	04-03628-00	04-03629-00	04-03631-00
17	Diaphragm Bolt	Steel	05-04774-00	05-04775-00	05-04780-00	05-04782-00
18	Base	Cast Iron	—	—	—	—
19	*Diaphragm	Hycar	05-01674-00	05-01675-00	05-01676-00	05-01677-00
20	Hood	Cast Iron	04-02609-00	04-02610-00	04-02611-00	04-02612-00
21	Diaphragm Nut	Steel	05-02874-00	05-02874-00	05-02877-00	05-02877-00
22	Stem Washer	Stainless Steel	04-06249-00	04-06270-00	04-06250-00	04-06251-00
23	Retaining Ring	Stainless Steel	05-09386-00	05-09387-00	05-09388-00	05-09389-00
24	Top Flange	Cast Iron	04-02261-00	04-02263-00	04-02268-00	04-02266-00
	Repair Kit		08-09587-01	08-10990-00	08-10995-00	—

\*These parts furnished in Repair Kit

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

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

Specify complete part number when ordering.

**WARNING:** This product operates in pipelines or with equipment that carries fluids and/or gases at elevated temperatures and pressures. Caution should be taken to make sure that the equipment is installed correctly and inspected regularly. Caution should also be taken to protect personnel from fluid or gas leakage.\*

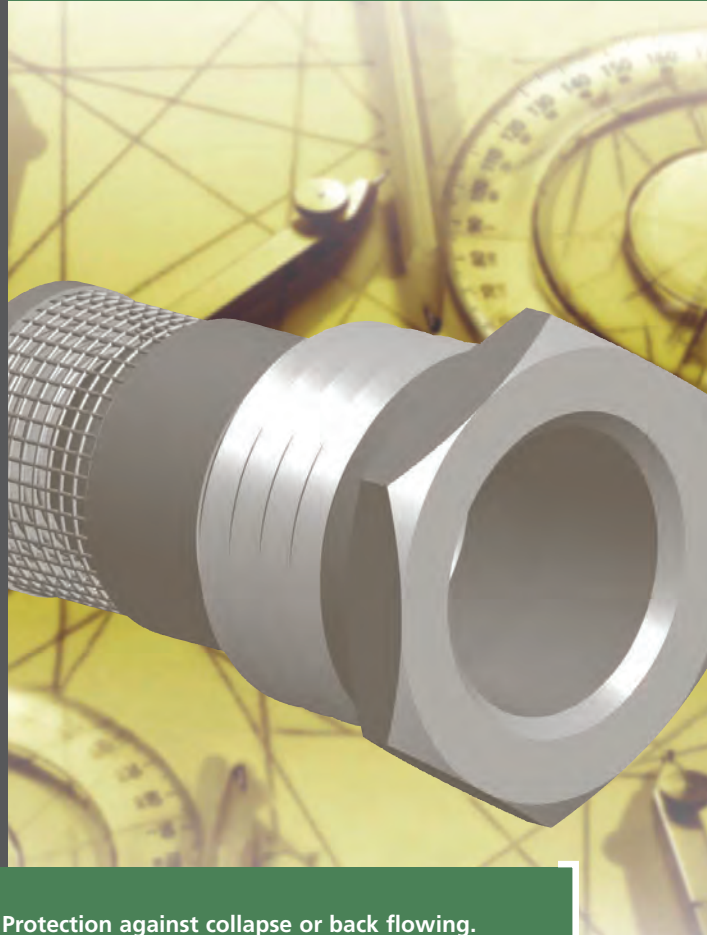


# Vacuum Breakers

## Anti-siphoning check valves

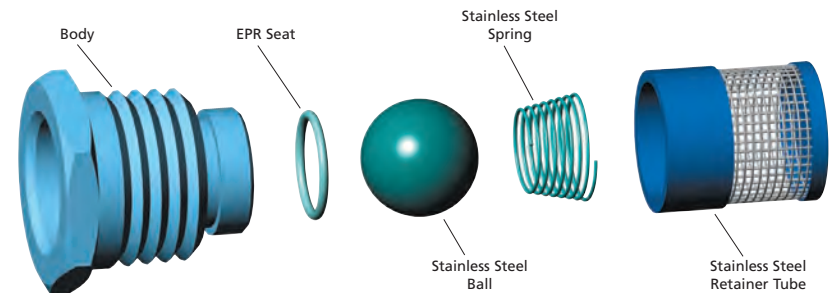
**KADANT**  
JOHNSON

Vacuum check  
valves and  
backflow devices.



Protection against collapse or back flowing.

## Series VB8



### Fast acting, tight closing, high capacity

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

### Positive closing, low breakaway

The successful combination of the spring action on a round ball and the soft resilient seat assures positive bubble-tight closing, even at very low differential pressures. And, of course, the higher the pressure the tighter the seal.

Since only slight spring pressure is needed for seating, the ball comes off the soft seat at a very low vacuum condition, providing almost instantaneous protection. Sealing is accomplished by an EPR o-ring. The supporting seat, however, is designed to assume any pressure in excess of the small amount needed for sealing, thus preventing any excessive compression of the o-ring.

### Quiet, trouble-free operation

The soft resilient seat, combined with the gentle spring action, provides quiet opening and closing; chatter is completely eliminated. Corrosion-resistant seating surfaces leave little danger of any sticking or leaking. The simple design assures long and dependable service life, as proven both in the laboratory and in the field.

### Easily installed, easily maintained

Kadant Johnson Vacuum Breakers have hex heads and standard NPT pipe threads, and are simply threaded into pipe fittings or available tank openings. Outlets can be threaded if desired.

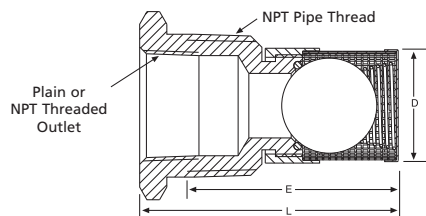
### Rigorously tested

In exhaustive endurance tests Kadant Johnson Vacuum Breakers have been subjected to 120 psig of steam and then vacuum, four times a minute, and still opened freely and closed bubble-tight after a million such test cycles. Every individual vacuum breaker is bubble-tested before it leaves the factory.

### High pressure and temperature

Kadant Johnson Vacuum Breakers are rated for use with pressures up to 300 psig and temperatures up to 365°F. Higher operating pressures are possible, depending upon size, seal materials, and temperatures.





Size	Quick Ship No. (Brass)	Quick Ship No. (Stainless Steel)	Outlet	Outlet Size	Total Length "L"	Engaged Length "E"	O.D. of Tube "D"	Diameter of Orifice
3/8"	—	24A75500	Plain	1/4"	1-1/2"	1-1/8"	9/16"	1/4"
3/8"	24A75200	24A75600	Threaded	1/4"	1-1/2"	1-1/8"	9/16"	1/4"
1/2"	24A75900	24A76300	Plain	3/8"	1-3/4"	1-3/8"	11/16"	9/32"
1/2"	24A76000	24A76400	Threaded	3/8"	1-3/4"	1-3/8"	11/16"	9/32"
3/4"	24A76700	24A77100	Plain	1/2"	2-1/8"	1-5/8"	13/16"	13/32"
3/4"	24A76800	24A77200	Threaded	1/2"	2-1/8"	1-5/8"	13/16"	13/32"
1"	24A77500	24A77900	Plain	3/4"	2-3/8"	1-7/8"	1-1/16"	19/32"
1"	24A77600	24A78000	Threaded	3/4"	2-3/8"	1-7/8"	1-1/16"	19/32"
1-1/4"	24A78300	24A78500	Plain	1"	2-15/16"	2-5/16"	1-5/16"	3/4"
1-1/4"	24A78400	24A78600	Threaded	1"	2-15/16"	2-5/16"	1-5/16"	3/4"
1-1/2"	24A78700	24A78900	Plain	1-1/4"	3-1/16"	2-1/2"	1-9/16"	7/8"
1-1/2"	24A78800	24A79000	Threaded	1-1/4"	3-1/16"	2-1/2"	1-9/16"	7/8"

### Simple Installation

The drawings at the right show how the vacuum breaker can be installed in a threaded opening in either a vertical or horizontal position. When installed in a pipeline fitting, use of a reducing bushing is required to make sure the vacuum breaker does not intrude far enough to impede flow in the line or bind against any internal wall.

Figure 1  
Horizontal installation in either end or side outlet of tee, showing use of reducing bushing.

Figure 2  
Vertical installation in top outlet of tee, showing use of reducing bushing.

Figure 3  
Vertical installation in bottom outlet of tee, showing use of reducing bushing.

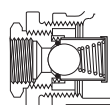


Figure 1

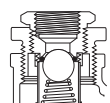


Figure 2

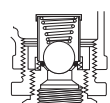


Figure 3

### Vacuum Required to Open

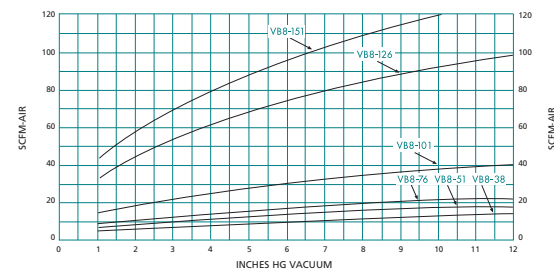
			Horizontal				Vertical		
			Top Outlet		Bottom Outlet		No Spring		
VB8-38 3/8"	In. H <sub>2</sub> O	7.00	4.30	10.5	3.50				
	In. Hg	0.51	0.32	0.77	0.26				
	PSI	0.25	0.16	0.38	0.13				
VB8-51 1/2"	In. H <sub>2</sub> O	9.30	10.6	18.0	4.40				
	In. Hg	0.68	0.78	1.32	0.32				
	PSI	0.34	0.38	0.65	0.16				
VB8-76 3/4"	In. H <sub>2</sub> O	15.3	15.0	25.0	5.10				
	In. Hg	1.13	1.10	1.84	0.37				
	PSI	0.55	0.54	0.90	0.18				
VB8-101 1"	In. H <sub>2</sub> O	10.0	5.90	19.5	6.60				
	In. Hg	0.73	0.43	1.43	0.48				
	PSI	0.36	0.21	0.70	0.24				
VB8-126 1-1/4"	In. H <sub>2</sub> O	10.5	7.10	21.0	6.90				
	In. Hg	0.77	0.52	1.54	0.51				
	PSI	0.38	0.26	0.76	0.25				
VB8-151 1-1/2"	In. H <sub>2</sub> O	10.0	4.90	20.3	7.90				
	In. Hg	0.73	0.36	1.49	0.58				
	PSI	0.36	0.18	0.73	0.29				

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

## Kadant Johnson Vacuum Breakers

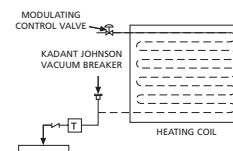
### Approximate Air Handling Capacities

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

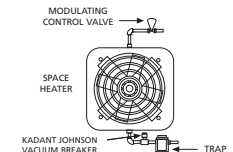


NOTE: Capacities will vary slightly due to position of installation.

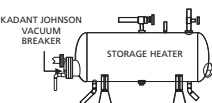
### Typical Installations of Kadant Johnson Vacuum Breakers



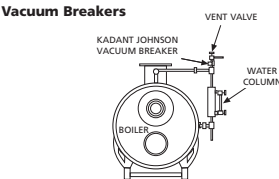
Kadant Johnson Vacuum Breaker installed on heating coil. When the modulating control valve closes, the steam in the coil will condense. A vacuum may exist in the coil even with the control valve partly open and positive pressure between the control valve and the coil.



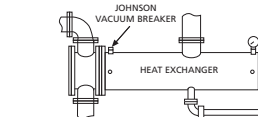
Typical space heater installation with Kadant Johnson Vacuum Breaker protection.



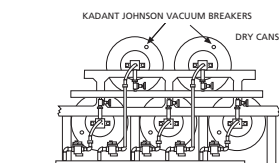
Horizontal storage heater with heating coils protected by a Kadant Johnson Vacuum Breaker.



Typical application of a Kadant Johnson Vacuum Breaker as used on a steam boiler to break a vacuum imposed when a boiler is shut down, thereby condensing the steam in the boiler and creating a vacuum. This condition causes the boiler to be flooded by pulling in excess water from the return system.



Typical installation of a Kadant Johnson Vacuum Breaker in a heat exchanger.



Textile dry cans, multiple slasher cylinders, print cans, etc., can be protected against collapse with Kadant Johnson Vacuum Breakers.

