Algas·SDI™

...Innovative liquid vaporizing and gas mixing solutions

ISO 9001 Certified

QM

Packaged Propane-Air Vaporizer/Mixer System
Models: QM 28 through QM 150

Operations & Maintenance Manual

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ECLIPSE Innovative Thermal Solutions

WARNING

Read the OPERATION MANUAL before operating this equipment.

- **NOTE: Algas-SDI reserves the right to use alternate manufacturers' components as vendor delivery applicability dictates. Literature contained in the Operation Manual has been supplied by vendors. Please check to be sure supplied data matches your configuration. Contact Algas-SDI if any questions exist.**
- **This equipment uses LPG-a flammable fuel handled under pressure. Inherent hazards exist and a thorough understanding of the equipment is required to allow safe operation and maintenance.**
- **Allow only a TRAINED and FULLY QUALIFIED PERSON to service this equipment.**
- **Any time a component must be replaced, use the same type, model, etc. DO NOT SUBSTITUTE! The consequence from such actions are unpredictable and may lead to dire consequences. When components are replaced with components not approved for use in our FM/CSA listed equipment, the FM/CSA listing becomes void for that unit.**

DISCLAIMER and WARNING

Read this Operation and Maintenance Manual before operating the QM system.

DISCLAIMER

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In accordance with the manufacturer’s policy of continual product improvement, Algas-SDI. reserves the right to use alternate manufacturer’s components as vendor delivery applicability dictates. Literature contained in the Operation Manual has been supplied by vendors. Please check to be sure supplied data matches your configuration. Contact Algas-SDI. if any questions exist.

WARRANTY REGISTRATION

To Register your new equipment: Visit **Algas-SDI's** web site at: algas-sdi.com, then click on the "Tech Support" button. Select online Registration or print out the Acrobat Warranty Registration.

OR

Fill out the Warranty Registration information on the last page of this manual. Then make a photocopy and mail to the address shown at the bottom.

WARRANTY, COPYRIGHTS AND APPROVALS

WARRANTY

Algas-SDI International, LLC (ASDI) warrants that the equipment is free of defects in materials and workmanship under normal use and service. ASDI agrees to repair or replace, at our option, without charge f.o.b. factory, any part which has proven defective to the satisfaction of Algas-SDI International, LLC within one (1) year from the date of the original installation or within 18 months from the date of shipment, whichever is earlier. Equipment, which in the opinion of ASDI, has been damaged by improper installation or operation, or has been abused or tampered with in any way, will not be accepted for return under warranty.

Algas-SDI International, LLC will not accept back charges for work performed by others upon or in conjunction with ASDI equipment, unless prior authorization is given by means of an Algas-SDI International, LLC purchase order. Algas-SDI International, LLC will not be liable by reason of shutdown, non-operation or increased expense of operation of other equipment, or any other loss or damage of any nature, whether direct or consequential, arising from any cause whatsoever.

Algas-SDI International, LLC makes NO other warranty of any kind, whatsoever expressed or implied; and all warranties of merchantability and fitness for a particular purpose are hereby disclaimed by Algas-SDI International, LLC and excluded from these terms of sale. No person has any authority to bind Algas-SDI International, LLC to any representation or warranty other than this warranty.

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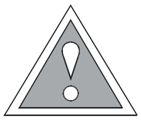
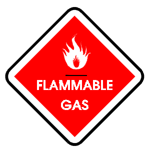
SYMBOLS AND CONVENTIONS

Special symbols are used to denote hazardous or important information. You should familiarize yourself with their meaning and take special notice of the indicated information.
Please read the following explanations thoroughly.



GENERAL WARNING OR CAUTION

Indicates hazards or unsafe practices which can result in damage to the equipment or cause personal injury. Use care and follow the instructions given.



FLAMMABLE GAS HAZARD

Indicates a potential hazard which can result in severe personal injury or death. Use extreme care and follow the instructions given.

ELECTRICAL DISCONNECT REQUIRED

Indicates a potentially dangerous situation which can result in severe personal injury or death or damage to equipment. Use great care and follow the instruction given.

ASDI CONTACT NUMBERS

If you have questions, need help with your equipment, or want information on other products, contact Algas-SDI at:

Telephone: 206.789.5410 (ext. 116)

Facsimile: 206.789.5414

Email: sales@algas-sdi.com

Internet: http://www.algas-sdi.com

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Appendix A Component Information

Warranty Registration - Refer to the nameplate on the unit to fill out the product registration. Then Photo copy and mail to address shown. Or register on line by visiting Algas-SDI web site under "Tech Support".

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Introduction 1

Description/Overview

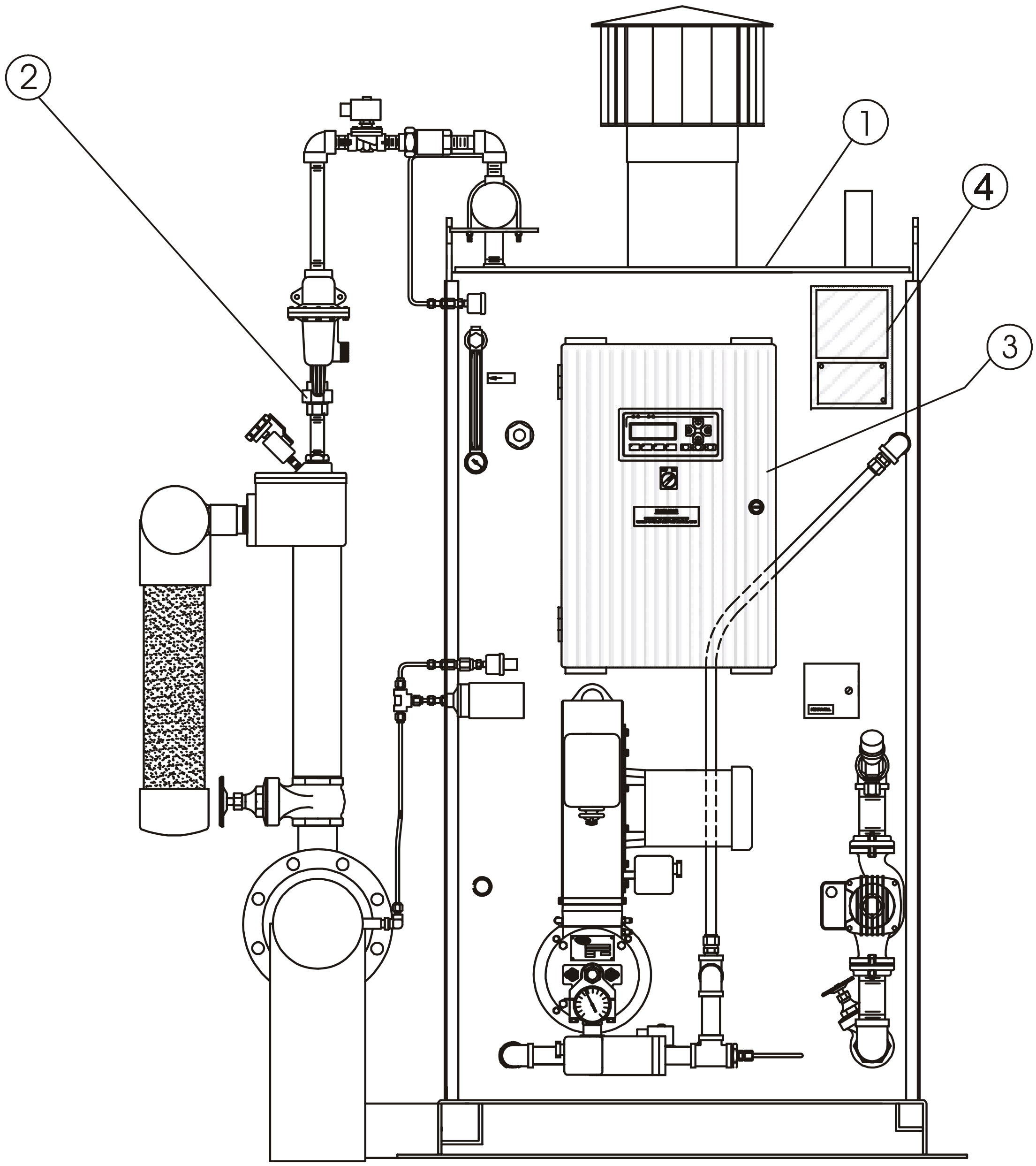
The **Algas-SDI QM** natural gas replacement system is a combination gas fired waterbath LPG vaporizer and an atmospheric venturi LPG/Air mixer. The QM system first vaporizes the Liquid Propane Gas (LPG fed from a storage tank, by passing it through a heat exchanger immersed in a heated water/glycol mixture. A forced draft burner keeps the waterbath at the required temperature. Venturi's mix the LPG vapor with air giving it combustion characteristics of natural gas. Responding to different loads, a Programmable Logic controller (PLC) controls the heating and mixing processes maintaining a steady mixed gas pressure in the accumulator tank. The QM is designed for outdoor installation as a baseload or standby system; offered in several sizes and mixing pressures to best fit specific operating requirements.

Optional features include PC link software for remote monitoring and control, Industrial Risk Insurers (IRI), or Canadian Gas Association (CGA) burner controls, and a backup electric bath heater.

QM SYSTEM BASIC FEATURES

- An indirect fired LPG vaporizer composed of two heat exchangers, burner, and a waterbath heat transfer medium.
- An LPG/AIR MIXER blends the LPG vapor with air at an established ratio enabling the mixture to burn with qualities similar to natural gas.
- A cabinet houses the Operator Interface, fuses, and the PLC Sequencer. Should a safety circuit fail, the panel annunciator displays the alarm. A heater is housed in the control box to maintain an optimum operating temperature for all internal parts. NOTE: Leave power on during shutdowns so heater can continue to function. LPG circulation pump control enables pump operation when needed.
- The Safety Circuit includes an electronic flame safeguard to guarantee positive and safe burner operation through constant flame monitoring. Fuses in the control box prevent overloads. The vaporizer will shut down in the event of high waterbath temperature, liquid LPG level carryover, high and/or low burner gas supply pressure, low water bath level, burner failure, or high mixed gas pressure.
- In addition to the safety circuit elements, the LPG/AIR Mixer will shut down on low vapor pressure, or the optional alarms, if used.

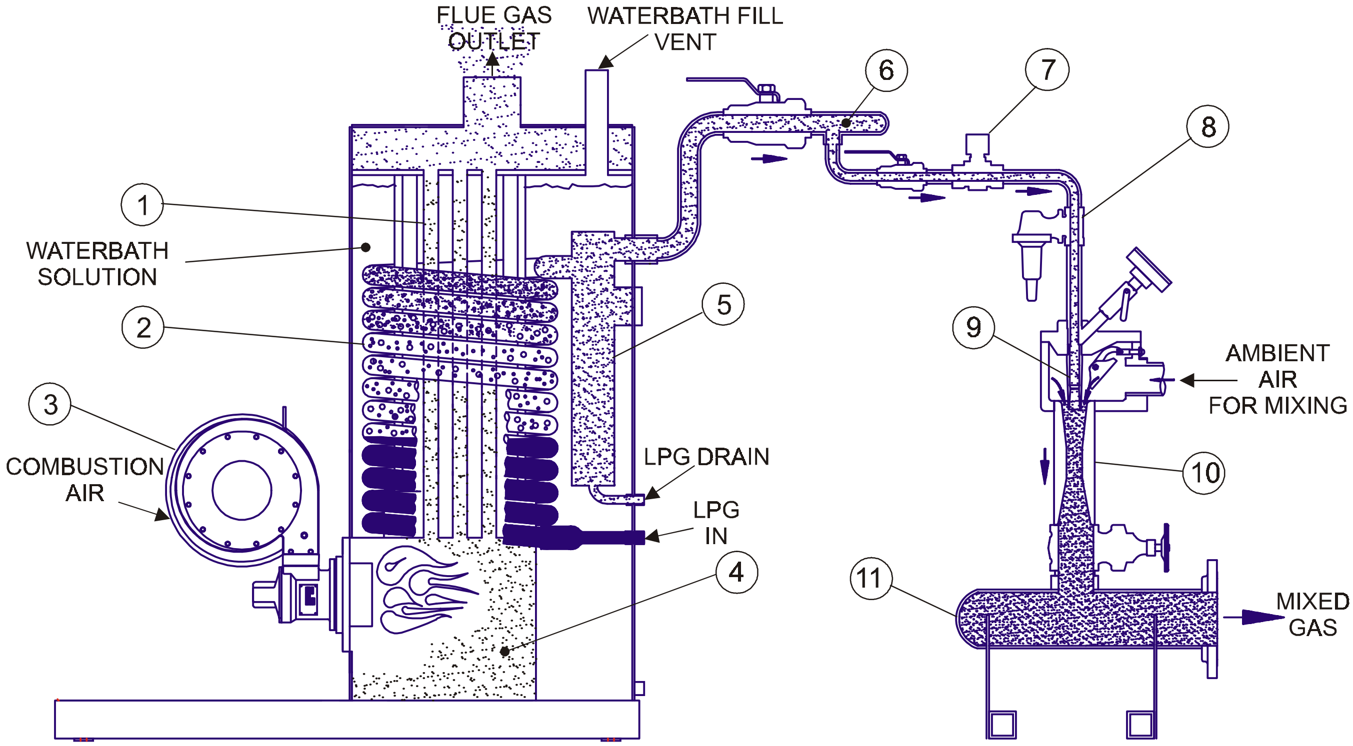
Figure1 — *QM Vaporizer - LPG/Air Mixer System Basic Features*



QM Vaporizer.wmf

1. **LPG vaporizer**
2. **LPG/air mixer**
3. **Operator panel**
   - **Operator interface**
   - **PLC sequencer**
4. **Flame safeguard**

***Figure 2** — QM System Dynamics*

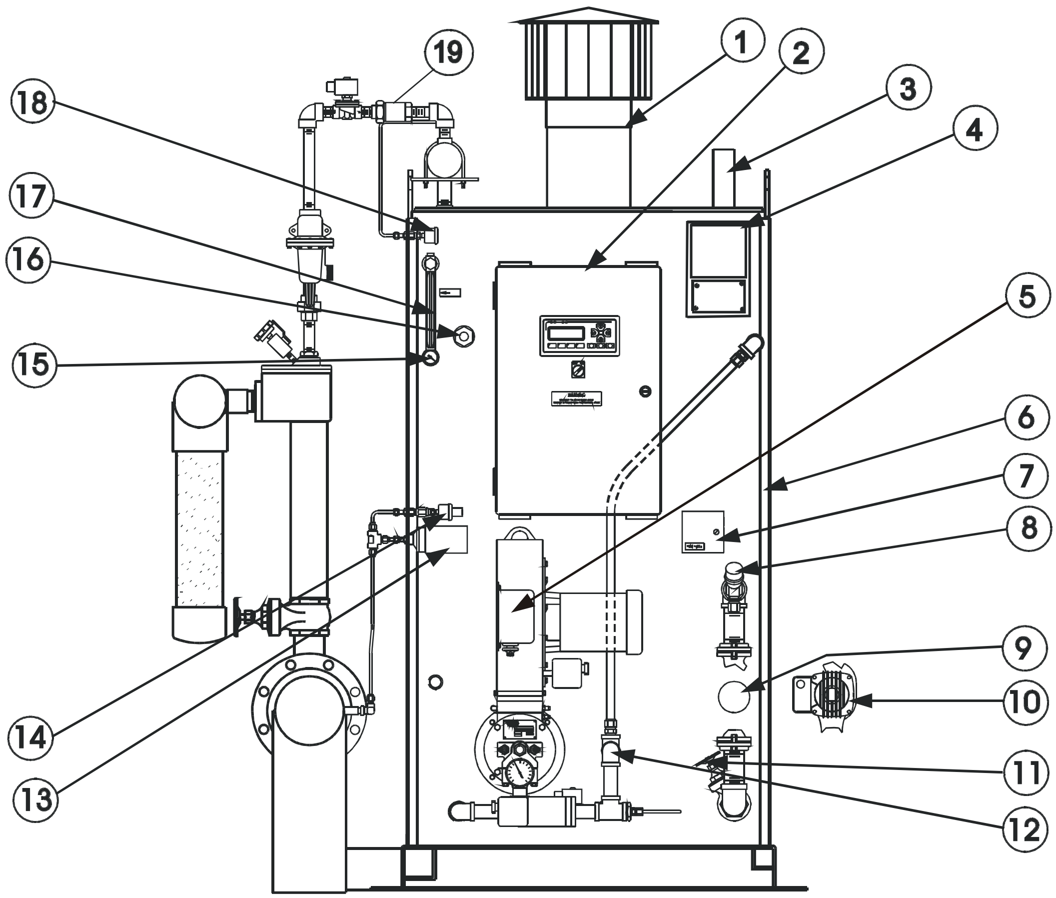


QM System Dynamics.wmf

1. **Fire tubes (typical)**
2. **LPG heat exchanger**
3. **Burner / blower assembly**
4. **Combustion chamber**
5. **LPG outlet manifold**
6. **High pressure LPG vapor**
7. **Venturi solenoid valve**
8. **Pressure control regulator**
9. **Venturi nozzle**
10. **Venturi diffuser**
11. **Mixed gas outlet manifold**

Major Component Drawings 2

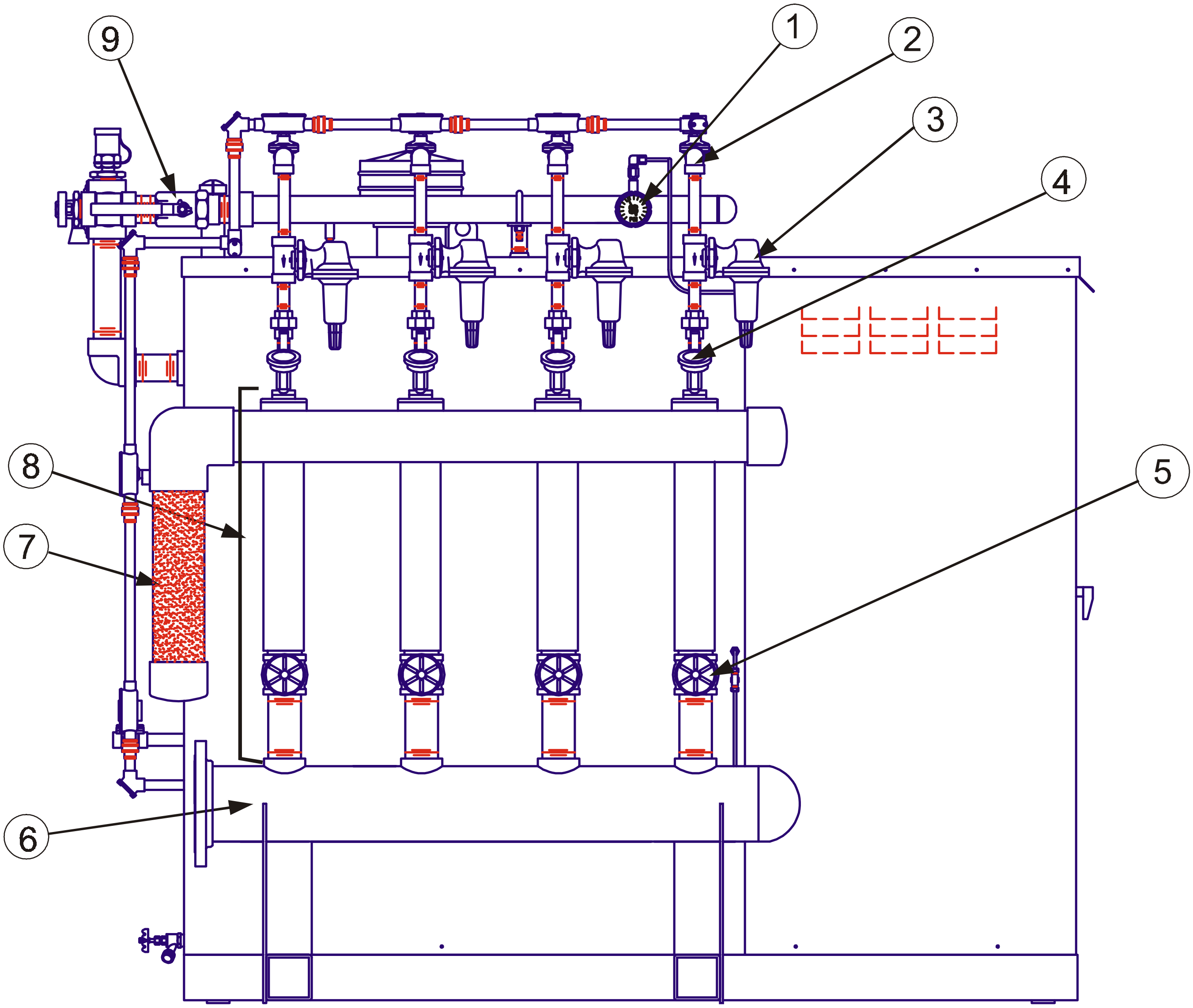
Figure 3 — *QM Component Diagram - Front View, Door Open*



QM Comp Diag.wmf

1. **Flue gas outlet**
2. **Control box,** ***See also Figure 6.***
3. **Waterbath fill**
4. **Flame safeguard**
5. **Ignition transformer**
6. **Waterbath heat exchanger**
7. **High water temperature limit**
8. **Waterbath temperature transmitter**
9. **Standby electric bath heater (optional)**
10. **Water circulation pump**
11. **Water train isolation valve**
12. **Burner gas train, S*ee also Figure 7 & Figure 8***
13. **High mixed gas pressure switch**
14. **Mixed gas pressure transmitter**
15. **Waterbath temperature gauge**
16. **Low Water level switch**
17. **Water fill sight glass**
18. **Low vapor pressure transmitter**
19. **Venturi vapor shutoff hand valve**

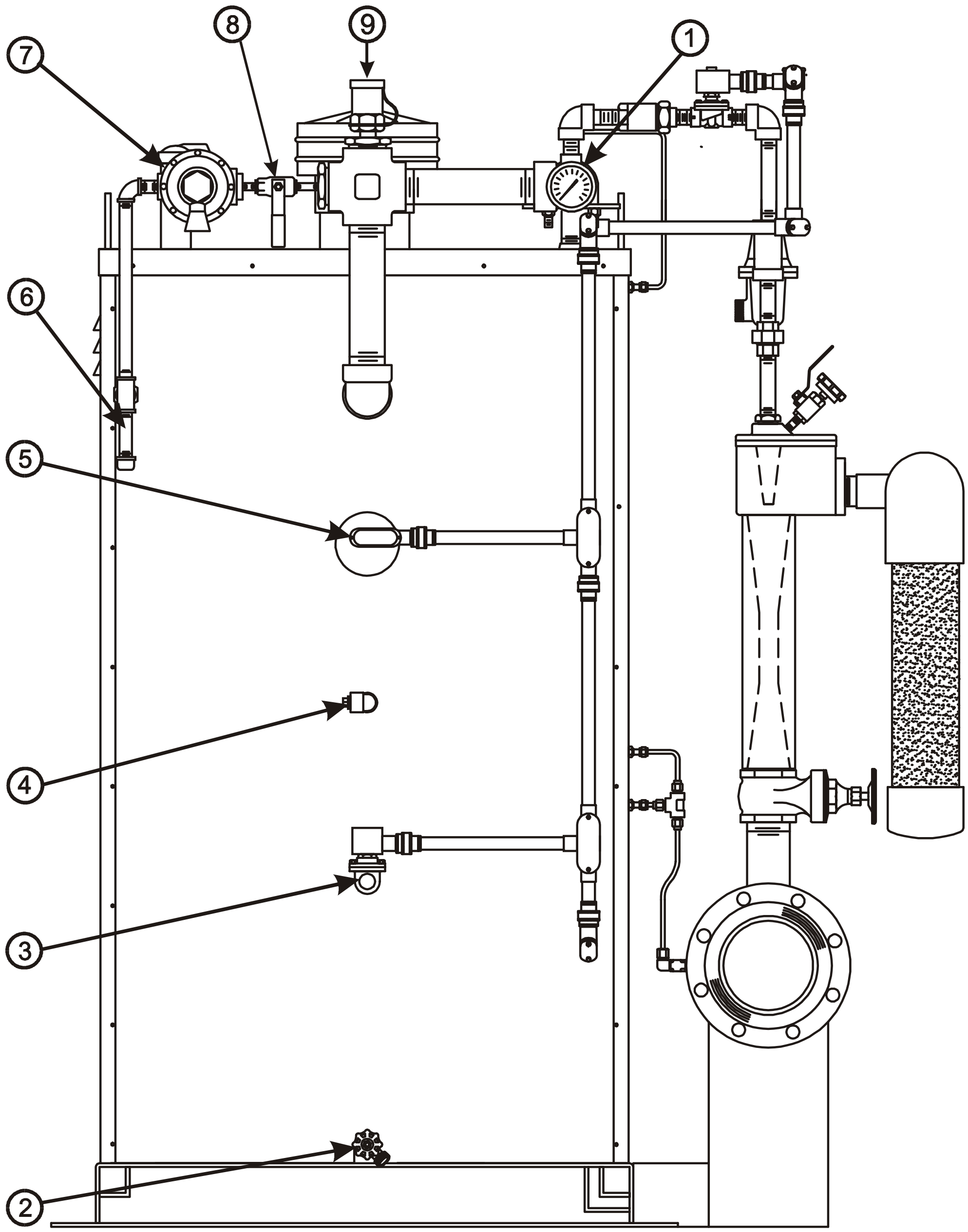
Figure 4 — *QM Component Diagram - Side View*



QM Comp Diag-side.wmf

1. **Vapor pressure gauge**
2. **Venturi solenoid valve**
3. **Venturi pressure regulator**
4. **Venturi pressure gauge**
5. **Venturi isolation valve**
6. **Mixed gas outlet header**
7. **Air inlet header**
8. **Venturi train**
9. **Vapor outlet shutoff valve**

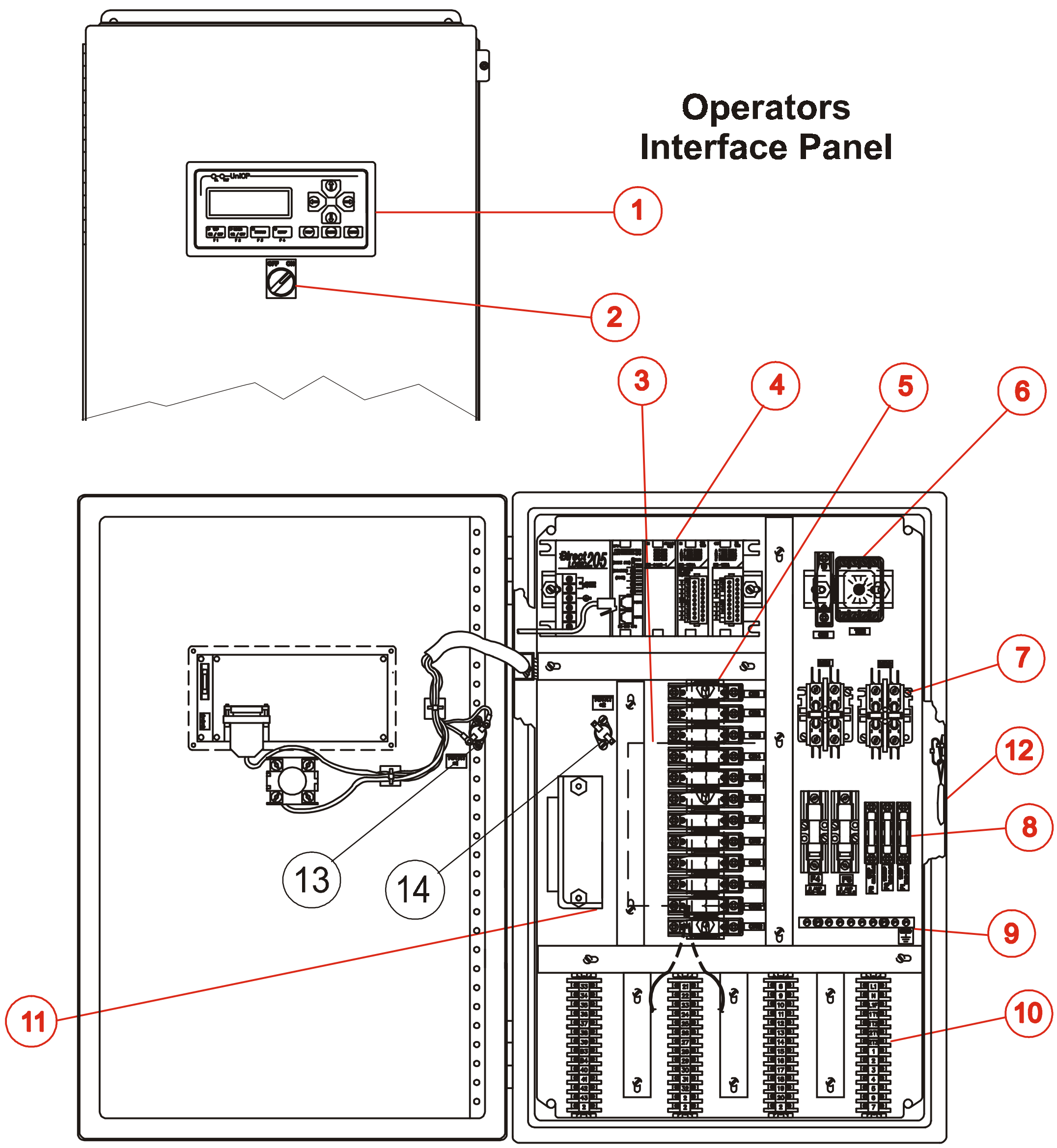
***Figure 5** — QM Component Diagram - Back View*



QM Comp Diag-back.wmf

1. **Vapor outlet temperature gauge**
2. **Waterbath drain**
3. **LPG inlet solenoid valve**
4. **LPG/contaminants drain**
5. **Liquid LPG level float switch**
6. **Burner train drip leg**
7. **Burner regulator**
8. **Burner supply hand valve**
9. **LPG relief valve**

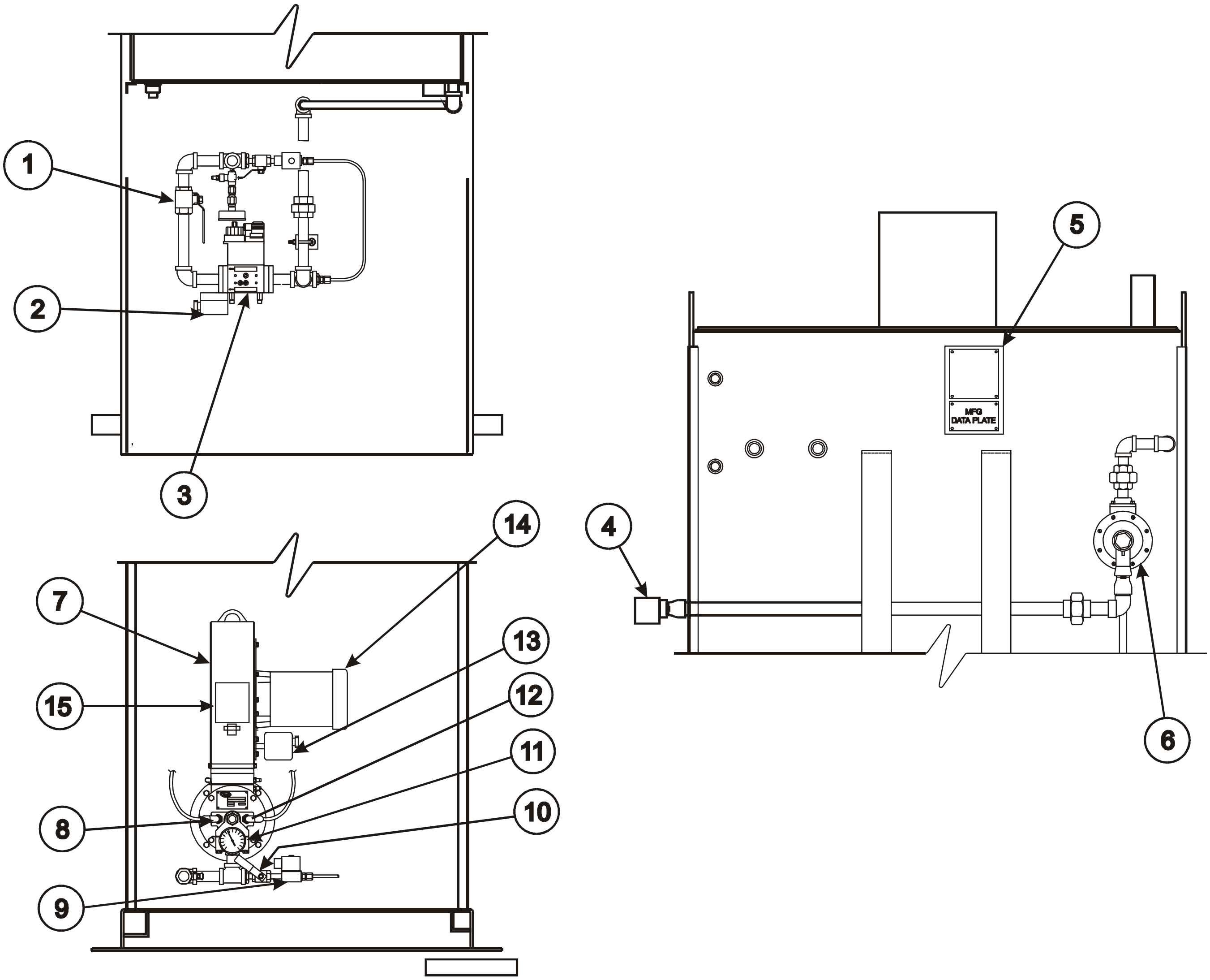
Figure 6 *— QM Component Diagram - Inside Control Box*



QM Control Box.wmf

1. Operator interface panel
2. Master control switch
3. Control panel heater
4. PLC sequencer
5. Output relays
6. Time delay relay
7. Motor control contactors
8. Fuse blocks
9. Ground buss
10. Control box terminals
11. 24 VDC power supply
12. Moisture desiccant packet
13. Heater operating thermostat
14. Heater overtemp safety