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AN ACCENT ON INNOVATION

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### Contact us:

KADANT JOHNSON  
805 Wood Street  
Three Rivers, MI 49093 USA

Tel: +1-269-278-1715  
Fax: +1-269-279-5980  
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## SERIES WFT

### FLOAT & THERMOSTATIC STEAM TRAP

#### INSTALLATION INSTRUCTIONS

INSTRUCTION PART NO. 2251800 REVISION D

### INSTALLATION

- Before installing the trap, blow out piping thoroughly to remove loose scale and dirt. Use pipe dope or teflon tape sparingly when attaching the trap to the pipe. Observe the pressure limitation shown on the trap label.
- Install the trap below the equipment being drained in a location easily accessible for maintenance and inspection. Be certain to install with flow in direction indicated on diagram.
- Install a drip pocket to keep dirt away from the trap.
- Discharge piping should be amply sized to avoid excessive back pressures.
- To provide for easy maintenance and service, install a block valve on each side of the trap and install a strainer ahead of the inlet connection.
- All valves should be full ported to achieve the rated capacity of the trap.
- If discharge piping is to be elevated, be certain that the available differential pressure is adequate to permit proper drainage. Remember, two feet of lift equals approximately one psig.

### MAX. OPERATING PRESSURES

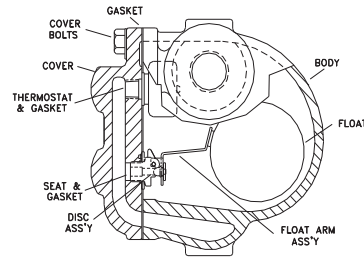
WFT-15	15 PSIG
WFT-30	30 PSIG
WFT-75	75 PSIG
WFT-125	125 PSIG
WFT-175	175 PSIG
WFT-250	250 PSIG

### TROUBLESHOOTING

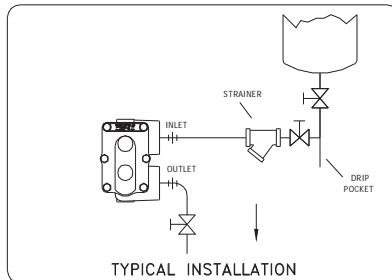
PROBLEM	CAUSE	ACTION
1. Trap does not discharge.	a) Damaged float. b) Operating pressure too high.	a) Replace float. b) Install trap suitable for operating pressure.
2. Trap does not close.	a) Dirt lodged on valve disc or thermostat seat area. b) Worn out internals; damaged thermostat.	a) Clean trap; replace thermostat; install strainer b) Replace internals or thermostat; be sure to match model no. and pressure

Each Watson McDaniel Company Product is warranted against defects in material and workmanship for one year from date of shipment. This warranty extends to the first retail purchaser only. All defective material must be returned to the person from whom you purchased the Product, transportation prepaid, free of any liens or encumbrances, and if found to be defective will be repaired free of charge or replaced, at the warrantor's or seller's option. If the material is replaced, any replacement will be invoiced in the usual manner and after inspection of alleged defective material an adjustment will be made for depreciation caused by purchaser's use. In no event will Watson McDaniel Company be liable to do more than refund the original contract price. Incidental and consequential damages are excluded, whether under this warranty or otherwise. All implied warranties, including warranties of merchantability and fitness for a particular purpose, are disclaimed and excluded.

TRAP MAY NOT EXACTLY MATCH THIS ILLUSTRATION



PMA	250 PSIG up to 450°F
TMA	450°F @ 250 PSIG
PMO	250 PSIG
TMO	Sat. Steam Temp



### ORDERING SPARE PARTS

Specify the description of the part.  
Indicate the Model Number, Size, and Operating Pressure, which are shown on the name plate.

Typical Specification: Cover & Gasket for 2" WFT-125 steam trap



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## SERIES FTE & FTES

### FLOAT & THERMOSTATIC STEAM TRAP

#### INSTALLATION INSTRUCTIONS

INSTRUCTION PART NO. 2217700 REVISION 0

### INSTALLATION

- Before installing the trap, blow out piping thoroughly to remove loose scale and dirt. Use pipe dope or teflon tape sparingly when attaching the trap to the pipe. Observe the pressure limitation shown on the trap label.
- Install the trap drainer in a horizontal pipeline below the equipment being drained in a location easily accessible for maintenance and inspection. Be certain the 2" and 2 1/2" traps are supported under the trap body.
- Install a drip pocket to keep dirt away from the trap.
- Discharge piping should be amply sized to avoid excessive back pressures.
- To provide for easy maintenance and service, install a block valve on each side of the trap and install a strainer ahead of the inlet connection.
- All valves should be full ported to achieve the rated capacity of the trap.
- If discharge piping is to be elevated, be certain that the available differential pressure is adequate to permit proper drainage. Remember, two feet of lift equals approximately one psig.

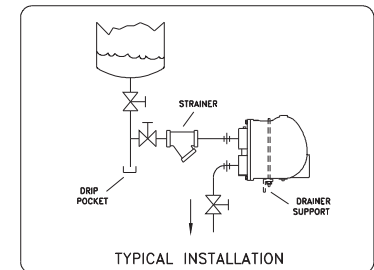
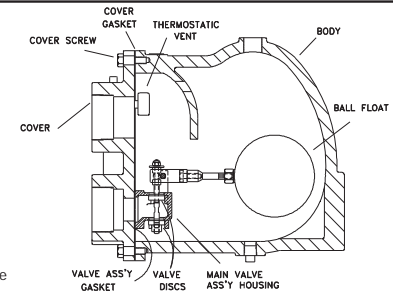
### MAX. OPERATING PRESSURES

Ductile Iron Body	PMO	200 PSIG
	TMO	450°F
Steel Body	PMO	300 PSIG
	TMO	750°F
FTE-20		20 PSIG
FTE-50		50 PSIG
FTE-125		125 PSIG
FTE-200		200 PSIG

### TROUBLESHOOTING

PROBLEM	CAUSE	ACTION
1. Trap does not discharge.	a) Damaged float. b) Operating pressure too high.	a) Replace float. b) Install trap suitable for operating pressure.
2. Trap does not close.	a) Dirt lodged on valve disc or thermostat seat area. b) Worn out internals; damaged thermostat.	a) Clean trap; replace thermostat; install strainer b) Replace internals or thermostat; be sure to match model no. and pressure

Each Watson McDaniel Company Product is warranted against defects in material and workmanship for one year from date of shipment. This warranty extends to the first retail purchaser only. All defective material must be returned to the person from whom you purchased the Product, transportation prepaid, free of any liens or encumbrances, and if found to be defective will be repaired free of charge or replaced, at the warrantor's or seller's option. If the material is replaced, any replacement will be invoiced in the usual manner and after inspection of alleged defective material an adjustment will be made for depreciation caused by purchaser's use. In no event will Watson McDaniel Company be liable to do more than refund the original contract price. Incidental and consequential damages are excluded, whether under this warranty or otherwise. All implied warranties, including warranties of merchantability and fitness for a particular purpose, are disclaimed and excluded.



### ORDERING SPARE PARTS

Specify the description of the part.  
Indicate the Model Number, Size, and Operating Pressure, which are shown on the name plate.

Typical Specification: Cover & Gasket for 2" FTE-20, 20 psi steam trap

## SERIES TD600 & TD600S

### THERMODYNAMIC TRAPS

### INSTALLATION INSTRUCTIONS

INSTRUCTION PART NO. 2266700 C.R.-3497  
REVISION 2

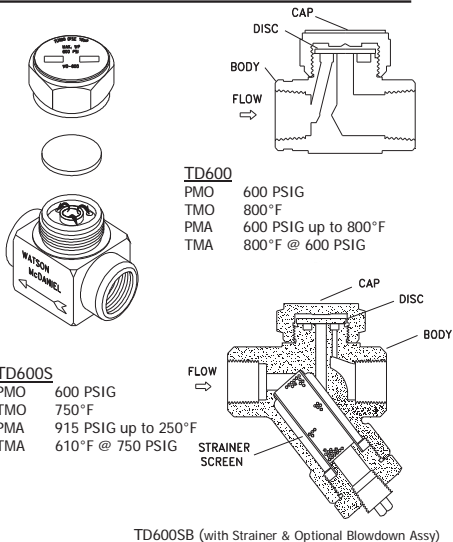
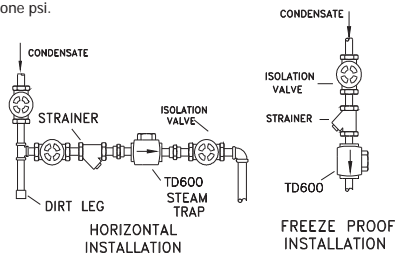
## HOW IT WORKS

The Thermodynamic steam trap cycles periodically to discharge condensate very near to steam temperature.

It is unaffected by waterhammer or superheat. An insulating cover minimizes the effect of ambient conditions.

## INSTALLATION

- Before installing the trap, blow out piping thoroughly to remove loose scale and dirt. Use pipe dope or Teflon tape sparingly when attaching the trap to the pipe. Observe the pressure limitation shown on the trap label.
- Install the trap below the equipment being drained in a location easily accessible for maintenance and inspection. Be certain to install with flow in direction indicated on the trap body.
- Install a drip pocket to keep dirt out from the trap & to keep from freezing.
- Discharge piping should be amply sized to avoid excessive back pressures.
- To provide for easy maintenance and service, install a block valve on each side of the trap and install a strainer ahead of the inlet connection. Strainer must always angle downward.
- All valves should be full ported to achieve the rated capacity of the trap.
- If discharge piping is to be elevated, be certain that the available differential pressure is adequate to permit proper drainage. Remember, two feet of lift equals approximately one psi.



**Note:** TD600S trap with integral strainer is alternate to separate upstream wye (Y) Strainer.

## ORDERING SPARE PARTS

Specify the description of the part.  
Indicate the Model Number and Size which are shown on the name plate.

AVAILABLE SPARE PARTS		
	TD600	TD600S
Disc	X	X
Cap	X	X
Insul-Cap (optional)	X	X
Strainer Screen		X
Blowdown Valve Assy (optional)		X

Typical Specification: Disc for 1/2" TD600 Steam Trap.

## CAP TORQUE (ALL SIZES)

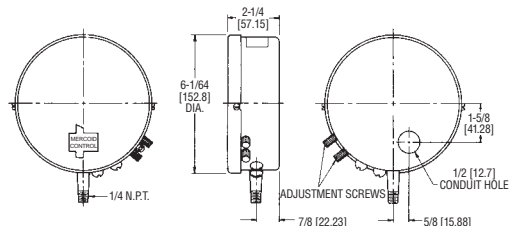
- 70 ft-lbs

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## Series DA/DS-7000 Bourdon Tube Pressure Switches

### Specifications - Installation and Operating Instructions



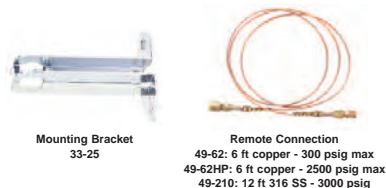
**Series DA/DS-7000 Bourdon Tube Pressure Switches** are SPDT snap-action switches that combine extremely high sensitivity and repeatability with easily adjustable set and reset points through non-interactive external adjustments. These switches have visible calibrated dials for set points and on-off indicators to indicate switch actuation. DA models are equipped with two external adjustments. One sets the high pressure operating point; the other sets the reset point. Deadband or the difference between set and reset points is adjustable over the full scale. DS models have a fixed deadband.

**Note:** The DS7300 has no status indicator.

#### INSTALLATION

The switch may be mounted in any position. Select a location recommended by equipment manufacturer. Where excessive vibration occurs, mount the switch remotely, using an appropriate remote connection and mounting bracket. See accessories, below.

#### ACCESSORIES



#### SPECIFICATIONS

**Wetted Materials:** Brass, 403 SS, or 316 SS.

**Temperature Limit:** 180°F (82°C).

**Pressure Limit:** Maximum pressure of the operating range.

**Enclosure Rating:** General purpose, weatherproof or explosion-proof.

**Repeatability:** ±1% of full operating range.

**Switch Type:** See circuit chart.

**Electrical Rating:** See electrical ratings chart.

**Electrical Connections:** Screw terminal.

**Conduit Connection:**

General purpose: 1/2" hole for conduit hub;

Weatherproof: 1/2" conduit hub;

Explosion-proof: 3/4" female NPT.

**Process Connection:**

General purpose and weatherproof: 1/4" male NPT, 1/2" male NPT on ranges 15S and 16S;

Explosion-proof: 1/2" male NPT and 1/4" female NPT.