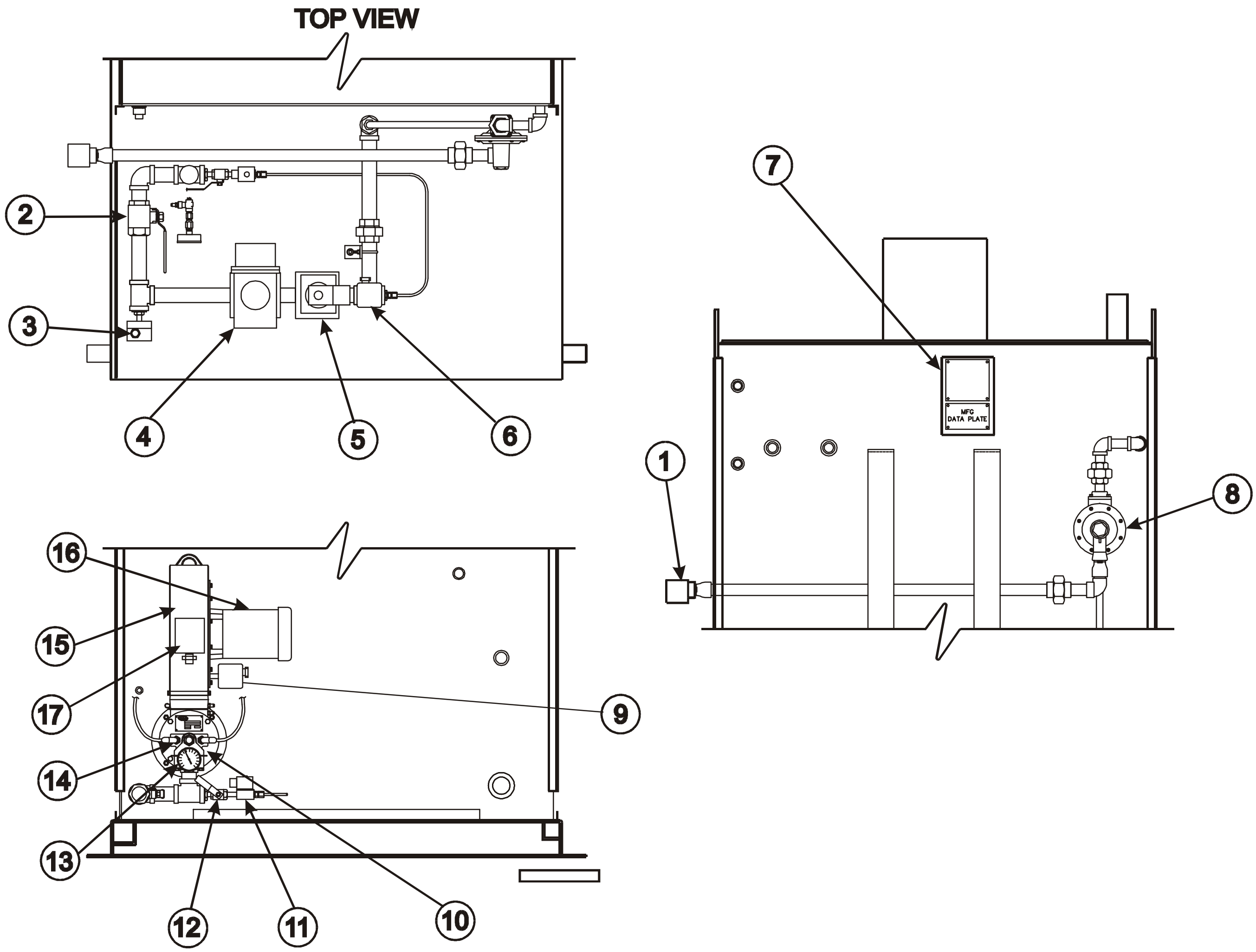
Figure 7 – *Burner Train Component Layout*
Standard Q320V through Q1650V Models and Minnesota Q320V or Q800V



QM Burner Train.wmf

1. **Main gas supply hand valve**
2. **High gas pressure switch**
3. **Dual main gas valve**
4. **2nd stage regulator relief vent (on Q1120V & Q1650V only)**
5. **Flame safeguard**
6. **2nd stage burner regulator (on Q1120V & Q1650 only)**
7. **Blower housing assembly**
8. **Flame rod / UV scanner (on Q1650 only)**
9. **Gas pilot solenoid valve**
10. **Pilot supply hand valve**
11. **Burner inlet pressure gauge**
12. **Ignition spark plug**
13. **Air flow switch**
14. **Blower motor**
15. **Ignition transformer**

Figure 8 — *Burner Train Component Layout*
Q1120V & Q1650V, Minnesota Option



QM Minnesota Burner.wmf

1. **2nd stage regulator relief vent**
2. **Main gas supply hand valve**
3. **High gas pressure switch**
4. **Main gas safety valve**
5. **2nd gas safety valve**
6. **Low gas pressure switch**
7. **Flame safeguard**
8. **2nd stage burner regulator**
9. **Air flow switch**
10. **Ignition spark plug**
11. **Gas pilot solenoid valve**
12. **Pilot supply hand valve**
13. **Burner inlet pressure gauge**
14. **Flame rod / UV scanner (on Q1650 only)**
15. **Blower housing assembly**
16. **Blower motor**
17. **Ignition transformer**

Installation 3

QM SYSTEM INSTALLATION

PROCEDURE

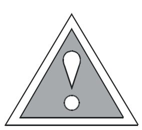
Installation of the QM system begins with the physical placement of your unit on a concrete base. Second, connect all required liquid piping from the LPG storage tank to the QM system. Third, hook up the mixed gas outlet to the accumulator tank. Fourth, make necessary system electrical connections, which will include power to the operator panel, and may include connections to the LPG pump (optional). Finally, protect your new QM system for freezing and corrosion for many years of service, by addition of a heat transfer fluid.

Install the QM system in accordance with applicable codes and local regulations as required. Consult state, provincial, and local authorities, as well as insurance carriers for installation requirements.

NOTE

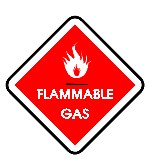
The software program for controlling the blending operation is set at the factory and is protected by international copyright laws.

WARNING



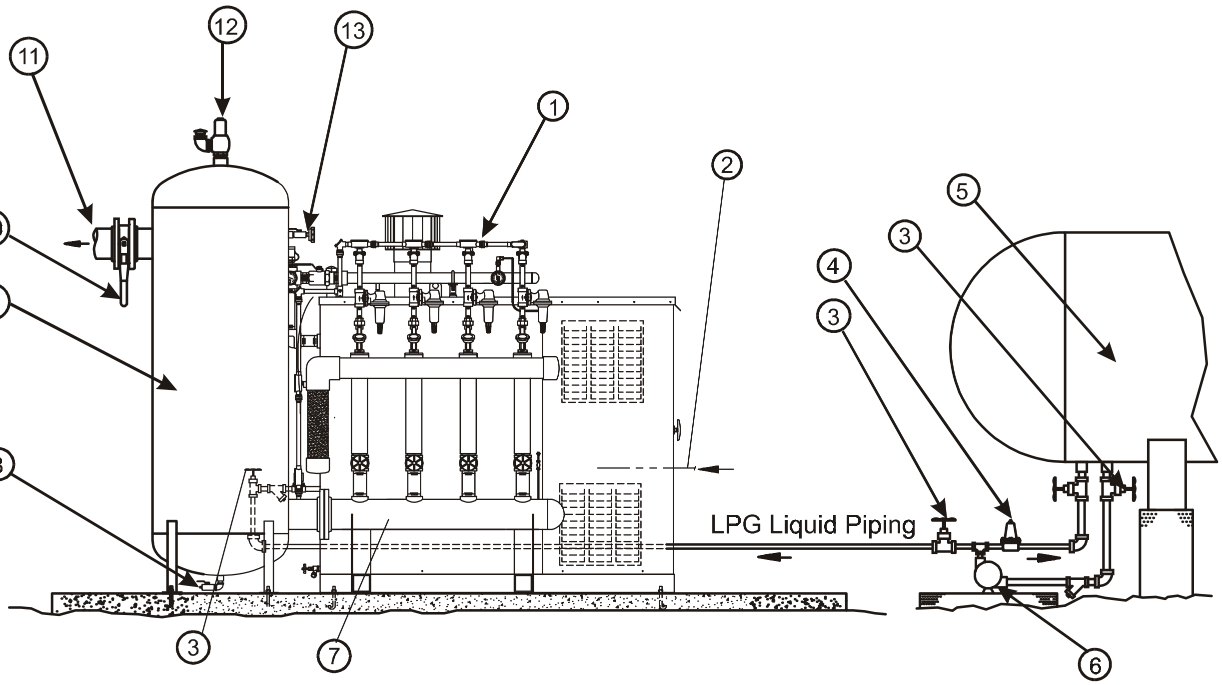
If not operated and maintained in accordance with the manufacturer's instructions, this product could expose you to substances in fuel or combustion which could cause death or serious illness, which are known to the state of California to cause cancer, birth defects and/or reproductive harm. Improper servicing of this equipment may create a potential hazard to equipment and operators.

CAUTION



All servicing of LPG equipment should be performed by qualified technicians.

Figure 9 *— Typical QM System Installation with External Components*



QM Installation.wmf

1. Packaged QM vaporizer/mixer system	***8. Accumulator tank drain**
***2. Electrical service required**	***9. Accumulator tank**
***3. Isolation valve with hydrostatic relief**	***10. Mixed gas outlet valve**
***4. Pump pressure control valve**	***11. Mixed gas outlet**
***5. LPG storage tank**	***12. Relief valve**
***6. LPG pump**	***13. Pressure gauge**
***7. Liquid line Strainer**	*** Customer supplied**

NOTE

Install QM system per NFPA 58, 70, and other applicable codes.

Physical Requirements

A typical installation configuration of a QM system with external components is shown above. Install the system on a firm level base, preferably a reinforced concrete pad that meets local regulation requirements for the system. Bolt the system securely through the mounting holes provided. Prior to making final piping connections, clean all foreign material from the pipes. Protect the unit against damage from moving vehicles with an appropriate barrier.

If any portion of the system is installed indoors, pipe all relief valves, flue outlets and regulator vents **OUTSIDE** of the enclosure or building per applicable codes and local regulation, as required.

Liquid Piping Installation

Size the liquid line from the storage tank to the vaporizer to supply the vaporizer at full capacity with a minimal pressure drop.

CAUTION

A liquid pump must be installed if the pressure drop in the liquid line between the vaporizer and the tank exceeds the hydrostatic liquid head in the storage tank. ONE FOOT OF LIQUID PROPANE EQUALS .21 PSI! Liquid line frosting is a sure indication of too much pressure drop in the liquid line.

LIQUID PUMP

Is a Liquid Pump necessary? What are your vapor pressure requirements?

Pressure in the storage tank depends on temperature. A good “rule of thumb” for determining when a Liquid Pump is necessary is this: If the storage pressure will not always exceed the required distribution pressure by 5 psig (0.35 kg/cm^2), a pump is necessary. Install an **ASDI STABILAIRE LIQUID PUMP** in the liquid line close to the storage tank. To prevent cavitation, place the liquid strainer at least five feet upstream of the pump inlet. Typically a pump is not required unless a mixing system is used or temperature at the installation will be extremely low, causing the pressure to drop below the pressure the required process pressure.

- Piping connections will begin at the LPG storage tank and enter the QM unit at the vaporizer’s liquid inlet.
- Connect the liquid LPG supply line **(Figure 9)** to the vaporizers liquid inlet **(Figure 5, Item 3)**.

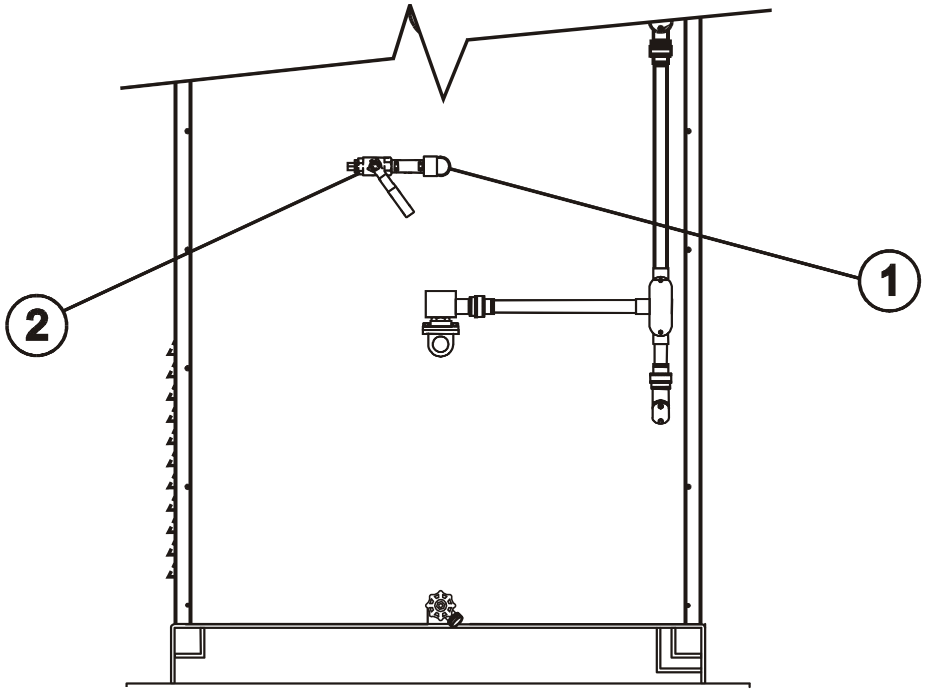
NOTE

Do not install check valves or other devices that prevent backflow in the liquid LPG line.

Determine the minimum LPG supply pressure required (***See Data Sheet***) and install a suitable pump if needed.

- Install a **LIQUID LINE STRAINER (Figure 9, Item 7)** upstream of the vaporizer. The strainer should be 40 mesh with a magnetic plug.

Figure 10 – *Installation Position of Plugged Drain at LPG Contaminants Drain*

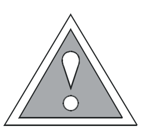


LPG Contaminants Drain.wmf

1. LPG contaminants drain **2. Plugged drain valve**

- Clean all foreign material from all pipe lines prior to making final connections. All joints require a pipe sealant suitable for Liquid Propane Gas. Test for leaks using an inert gas, such as carbon dioxide or nitrogen, at approximately 30 PSIG (2.1 kg/cm^2) in all mixed gas lines after the LPG/Air mixer. Check all connections using an appropriate leak detection solution or device.

NOTE



Undersized inlet pipes for LPG are frequently the cause of vaporizer problems.
Frost covering inlet pipes is a sure sign that the pipe is undersized. If the inlet pipe is too small, the LPG vaporizes before it enters the vaporizer causing a drastic drop in efficiency. Inlet pipes sized too small can reduce vaporizer output as much as 50%.
Even small piping leaks are unacceptable! Eliminate all leaks prior to operation. Check all connections using an appropriate leak detection solution or device.
If water is used for hydrostatic testing, make sure all water is removed from piping prior to operating the equipment.

Mixed Gas Outlet Installation

ACCUMULATOR SIZE

- Provide a correctly sized **MIXED GAS ACCUMULATOR, (SURGE TANK, Figure 9, Item 9)** suitable for the intended service and pressure. The tank must have a relief valve, drain, pressure gauge, mixed gas inlet and outlet (the same size), pressure sensing port and gas sampling port. Refer to the table below for accumulator tank requirements. An oversized tank is actually preferred because it improves CV stabilization by reducing venturi cycling rates.

Table 1 - *Surge Tank Requirements*

<table>
<tr><th rowspan="2">MODELS[1]</th><th colspan="5">DELIVERY PRESSURE[2]</th></tr>
<tr><th>5 PSI</th><th>8 PSI</th><th>10 PSI</th><th>12 PSI</th><th>15* PSI</th></tr>
<tr><td>28</td><td colspan="4" rowspan="11">240 U.S. GALLONS</td><td rowspan="11">500 U.S. GALLONS</td></tr>
<tr><td>35</td></tr>
<tr><td>39</td></tr>
<tr><td>42</td></tr>
<tr><td>52</td></tr>
<tr><td>56</td></tr>
<tr><td>65</td></tr>
<tr><td>70</td></tr>
<tr><td>75</td></tr>
<tr><td>84</td></tr>
<tr><td>88</td></tr>
<tr><td>100</td><td colspan="5" rowspan="3">500 U.S. GALLONS</td></tr>
<tr><td>125</td></tr>
<tr><td>150</td></tr>
</table>

All 15 PSI models require an accumulator tank of at least 500 gallons capacity.

[1]Capacity is based on a nominal mixed gas gross heating value of 1450 BTU/SCF with commercial grade LPG. Actual capacity and mixed gas heating value may vary slightly based on installation and operating conditions.

[2]Delivery pressures shown are valid up to 2,000 feet elevation. Contact the factory for information regarding applications at higher elevations.

- Connect the **MIXED GAS OUTLET (Figure 9, Item 11)** of the unit to **ACCUMULATOR OPENING**, or tee the accumulator into the **MIXED GAS OUTLET SPOOL**. It is not necessary for the flow to pass through the accumulator since its purpose is to act as a volume buffer. The interconnecting spool should be the same diameter as the **MIXED GAS OUTLET** and no longer then **TEN FEET**. A shutoff valve should be installed connected into the **MIXED GAS OUTLET SPOOL.**

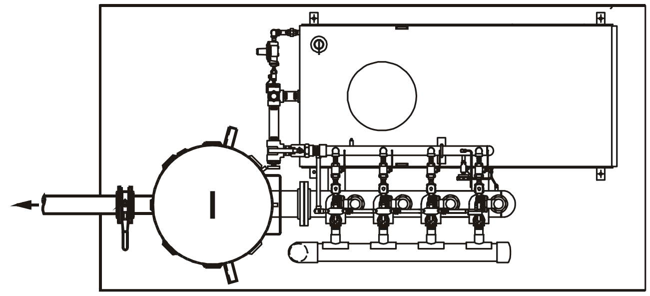
- Algas-SDI can provide an appropriately sized accumulator for your system. Illustrated below are several piping arrangements that could be used with the Algas-SDI accumulator tank (optional).