**Mounting Orientation:** Vertical.

**Set Point Adjustment:** Thumbscrew.

**Weight:**

General purpose: 4 lb (1.8 kg);

Weatherproof: 6 lb (2.7 kg);

Explosion-proof: 8 lb (3.5 kg).

**Deadband:** See Ranges and Differentials Chart.

#### CAUTIONS:

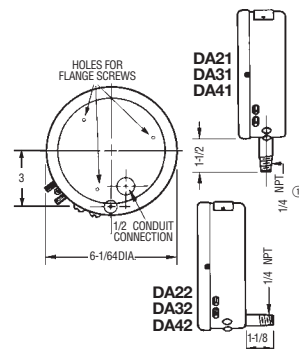
Control movement must not be oiled. Do not overload. Note electrical rating on name plate and be sure that total current passing through the switch is within specified rating.

When testing a boiler or system, never exceed maximum pressure rating on control or it may be seriously damaged. Remove control if higher pressures are required.

Do not fail to use a siphon on steam where range is 35 lbs (2413 mbar) or more.

#### GENERAL PURPOSE CONTROLS, TYPES DA, DL, DR, DS

Mount control in any position. Do not twist the case when installing. Use a wrench on the square part of the control connection. On controls with operating Range No. 15S (500 to 5000 psi (34.47 to 344.75 bar)) or Range No. 16S (800 to 8000 psi (55.16 to 551.6 bar)), be sure the special sealing nut (with PTFE insert) is turned to the uppermost threaded section of the 1/2" pressure connection. Apply a flat open-end wrench to the flat side of the bottom pressure connection when piping the control. After properly connecting the control, tighten the sealing nut to assure a leak-proof connection.

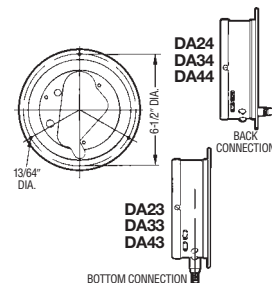


General Purpose Types DA, DS, DR, DL

#### FLANGED CASE CONTROLS

Mount by means of the three holes in the flange. Note: Series D7030 when used for steam with operating ranges of 35 psi (2.413 bar) or higher, must be siphoned to prevent live steam entering the Bourdon tube. With high-pressure steam exceeding 100 psi (6.895 bar), use a remote connection. (Note accessories on Page 1.)

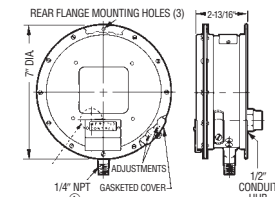
Series D-7020 incorporate an orifice as standard in the pressure connection to dampen surges or pulsations.



Flange for Surface Mounting

#### WATERTIGHT AND WEATHERPROOF NEMA 2, 3, 4, 5, TYPES DAW, DRW, DSW

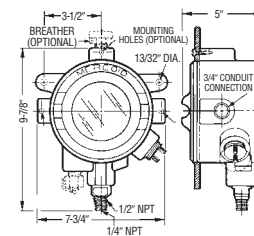
These switches are supplied with flanged case, bottom connection, for surface mounting only.



Weather-Proof Types DAW, DSW, DRW

#### EXPLOSION-PROOF TYPES DAH, DRH, DSH

Mount with mounting lugs attached to control housing.



Explosion-Proof Types DAH, DRH, DSH

#### WIRING

Wire in accordance with the National Electrical Code and local regulations. For general purpose controls, use a short piece of BX between the rigid conduit and the control so the control will not be subjected to conduit expansion and contraction. Where the control is directly connected into the load circuit, it should be connected into the hot side of the line. Do not exceed electrical rating as stamped on the control nameplate. DS-7300 controls are equipped with a terminal block. Field connection should be made to terminal block pole in common with required pole of the control's switch. The color code is:

Black - Common

Blue - ON Hi

Red - ON Lo

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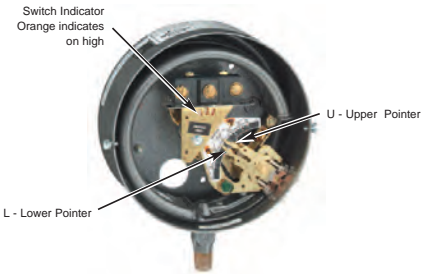
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ADJUSTMENTS: HOW TO SET OPERATING POINT

Double Adjustment Types - Fully Automatic:

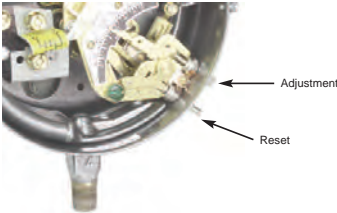
With double-adjustment switches (prefixed DA, DAH or DAW), adjust the upper pointer "U" to set HIGH PRESSURE POINT for switch operation and adjust the lower pointer "L" to set LOW PRESSURE OPERATING POINT. The difference between the "U" and "L" pointers is the operating differential between "on-off" switch operation.



Double-Adjustment Types Fully Automatic

Semi-Automatic Control with Manual Reset:

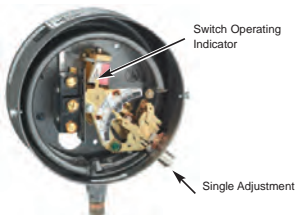
Models prefixed DR, DRH, DRW and with suffix L or U (example: DR-7021-153U) have a single adjustment that sets the operating point for automatic operation. A push-button reset must be operated manually to restore the circuit to the original position after automatic operation. Example: Type DR-7021-153L has a circuit that opens automatically on a pressure rise to the pressure indicated by the pointer on the scale; no matter how much the pressure drops, the circuit will not re-close until the reset button is operated. Suffix L denotes control will operate automatically on an increase. Suffix U denotes control will operate automatically on a decrease.



Semi-Automatic Types with Manual Reset

SINGLE ADJUSTMENT TYPES—FULLY AUTOMATIC:

Models prefixed DS, DSH, DSW, N3DSW are equipped with a single adjustment. Differential is fixed (not adjustable). The single pointer on the scale sets the pressure at which switch operation occurs. Differential is listed in chart indicates approximate fixed differential.



Single Adjustment Types Fully Automatic

LOCKING DEVICE

When the control has been adjusted to desired range, the locking bar may be inserted between the adjustment screws with the slot passing over the projecting lugs. By placing a sealing wire between the locking bar and the hole in the lug protruding from the adjustment assembly, adjustments cannot be tampered with.

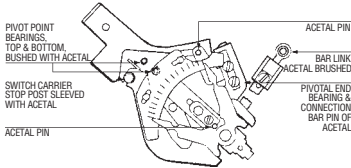
For DRF, DAW, DRW, adjusting knob cover may be sealed in place with sealing wire through cover bolt hole. For DAH, sealing wire may pass through locking bar and hole in hub above adjusting knobs.

ACETAL BUSHED MOVEMENT "B"

Acetal bushed movements prolong control life by alleviating wear of metal surfaces due to excessive vibration and/or pulsation. They also prolong switch life in environments where corrosion may be a factor. Models with Acetal movements are identified by the letter "B" after the suffix number. Examples: -153B, -153UB, etc.

CONTROL NUMBER

Part of the control number (the fourth number in the sequence) identifies the type of control case. Digit 1 of 7021, 7031, 7041, denotes a plain case with bottom connection. Digit 2 of 7022, 7032, etc., denotes a plain case with back connection. Digit 3 of 7023, 7033, 7043, etc., denotes a flanged case with bottom connection. Digit 4 of 7024, 7034, etc., denotes a flanged case with back connection. (Digit 3 of 7321, 7331, 7341, etc., denotes hermetically sealed snap switch.)



Acetal Bushed Movement "B"

CIRCUITS (SWITCH OPERATION)

Suffix number after control number denotes switch action:

Suffix -153 designates SPDT; one circuit closes as other circuit opens.

Suffix -804 designates two SPDT switches; two close, two open.

RANGES:		TYPE DA Double Adjustment Minimum Differential (psig)		TYPE DS Single Adjustment Fixed Differential (psig)	
Bourdon Tube Material	Range Number	Adjustable Operating Range (psig)	SPDT DA-7031-153 DAW-7033-153 DAH-7031-153	SPDT DS-7231-153 DSW-7233-153 DSH-7231-153	(2) SPDT DS-7231-804 DSW-7233-804 DSH-7231-153
Brass Bourdon Tube	2	0-30" Hg Vac	13.5" Hg	3" Hg	2.5" Hg
	3	1.0" Hg Vac-12	6	1.5	1.25"
	1	1/8-15	6	1.5	1.25
	3A	1/8-20	6	1.5	1.25
	4	1-35	7	1.5	1.5
	27	25" Hg Vac-50	12	2.5	2
	5	2-60	9	2	1.5
	6	5-100	13.5	2.5	2
	7	5-150	24	3.5	3.5
403SS Bourdon Tube	8	10-200	24	4.75	4
	9	10-300	37.5	6	6
	Range Number	Adjustable Operating Range (psig)	SPDT DA-7021-153 DAW-7023-153 DAH-7021-153	SPDT DS-7221-153 DSW-7223-153 DSH-7221-153	(2) SPDT DS-7221-804 DSW-7223-804 DSH-7221-804
	25S	30" Hg Vac-60	18	3.5	3
	26S	30" Hg Vac-75	22.5	3.5	3
	5S	2-60	13.5	3	2.5
	6S	5-100	19.5	3.5	3
	8S	10-200	22.5	4.75	4
	9S	10-300	28.5	7	6
316SS Bourdon Tube	9AS	40-350	30	7	6
	10S	25-600	67.5	12	10
	11S	50-1000	142.5	22	20
	12S	100-1500	195	35	30
	13S	300-2500	390	60	50
	15S	500-5000	1350	200	110
	16S	800-8000	2250	500	180
	Range Number	Adjustable Operating Range (psig)	SPDT DA-7041-153 DAW-7043-153 DAH-7041-153	SPDT DS-7241-153 DSW-7243-153 DSH-7241-153	(2) SPDT DS-7241-804 DSW-7243-804 DSH-7241-804
	26E	30" Hg Vac-75	15	3.5	4
316SS Bourdon Tube Carbon Steel Bottom Connection	23E	5-75	12	4	2.5
	6E	10-100	15	3.5	4
	24E	10-150	16.5	4.5	3
	9E	10-300	42	8	6
	21E	30-400	78	12	10
	22E	75-800	180	25	17
	11E	100-100	285	35	30
	13E	200-2500	600	75	95
	Range Number	Adjustable Operating Range (psig)	SPDT DA-7041-153 DAW-7043-153 DAH-7041-153	SPDT DS-7241-153 DSW-7243-153 DSH-7241-153	(2) SPDT DS-7241-804 DSW-7243-804 DSH-7241-804
Electrical Ratings		See Code F*	See Code E	See Code D	See Code K
AC Capacity		DC Capacity		AC Horsepower	
Code	120V	240V	480V	120V	240V
D	10A	10A	NA	5A	25A
E	15A	15A	15A	NA	NA
F	12A	10A	5A	5A	25A
G	5A @ 250 AC, Resistive & Inductive; 30V DC Resistive				
K	5A @ 125/250 AC, Resistive; 30V DC Resistive				
Circuit Suffix No.	Switch Action on Pressure Increase	Electrical Rating Code			
-153	SPDT: one OPENS as one CLOSES	D	E	K	
-804	(2) SPDT: two OPEN as two CLOSE	F*	G		
*Note: Minimum differentials increase when using multiple circuits. Controls using #804 circuits in ranges over 35 psig have 30% higher minimum differentials; ranges under 35 psig are not available in Code F.					

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#### Pre-Installation

##### Verification of Model and Service Media/Capacity/Temperature/Pressure Limits

(Reference attached Model Description/Guide.) Verify the Model Number on the tag against the Model Number of the order. For European service, verify the "CE Mark" tag is connected to the valve. Verify the Service Media, Capacity, and Temperature and Pressure Limits of the valve against the application. Please note the marked capacity is based on Standard Temperature and Pressure conditions and is valid only for the service media noted on the catalog order guide. Adjustments to the capacity must be performed for different temperatures or service media, and are the responsibility of the end user to determine.

## Pressure Relief Valves

### Installation and Operating Instructions

#### Handling

This pressure relief valve is designed to protect equipment from overpressure. The valve should be handled with care, not subjected to heavy shock loads, and protected to prevent contamination from getting inside. It should be installed correctly per A.S.M.E. Boiler & Pressure Vessel Code requirements, where applicable. Failure to do so could result in property damage or serious injury to personnel. When hoisting the valve into position for installation, care should be exercised so that lifting straps do not contact the valve lift lever.