Figure 11 - *Accumulator Tank Piping Arrangements*

NOTE

All 5, 8, 10 & 12 PSIG Systems

84 MM BTU / HR or less

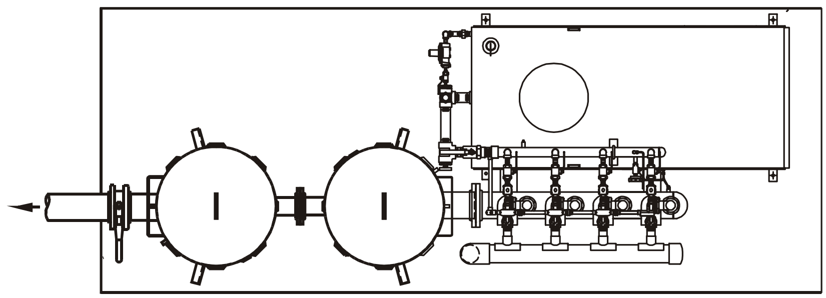


NOTE

All 15 PSIG Systems

QM 28-15 through QM 84-15

**OK for use with all systems
84 MM BTU / HR or less**

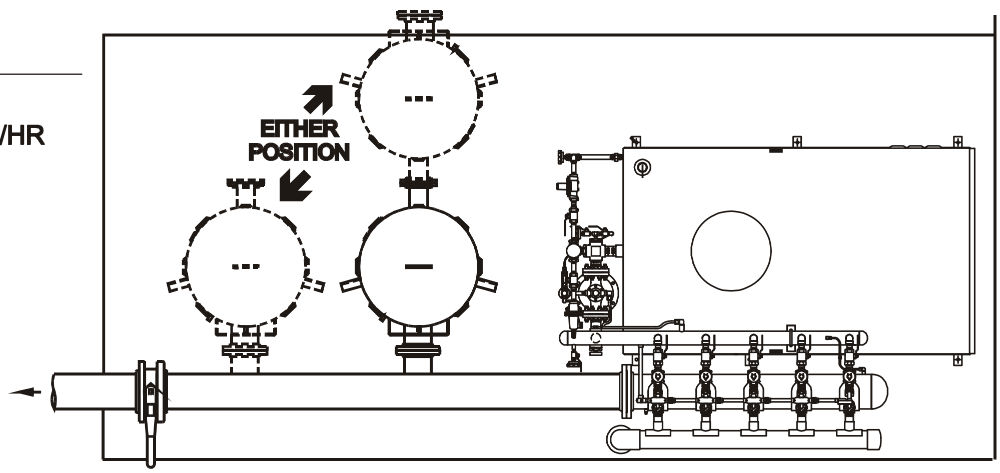


NOTE

**All Systems
greater than 84 MM BTU/HR
& 15 PSIG Systems**

QM 100 - QM 150

**OK for use with smaller
systems but not required**



Accumulator Arrangments.wmf

- Clean all **PIPELINES** prior to making final connections. Welding slag can jam piston-type solenoid valves. All joints require a pipe sealant for LPG. Test for leaks using an inert gas such as carbon dioxide or nitrogen at 150 PSIG (10.5 kg.cm^2).

Install Flare Stack

- ASDI recommends that a **FLARE STACK** be installed so the QM system can be operated for a short initial period to permit setting the desired mixed gas pressure (system delivery), to confirm adjustments to the motive pressure regulators and check the BTU valve of mixed gas.

Electrical

- Make **ELECTRICAL SERVICE CONNECTIONS** to the **CONTROL PANEL (Figure 3, Item 2, AND Figure 6).** Conduit should be brought through the side or bottom of the QM cabinet enclosure. Connections to the control panel must be watertight. A disconnect should be provided by the installer. Check your QM system **ELECTRICAL RATING** on the rating plate or ***Data Sheet*** for electrical service requirements.

An opening has been provided in the bottom of the control box for the electrical service entrance. Algas-SDI lets the installer determine the most suitable location for the electrical service to enter the equipment cabinet enclosure when the unit is at the jobsite. The preferred electrical service entrance should be made at the lower right side towards the front of the cabinet. For wiring from the inside of the cabinet to the control box use flexible conduit.

- An **ELECTRICAL GROUND** must be connected to the control panel. The ground buss is located inside the control panel and identified by a green ground label. The size of the ground wire is determined by applicable codes or standards.
- Verify **L1 (120 VAC)** and **N (NEUTRAL)** are not reversed at the unit. The voltage between **N** and **GROUND** should be zero volts. Verify that the neutral is grounded at your distribution panel and/or if you are using a step down transformer, to power out unit; the **SECONDARY NEUTRAL** should be grounded. Check continuity between N and ground.
- If the system is equipped with the **OPTIONAL STANDBY ELECTRIC BATH HEATER,** a **SEPARATE ELECTRICAL CIRCUIT IS REQUIRED**. The circuit should be protected by an appropriately sized circuit breaker or fused disconnect.

DETERMINING WIRE SIZE

As the length of the wire run affects the overall wire size requirements, always refer to NFPA 70 (NEC) for proper wire selection. Several wire-sizing charts have been provided for determining the size of wire required due to load and length of wire.

When installing the wire it is important to have a good connection at the terminal lugs. Loose terminals may cause an excessive temperature rise at the terminal lugs, which can lead, to premature contactor failure, transformer failure, and/or overheating and possible destruction of the transformer. For this reason it is strongly recommended that the wire terminations be checked and re-tightened periodically to prevent excessive overheating at the terminals due to loose connections.

Optional Outputs

***See Operation section**,* for information on operation and wiring for system status indication, alarm indication and LPG pump control.

Freeze and Corrosion Protection

The QM consists of an open system waterbath vaporizer, meaning it is vented to atmosphere and requires a little greater corrosion protection than closed systems. Corrosion protection us accomplished by increasing the percentage of **CORROSIONS INHIBITOR** from manufacturer's recommendations, which are normally for closed systems.

NOTE

The QM system must have corrosion inhibitors added to the waterbath solution.

CHOOSING A GLYCOL PRODUCT

ETHYLENE or *PROPYLENE GLYCOL*, either in pure form or in one of the Dow products, lower the freezing point and raise the boiling point of the coolant solution. Ethylene glycol products provide better heat transfer and pumping characteristics than propylene glycol products because of their lower viscosity. However, in applications where toxicity is a concern, propylene glycol may be preferred because of its low acute toxicity versus moderate toxicity of ethylene glycol products.

WATERBATH FILL LEVEL

The *Cold Fill Line* on the sight gauge is for filling at 60° F (15.6°C). However, the waterbath will only vary ½ to ¾ inch below the fill line from 60° F (15.6°C). To -20° F (-28.9°C)., and a total of 2 to 2 ½ inches from -20° F (-28.9°C). To 170° F (76.7°C). Due to temperature variation, for the initial fill we recommend filling to the *Cold Fill Line* regardless of the temperature. The waterbath level will then be 1 to 2 inches above the fill line at operating temperature.

RECOMMENDED WATERBATH TREATMENT SPECIFICATION

The recommendations below are for corrosion and freeze protection when required. To contact manufacturers, ***See ordering information in this Section.***

- **DOWTHERM SR-1** and water.
- **DOWTHERM 4000** and water.
- **DOWFROST** and water.
- **DOWFROST HD** and water.
- Water and **CH20 HYDRO-TREAT**, product # 6435
- Pure Ethylene Glycol and water with **CH20 HYDRO-TREAT**, product # 6435
- Pure Propylene Glycol and water with **CH20 HYDRO-TREAT**, product # 6435.

See Freeze & Corrosion Product Calculation in this Section for determining proper amounts of product for protection.

Never use pure ethylene or propylene glycol without a corrosion inhibitor. Glycol products break down under use to form acidic end products what will cause major corrosion to occur. Dow products and **CH20's HYDRO-TREAT** have chemicals to neutralize these acids.

Also, never use pure water without a corrosion inhibitor. Oxygen and other gases will readily dissolve in water greatly accelerating corrosion. An inhibitor forms a layer, only molecules thick, on the metal surface for protection from the corrosive effect of dissolved gases.

Freeze and Corrosion Product Calculation

FREEZE PROTECTION

To calculate gallons of pure glycol or Dow products to add for freeze protection:

- Determine freeze protection required. This should be at least 5°F (-15°C). below the lowest ambient temperature or lowest temperature the waterbath will reach.
- Determine the percent volume of anti-freeze product required in final mix for chosen product from Table # 2.
- Determine total coolant gallons required from Table #3.
- Multiply the total gallons mix required by % volume required to determine gallons of anti-freeze product required.

EXAMPLE:

-10°F (15°C) is the lowest operating temperature for a QM42-12 using **DOWTHERM SR-1** product for freeze protection:

- Freeze protection required: -15 F (-26.1°C)
- Percent volume **DOWTHERM SR-1** required at -15° F (-26.1°C): P_V = 43.2%

  (***See Table # 2***)
- Total Coolant Gallons for QM42-12: TCG=221

  (***See Table # 3***)
- Gallons **DOWTHERM SR-1** required: GAL_{SR-1}

  TCG X P_V = GAL_{SR-1}

  221 X 0.432 = 95.5 (+125.5 gallons of water)

RECOMMENDED WATER SPECIFICATION

DISTILLED or **DE-IONIZED WATER** is recommended for both initial fill and make up due to evaporation. Tap water should **NOT** be used because of undesirable dissolved solids and gases present which can interfere with corrosion inhibitor effectiveness and increase inhibitor depletion rate. If distilled or de-ionized water is not available, water quality should meet the following minimum quality requirements:

Chlorides	25 PPM (max)
Sulfates	25 PPM (max)
Calcium	50 PPM (max)
Magnesium	50 PPM (max)

Total amount of above constituents should not exceed 100 PPM.

CORROSION PROTECTION

Freeze protection that requires less than 50%, by volume, or **DOWTHERM** or **DOWFROST** will need inhibitor adjustment equivalent to a 50/50 mix. Contact Dow for further information on inhibitor adjustment.

When using pure glycol or 100% water, use Table #3 to determine the required amount of **CH20 HYDRO-TREAT** to add.

NOTE

IMPORTANT! Components can be added in any order, however it is strongly recommended that the system be run at operating temperature for 24 hours to insure effectiveness of the inhibitors.

NOTE

Refer to Waterbath Maintenance in Section 6 for addition information.

***Table 2** – Anti-Freeze Products*

ETHYLENE PRODUCTS					PROPYLENE PRODUCTS				
FREEZE POINT (F)	BOILING POINT (F)	% VOL ETHYLENE GLYCOL.	%VOL DOWTHERM SR-1	%VOL DOWTHERM 4000	FREEZE POINT (F)	BOILING POINT (F)	% VOL. PROPYLENE GLYCOL	%VOL. DOWFROST	%VOL. DOWFROST HD
32	212	0	0	0	32	212	0	0	0
25	214	10.3	12.7	13.2	25	212	11.3	11.8	12
20	215	15.9	16.8	17.3	20	213	18.3	19.2	19.5
15	217	21.1	21.9	22.6	15	215	24	25.2	25.6
10	218	24.5	26.2	27.1	10	216	28.7	30	29.8
5	220	28.3	30.5	31.4	5	217	32.6	34.1	34.7
0	221	32.8	34	35.7	0	218	35.2	38.1	38.6
-5	221	35.8	37.5	38.6	-5	219	38.9	40.7	41.5
-10	222	38.6	40.9	42.2	-10	219	41.7	43.6	44.4
-15	223	41.3	43.2	446	-15	219	44.2	46.2	47
-20	224	43.4	46.1	47.6	-20	220	46.5	48.3	49.2
-25	224	45.9	48.6	49.5	-25	221	48.6	50.8	51.7
-30	225	48.1	50.5	51.9	-30	222	50.5	52.8	53.7
-35	226	51.1	52.4	54.3	-35	222	52.4	54.8	55.7
-40	226	52	54.1	56.1	-40	223	54.1	56.6	57.5
-45	227	53.8	55.7	59.3	-45	223	55.7	58.2	59.3

***Table 3** – Total Coolant Gallons*

QM MODELS	AQUAVAIRE MODELS	TOTAL COOLANT GALLONS	HYDROTREAT GALLONS
QM28-15	Q480V	129	0.5
QM35-12			
QM39-10			
QM42-5, QM42-8			
QM42-12, QM42-15	Q640V	221	1
QM52-10			
QM56-5, QM56-8			
QM56-12, QM56-15	Q800V	279	1.5
QM65-10			
QM70-5, QM70-8			
QM70-12	Q960V	279	1.5
QM70-15	Q1120V	475	2.5
QM75-10	Q960V	279	1.5
QM84-5, QM84-8			
84-12	Q1120V	475	2.5
84-15	Q1375V	475	2.5
100-5, 100-8	Q1120V	475	2.5
100-12	Q1375V	475	2.5
125-5, 125-8	Q1375V	475	2.5
125-12, 150-8	Q1650V	475	2.5

ORDERING INFORMATION

- DOW

Phone: 1-800-447-4369

DOW ANALYSIS KITS

Phone: 1-800-447-4369

The Dow Chemical Company
Larkin Lab
C/O Thermal Fluids Testing Lab
1691 North Swede Road
Midland, Michigan 48674

- CH20

Phone: 1-800-562-6184 Fax: 1-360-352-4813
Web Site: www.ch20.com/ch20

CH20
8820 Old Hwy 99 SE
Olympia, WA 98501

- MISCO PRODUCTS

Phone: 1-800-358-1100 Fax: 1-216-831-1195

Web Site: www.misco.com

MISCO PRODUCTS
3401 Virginia Road
Cleveland, OH 44122-4218

- OMEGA

Phone: 1-800-826-6342 Fax: 1-800-848-4271

OMEGA
One Omega Drive
Stamford, CT 06907-0047

Installation is now complete. Read completely the operating, maintenance, and troubleshooting sections as further resources for details on the QM system.

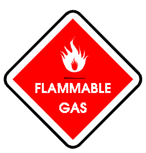
Startup 4

WARNING

LPG is explosive and extremely flammable. Appropriate safety procedures must be observed when installing, starting, and operating the system. Any leak anywhere in the system is extremely dangerous and should not be tolerated. If any leak is detected the entire system must be shut down, power turned off, lines bled to zero. The leak must be properly repaired.

WARNING

During initial startup, the operator must be on constant alert for emergency conditions such as fuel leaks or electrical malfunctions. The location of all manual shutoff valves and disconnect switches should be found so the burner can be quickly shut down, if necessary.



FOR YOUR SAFETY — IF YOU SMELL GAS:

- DO NOT TOUCH ANY ELECTRICAL SWITCHES.
- EXTINGUISH ANY OPEN FLAME.
- SHUT OFF GAS SUPPLY IMMEDIATELY.

NOTE

Persons responsible for the startup and operation of the vaporizer should read and be familiar with the BURNER INSTRUCTION MANUAL as well as this QM OPERATIONS AND MAINTENANCE MANUAL before starting the system.

Only a qualified startup specialist should perform the startup.

Initial Startup Instructions

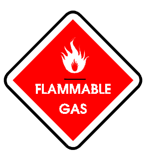
NOTE

All initial settings were made at the ASDI factory. However, some settings may need adjustment upon setup. Refer to the QM Data Sheet for all control settings. VENTURI GAS MIXTURE ADJUSTMENT must be made on startup.

INITIAL VAPORIZER STARTUP

- Turn on the customer provided **DISCONNECT** for the equipment.
- Check for correct **VOLTAGE** to the control cabinet by testing input terminals with a voltmeter. The voltage should be 110-130 volts. Voltage should not drop below 100 volts at any time during startup.
- Manually close the **VAPOR OUTLET VALVE.**
- If this is the first time it has been started, purge air from the **LPG LIQUID LINE** between the LPG storage tank, the LPG pump (if used), and the vaporizer.
- Turn control panel master control switch on.
- Verify **OPERATING COMPONENTS** and **SAFETY SETTINGS** and **OPERATOR INTERFACE SETPOINTS**. ***Refer to the Data Sheet for factory settings.***
- Press the **F1** key on the operator interface panel to allow LPG to enter the heat exchanger and begin the burner operation sequence.

NOTE



The initial run through of the VAPORIZER STARTUP MAY FAIL due to air left in lines from installation. Purge air from the burner gas train by opening the copper connector on the pilot gas train. When the air is purged from the burner gas train, tighten the union. Test for leaks.

- After the air has been purged, **RESET** the **FLAME SAFEGUARD** and **DEPRESS** the **CLEAR KEY** on the operator interface panel.
- **DEPRESS** the **F1 KEY** on the operator interface panel again. If the burner fails to light, **RESET** the **FLAME SAFEGUARD** again and **DEPRESS** the **CLEAR KEY**, then the **F1 KEY** on the operator interface panel.
- The LPG inlet valve will open and close allowing the minimum LPG required to operate the burner until the waterbath temperature increases enough to prevent high LPG level. Once the waterbath temperature has increased, the inlet valve will remain open. Indicator box on the PLC output module will indicate solenoid valve **ON/OFF**.
- The **VAPORIZER** will now warm up to its standby setpoint as set on the operator interface panel; factory set at 100° F. The **OPERATOR INTERFACE DISPLAY** will flash **WATERBATH WARMING** during this period.
- The BURNER INLET PRESSURE GAUGE SETTING should be the same as indicated on the data sheet.

Initial LPG/Air Mixer Startup

Before beginning the **MIXER** startup procedure, allow the vaporizer to warm up to the standby setpoint temperature 100° F (37.8° C). When the vaporizer is up to temperature, the burner will shut off and the operator indicator interface will indicate **STANDBY**.

- Manually close the **MIXED GAS OUTLET VALVE** which is located at the outlet of the accumulator tank. ***See Figure 9, Item 10.***
- Drain the **ACCUMULATOR TANK**, check that no moisture or oils are present, reclose the valve. ***See Figure 9, Item 8.***
- Insure that the **VAPOR OUTLET VALVE** and the **VENTURI VAPOR SHUTOFF VALVE** are open. ***See Figure 4, Item 9 and Figure 3, Item 19.***
- If needed, at this time, start the **LPG PUMP**, to bring the system to the required LPG pressure for mixing. ***See the Data Sheet*** for minimum LPG pressure required to operate system.
- Check the **VAPOR PRESSURE GAUGE** to verify the proper LPG vapor pressure. ***See Figure 4, Item 1.***
- Open the **VENTURI ISOLATION VALVE** on each venturi train. ***See Figure 4, Item 5.***
- Depress **F2** on the operator interface panel, **MIXER ON** to start **MIXER**.
- The **VAPORIZER BURNER** will start and when the waterbath temperature reaches the **MIXER START TEMPERATURE**, the mixer will come on.
- The **VENTURIS** will now start to cycle on. The pressure in the accumulator tank should build up to the mixed gas pressure setpoint. ***Refer to the Mixed Gas Pressure adjustment instruction section in Operations, Section 5.***
- ***Refer to VENTURI MOTIVE PRESSURE ADJUSTMENT procedure in Operations, Section 5 for proper method for setting venturi pressure trains.***
- When all of the venturis are adjusted, go to the setup screen on the operator interface panel and turn off the setup mode, then open all of the isolation valves, turn on the power and test for proper operation.
- The QM system is now ready for operation.
- ***Refer to the troubleshooting guide for any problems.***

WARNING

Do not close BOTH the outlet and inlet valves when shutting off the vaporizer. Closing both valves may trap liquid propane in the vaporizer, cause pressure build-up and open the safety relief valve.

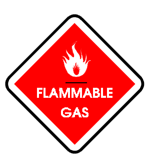
Operation 5

OVERVIEW

The Operations section includes:

- Start/stop sequence steps for the vaporizer and LPG/air mixer.
- Complete QM operation details, including operator interface panel, key and page definitions.
- Special component control procedures.
- Burner and flame safeguard operation for all standard models, plus Minnesota options Q1120V through Q1650V.
- Pressure adjustments to the mixing system.
- Component operation and adjustment with information on additional safety and operation switches.
- Waterbath circulation and operation.

Please thoroughly read this section before starting your system.



CAUTION

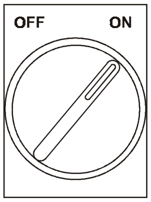
LPG is explosive and extremely flammable. Appropriate safety procedures must be observed when installing, starting, and operating the system.

VAPORIZER/MIXER MODES OF OPERATION

The QM natural gas replacement system has two modes of operation; **VAPORIZER IN STANDBY** and **MIXER RUNNING**. When in standby mode the burner will start and warm the waterbath up to its standby waterbath setpoint. While the burner is warming the waterbath, the operator display will flash between **SYSTEM STANDBY** and **WATEBATH WARMING**. When the standby waterbath setpoint is achieved the operator display will indicate a continuous **SYSTEM STANDBY**.

When in **MIXER RUN MODE** the burner will start and warm the waterbath up to its **MIXER RUN** setpoint. While the burner is warming up the waterbath the operator display will indicate **WATERBATH WARMING**. When the mixer start temperature setpoint is reached the mixer will start mixing gas and the operator panel will indicate **MIXER RUNNING**. When the waterbath setpoint is achieved the burner will shut off.

Start/Stop and Standby Sequence



Turn power switch **ON**. Display panel reads **SYSTEM OFF**.

F 1

VAPORIZER START PROCEDURE
(Vaporizer Standby)

- Press **F1** once on the **OPERATOR INTERFACE PANEL**.
- Watch for the green LED to illuminate over **F1**.
- The vaporizer begins the warm-up sequence. **SYSTEM STANDBY/ WATERBATH WARMING** flash alternately on the screen.
- When vaporizer temperature reaches 100° F (37.8°C), **SYSTEM STANDBY** shows steady and burner shuts off.

F 2

VAPORIZER-LPG/AIR MIXER START PROCEDURE
(Vaporizer/Mixer On)

- Close the accumulator mixed gas outlet valve.
- Press **F2** on the **OPERATOR INTERFACE PANEL**.
- Watch for the green LED to Illuminate over both **F1** and **F2**.
- If the Waterbath Temp is in standby condition 100° F (37.8°C) the burner will start to heat it up to 160° F (71°C) where the mixer will startup.
- When the accumulator tank has obtained operating pressure, slowly open the accumulator mixed gas outlet valve.

MIXER SHUTDOWN PROCEDURE

- Close the accumulator mixed gas outlet valve.
- Press F2 on the **OPERATOR INTERFACE PANEL**.
- Green LED will shut off over **F2**.

VAPORIZER-MIXER SHUTDOWN PROCEDURE

- Close accumulator mixed gas outlet valve.
- Press F1 on the **OPERATOR INTERFACE PANEL**.
- Green LED shut off over both **F1** and **F2**.

WARNING

Do not close BOTH the outlet and inlet valves when shutting off the system. Closing both valves may trap liquid propane in the vaporizer, cause a pressure buildup and open the safety relief valve.

NOTE

A heater is included in the control enclosure to maintain an even temperature. When shutting the system off, do not remove power from the system. Shut the power switch off but leave power applied to the vaporizer.

Operator Panel Menu Levels

VAP ON / OFF
F 1

Vaporizer Standby on / off button

MIXER ON / OFF
F 2

Mixer on / off button

STATUS
F 3

Status page menu button (shows present status of all parameters)

or — Parameter scroll arrows.

SETUP
F 4

Setup page menu button (shows setpoints and allows adjustments of parameters)

or — Parameter scroll arrows.

ENTER ENTER — Parameter modifications.

or — Shift cursor right or shift cursor left.

Increment Value / Up.

or

Decrement Value / Down.

ENTER — Save parameter modification.

or

CLEAR — Reverts to previous entry.

or

or — Toggles parameter mode. (on/off, reset, yes/no)

HELP

Help menu button

Scroll line by line, Up.

or

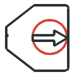
Scroll line by line, Down.

or — Scroll by page, Forward. Scroll by page, Backward.

Command Modes

(Hold for 2 seconds) Prompts to Command Mode.

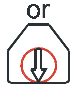
This mode is normally not used by an operator.
See *command mode details* at the end of Chapter 5.



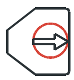
Scroll to TIM to change the Date and Time

Alarm Menu Active only when an alarm condition exists.

or



Current Alarms list.
Scrolls up or down.



Prompts to **Alarm Event Log**.

Clears all alarms and prompts to main menu.

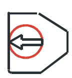
or

Displays help information for specific alarm

Scroll up or down

Prompts to Main Menu

or



Prompts back to Main Alarm Menu
To view other alarm information

QM Operation Details

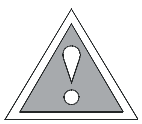
OPERATOR PANEL

The **OPERATOR INTERFACE PANEL** gathers various kinds of data and information from the PLC Sequencer.

The display panel has the following capabilities:

- Displays system parameters in real-time.
- Monitors system for shutdown conditions and faults.
- Allows operators to operate the system easily from a single location.
- Monitors the number of solenoid and burner activations for maintenance purposes.
- Burner and LPG/air mixer annunciators show the number of run-time hours.

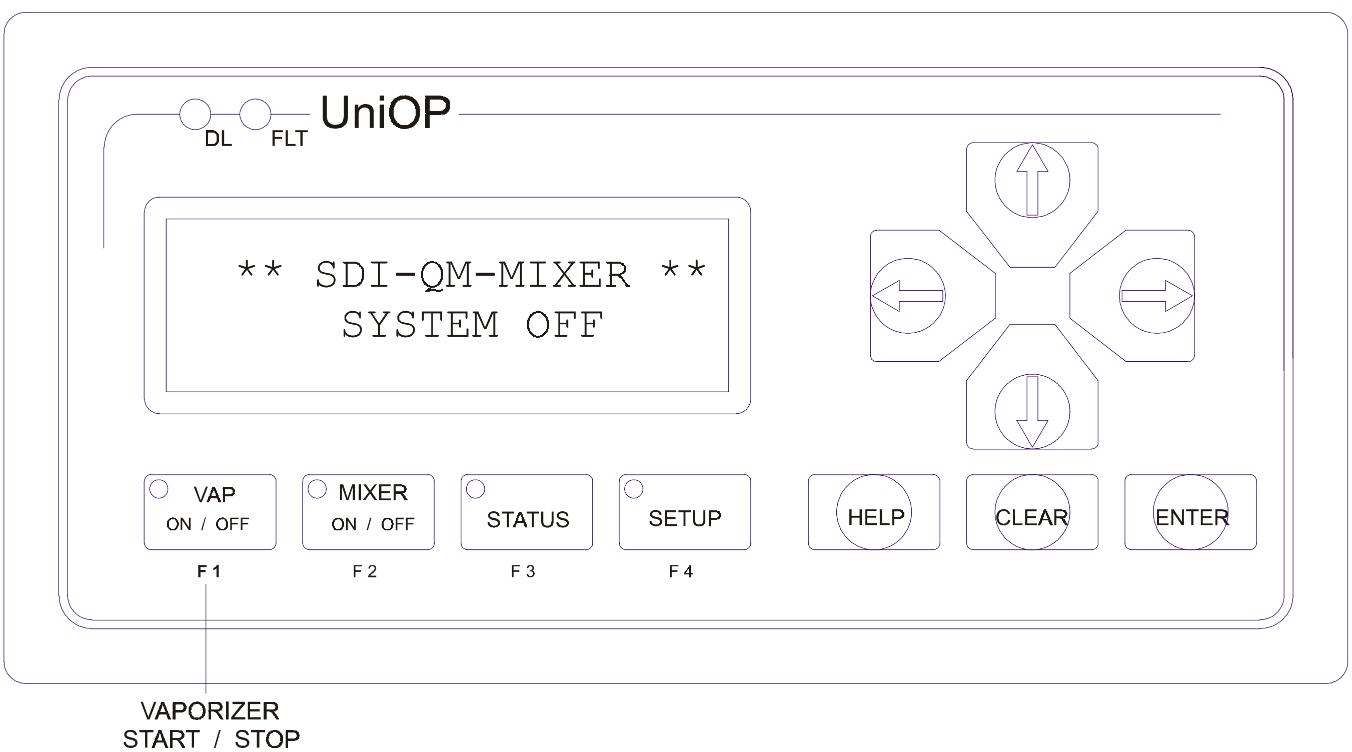
NOTE



The MD01 operator interface panel does not have a battery to save clock settings when power is lost. The time and date must be re-entered to accurately log faults in the event log. See Panel Command Modes in Section 5, to reset clock.

OPERATOR INTERFACE PANEL, KEY AND PAGE DEFINITIONS

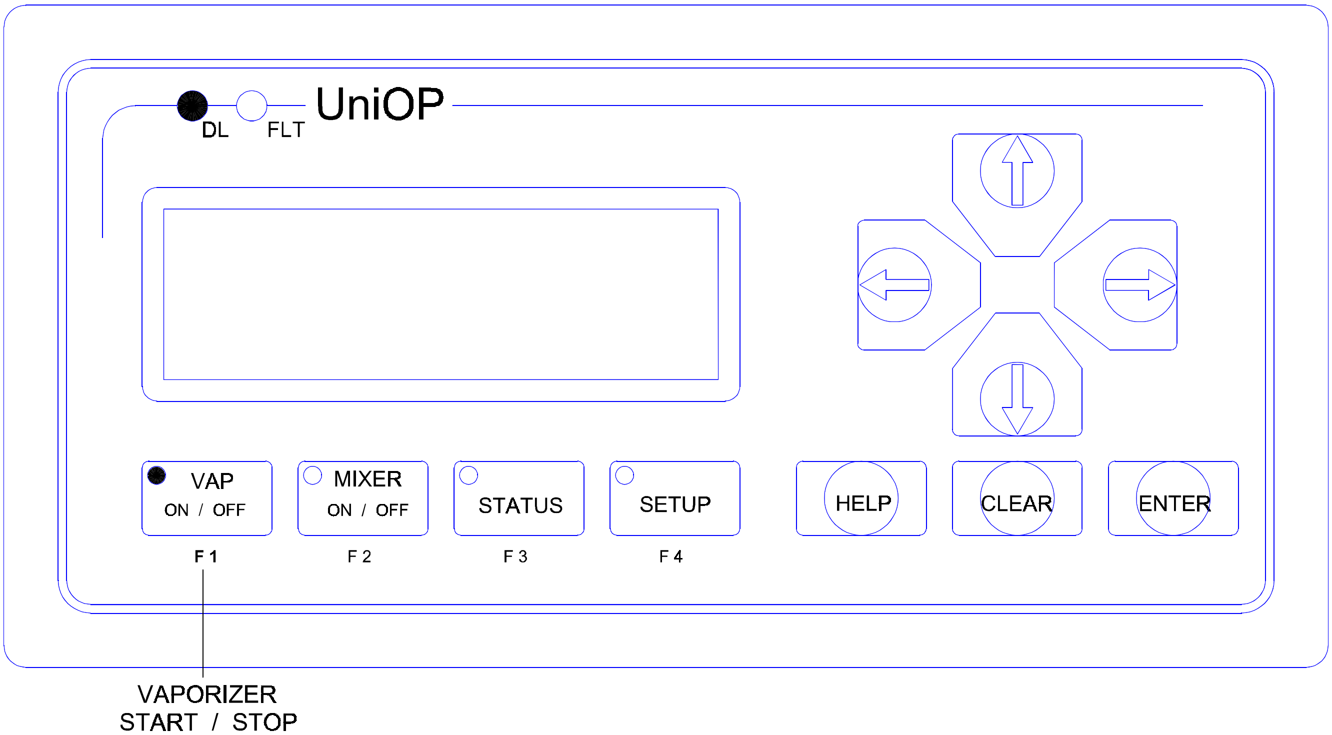
***Figure 12 –** Initial Screen, with ASDI "System Off" Message*



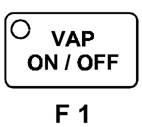
Screen.wmf

VAPORIZER START SEQUENCE

***Figure 13** — F 1 Screen, Vaporizer Start/Stop Key, Annunciated Messages and Settings.*



F1 Screen – Vap Start.wmf



Press **F1** to start **VAPORIZER**. The burner will start if the waterbath standby setpoint is higher than the actual waterbath temperature.

When the vaporizer standby mode is enabled and running the green LED will illuminate.

The display on the main page could indicate one of the following messages:

- **SYSTEM OFF** means the system is not running.
- **WATERBATH WARMING** shows the vaporizer is running and the waterbath temperature is below the waterbath standby setpoint.
- **SYSTEM STANDBY** shows the vaporizer is running and the waterbath temperature is above the waterbath standby setpoint.

When **F1** is pressed a second time the vaporizer will shut off and the **F1 LED** will go out.

NOTE

Standby operation is used to expedite quick changeover when the vaporizer is required to produce gas on short notice. By keeping the waterbath up to standby temperature 100° F (37.8°C), the changeover can occur rapidly.

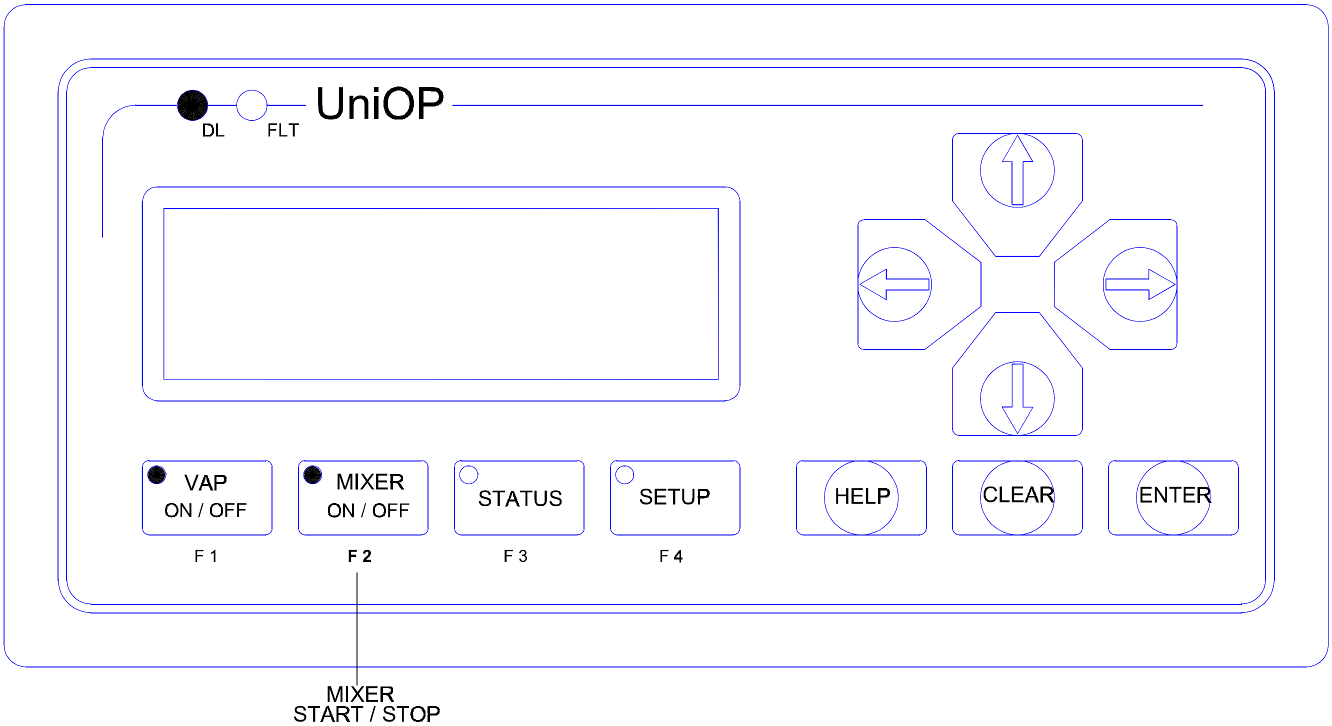
Changeover is accomplished by pressing F2 on the operator interface panel starting the LPG/Air mixer and pump controls, then opening the mixed gas outlet valve. If operation is anticipated on a weekly level the system should be left in the standby mode.

WARNING

Always put the vaporizer in the standby mode before temperatures fall below 0° F (-17.8°C). Power must be applied to the panel to energize the panel heater before temperature falls below 32° F (0°C). Energizing the panel heater will help prevent condensation and insure all electrical components will operate within allowed temperature ranges.

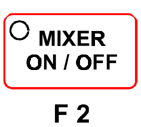
LPG/AIR MIXER START SEQUENCE

Figure 14 *— F2 Screen, Mixer Start and Stop Key, Annunciated Messages and Settings*



F2 Screen – Mixer Start.wmf

Press **F2** to start **MIXER**. When the vaporizer *is not* running, it will start and the green **F1 LED** will light. If the vaporizer *is* running and up to temperature the system will enter **LPG/AIR MIXER RUN MODE**. If the waterbath temperature is below mixer start setpoint, the burner will start, then warm up the waterbath. When the waterbath temperature is above the mixer start temperature setpoint, the mixer will start.



The F2 display will indicate one of the following messages:

- The **F2 LED** will illuminate.
- **WATERBATH WARMING** shows the vaporizer is running and the waterbath temperature is below the mixer start waterbath setpoint.
- **MIXER RUNNING** shows the waterbath temperature is above the LPG/Air mixer start setpoint and the mixer is running.