#### Installation

Always wear proper safety equipment, including safety glasses and ear protection.

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

#### Operation

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

#### Maintenance

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



#### WARNING!

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

**Kunkle Valve Division**  
953 Old US 70, Black Mountain, NC 28711





Form 222B  
Bulletin No. 100205-1  
Rev. H

## Warrick® Dual Function Control Installation and Operation Bulletin

This bulletin should be used by experienced personnel as a guide to the installation of Dual Function Controls. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors or a representative if further information is required.

### Specifications

**Control Design:** Open-board design (no housing)

**Contact Design:**

Limit Control -1 SPDT (1 form C), dry contacts

Level Control -1 SPDT (1 form C), dry contacts

**Contact Ratings:** 10A @ 120/240-VAC resistive (120°F),  
1A @ 120, 208/240, 240 resistive (150°F), 1/3 Hp @ 120,  
208/240, 240 VAC

**Contact Life:** Mechanical - 5 million operations  
Electrical -100,000 operations minimum at rated load

**Supply Voltage:** 24, 120, 220, or 240 VAC models, +10%/-15%,  
50/60 Hz. **208/240 Model:** 187V Min to 242V Max, VAC 50/60 Hz

**Power Consumption:** 24/120/220/240-VAC with both relays energized  
- 4.4 VA.

**Secondary Circuit:** 2.3 VAC RMS voltage on probes,  
< 1 milliampere source capability.

**Sensitivity:** Factory programmed to 4.7K, 10K, 26K, 50K, or 100K Ohms

**Operating Ambient Temperature Range:** -40°F to +150°F  
(-40°C to +65°C)

**Terminals:** Probe connections 3/16" male quick connects, Line and  
Power connections 1/4" male quick connects

**Time Delays:** Standard, 0.5 seconds rising level, LLCO probe,  
3 seconds lowering level.

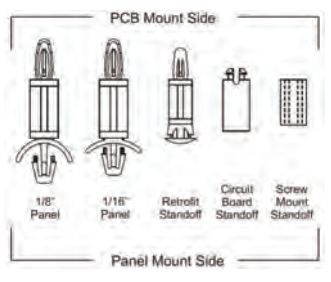
**Listings:** Entire control carries U.L. Limit Control Listing (UL-353) for  
supply voltages of 120-VAC and below.

### Installation

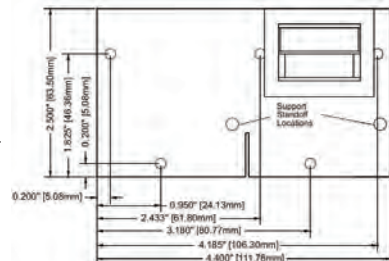
- Drill five 0.187" holes in customer supplied back plate using  
stick on template supplied with control. Standard standoffs  
are designed for back plate thickness of 0.062 (1/16").  
Standoffs are available for back plates of 0.125 (1/8") nomi-  
nal thickness. If retrofit plate standoffs are used, drill 5  
(five) 0.250 dia. Holes in proper locations.
- Install five standoffs into back plate. Install two support stand-  
offs into circuit board. **CAUTION:** Be careful not to bend or flex  
the circuit board during installation as this can damage the control.  
Do not push down on transformer or relays during installa-  
tion. Install circuit board onto standoffs by gently pushing down  
on circuit board at board edges near standoff locations until  
board is fully seated. See sketch for proper installation. Install  
control in appropriate enclosure.
- Wire controls per wiring diagram, following N.E.C. and local  
codes. Use appropriately sized spade terminals.

### Standoff Options

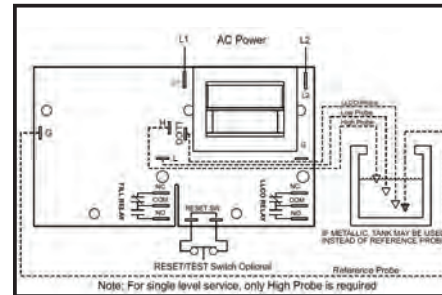
There are 5 standoff styles offered by  
Gems to connect circuit boards to  
panels.



### Dimensional Drawing



### Wiring Diagram



### Operation

#### DIRECT MODE BOTH FUNCTIONS

**AUTOMATIC RESET** (Reset Switch terminals not wired) When the  
liquid rises to the electrode on terminal LLCO, the control energizes,  
changing state of the load contacts. (LED will be lit) The control re-  
mains energized until the liquid level recedes below electrode on  
terminal LLCO. The control then de-energizes, (LED will not be lit)  
returning load contacts to original state. Unless otherwise specified,  
there is a three second time delay on decreasing level. Liquid must  
be below probe on terminal LLCO for a full three seconds before con-  
trol de-energizes.

**MANUAL RESET** (Normally closed pushbutton installed across reset  
terminals) When the liquid rises to the electrode on terminal LLCO,  
the control will remain de-energized until the pushbutton is de-  
pressed. Upon Reset Switch activation, the control will energize,  
(LED will be lit) changing the state of the contacts. The control re-  
mains energized until the liquid level recedes below electrode on  
terminal LLCO. The control then de-energizes, (LED will not be lit)  
returning load contacts to their original state. Unless otherwise spec-  
ified, there is a three second time delay on decreasing level. Liquid  
must be below probe on terminal LLCO for full three seconds before  
control de-energizes. **Operator to wait 5 full seconds after power is  
applied before pressing reset switch (if manual reset is used).**

**H-L Function:** When the liquid rises to the electrode on terminal H,  
the associated relay energizes, changing the state of the load con-  
tacts. (LED will be lit). The relay remains energized until the liquid  
level recedes below electrode on terminal L. The associated relay  
then de-energizes, (LED will not be lit) returning load contacts to  
original state. Unless otherwise specified, there is a one half second  
time delay on increasing level. Liquid must be in contact with probe  
on terminal H for a full half-

DF XXXXX-XX-XX-XX

**Time Delay:** (Decreasing Level) LLCO level function 3  
sec. Standard.

**Time Delay:** (Decreasing Level) H-L level function 1-20  
sec.

**Time Delay:** (Increasing Level) H-L level function 1-20  
sec.

**Optional Character:** see Chart

**Enclosure:** 0-none, 1-NEMA 1, 4-NEMA 4, 7-NEMA 7,  
12-NEMA

**Standoff Style:** A-1/16" panel, B-1/8" panel, C-  
screw mount, D-retrofit

**Supply Voltage:** 1-120VAC (+10%/-15%), 2-240VAC  
(+10%/-15%), 3-24VAC (+10%/-15%), 5-220VAC (+10%/-  
15%), 8-208/240VAC (187 to 242 VAC Absolute Range)

**Mode/Sensitivity:** LLCO, H-L Direct A-4.7K, B-10K, C-  
26K, D-50K, E-100K - LLCO, H-L Inverse K-4.7K, L-  
10K, M-26K, N-50K, P-100K

second before control energizes. This function can be wired for  
single level service by using only the H terminal.

#### INVERSE MODE

**LLCO Function:** LLCO always functions in direct mode only see  
above for operation.

**H-L Function:** Associated relay energizes with power, (LED will be  
lit) changing the state of the load contacts. When the liquid rises to  
the electrode on terminal H, the relay de-energizes, returning load  
contacts to shelf state. (LED will not be lit). The associated relay  
remains de-energized until the liquid level recedes below electrode  
on terminal L. The relay then energizes.

#### TEST FEATURE

Allows LLCO circuit to be tested without the need to drop the water  
level in the boiler to create a dry probe condition. Holding down the  
reset button for 3 seconds will allow the LLCO circuit to trip, simulat-  
ing a dry probe. The controller will return to normal operation once  
the reset button is pressed a second time.

**LED Status Indicator** In normal operation, the LED on the control  
will either be on or off depending on the controller state. On-board  
microprocessors continuously monitor for fault conditions. In the  
event a fault is detected, the LED will blink a pattern indicating the  
fault type. If you experience an inoperable control and the LED is  
blinking, attempt to leave the control in the blinking state and con-  
tact the factory for assistance.

#### Options

**Manual Reset with optional Power Outage Feature:** The Power  
Outage option, used in conjunction with the Manual Reset option,  
eliminates the need for a manual reset in the event of a power out-  
age during normal boiler operation. With the Power Outage option, if  
there is a loss of power with liquid present on the LLCO probe, the  
control will self-reset (energize) IF liquid is still present on the LLCO  
probe at the time when power is re-established. If the control did not  
have liquid on the LLCO probe at the time of the power outage, or if  
there is no liquid present at the time power is re-established, the  
control will de-energize and remain so until liquid again rises to the  
LLCO probe and the Manual Reset pushbutton is depressed.

**Time Delays associated with terminals H and L:** With time delay on  
increasing level, the liquid must be in contact with the high electrode  
for the full duration of the time delay before control will operate. With  
delay on decreasing level, the liquid must be below the low elec-  
trode for the full duration of the time delay before control will oper-  
ate.

**Time Delays associated with terminal LLCO:** 3 Second time delay  
on decreasing level is standard.

	Reset Function	N.C. Pushbutton	Power Outage	Retrofit Plate	Test Feature
D	X				
G	X	X	X		
J	X	X	X	X	
K	X		X		
L	X		X	X	
R				X	
S	X				
T	X			X	
W	X			X	
B	X				X
Y	X	X			X
Z			X		X
A	X	X	X		X





## Warrick® Series 16 General Purpose Controls Installation and Operation Bulletin

Form 166  
Sheet PIN 100211-1  
Rev. F

This bulletin should be used by experienced personnel as a guide to the installation of Series 16 controls. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors Inc. or its local representative if further information is required.

### Specifications

**Control Design:** Open circuit board design

**Contact Design:** SPDT (1 form C): one normally open (N.O.) and one normally closed (N.C.), non-powered contacts.

**Contact Ratings:** 10A @ 120 or 240 VAC resistive (120°F), 1 A @ 120, 240 VAC resistive (150°F), 1/3 H.P. @ 120, 240 VAC (120°F)

**Contact Life:** Mechanical: 5 million operations.

Electrical: 100,000 operations minimum at rated load.

**Supply Voltage:** 120, 240 or 24 VAC models: +10% - 15%, 50/60 Hz. 2008/240 Model: 187 Vmin to 255 Vmax. VAC 50/60 Hz

**Supply Current:** Relay energized 4.4 VA.

**Secondary Circuit:** 12 VAC RMS voltage on probes, 1.5 milli-amp current.

**Sensitivity:** Models operate from 0 to 1,000,000 Ohm maximum specific resistance

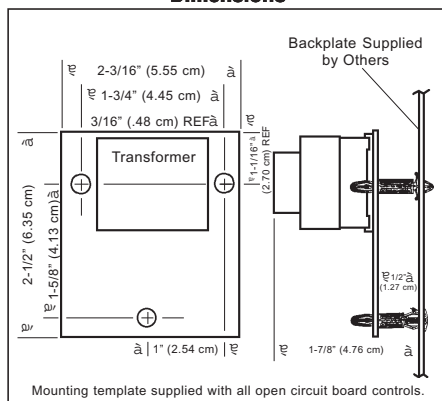
**Temperature:** -40 to 150° F. ambient.

**Terminals:** Probe connections 3/16" spade: Line and power connections 1/4" space

**Time Delays:** Standard H probe, 0.5 seconds on rising level

**Listing:** U.L. recognized, Industrial Motor Control (508)

### Dimensions



### Notes

If panel mount stand-off is to be used, thru-holes to be drilled in back plate should be .187" Dia.

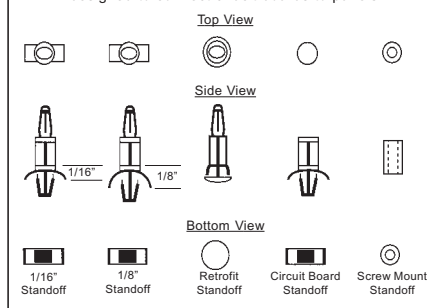
If retrofit stand-off is to be used, thru-holes to be drilled in back plate should be .250" Dia.