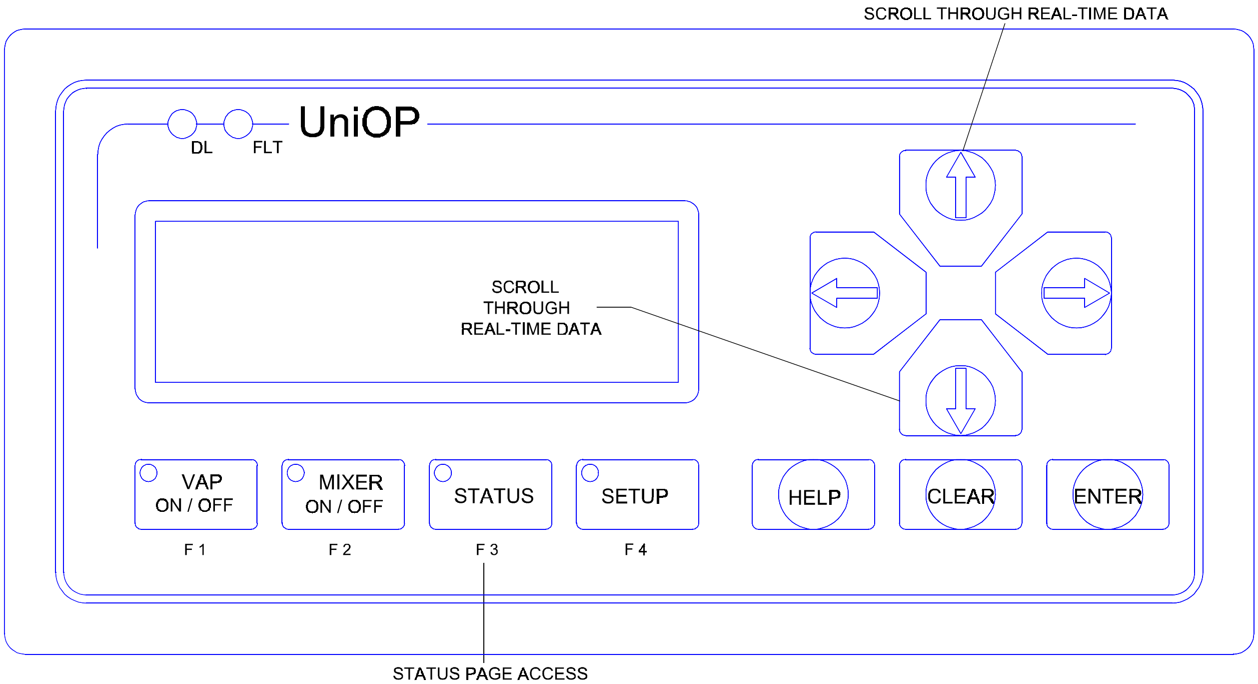
When **F2** is pressed a second time the LPG/Air mixer will shut off and the **F2 LED** will go out. The vaporizer will return to standby operation.

NOTE

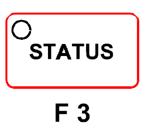
During operation, if the waterbath temperature drops down to the "Mixer On" temperature minus 5° F, the mixer will stop running. As soon as the waterbath temperature reaches the "Mixer On" temperature, it will begin to run again.

STATUS SCREEN

Figure 15 *— F3 Screen, QM Status Page for Real-Time Data*

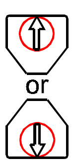


F3 Screen – Status.wmf



Press **F3** to transfer to the **MIXER STATUS SCREEN** for the QM system real-time data display, including on/off status of the LPG/Air mixer. While you are viewing in the status screen the F3 LED will flash.

The operator can scroll through the following data items using the up or down arrow keys.

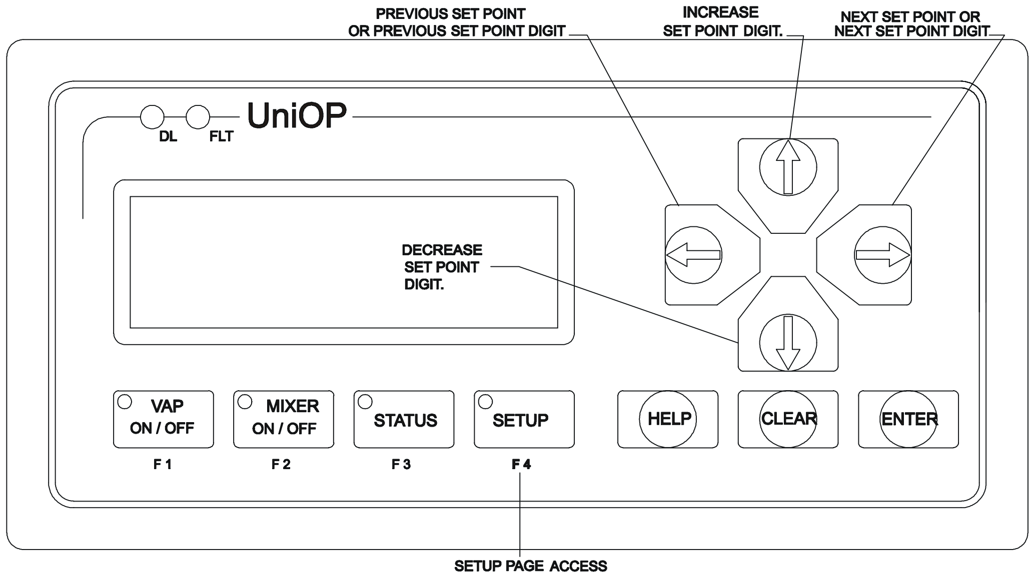


DATA MESSAGE	INDICATION
VAPORIZER STATUS:	On or Off
MIXER STATUS:	On or Off
NUMBER OF TRAINS ON:	Active venturis running
LPG INLET SOLENOID:	Open or Closed
CALL FOR HEAT:	Yes or No = Waterbath temp is satisfied
MIXED GAS PRESSURE:	Current mixed gas pressure / PSI
WATERBATH TEMPERATURE:	Current waterbath temperature / °F
VAPOR PRESSURE:	Current LPG vapor pressure / PSI
LPG PRESSURE:	Current LPG Tank pressure / PSI
LPG PUMP STATE ENABLED:	Enabled or Disabled if installed
LPG PUMP STATUS:	On or Off
CPU BATTERY VOLTAGE:	Volts D.C.
MIXER IN SETUP MODE:	Yes or No
CPU BATTERY STATUS:	CPU battery OK or replace CPU battery
FLOW TOTAL:	BTU's
FLOW RATE:	MMBTU/hr
TRAINS #1-6 CYCLES:	Up to 99,999,999 counts
BURNER CYCLES:	Up to 99,999,999 counts
BURNER RUN TIME:	Up to 99,999,999 hours
MIXER RUN TIME:	Up to 99,999,999 hours
PUMP RUN TIME:	Up to 99,999,999 hours

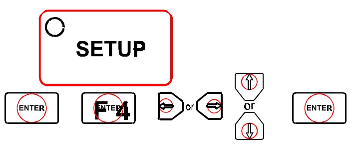
Press the **HELP KEY** at any time to return to the main page.

SETPOINTS SETUP SCREEN

Figure 16 – *F4 Screen, Setup Page for Displaying and Entering Setpoints*



F4 Screen – Setpoints Setup.wmf



F4 is the QM mixer setup screen where the following setpoints are displayed and set. While viewing in the setup screen **F4 LED** will flash.

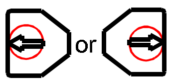
- The down arrow key advances to the next setpoint or page and the up arrow key decrements to the last setpoint or page.
- Press the **ENTER KEY** to enable data entry to change a setpoint; then press **ENTER** again to allow for cursor movement from digit to digit using the right and left arrow keys. The data entry fields will blink. Use the up and down arrow keys to increment or decrement the number the cursor is on. When all numbers have been changed, The **ENTER** key must be pressed again to down load the new parameter to the **PLC**.

DATE MESSAGE	SETPOINT RANGE
VAPORIZER WATERBATH SP:	150-190°F
MIXED GAS PRESSURE SP:	4-17 PSIG
MIXER START WATERBATH SP:	140-180°F
STANDBY MODE WATERBATH SP:	100-180°F
MIXER SETUP/NUMBER OF TRAINS:	0-6
LPG INLET SOLENOID WATERBATH SP:	20-120°F
LOW VAPOR PRESSURE SP:	25-165 PSIG
VENTURI TRAIN CAPACITY:	MMBTU/hr
ALLOW PUMP OPERATION SP:	Yes or No
PUMP START PRESSURE:	30-180 PSI
ALLOW SETUP:	Yes or No
RESET TRAINS #1-6 CYCLE:	Yes or No
RESET BURNER CYCLES:	Yes = →
RESET BURNER RUN TIME:	Yes = →
RESET LPG/air mixer RUN TIME:	Yes = →
LPG PUMP TIME RESET:	Yes **=** →
TOTAL FLOW RESET:	Yes **=** →

Default values for these parameters are set at the factory. ***See Data Sheet for appropriate settings.***

Press the **HELP KEY** at any time to return to the main page.

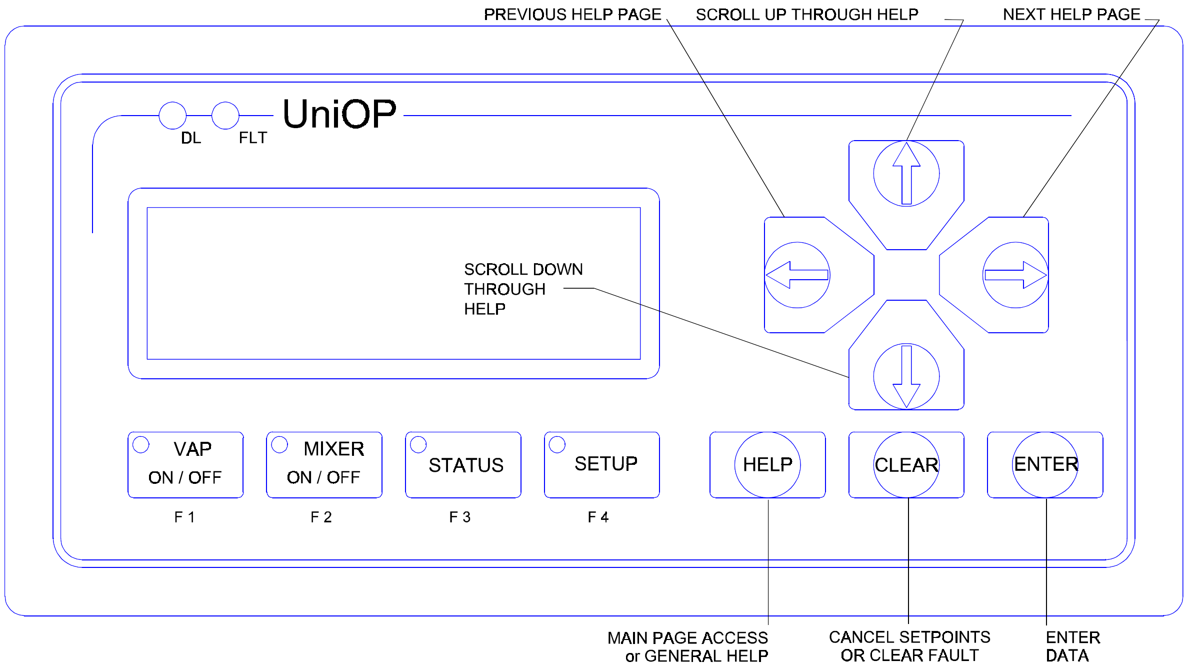
*** * SDI – QM – MIXER * ***



- The **SETUP MODE** is used to turn on all trains at the same time for adjustments. To enter **SETUP MODE** go to **ALLOW SETUP** and select **YES**. This is a test mode only and must be off for operation.
- To enable the pump or setup mode, the left **ARROW KEY** is used for the disable function and the right **ARROW KEY** is used for the enable the function.
- The **SETUP** button is used to change the display intensity. Press the **SETUP** button to access the first setup page **SDI-QM-MIXER SETUP SCREEN**. Then the right arrow key brightens the display and the left arrow key dims the display.
- **CYCLE COUNTERS** and **RESET TIMERS RESET** are used to reset to **ZERO**. Resetting to zero needs to be done after solenoid or burner component replacement of after maintenance has been accomplished.

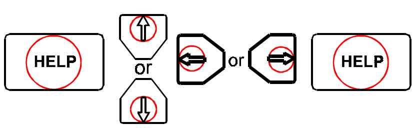
HELP PAGE SCREEN

***Figure 17** — Main Screen, General Instructions and Help Keys*



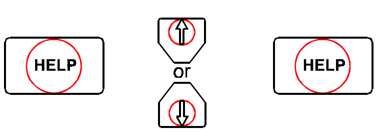
Mini-Screen.wmf

GENERAL HELP



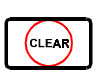
Help is available from the **MAIN SCREEN** by pressing the **HELP** key. Basic instructions and definitions of operator interface panel components is discussed. The up and down arrow keys allow the operator to scroll through the text line by line. The left arrow key switches to the previous page. The right arrow key advances to the next help page. At the end of the general help area, fault help can be viewed by pressing the right arrow key. Pressing the **HELP** key again takes the operator back to the main menu.

FAULT HELP PAGES



FAULT HELP PAGES are displayed when a fault or alarm occurs and the operator presses the **HELP** key. Help on the effected fault is then displayed. A description of what caused the problem and what can be done to correct the problem is displayed. The up and down arrow keys allow the operator to scroll through the text line by line. The left or right arrow keys switch to different pages. Pressing the key again takes the operator back to the main menu. *See printed fault help pages* at the end of Section 7.

CLEAR KEY



The **CLEAR** key has two functions. First, it is used to clear faults that have occurred while viewing the alarm page. Secondly, it will cancel setpoint data entry if a mistake is made while entering new data.

ENTER KEY

The **ENTER** is used to enter data or select menu items. When the **ENTER** key is depressed for two seconds, the operator interface panel exits the operation mode and shows the command menu. ***See Panel Command Modes.***

UP / DOWN FAULT HELP PAGES

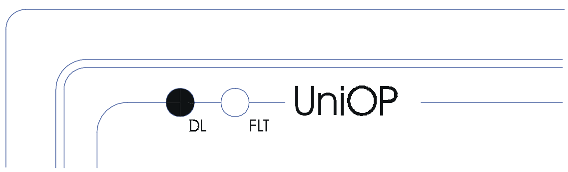
The **UP AND DOWN ARROW** keys are used scroll through real-time data line by line. They are also used increment or decrement setpoint values while in the data entry mode on the **SETUP** page.

RIGHT / LEFT ARROWS KEYS

The **RIGHT AND LEFT ARROW** keys are used to move the cursor between setpoint digits when data entry mode is enabled on the Setup Screen. They are also used to increment or decrement the display intensity while the operator is on the first page of the Setup Screen. The right arrow key is used to increment pages and the left arrow key is used to decrement to the previous page.

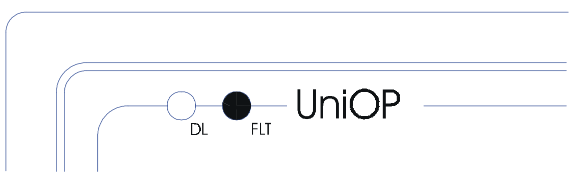
DL LED

The **DL LED** illuminates when a key is pressed on the display panel. When communications errors are occurring, the **DL LED** will blink on the operator interface panel. These types of errors are usually caused by faulty wiring to the PLC or a faulty processor.



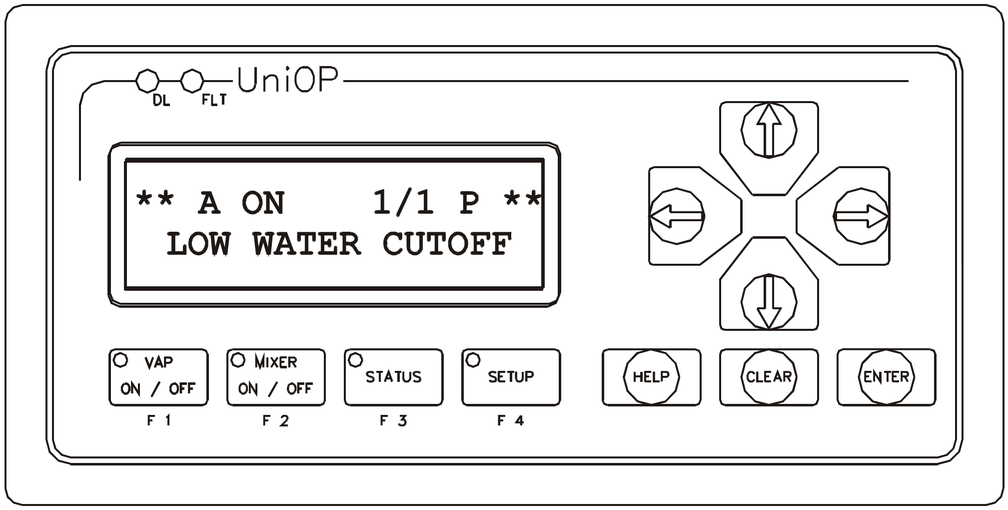
FLT LED

The **FLT LED** light will illuminate for a hardware problem with the operator interface panel display, i.e. faulty internal components.



ALARM SCREEN

The **ALARM SCREEN** is displayed automatically upon receiving an alarm. The "**A**" on line one indicates the operator is looking at the alarm list. The next character fields on line one are the current state of the alarm, **ON** or **OFF**. The last section of line one indicates the number of alarms in the alarm buffer, usually one alarm at a time. The second line indicates the type of alarm that has occurred.