### Installation

1. Drill three .187 dia. holes in customer supplied backplate using stick on template supplied with control. Standard standoffs are designed for backplate thickness of .062 (1/16"). Standoffs are available for backplates of .125 (1/8") nominal thickness. If retrofit plate standoffs are used, drill three .250 dia. holes in proper location.
2. Install three standoffs onto backplate. Install circuit board onto standoffs by pushing down on circuit board at outer edges of all four corners. Use both hands to slide board onto standoffs until standoffs lock. **CAUTION:** Do not overflex circuit board during installation. Do not push down on transformer or relays during installation. See sketch for proper installation. Install control in appropriate enclosure.
3. Wire control per diagram, following N.E.C. and local codes. Use appropriately sized spade terminals.

### Standoffs

We have four different types of standoffs, designed to connect circuit boards to panels

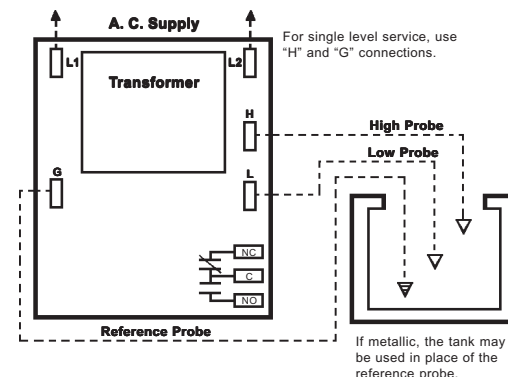


### Sensitivities vs Maximum Probe Wire Distance\*

Sensitivity Character	Sensitivity (K Ohms)	Distance (Ft)
A or K	4.7	10,000
B or L	10	5,700
C or M	26	2,200
D or N	50	1,075
E or P	100	570
F or R	470	270
G or S	1,000	38

\* Based on type MTW or THHN wire, #14 or #16 AWG

### Wiring Diagram



### Operation

**Direct Mode- Single Level Service:** When the liquid rises to the electrode on terminal H, the control energizes, changing state of the load contacts. (LED will be lit) The control remains energized until the liquid level recedes below electrode on terminal H. The control then de-energizes, (LED will not be lit) returning load to original state.

**Inverse Mode- Single Level Service:** Control energizes with power, changing state of the load contacts. (LED will be lit) When the liquid rises to the electrode on terminal H, the control de-energizes, returning the load contacts to shelf state. (LED will not be lit) The control remains de-energized until liquid level recedes below the electrode connected to terminal H. The control then energizes.

**Direct Mode- Differential Service:** When the liquid rises to the electrode on terminal H, the control energizes, changing state of the load contacts. (LED will be lit) The control remains energized until the liquid level recedes below electrode on terminal L. The control then de-energizes, (LED will not be lit) returning the load contacts to original state.

**Inverse Mode- Differential Service:** Control energizes with power, (LED will be lit) changing state of the load contacts. When the liquid rises to the electrode on terminal H, the control de-energizes, returning load contacts to shelf state. (LED will not be lit) The control remains de-energized until the liquid level recedes below the electrode on terminal L. The control then energizes.

### Optional

**Time Delays:** With time delay on increasing level, the liquid must be in contact with the short electrode for the full duration of the time delay before control will operate. With delay on decreasing level, the liquid must be below long electrode for the full duration of the time delay before control will operate. In single level service, terminals H and L must be jumpered together to achieve time delays on both increasing and decreasing levels or just decreasing level.

### 16 X-X-X-XX-XX

**Time Delay:** (decreasing level) 1-20 sec.  
**Time Delay:** (increasing level) 1-20 sec.  
**Enclosure:** 0-none, 1-NEMA 1, 4-NEMA 4, 7-NEMA 7, 12-NEMA 12  
**Standoff Style:** A- 1/16" panel, B- 1/8" panel, C-Screw mount, D- Retrofit plate  
**Supply Voltage:** 1- 120 VAC, 2- 240 VAC, 3- 24 VAC, 8- 208/240 VAC\*  
**Mode/Sensitivity:** Direct A- 4.7K, B- 10K, C- 26K, D- 50K, E- 100K, F- 470K, G- 1M  
Inverse K- 4.7K, L- 10K, M- 26K, N- 50K, P- 100K, R- 470K, S- 1M

\*187 Vmin to 255 Vmax VAC



Gems Sensors Inc.  
One Cowles Road  
Plainville, CT 06062-1198  
Tel: 860-793-4579  
Fax: 860-793-4580

# Installation & Maintenance Instructions

2-WAY INTERNAL PILOTED—OPERATED SOLENOID VALVES  
NORMALLY CLOSED OPERATION — GENERAL SERVICE  
3/8", 1/2" OR 3/4" NPT

SERIES  
8210  
8211

Form No.V5848R2

**NOTICE:** See separate solenoid installation and maintenance instructions for information on: Wiring, Solenoid Temperature, Cause of Improper Operation, Coil or Solenoid Replacement.

## DESCRIPTION

Series 8210 valves are 2-way normally closed internal pilot—operated solenoid valves designed for general service. Valves are made of rugged forged brass. Series 8210 valves are provided with a general purpose solenoid enclosure. Series EF8210 and 8211 are the same as Series 8210 except they are provided with an explosionproof or explosionproof/watertight solenoid enclosure.

## OPERATION

**Normally Closed:** Valve is closed when solenoid is de-energized; open when energized.

**IMPORTANT:** Minimum operating pressure differential required is 5 psi.

### Manual Operator (optional feature)

Manual operator allows manual operation when desired or during an electrical power outage. To engage manual operator (open the valve), push in knurled cap and rotate stem clockwise 180°. Valve will now be in the same position as when the solenoid is energized. To disengage manual operator (close the valve), turn stem counterclockwise 180°.

Push in and rotate  
180° clockwise to operate



**CAUTION:** For valve to operate electrically, manual operator stem must be fully rotated counterclockwise.

### Relocation of Manual Operator

Manual operator may be relocated at 90° increments by rotating the valve bonnet as follows:

**WARNING:** To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, and vent fluid to a safe area before relocating manual operator.

- See separate solenoid installation and maintenance instruction's and follow instructions to loosen solenoid to allow rotation of enclosure.
- Be sure manual operator stem is fully rotated counterclockwise.
- Remove bonnet screws from valve body.
- Lift valve bonnet slightly and rotate to desired position. Do not rotate the diaphragm assembly with the valve bonnet.
- Replace bonnet screws and torque in a crisscross manner to 95 ± 10 in-lbs [10,7 ± 1,1 Nm].
- Position and tighten solenoid in place, see separate instructions.

**WARNING:** To prevent the possibility of death, serious injury or property damage, check valve for proper operation before returning to service.

- Test operate valve electrically and manually. Be sure valve can be test operated without effecting other equipment.
- Restore line pressure and electrical power supply to valve.

## INSTALLATION

Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

### Future Service Considerations

Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

### Temperature Limitations

For maximum valve ambient and fluid temperatures, refer to chart below. Check catalog number and watt rating on nameplate.

Watt Rating	Catalog Number Prefix	Solenoid Class	Max. Amb. Temp. °F	Max. Fluid Temp. °F
6 AC or DC	None or DF	F	122	180
AC	HT	H	140	180
6.1 AC	None, KF, SF, or SC	F	125	180
HT, KH, ST or SU	H	140	180	
11.2 DC	None or HT	F or H	77	150
11.6 DC	None, HT, KF, KH, SC, SF or ST	F or H	104	150

### Positioning

This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub—assembly area.

### Mounting

For mounting bracket (optional feature) dimensions, refer to Figure 1.

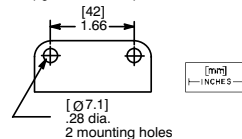


Figure 1. Mounting bracket dimensions

### Piping

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

**CAUTION:** To protect the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601 and 8602 for strainers.

## MAINTENANCE

**WARNING:** To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, and vent fluid to a safe area before servicing the valve.

**NOTE:** It is not necessary to remove the valve from the pipeline for repairs.

### Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to open or close. Clean strainer or filter when cleaning the valve.

### Preventive Maintenance

- Keep the medium flowing through the valve as free from dirt and foreign material as possible.
- While in service, the valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

### Causes of Improper Operation

- Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
- Excessive Leakage:** Disassemble valve and clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

### Valve Disassembly

- Disassemble valve in an orderly fashion using exploded views for identification and placement of parts. Refer to Figure 2 for AC construction; Figure 3 for DC construction.
- Remove solenoid enclosure. See separate instructions.

**For AC construction (standard or with manual operator), proceed as follows:**

- For standard construction, remove bonnet screws, solenoid base sub—assembly, core spring, core assembly, diaphragm spring, diaphragm assembly and body gasket from valve body.
- For manual operator constructions, unscrew solenoid base sub—assembly first then follow step 3 for removal of parts.
- For normal maintenance (cleaning) it is not necessary to disassemble the manual operator unless an ASCO Rebuild Kit is being installed. To disassemble, remove stem pin, manual operator stem, stem spring and stem gaskets (2).

**For DC construction (standard or with manual operator), proceed as follows:**

- Unscrew solenoid base sub—assembly first then follow step 3 and 5 for removal of parts.

**Note:** Diaphragm spring is omitted for DC construction.

- All Parts are now accessible for cleaning or replacement. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

### Valve Reassembly

- Lubricate body gasket and solenoid base gasket with DOW CORNING® 200 Fluid lubricant or an equivalent high—grade silicone fluid.

- Lubricate manual operator stem gaskets (2) with DOW CORNING® 111 Compound lubricant or an equivalent high—grade silicone grease.
- Replace body gasket and diaphragm assembly. Locate bleed hole in diaphragm assembly approximately 45° from valve outlet.

**For AC construction (standard or with manual operator), proceed as follows:**

- Position diaphragm spring on diaphragm assembly. Be sure large end of diaphragm spring seats in cup of diaphragm assembly. For manual operator constructions, small end of diaphragm spring seats in cup of diaphragm assembly.
- Install wide end of core spring in core assembly first, closed end protrudes from top of core assembly.
- For standard construction, position core assembly with core spring and solenoid base sub—assembly (integral with bonnet) over diaphragm spring and diaphragm assembly.
- Install bonnet screws and hand thread screws as far as possible, then torque bonnet screws in a crisscross manner to 95 ± 10 in-lbs [10,7 ± 1,1 Nm].
- For valve constructions with a manual operator, first install valve bonnet and bonnet screws as described in step 7.
- Install solenoid base gasket, core assembly with core spring and solenoid base sub—assembly.
- Torque solenoid base sub—assembly to 175 ± 25 in-lbs [19,8 ± 2,8 Nm].
- For valves with a manual operator proceed as follows:
  - Install two manual operator stem gaskets on stem. Refer to Step 2 for lubrication instructions.
  - Install stem spring and stem assembly with gaskets into valve bonnet.
  - Push stem assembly into valve bonnet; align stem pin hole and install stem pin.
  - Operate manual operator to be sure there is no misalignment or binding. Then rotate manual operator stem counterclockwise as far as possible.

**For DC construction (standard or with manual operator), proceed as follows:**

- For standard or manual operator constructions, replace valve bonnet and follow steps 7, 9 and 10. For manual operator constructions, install core spring in core assembly following step 5.
- Install solenoid. See separate instructions.

**WARNING:** To prevent the possibility of death, serious injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.

- Restore line pressure and electrical power supply to valve.
- After maintenance is completed, operate the valve a few times to be sure of proper operation. A metallic click signifies the solenoid is operating.

## ORDERING INFORMATION FOR ASCO REBUILD KITS

Parts marked with an asterisk (\*) in the exploded view are supplied in Rebuild Kits. When Ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate. If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.

# Installation & Maintenance Instructions



OPEN—FRAME, GENERAL PURPOSE, WATERTIGHT/EXPLOSIONPROOF SOLENOIDS

## SERIES

8003G

8202G

Form No.V6584R8

### — SERVICE NOTICE —

ASCO® solenoid valves with design change letter “G” or “H” in the catalog number (ex. 8210G 1) have an epoxy encapsulated ASCO® Red Hat II® solenoid. This solenoid replaces some of the solenoids with metal enclosures and open—frame constructions. Follow these installation and maintenance instructions if your valve or operator uses this solenoid.

*See separate instructions for basic valve.*

### DESCRIPTION

Catalog numbers 8003G and 8202G are epoxy encapsulated pull—type solenoids. The green solenoid with lead wires and 1/2” conduit connection is designed to meet Enclosure Type 1—General Purpose, Type 2—Dripproof, Types 3 and 3S—Raintight, and Types 4 and 4X—Watertight. The black solenoid on catalog numbers prefixed “EF” or “EV” is designed to meet Enclosure Types 3 and 3S—Raintight, Types 4 and 4X—Watertight, Types 6 and 6P—Submersible, Type 7 (A, B, C & D) Explosionproof Class I, Division 1 Groups A, B, C, & D and Type 9 (E, F, & G)—Dust—Ignitionproof Class II, Division 1 Groups E, F & G. The Class II, Groups F & G Dust Locations designation is not applicable for solenoids or solenoid valves used for steam service or when a class “H” solenoid is used. See *Temperature Limitations* section for solenoid identification and nameplate/retainer for service. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250–28 UNF–2B tapped hole, 0.38 or 0.63 minimum full thread.

NOTE: Catalog number prefix “EV” denotes stainless steel construction. Catalog numbers 8202G1, 8202G3, 8202G5 and 8202G7 are epoxy encapsulated push—type, reverse—acting solenoids having the same enclosure types as previously stated for Catalog numbers 8003G1 and 8003G2.

**Series 8003G and 8202G solenoids are available in:**

- **Open—Frame Construction:** The green solenoid may be supplied with 1/4” spade, screw or DIN terminals. (Refer to Figure 4)
- **Panel Mounted Construction:** These solenoids are specifically designed to be panel mounted by the customer through a panel having a .062 to .093 maximum wall thickness. Refer to Figure 1 and section on *Installation of Panel Mounted Solenoid*.

### Optional Features For Type 1 – General Purpose Construction Only

- **Junction Box:** This junction box construction meets Enclosure Types 2,3,3S,4, and 4X. Only solenoids with 1/4” spade or screw terminals may have a junction box. The junction box provides a 1/2” conduit connection, grounding and spade or screw terminal connections within the junction box (See Figure 5).
- **DIN Plug Connector Kit No.K236034:** Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 6).

### OPERATION

Series 8003G – When the solenoid is energized, the core is drawn into the solenoid base sub—assembly. **IMPORTANT: When the solenoid is de—energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 11 ounces, and 5 ounces for DC construction.**

Series 8202G – When the solenoid is energized, the disc holder assembly seats against the orifice. When the solenoid is de—energized, the disc holder assembly returns. **IMPORTANT: Initial return force for the disc or disc holder assembly, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force is 1 pound, 5 ounces.**

### INSTALLATION

Check nameplate for correct catalog number, service, and wattage. Check front of solenoid for voltage and frequency.

**⚠ WARNING: Electrical hazard from the accessibility of live parts. To prevent the possibility of death, serious injury or property damage, install the open — frame solenoid in an enclosure.**

### FOR BLACK ENCLOSURE TYPES 7 AND 9 ONLY

**⚠ CAUTION: To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 165° C. On valves used for steam service or when a class “H” solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180° C. See nameplate/retainer for service.**

NOTE: These solenoids have an internal non—resettable thermal fuse to limit solenoid temperature in the event that extraordinary conditions occur which could cause excessive temperatures. These conditions include high input voltage, a jammed core, excessive ambient temperature or a shorted solenoid, etc. This unique feature is a standard feature only in solenoids with black explosionproof/dust—ignitionproof enclosures (Types 7 & 9).

**⚠ CAUTION: To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.**

### Temperature Limitations

For maximum valve ambient temperatures, refer to chart. The temperature limitations listed, only indicate maximum application temperatures for field wiring rated at 90°C. Check catalog number prefix and watt rating on nameplate to determine maximum ambient temperature. See valve installation and maintenance instructions for maximum fluid temperature.

NOTE: For steam service, refer to *Wiring* section, *Junction Box* for temperature rating of supply wires.

Temperature Limitations For Series 8003G or 8202G Solenoids for use on Valves Rated at 10.1, 11.6, 17.1, or 22.6 Watts			
Watt Rating	Catalog Number Coil Prefix	Class of Insulation	Maximum † Ambient Temp.
10.1 & 17.1	None, FB, KF, KP SC, SD, SF, & SP.	F	125°F (51.7°C)
10.1 & 17.1	HB, HT, KB, KH, SS, ST, SU.	H	140°F (60°C)
11.6 & 22.6	None, FB, KF, KP SC, SD, SF, & SP.	F	104°F (40°C)
11.6 & 22.6	HP, HT, KB, KH, SS, ST, SU, & SV	H	104°F (40°C)

† Minimum ambient temperature –40° F (–40° C).

### Positioning

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub—assembly area.

### Wiring

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2” conduit connection. To

facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

**⚠ CAUTION: Cryogenic Applications — Solenoid lead wire insulation should not be subjected to cryogenic temperatures. Adequate lead wire protection and routing must be provided.**

### Additional Wiring Instructions For Optional Features:

- **Open—Frame solenoid with 1/4” spade terminals.**  
For solenoids supplied with screw terminal connections use #12–18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to 10 ± 2 in—lbs [1.0 ± 1.2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10–32 machine screw. Torque grounding screw to 15 – 20 in—lbs [1.7 – 2.3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 – 20 in—lbs [1.7 – 2.3 Nm] with a 5/32” hex key wrench.
- **Junction Box**  
The junction box is used with spade or screw terminal solenoids only and is provided with a grounding screw and a 1/2” conduit connection. Connect #12–18 AWG standard copper wire only to the screw terminals. Within the junction box use field wire that is rated 90°C or greater for connections. For steam service use 105°C rated wire up to 50 psi or use 125°C rated wire above 50 psi. After electrical hookup, replace cover gasket, cover, and screws. Tighten screws evenly in a crisscross manner.
- **DIN Plug Connector Kit No.K236034**  
1. The open—frame solenoid is provided with DIN terminals to accommodate the plug connector kit.  
2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.  
3. Use #12–18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4” for installation in socket terminals. The use of wire—end sleeves is also recommended for these socket terminals. Maximum length of wire—end sleeves to be approximately 1/4”. Tinning of the ends of the lead wires is not recommended.  
4. Thread wire through gland nut, gland gasket, washer and connector cover. NOTE: Connector housing may be rotated in 90° increments from position shown for alternate positioning of cable entry.  
5. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.  
6. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in—lbs [0.6 ± 1.1 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it may be necessary to change the complete solenoid including the core and solenoid base sub—assembly, not just the solenoid. Consult ASCO.

### Installation of Solenoid

Solenoids may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid.

### Installation of Panel Mounted Solenoid (See Figure 1)

1. Disassemble solenoid following instruction under *Solenoid Replacement* then proceed.
2. Install solenoid base sub—assembly through customer panel.
3. Position spring washer on opposite side of panel over solenoid base sub—assembly.
4. Replace solenoid, nameplate/retainer and red cap.
5. Make electrical hookup, see *Wiring* section.

### Solenoid Temperature

Standard solenoids are designed for continuous duty service. When the solenoid is energized for a long period, the solenoid becomes hot and can be touched by hand only for an instant. This is a safe operating temperature.

### MAINTENANCE

**⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize solenoid operator and/or valve, and vent fluid to a safe area before servicing.**

### Cleaning

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the solenoid is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

### Preventive Maintenance

- Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
- While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any worn or damaged parts.

### Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* signifies that the solenoid is operating. Absence of the *click* indicates loss of power supply. Check for loose or blown fuses, open—circuited or grounded solenoid, broken lead wires or splice connections.
- **Burned—Out Solenoid:** Check for open—circuited solenoid. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate/retainer and marked on the solenoid. Check ambient temperature and check that the core is not jammed.
- **Low Voltage:** Check voltage across the solenoid leads. Voltage must be at least 85% of rated voltage.

### Solenoid Replacement

1. Disconnect conduit, coil leads, and grounding wire.  
NOTE: Any optional parts attached to the old solenoid must be reinstalled on the new solenoid. For 3—way construction, piping or tubing must be removed from pipe adapter.
2. Disassemble solenoids with optional features as follows:
  - **Spade or Screw Terminals**  
Remove terminal connections, grounding screw, grounding wire, and terminal block (screw terminal type only).

NOTE: For screw terminals, the socket head screw holding the terminal block serves as a grounding screw.

- **Junction Box**  
Remove conduit and socket head screw (use 5/32” hex key wrench) from center of junction box. Disconnect junction box from solenoid.
  - **DIN Plug Connector**  
Remove center screw from DIN plug connector. Disconnect DIN plug connector from adapter. Remove socket head screw (use 5/32” hex key wrench), DIN terminal adapter, and gasket from solenoid.
3. Snap off red cap from top of solenoid base sub—assembly. For 3—way construction with pipe adapter (Figure 3), remove pipe adapter, nameplate and solenoid. Omit steps 4 and 5.
  4. Push down on solenoid. Then using a suitable screwdriver, insert blade between solenoid and nameplate/retainer. Pry up slightly and push to remove.

NOTE: Series 8202G solenoids have a spacer between the nameplate/retainer and solenoid.

5. Remove solenoid from solenoid base sub—assembly.
6. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.
7. Torque pipe adapter to 90 inch—pounds maximum [10.2 Nm maximum]. Then make up piping or tubing to pipe adapter on solenoid.

### Disassembly and Reassembly of Solenoids

1. Remove solenoid, see *Solenoid Replacement*.
2. Remove spring washer from solenoid base sub—assembly. For 3—way construction, remove plugnut gasket.
3. Unscrew solenoid base sub—assembly from valve body.
4. Remove internal solenoid parts for cleaning or replacement. Use exploded views for identification and placement of parts.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Torque solenoid base sub—assembly and adapter to 175±25 in—lbs [19.8±2.8 Nm].

### ORDERING INFORMATION FOR ASCO SOLENOIDS

When Ordering Solenoids for ASCO Solenoid Operators or Valves, order the number stamped on the solenoid. Also specify voltage and frequency.



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Form No.V6584R8

**Torque Chart**

Part Name	Torque Value Inch-Pounds	Torque Value Newton-Meters
solenoid base sub-assembly & adapter	175 ± 25	19,8 ± 2,8
pipe adapter	90 maximum	10,2 maximum

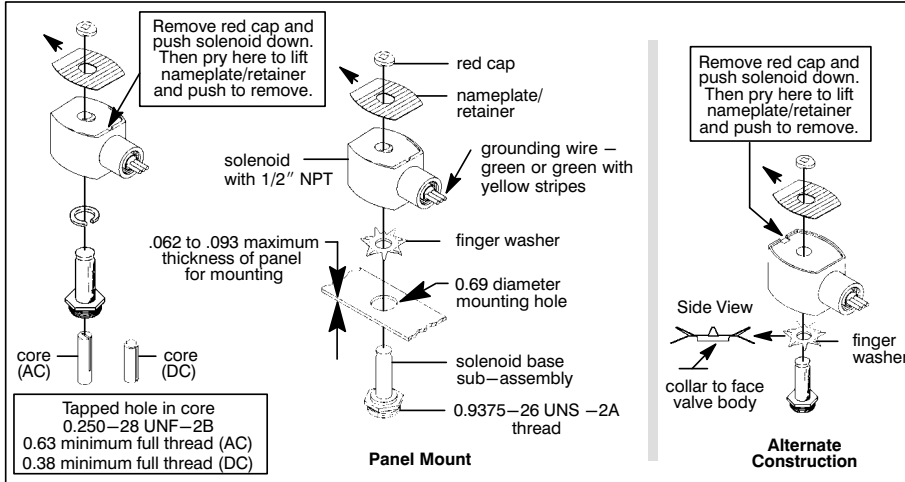


Figure 1. Series 8003G solenoids

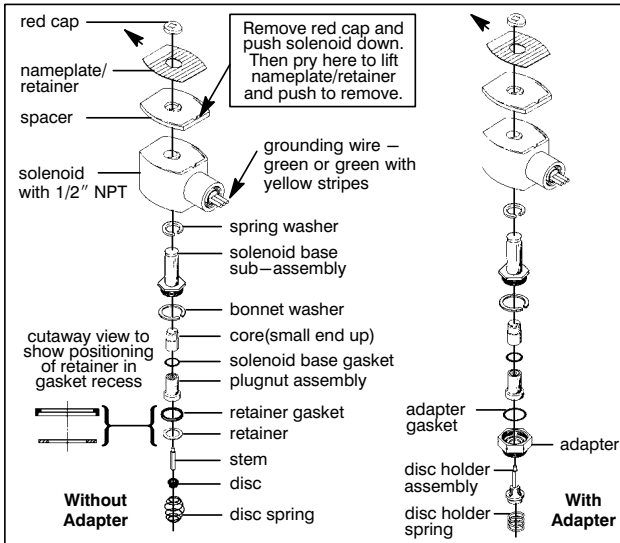


Figure 2. Series 8202G solenoids

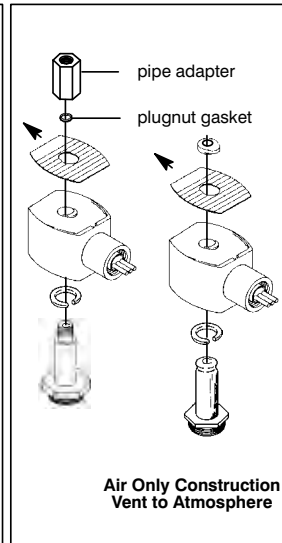


Figure 3. 3-Way Construction

**Torque Chart**

Part Name	Torque Value in Inch-Pounds	Torque Value in Newton-Meters
terminal block screws	10 ± 2	1,1 ± 0,2
socket head screw	15 – 20	1,7 – 2,3
center screw	5 ± 1	0,6 ± 0,1