Mini-Screen.wmf

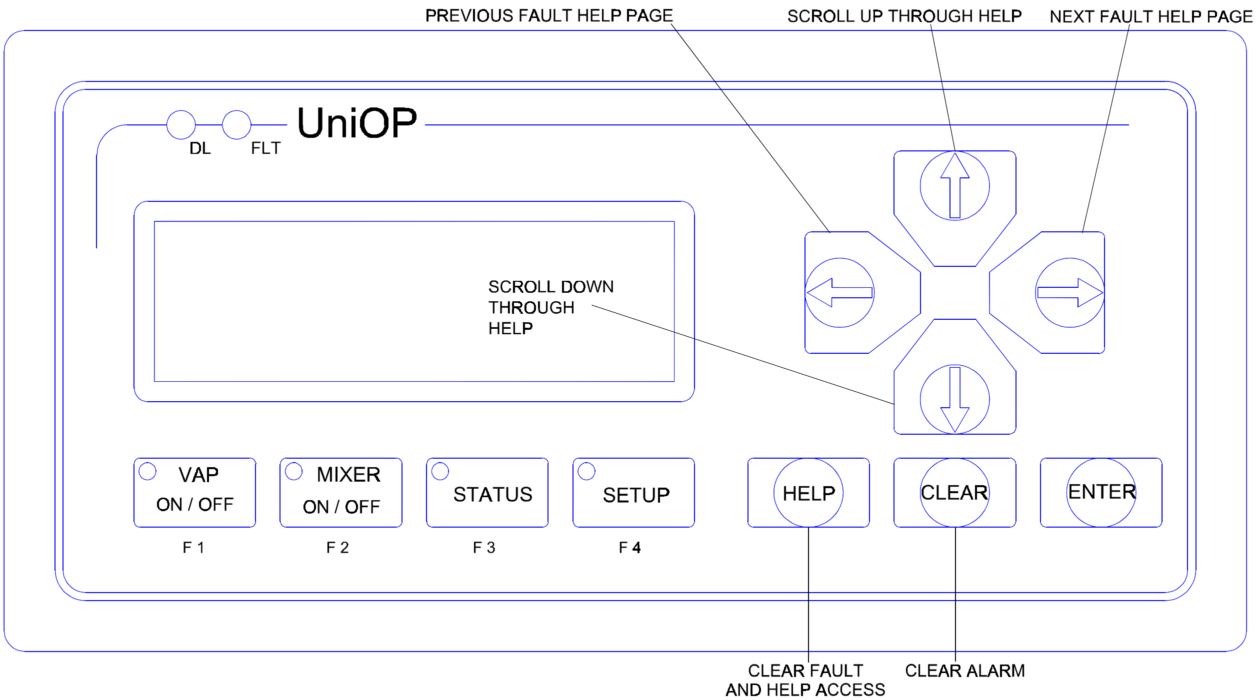
While viewing the alarm screen, the right arrow can be used to view the fault time and date, the left arrow will return the operator to the alarm page. The **F1** and **F2** keys are not allowed while viewing the alarm screen. When an alarm occurs the operator **MUST** fix the problem, then clear the alarm using the **CLEAR** or **HELP** keys. The **HELP** key gets the operator to specific troubleshooting points pertinent to the current alarm. If the alarm is not fixed upon restart, the system will fault and shutdown.

FLAME FAILURE FAULT

The **FLAME FAILURE FAULT** must be reset using the flame safeguard reset/test button.

ALARM SCREEN

***Figure 18** — Control Panel General Help and Alarm Screen*



Alarm Screen.wmf

ALARM MESSAGES

Help with alarms can be viewed by pressing **HELP** during the alarm message. Possible alarm messages are outlined as below:

HIGH LPG LEVEL	Burner Safety Circuit
LOW WATER CUTOFF	Burner Safety Circuit
FLAME FAILURE	Burner Safety Circuit
HIGH WATER TEMPERATURE	Burner Safety Circuit
HIGH BURNER GAS PRESSURE	Burner Safety Circuit
LOW BURNER GAS PRESSURE	Burner Safety Circuit
HIGH MIXED GAS PRESSURE	Mixer Safety Circuit
OPTIONAL ALARM	Customer installed
LOW LPG VAPOR PRESSURE	Mixer Safety Circuit
BACKUP TANK PRESSURE	Calculated by the PLC program

EVENT LOG

The **EVENT LOG** captures the alarms that have occurred during operations. Alarms are stored until the power to the operator interface panel is interrupted. To gain access to the event log, the operators hold the **ENTER** button until the operator interface panel main screen is displayed. Cursor to **EVT** and press **ENTER** again. The **E** on line one indicates the operator is looking at the event log not the alarms list. The last section of line one indicates the number of events in the event buffer.

While viewing the event log, the right arrow can be used to view the event time and date, the left arrow will return the operator back to the **EVENT LOG PAGE**. The **F1** and **F2** keys are not allowed while viewing the event log.

Press **CLEAR** to return to the main page or select **EXT** and **ENTER**.

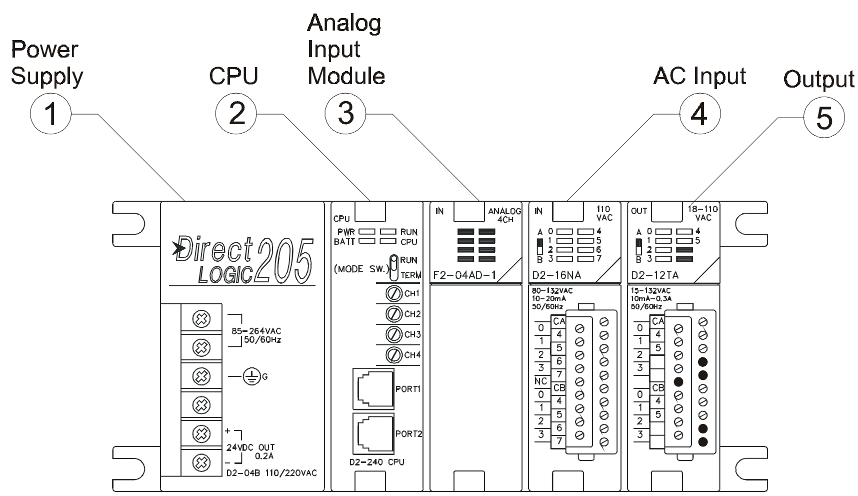
PANEL COMMAND MODES

The **OPERATOR INTERFACE PANEL** uses an operating system similar to other computers used to execute applications. When the **ENTER** key is pressed for two seconds the main menu will appear displaying the following commands. Use the arrow keys to highlight the command and the **ENTER** key to select or execute the command.

PGS (Single page access)	Go to a single page directly.
ALM (Alarm page)	Automatic alarm logging page.
EVT (Event log)	Automatic event logging page.
PSW (Password page)	Multi-level password protection.
CFG (Configuration)	Upload or download applications.
TIM (Sets time and date)	No battery, not used.
ACC (Direct access mode)	Not used.
SYS (System parameters)	Used for troubleshooting.
EXT (Exit)	Returns to the operations mode.

Special Components Operation

PLC SEQUENCER



The **PLC SEQUENCER** transforms information from four pressure transmitters and setpoints on the operator interface panel to data used to determine appropriate outputs to the vaporizer, LPG/air mixer and LPG pump.

The sequencing mixing system opens the venturis progressively so they are all used equally. They are controlled in a first on - first off rotation. For example: if five venturis are used and the load requires two venturis on with one cycling, the following numbered venturis will come on in sequence: #1, #2, and #3. When the pressure is satisfied, #1 will shut off. When more pressure is needed, #4 will come on leaving #2, #3 & #4 on. The venturi to shut off next is #2 and the next one to come on is #5. In the next sequence, #3 will shut off and #1 will come on. That rotation will continue on every cycle to insure even wear of the venturi check valves, solenoid valves, and pressure regulators.

The PLC password protection by Algas-SDI, is not intended to be modified by the user.

CPU MODULE

When the system is operating normally the following PLC LEDs are lit:

PWR
RUN

The **CPU LED** is normally off. It will only come on if the **CPU** fails. The system does not have a battery, so the battery indicator light is **ON**, there is a battery failure. If the battery is not functioning and the unit is without power, for extended periods, all setpoint parameters will be lost. If this happens, the values will have to be re-entered.

The mode switch must always be in the - **TERM** - position.

The four analog pots **(CH1**, **CH2**, **CH3**, and **CH4)** on the front of the CPU module are not used. No adjustment is required.

ANALOG INPUT MODULE

The **ANALOG INPUT MODULE** (**SLOT 0**) receives 4 - 20mA signals from several transmitters used in the control of the mixing system. There are no LED indicators on the analog input module.

The inputs for the analog module are as follows:

CH1	Mixed Gas Pressure	**CH3**	Vapor Pressure
CH2	Water Temperature	**CH4**	LPG Tank Pressure

See Section 2 for transmitter locations.

AC INPUT MODULE

The **AC INPUT MODULE** (**SLOT 1**) receives inputs which the sequencer uses to control the mixing system. The input module has 8 LED indicators numbered 0-7. Each LED represents two different inputs. For example, inputs A1 and B1 are both represented by LED number 1. The input being represented by the LED, A1 or B1, is determined by the position of the A/B switch located to the left of the LED indicators.

The inputs for the AC input module are as follows:

A0	High LPG level	**B0**	High mixed gas pressure
A1	Flame fail	**B1**	Spare (not used)
A2	High gas pressure	**B2**	Spare (not used)
A3	Power on/reset	**B3**	Spare (not used)
A4	Low water level	**B4**	Spare (not used)
A5	High water temperature	**B5**	Spare (not used)
A6	Optional low gas pressure	**B6**	Spare (not used)
A7	Optional alarm	**B7**	Spare (not used)

AC OUTPUT MODULE

The **AC OUTPUT MODULE (SLOT 2)** provides the outputs which control the mixing system and indicate if the LPG/air mixer is running. The output module has six (6) LED indicators numbered 0-5. Each LED represents two different outputs. For example, outputs A1 and B1 are both represented by LED number 1. The output being represented by the LED, A1 or B1, is determined by the position of the A/B switch located to the left of the LED indicators.

The outputs for the AC output module are as follows:

A0	Venturi solenoid #1	**B0**	LPG inlet solenoid
A1	Venturi solenoid #2	**B1**	Burner safety reset
A2	Venturi solenoid #3	**B2**	Burner control relay
A3	Venturi solenoid #4	**B3**	Pump start
A4	Venturi solenoid #5	**B4**	System status
A5	Venturi solenoid #6	**B5**	System alarm

Optional Outputs

SYSTEM STATUS INDICATION

Terminals 38 and 39 can be wired for a **SYSTEM STATUS INDICATOR** or system device by the customer. When the LPG/air mixer is running the output is turned on and the contacts close. The contact rating is 7 Amp @ 240 VAC (max.).

ALARM INDICATION

Terminals 40 and 41 can be wired by the customer as an **ALARM ANNUNCIATOR**. When any system alarm occurs, the output is turned on and the contacts close. The contact remains closed until the alarm is cleared. The contact rating is 7 Amp @ 240 VAC (max.).

LPG PUMP CONTROL

The **LPG PUMP CONTROL** has **TWO** modes of operation.

- The first mode of operation requires an external LPG pump motor starter coil wired through terminals 30 and 31 and the LPG pump operation **ENABLED** with the setup screen on the operator panel **(F3)**. Contacts between terminals 30 and 31 will close when the mixer is started. The pump will start and remain on until the mixer is shut off.
- The second mode of operation requires an external LPG pump motor starter coil wired through terminals 30 and 31 and the LPG pump operation **ENABLED** in the setup screen on the operator panel (3). It also requires 0-200 PSIG (14.06 kg/cm^2), 4-20mA current transmitter wired to terminals B3 (for 24 V excitation), 36 (shield) and 37 (signal). ***See wiring diagram*.**

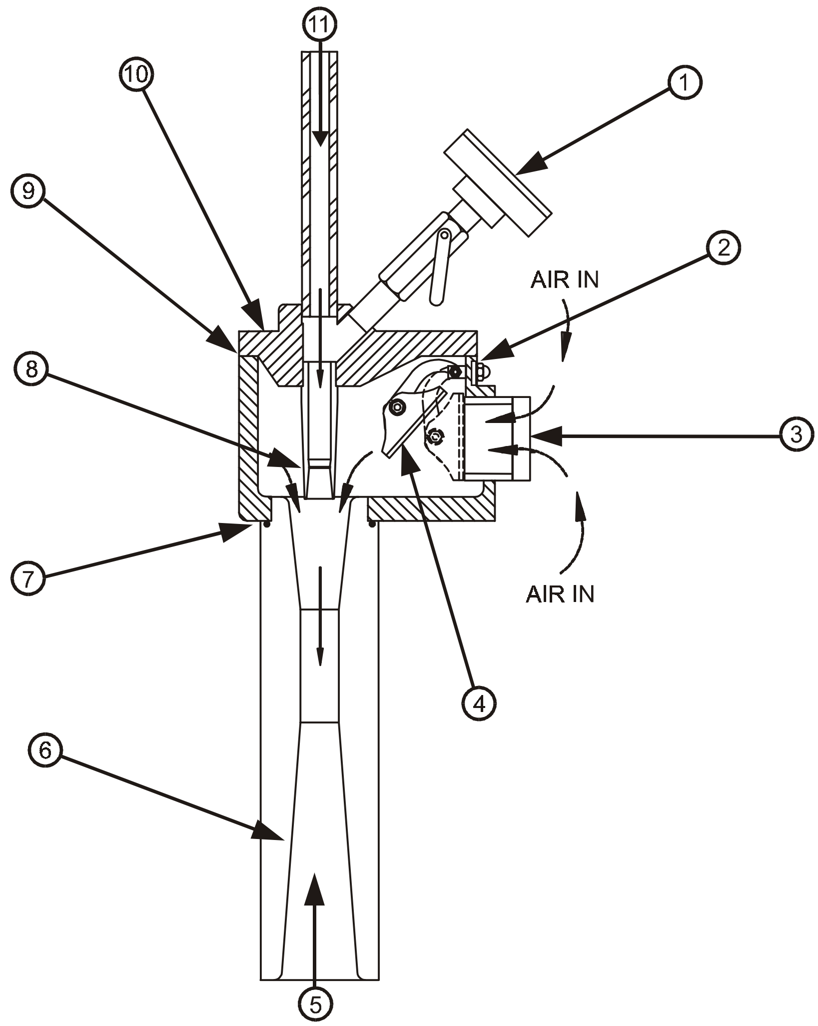
The transmitter should be piped to a point before the inlet of the LPG pump. For the pump to start, an economy setpoint is required and must be entered in the setup screen on the operator panel (F3). The pump will initiate when the mixer is started and the LPG storage tank pressure drops below the economy pump setpoint. The pump will remain on until the LPG storage tank pressure rises above the economy setpoint or the mixer is shut off.

The contact rating is 7 Amp @ 240 VAX (max.).

LPG/Air Venturi Type Mixers

Mixed gas is produced by the **VENTURI ASSEMBLY**. High pressure LPG vapor is introduced into the venturi nozzle. It accelerates through the venturi nozzle forming a vacuum as it exits the nozzle. That vacuum draws in air through the venturi check valve that is then mixed with the propane. This gas/ air mixture is carried into the diffuser where it decelerates and gains pressure as it fills the mixed gas accumulator tank. The mixed gas is held in the accumulator tank at a pressure controlled by the **PLC SEQUENCER** until withdrawn through the mixed gas discharge valve.

Figure 19 *— LPG/Air Venturi Mixer Diagram*



QM LPG-Air Venturi Mixer Diag.wmf

1. Motive pressure gauge
2. Sealing Washer
3. Air inlet
4. Venturi check valve
5. Mixed gas to accumulator
6. Venturi diffuser
7. O-ring
8. Venturi nozzle
9. Venturi housing gasket
10. Venturi cover
11. High pressure LPG vapor

Pressure Adjustments

The following subsections discuss **PRESSURE ADJUSTMENTS** to the mixing system. With the LPG vaporizer at operating temperature, put a load or flare stack on the system so at least one venturi is cycling. Note the number of venturis that are not cycling. Note the high and low cycling pressure in the accumulator tank.

MIXED GAS PRESSURE ADJUSTMENT

The **MIXED GAS PRESSURE SETPOINT** is adjusted using the setpoint on the **SETUP SCREEN** of the operator interface panel.

VENTURI MOTIVE PRESSURE ADJUSTMENT

MOTIVE PRESSURE: The pressure of the propane entering the venturi.

The factory set motive pressure for the venturi is stamped on the base of the venturi housing and is also indicated on the ***Data Sheet***. This is a starting point for proper adjustment of the venturi.

ADJUSTING THE MOTIVE PRESSURE ON SYSTEMS WITH INDIVIDUAL REGULATORS:

- Close all venturi vapor shut off valves.
- In **SETUP (F4)** on the operator panel, put the unit in setup mode.
- Connect a BTU analyzer or other device that will provide gas/air mixture quality.
- Press the mixer start **(F2)** to start the **LPG/AIR MIXER**.
- Open the shut off valve at the first venturi to be adjusted. The tank pressure should increase to the setpoint and the venturi will shut down.
- Open the accumulator tank outlet and establish the flow to keep the venturi cycling at 50% on, 50% off.
- Adjust the BTU value of the mixture by varying the venturi motive pressure with the pressure regulator adjustment.
- When the selected venturi is adjusted, close its shutoff valve and open the shutoff valve to the second venturi to adjust it.
- Continue this process until all of the venturis are set.
- When all of the venturis are adjusted, press the LPG/air mixer **START (F2)** to stop the LPG/air mixer.
- Take the LPG/air mixer out of **SETUP MODE** and open all of the shutoff valves.
- The **MIXER** is now set and ready for operation.

ADJUSTING THE MOTIVE PRESSURE ON SYSTEMS WITH A SINGLE REGULATING STATION:

- Close all venturi shutoff valves.
- Close the shutoff valve on the pilot supply line to the pilot operator for the main reactor.
- In **SETUP (F4)** on the operator panel, put the unit in setup mode.
- Press the mixer **START (F2)** to start the LPG/air mixer.
- Connect a BTU analyzer or other device that will provide gas/air mixture quality.
- Open the **SHUTOFF VALVE** at the first venturi. The tank pressure should increase to the setpoint and the venturi will shut down.
- Open the accumulator tank outlet and establish the flow to keep the venturi cycling at 50% on, 50% off.
- Set the **MANIFOLD PRESSURE** by adjusting the Fisher 627 by-pass regulator to **1.0 PSI LOWER** than the motive pressure stamped on the base of the venturi housing and listed on the equipment ***Data Sheet***. For example: adjust to 34 PSIG (2.39 kg/cm^2) when the pressure is listed as 35 PSIG (2.46 kg/cm^2).
- Open the shutoff valve on the pilot supply line to the pilot operator.
- Set the manifold pressure by adjusting the pilot operator on the large regulator set, to the motive pressure required for propane/air mixture according to the BTU analyzer.
- Once you have adjusted one venturi for the correct output, shut it off and check each venturi individually to insure they are providing the correct mixture. Any significant deviation could indicate a mechanical problem with the venturi.