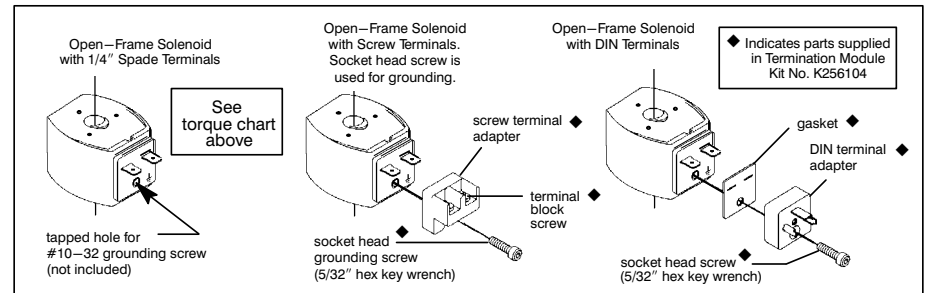


Figure 4. Open-frame solenoids

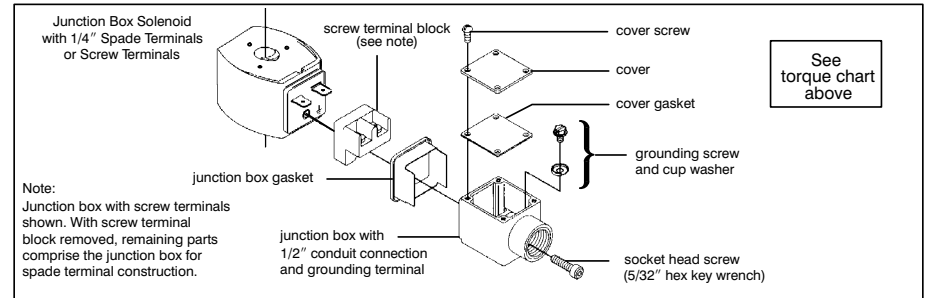


Figure 5. Junction box (optional feature)

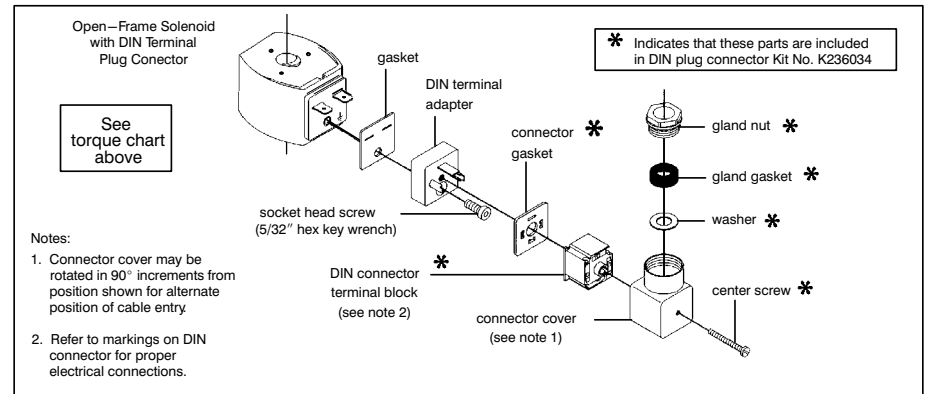


Figure 6. DIN plug connector kit No. K236034 (optional feature)



## Electronic 1-Circuit 7-Day Time Switch

With 100-Hour Backup

### MODELS ET2715C, ET2715CR, ET2715CP Installation and Setup Instructions

#### **WARNING** Risk of Fire or Electric Shock

- Disconnect power at the circuit breaker(s) or disconnect switch(es) before installing or servicing.
- More than one circuit breaker or disconnect switch may be required to de-energize the equipment before servicing.
- For plastic enclosures, bonding between conduit connections is not automatic and must be provided as part of the installation.
- Installation and/or wiring must be in accordance with National and Local Electrical Code requirements.
- Use #14-#8 AWG wires, rated at least 105°C - COPPER conductors ONLY.
- If the power disconnect point is out of sight, lock it in the OFF position and tag it to prevent unexpected application power.
- Make sure there is no wire insulation under the terminal plate on the time switch connector. Firmly tighten terminal screws.
- For outdoor locations or wet locations (rain-tight), conduit hubs that comply with requirements of the UL514B (standard for fitting conduit and outlet boxes) are to be used.
- Do not remove insulator that is covering terminals.
- Do NOT exceed maximum current carrying capacity.
- KEEP DOOR CLOSED AT ALL TIMES when not servicing.

#### **NOTICE**

- Do NOT touch circuit board components, contact can create a static discharge, which can damage these electronic components.

#### Description

This document explains the setup and configuration of the Intermatic ET2715 1-Circuit Electronic 7-Day Time Switch. The ET2715 time switch automatically switches loads according to the entered weekly schedule. The time switch can support up to 48 fixed ON and 48 fixed OFF events (96 total). Each fixed event can be applied to any combination of days.

The time switch features an LCD and panel-mounted control buttons to set, review, and monitor the time switch functions, including setting date and time, schedule creation, enabling or disabling Daylight Saving Time (DST) and configuring DST switchover dates.

Follow these instructions to complete the installation and programming of the ET2715 time switch.



Shown in indoor/outdoor  
lockable metal enclosure

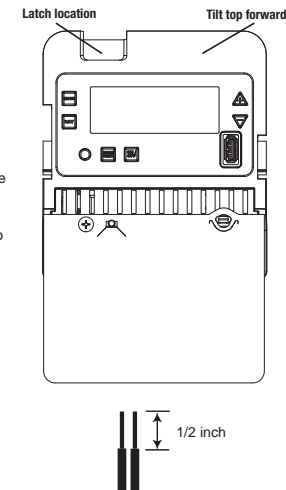
#### Federal Communications Commission (FCC) Notice for ET2000 Series Time Switches

*This device complies with part 15 of the FCC rules. Operation of this device is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference, including interference that may cause undesired operation. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and radiates radio frequency energy and, if not installed and used in accordance with instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference that requires the user to correct at his or her own expense.*

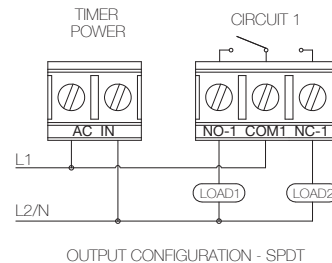
#### Installation

Follow these instructions to install the time switch.

1. Open the time switch enclosure door.
2. Remove and retain the screw that secures the plastic insulator.
3. Lift the left side of the plastic insulator and pivot away to expose the terminal strip.
4. Press the latch at the top of the enclosure and pull out the mechanism from the enclosure.
5. Choose and remove the selected knockout(s) from the enclosure.  
**NOTE:** There are five 1/2 inch to 3/4 inch combination knockouts available. There are two on the bottom of the enclosure, one on each side, and one on the rear. If a 3/4 inch knockout is needed, remove the 1/2 inch knockout first, then the 3/4 knockout.
6. Place the enclosure in the desired location providing space for the enclosure door to swing open fully.
7. Securely mount enclosure using provided mounting holes.
8. Use appropriately rated fittings for the installation.
9. Snap the mechanism back into the enclosure.
10. Strip 1/2 inch off the supply and load wires. Use AWG #14-#8 copper conductors rated at least 105°C. Torque to 15.6 lbf-in.
11. Connect the wires to the proper terminals on the time switch and tighten the screws firmly (See wiring diagrams).
12. Connect ground wire to grounding terminal at the bottom of metal enclosures.
13. Return the insulator to its original position and replace the screw.
14. Close enclosure door.
15. Apply power to the time switch.



#### Wiring Diagram



Initial Setup

The following sections provide instructions for the initial setup of the time switch.

Programming Overview

The steps to program the time switch include setting the current date, time, fixed events, DST, and holiday events, setting the time switch's operation to AUTO mode, ENERGY SAVER mode or MANUAL mode (only MANUAL mode will appear if there are no scheduled events) and read or write an event schedule from a USB memory stick.

**NOTE:** If the time switch is left inactive for five minutes in a programming mode, it will return to the AUTO mode screen (AUTO icon turned on). If no scheduled events are programmed, the time switch will return to MANUAL mode. If the date has not yet been entered, the time switch will go to the Enter Date Mode.

Setting Date

Follow this procedure below to set the date and time in the time switch.

**NOTE:** If necessary, hold + or - to scroll through the digits rapidly.

- 1. Press MODE to scroll through the mode selections until **SET** and **DATE** icons appear at the top of the display. The month flashes.
- 2. Press + or - to select the current month and then press ENTER/NEXT. The day of the month flashes.
- 3. Press + or - to select the current day of the month, and then press ENTER/NEXT. The year flashes.
- 4. Press + or - to enter the current year, and press ENTER/NEXT. The month will flash again.
- 5. Press MODE to move to the next mode selection.

Setting Time

Follow the procedure below to set the time in the time switch.

**NOTE:** If necessary, hold + or - to scroll through the digits rapidly.

- 1. Press MODE to advance to the Set Clock mode selection if this selection is not already active. The **SET** and **TIME** icons appear on the display and a flashing 12:00 AM appears (if clock has not been set).
- 2. Press + or - to select the current time. **NOTE:** Seconds can be set to 00 by pressing ENTER/NEXT.
- 3. Press MODE to save the time and move to the Enable Daylight Saving Time mode selection.

**NOTE:** If the time switch programming data is to be read from a USB memory stick, refer to the "Read Time Switch Program Data..." section in these instructions.

Enable/Disable Daylight Saving Time and Setting Daylight Saving Time Rule

Configure the time switch to automatically adjust for Daylight Saving Time (DST). If DST does not apply to your region, disable the option as directed in this procedure. Follow this procedure to enable/disable the Daylight Saving Time feature, and if applicable, set the DST rule.

- 1. Press MODE to advance to the Set DST mode selection if this selection is not already active. The **SET** and **DST** icons appear on the display.
- 2. Press + to display ON (enable DST) or press - to display OFF (disable DST) and then press ENTER/NEXT to save.

If DST is	Then
Enabled	Go to step 3.
Disabled	Press MODE to save and exit. The procedure is complete.

- 3. Press + or - to scroll to the desired DST rules for your area.

**NOTE:** The DST rules are US2007 (US rules), MX1986 (Mexico rules), and CUSTOM (user-defined start/end dates).

If you select	Then
US2007 or MX1986	Go to step 8. <b>NOTE:</b> To view the start and end dates for a DST rule, press ENTER/ NEXT to scroll through the dates and then press MODE.
Custom	Press ENTER/NEXT. The screen displays a flashing <b>MAR</b> and <b>2ND</b> . Go to step 4.

- 4. Press + or - to select a starting month for customized DST and press ENTER/NEXT.
- 5. Press + or - to select a starting week (1ST, 2ND, 3RD, 4TH, or LST) and press ENTER/NEXT.  
**NOTE:** DST changes at 2:00 A.M. on Sunday of the user-configured starting and ending weeks. Select LST for the fifth Sunday of a month.
- 6. Press + or - to select an ending month and press ENTER/NEXT.
- 7. Press + or - to select an ending week and press ENTER/NEXT.
- 8. Press MODE to save the DST rules and move to the next mode selection.

Setting Fixed Timed Events

Access the Fixed ON/OFF screen to set fixed switching times. Odd-numbered events are for ON switching and even-numbered events are for OFF switching. Follow these steps to set fixed time events (if no fixed events need to be set press MODE to move to the next mode selection):

- 1. Press MODE to advance until **SET FIXED ON/OFF EVENTS** and **ON@** icons appear on the display (if this selection is not already active). The Event Number and **LOAD** icon are also displayed. Press ENTER/NEXT if this fixed on event is not needed, go to step 8.
- 2. If an event is not set the time display will show - - -.
- 3. Press DAY. The screen displays 12:00 am and the days of the week.
- 4. Press + or - to set the time for the fixed event to occur.

If the desired days for this event are	Then
MON-SUN	Press ENTER/NEXT to save. Go to step 8.
MON-FRI	Press DAY once and then press ENTER/NEXT to save. Go to step 8.
SAT-SUN	Press DAY twice and then press ENTER/NEXT to save. Go to step 8.
SET EACH DAY INDIVIDUALLY On the display, the day of the week being set is flashing.	Press DAY three times and the MON icon will flash. Go to step 5.

- 5. Press - to eliminate this event or press + to keep this event for the selected day.
- 6. Press DAY to move to the next day of the week repeat step 5.
- 7. When all the days are set, press ENTER/NEXT to save.
- 8. The Event Number increments and the **SET FIXED ON/OFF EVENTS** and **OFF@** icons are displayed. Press ENTER/NEXT if this fixed off event is not needed, go to step 15.
- 9. If an event is not set the time display will show - - -.
- 10. Press DAY. The screen displays 12:00 am and the days of the week.
- 11. Press + or - to set the time for the fixed event to occur.

If the desired days for this event are	Then
MON-SUN	Press ENTER/NEXT to save. Go to step 15.
MON-FRI	Press DAY once and then press ENTER/NEXT to save. Go to step 15.
SAT-SUN	Press DAY twice and then press ENTER/NEXT to save. Go to step 15.
SET EACH DAY INDIVIDUALLY On the display, the day of the week being set is flashing.	Press DAY three times and the MON icon should flash. Go to step 12.

- 12. Press - to eliminate this event or press + to keep this event for the selected day.
- 13. Press DAY to move to the next day of the week repeat step 12.
- 14. When all the days are set, press ENTER/NEXT to save.
- 15. The Event Number increments and the **SET FIXED ON/OFF EVENTS** and **ON@** icons are displayed. Press ENTER/NEXT if this fixed off event is not needed.

If	Then
Another fixed event needs to be set	Return to step 2.
All the events are set	Press MODE to save and exit. The procedure is complete.

Setting Holidays

There are 50 Holiday blocks that can be programmed along with a single schedule for each block. For each block there will be a start date and an end date. Within each block one scheduled "on" event and one "off" event can be programmed. Holidays are recognized by an H on the display. During the dates chosen, the relays will remain in the "OFF" state and HOLIDy will show on the display. **NOTE:** During holiday blocks only programmed holiday events will trigger relay operations.

To program holiday blocks follow these guidelines:

- Press MODE to advance until the **SET, DATE and ON@** icons appear on the display if this selection is not already active. A holiday Number is also displayed on the right side of the display.
  - The time display will flash - - - - and also show 1H.
  - Press the + or - buttons to choose the month that the holiday will start.
  - Press ENTER/NEXT and the day of the month, the 1, will flash.
  - Press the + or - buttons to choose the day that the holiday will start.
  - Press ENTER/NEXT and the **OFF@** icon is displayed.
  - The time display will flash - - - - and also show 1H.
- 
- Press the + or - buttons to choose the month that the holiday will end.
  - Press the ENTER/NEXT and the day of the month, the 1, will flash.
  - Press the + or - buttons to choose the day that the holiday will end.
  - Press ENTER/NEXT and the **SET ON@ ON/OFF EVENTS** icons are displayed. (Press ENTER/NEXT twice to skip setting an event during the holiday period in which case the circuit will remain off.)
  - The time display shows - - - - and event number 1 is also displayed on the right side of the display.
  - Press the + or - buttons to set the time for this holiday event to start.
  - Press ENTER/NEXT and the **OFF@** icon is displayed.
  - The time display shows - - - - and event number 2 is also displayed on the right side of the display.
  - Press the + or - buttons to set the time for this holiday event to end.
  - Press ENTER/NEXT and the **SET, DATE and ON@** icons appear on the display. The next holiday number is displayed on the right side of the display.

If	Then
Another holiday period needs to be set	Return to step 2.
All the events are set	Press MODE to save and exit. The procedure is complete.

Example: July 4th would have a start date of Jul 4 and an end date of Jul 5. At 12:00 AM on July 4th the circuit will be turned to the OFF state. At 12:00 AM on July 5th the circuit will reconcile and will be turned to their correct state of operation.

Setting Operating Mode

The time switch can be set to one of three operating modes: AUTO (default setting), ENERGY SAVER or MANUAL. Once operating mode is selected the time switch setup is complete.

NOTE: If no scheduled events are programmed, only MANUAL mode is available.

In AUTO mode, the time switch follows the user-programmed events and the circuit turns ON and OFF at the programmed time(s).

- To place in AUTO mode, press MODE and advance until the **AUTO** icon appears on the display.
- In AUTO mode, pressing an ON/OFF button temporarily overrides the current state of the circuit. The time switch returns to the normal schedule at the next programmed event.

In ENERGY SAVER mode the time switch operates similarly to AUTO mode with the following exceptions:

- The ON/OFF buttons manually activate the circuit for only a 2-hour period.
- When a 2-hour period is active, pressing ON/OFF extends the active period by 2 hours.
- Pressing and holding (for 3 seconds) the ON/OFF button will turn OFF the circuit.

For ENERGY SAVER mode, press the MODE button until the **AUTO** icon on the display flashes.

In MANUAL mode the time switch does not follow any programmed events and only activates the circuit when the ON/OFF button is pressed.

- For MANUAL mode, press the MODE button until the **MANUAL** icon appears on the display.

Deleting (Clearing) an Event

Fixed events can be deleted from the time switch. If you need to delete an event, follow this procedure.

- If necessary, press MODE to scroll through the different mode selections until SET FIXED ON/OFF EVENTS appear on the display.
- Press ENTER/NEXT as necessary to scroll through the scheduled events until you see the event you want to delete.
- Press + and - **at the same time** until the display shows --:-- --. This indicates the event is erased.
- If necessary, press ENTER/NEXT to scroll through the other configured events.
- Press MODE to save the changes and exit.

Clearing Time Switch Memory

During a "Clear Time Switch Memory" operation, the time switch resets all programmed settings to their factory default value. The following occurs:

- After a brief period of time the time switch model number appears, followed by the USB Boot Loader version, EE Boot Loader version, the firmware revision and finally the Reset Reason Code.
- MEMCLR is displayed followed by DONE when the operation is completed.

To perform a "Clear Time Switch Memory" operation do the following:

- Press and hold ENTER/NEXT.
- While pressing and holding ENTER/NEXT, press and release the RESET (round) button. Do not release ENTER/NEXT.
- Continue to press and hold ENTER/NEXT until **MEM CLEAR** then **DONE** briefly appears.

Writing Time Switch Program Data to a USB Memory Stick

The time switch has the capability to copy its programmed data (event schedules, holidays, output configuration, DST on/off setting, DST rule setting and geographical location) to a USB memory stick. Follow these steps to transfer all programming from the time switch to a USB memory stick:

- Press MODE to advance until *wr USB* is displayed.
- Press ENTER and *insUSB* is displayed.
- Insert a USB memory stick into the USB port on the front face of the time switch.
- SCHEDL 01* is displayed. Press + or - to increment/decrement the schedule number on the display (01-99).
- When the desired number is displayed, press ENTER and this will write the data file to the USB memory stick. The file name will be *SCHEDL.xx.TXT* where xx is the schedule number selected in the previous step.
- After the file is written *REMOVE* is shown on the display.
- Remove the USB memory stick and the time switch will advance to the next mode selection. If all procedures are completed, press MODE repeatedly until back to the operating mode selection (AUTO, ENERGY SAVER, MANUAL).

Reading Time Switch Program Data from a USB Memory Stick

The time switch has the capability to read program data (event schedules, holidays, output configuration, DST on/off setting, DST rule setting and geographical location) from a USB memory stick. Follow these steps to transfer all programming from a USB memory stick to the time switch:

- Press MODE to advance until *rd USB* is displayed.
- Insert a USB memory stick containing the desired data file into the USB port on the front face of the time switch.
- Press ENTER and *insUSB* is briefly displayed.
- SCHEDL.xx* is displayed where xx is the first data file number found on the USB memory stick.
- Press + or - to scroll through the data files on the USB memory stick (if more than one file is stored on this stick).
- When the desired number is displayed, press ENTER and the time switch will read the data file from the USB memory stick.
- After the file is read into the time switch, *DONE* is briefly shown on the display followed by *REMOVE*.
- Remove the USB memory stick and the time switch will advance to the next mode selection. If all procedures are completed, press MODE repeatedly until back to the operating mode selection (AUTO, ENERGY SAVER, MANUAL).



USB error codes

If a problem occurs when attempting to perform a USB read or write operation the time switch will show an error code on the display. Following is a description of the different error codes:

OPFILE Er	File could not be created on the USB memory stick (stick may be write protected or corrupted)
wrFILE Er	Program data could not be written to the USB memory stick (stick may be full)
oPFILE ER	File could not be opened for reading from the USB memory stick
rdFILE Er	File could not be read from the USB memory stick
MSDH Er	USB device is not a memory type device
FATFS Er	Fat file system error indicating the memory stick contains a data format that is incompatible with the time switch
DEVICE Er	USB memory stick is defective
shCrt Er	The power supply for USB port on the time switch is not functioning

Specifications

Input Voltage: 120-277 VAC, 60 Hz

Power Consumption: 3 W MAX

Switch Configuration: SPDT x 1. See wiring diagrams in this manual.

Switch Ratings:

Rating NO	Rating NC	Load Type	Voltage	Frequency
20 A	10 A	Resistive	120-240 VAC	60 Hz
20 A	10 A	Resistive	28 VDC	—
20 A	10 A	Inductive	120-240 VAC	60 Hz
20 A	3 A	Magnetic Ballast	120-277 VAC	60 Hz
10 A	—	Electronic Ballast	120/277 VAC	60 Hz
1 HP	1/4 HP	Motor	120 VAC	60 Hz
2 HP	1/2 HP	Motor	240 VAC	60 Hz

Events: Time switch can support up to 48 fixed ON and 48 fixed OFF events.

Clock Backup: 100-hour Supercapacitor

Wire Size: AWG #14-#8

Minimum ON or OFF time: 1 minute

Maximum ON or OFF time: Indefinite

Shipping Weight: 2.5 lb. (1.1 kg)

Enclosures: Rainproof Type 3R indoor/outdoor lockable metal enclosure (ET2715CR), Type 1 indoor lockable metal enclosure (ET2715C), Rainproof Type 3R indoor/outdoor lockable plastic enclosure (ET2715CP)

Knockouts: Combination 1/2-3/4 in. size, 1 on rear and each side, 2 on bottom

LIMITED TWO-YEAR WARRANTY

If within the warranty period specified, this product fails due to a defect in material or workmanship, Intermatic Incorporated will repair or replace it, at its sole option, free of charge. This warranty is extended to the original household purchaser only and is not transferable. This warranty does not apply to: (a) damage to units caused by accident, dropping or abuse in handling, acts of God or any negligent use; (b) units which have been subject to unauthorized repair, opened, taken apart or otherwise modified; (c) units not used in accordance with instructions; (d) damages exceeding the cost of the product; (e) sealed lamps and/or lamp bulbs, LED's and batteries; (f) the finish on any portion of the product, such as surface and/or weathering, as this is considered normal wear and tear; (g) transit damage, initial installation costs, removal costs, or reinstallation costs.

INTERMATIC INCORPORATED WILL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES. ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY MODIFIED TO EXIST ONLY AS CONTAINED IN THIS LIMITED WARRANTY, AND SHALL BE OF THE SAME DURATION AS THE WARRANTY PERIOD STATED ABOVE. SOME STATES DO NOT ALLOW LIMITATIONS ON THE DURATION OF AN IMPLIED WARRANTY, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

This warranty service is available by either (a) returning the product to the dealer from whom the unit was purchased or (b) completing a warranty claim online at [www.intermatic.com](http://www.intermatic.com). This warranty is made by: Intermatic Incorporated, Customer Service 7777 Winn Rd., Spring Grove, Illinois 60081-9698. For warranty service go to: <http://www.Intermatic.com> or call 815-675-7000.

INTERMATIC INCORPORATED  
7777 Winn Road  
SPRING GROVE, ILLINOIS 60081-9698  
[www.intermatic.com](http://www.intermatic.com)

## **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.**

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**Ace Heaters, LLC**

[www.aceheaters.com](http://www.aceheaters.com)

SO # \_\_\_\_\_

Serial No. \_\_\_\_\_

Model No. \_\_\_\_\_