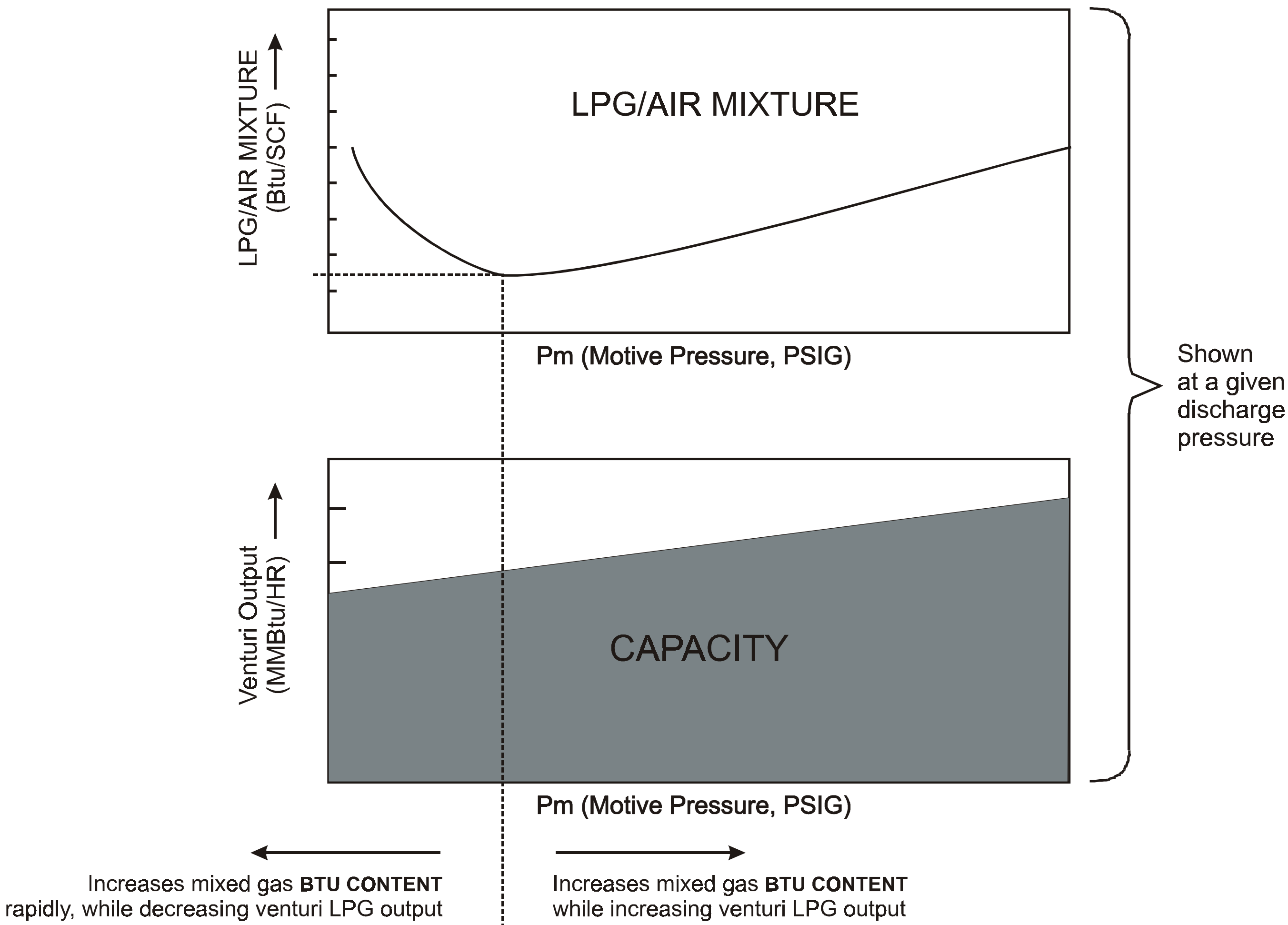
NOTE

Check that the manifold pressure lowers by 1.0 PSI (0.07 kg/cm^2) when the shutoff valve on the pilot supply line to the large regulator is closed and the venturi is cycling on. Return the shutoff valve on the pilot supply line to the open position after checking.

- Press the **MIXER START (F2)** to stop the LPG/air mixer.
- Take the mixer out of **SETUP MODE** and open all of the **SHUTOFF VALVES**.
- The **LPG/AIR MIXER** is now set and ready for operation.

Detailing Venturi Performance

Figure 20 - *Typical Venturi Performance Curve*



Venturi Performance Curve.wmf

The factory set **MOTIVE PRESSURE** is the point at which the venturi performance yields the leanest mixture at rated output and discharge pressure, when installed at elevations up to 2000 ft.

Increasing the motive pressure beyond the factory setpoint will increase the venturi output, while also putting a greater demand on the vaporizer. Increasing motive pressure beyond the setpoint should only be done when required, with caution to avoid overdrawing the vaporizer and increasing the mixed gas **BTU CONTENT**.

As the elevation exceeds 2000 ft., the atmospheric pressure reduces to the point at which the venturi may not achieve low mixed gas BTU values at the full rated discharge pressure. When this is the case, and a leaner mixture is required, the discharge pressure (mixed gas pressure setpoint) should be reduced while also slightly decreasing the motive pressure.

A general rule for discharge pressure reduction based on elevation is 1 PSI/2000 ft.

Additional Safety and Operation Switches

NOTE

All switches are preset at the factory. You should only have to adjust them after replacement.

HIGH MIXED GAS PRESSURE SWITCH (See Figure 3, #13)

The pressure switch is located in the burner cabinet. To set, turn the adjusting wheel to the approximate setting shown on the indicator scale on the switch. Turning the wheel counterclockwise decreases the pressure setting, turning it clockwise increases the setting. The indicator on the front of the switch is only a guide, pressure should be adjusted using a calibrated pressure gauge. Refer to the Data Sheet and the setpoints for the high tank pressure switch below:

Table 4 – *Setpoints for the High Mixed Gas Pressure Switch*

MIXED GAS DELIVERY PRESSURE FOR PROPANE	HIGH TANK PRESSURE SWITCH
5# PSIG	8# PSIG
8# PSIG	11# PSIG
10# PSIG	13# PSIG
12# PSIG	15# PSIG
15# PSIG	18# PSIG

HIGH WATER TEMPERATURE SWITCH ADJUSTMENT (See Figure 3, #7)

The high limit opens and the turns off the system when water temperature reaches the setpoint 200° F. (93.3° C.). The reset occurs when the water temperature drops below the setpoint and past a 10° F. differential. The lower limit is not used on this application. To adjust the high water temperature switch, remove the cover. Using your fingers, turn the adjustment screw to 200° F (93.3° F.). Lock this adjustment in place using the collar provided. Reinstall the cover.

HIGH AND LOW GAS PRESSURE SWITCH ADJUSTMENT (See Figure 8, #3 and 6)

Every unit has a **HIGH GAS PRESSURE SWITCH** to protect the burner from regulator failure, but only certain models, mainly Minnesota Q1120V through Q1650V, have a low gas pressure switch. Both switches are mounted on the main gas valve. The two switches look similar but are individually labeled. If the labels are missing consult the appropriate burner train schematic in the Major Component section for location. The switches are set by rotating the dial clockwise to increase the setpoint, counterclockwise to decrease it. Turn the dial until the desired pressure is opposite the white arrow on the yellow face. Consult the Data Sheet for correct setting.

Both high and low pressure switches have a manual reset button in the center of the pressure setting dial. When either switch has been tripped the fault must first be corrected. Then the reset button must be pushed to reset the switch.

HIGH LPG LEVEL SWITCH (See Figure 5, #5)

The **LIQUID FLOAT SWITCH** will open and shut off the system if liquid LPG has filled the heat exchanger and the liquid trap at the unit outlet.

LOW WATER LEVEL SWITCH (See Figure 3, #16)

A float switch that opens, shutting off the system, when the waterbath level is too low to safely operate the unit.

TIME DELAY RELAY (See Figure 6, #6)

The **TIME DELAY RELAY** allows the system to remain operating if there is a short temporary power loss or if any safety switch trips for less than 3 seconds. The time delay relay is fixed at 3 seconds and will not allow a shutdown of the vaporizer if the safety was open for less than that time.

Burner and Flame Safeguard

TYPICAL BURNER OPERATION SEQUENCE

For **ALL STANDARD MODELS**, and the Minnesota Q320V through Q960V, the burner uses a fixed fire start. The QM system uses a fast opening valve with a slow opening valve downstream. On standard models these two valves are packaged into the Dungs Multi-Valve. Gas pressure is controlled by a regulator. Combustion air is fixed with no adjustment required.

When the burner gets the signal to start, the pre-purge cycle begins. Upon completion, the ignition transformer energizes, the pilot solenoid valve opens and the gas pilot ignites. On Eclipse burners, the pilot flame is not a separate flame from the main flame, but merely a greatly reduced main flame.
The flame detector verifies the pilot flame, then opens safety shutoff valves and the flame comes to full fire. The pilot solenoid will then close. When the waterbath reaches operating temperature, the gas valves close, the blower motor shuts off and the burner is ready for the next cycle.

Q1120V through Q1650V MINNESOTA OPTION BURNERS use a low fire start, high fire run system. The only difference will be the burner sequence moves from pilot to low fire and then to high fire. Gas flow to the burner is controlled, but air flow is constant for all burner settings.

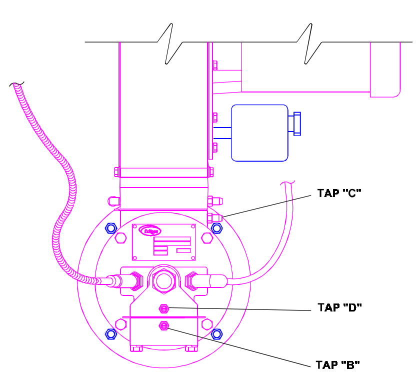
BURNER

The **ECLIPSE THERMAIR BURNER** is a nozzle mix burner with a packaged combustion air blower designed to fire with fixed combustion air over a wide gas turndown range. The only burner adjustment to be made is gas input, which is accomplished by adjusting the pressure regulator to achieve correct input pressure at the burner.

BURNER REGULATOR ADJUSTMENT

The dual stage, or **FIRST AND SECOND STAGE REGULATORS** were set at the factory and adjustment of the gas pressure/flow rate to the burner should not be necessary. If an adjustment must be made, check the Data Sheet for settings. The regulators are set when the burner is running.

Figure 21 - *Burner Regulator Adjustment*



The regulator pressure can be set by measuring either the differential pressure across the gas inlet orifice, taps "**B**" and "**D**", ***See Figure 21***, or the inlet pressure to the inlet orifice, tap "**B**". The pressure gauge on the burner measures the inlet pressure to the orifice same as tap "**B**". A **MANOMETER** is required to measure the pressure at the taps and to check the pressure gauge. Taps "**B**" and "**D**" are gate type valves. Before attaching the manometer, insert a screwdriver into the tap opening and rotate the screw counterclockwise one turn, to open the valve. Make sure to close the valve when the regulator setting is complete. Check the ***Data Sheet*** for the correct differential pressure or burner inlet pressure.

NOTE

If the pressure in the burner gas train is too high or too low pressure switches will shut down the burner.

The tension on the regulator spring can be adjusted to obtain the exact gas pressure in inches of water column, required at the inlet to the burner.

- Remove the cap or bonnet from the regulator to gain access to the adjustment screw or button.
- Turn the screw clockwise to increase the pressure and counterclockwise to decrease the pressure.
- Adjust the regulator to achieve the desired burner pressure as shown on the ***Data Sheet***.
- Reinstall the cap or bonnet after the regulator is adjusted.

MOTOR AND BLOWER

The motor/blower combination provides constant air flow to the burner. Depending on the application, an air orifice may be used, ***See Data Sheet*** for size. An air flow switch mounted on the blower side assures that there is sufficient air flow before allowing the burner to operate. Check the ***Data Sheet*** for the correct setting of this switch.

The pressure can also be checked by using an inches of water column (WC) pressure gauge or a manometer attached to tap "**C**" on the burner Figure 21. The pressure should be at least 4 inches WC.

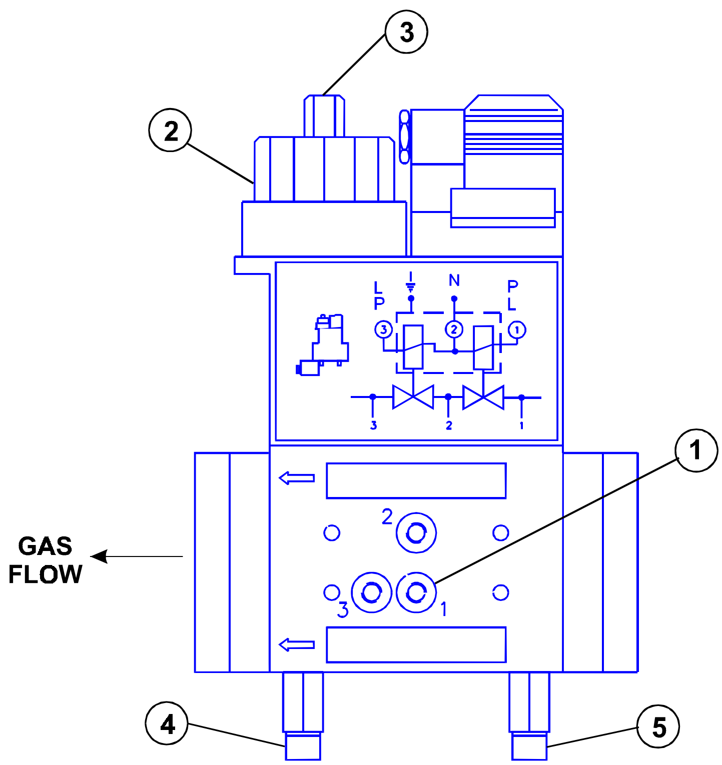
PILOT FLAME STRENGTH ADJUSTMENT

When the **PILOT TEST BUTTON** is pressed in, the Veri-flame holds the pilot flame on without the main gas valves. When in the test mode, the green **INTERLOCKS CLOSED** light will blink. Use a multimeter to measure the voltage, positive lead inserted in the test point on the front cover, negative lead on neutral. The reading should be 6 - 11 VDC. To exit the test mode push the test reset button again. ***For more information on pilot testing and set up refer to the Veri-flame Manual in Appendix A.***

DUNGS DUAL MULTI-VALVE AND VISUAL INDICATORS

Both safety shutoff gas valves, one quick opening and one slow opening, are combined in the Dungs Dual Multi-Valve (DMV) used on all standard and Minnesota units through Q960V. On the side of the valve are two visual indicators. When each valve is open, the red portion of the indicator can be viewed through the clear plastic cover. When closed, the white portion of the indicator will be viewed through the plastic cover. The visual indicator is a necessary part of the valve in order to maintain FM approval

Figure 22 - *Dungs Dual Multi-Valve and Visual Indicators*



Dungs.wmf

1. Pressure taps

2. Main flow setting adjustment cap

3. Initial fast lift adjustment cap.

4. Slow opening visual indicator.
(red = open white = closed)

5. Fast opening visual indicator.
(red = open white = closed)

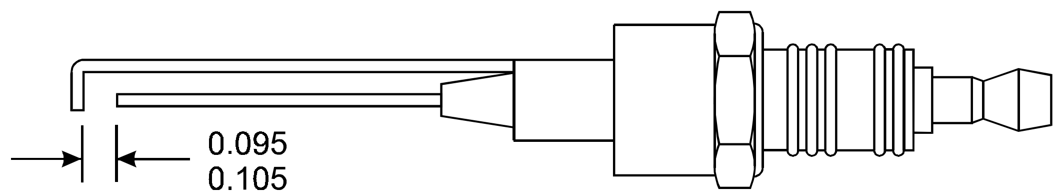
Each valve is supplied from the manufacturer with the main flow adjustment fully open and no initial fast lift. These settings should not need any adjustment since gas flow is controlled by the pressure regulator and the initial fast lift adjustment has little appreciable effect on the valves total opening time. If for some unforeseeable reason adjustment is necessary ***refer to the dungs valve in Appendix A****, component information* for instructions.

Q1120V through Q1650V Minnesota models use one quick opening solenoid and one slow opening motorized valve. Visual indicators are not used.

SPARK PLUG GAP

A recommended monthly maintenance practice is to clean the spark plug and check the electrode gap. The gap should be approximately 0.100 as measured in the diagram.

Figure 23 - *Spark Plug Gap*



Spark Plug Gap.wmf

FLAME MONITORING SYSTEM

Every vertical waterbath vaporizer contains a flame monitoring system, the Eclipse Veri-Flame, and the flame rod (UV scanner on Q1650V only) controlling the burner's startup operation. Indicators on the flame safeguard show the current operating status. The two-position button, **IN** and **OUT**, is for putting the burner in pilot test mode and resetting the flame safeguard. Preset once for **IN**, and a second time for **OUT**.

SAFEGUARD LED INDICATOR LIGHT

1. The LEDs on the flame safeguard indicate the following:

LED	FUNCTION
INTERLOCKS CLOSED:	Illuminates green when the Veri-Flame is on and operating. All operating limits are made.
SYSTEM ERROR:	Illuminates when a system errors is detected. Consult the Veri-Flame Manual.
FLAME FAILURE:	Illuminates RED when a pilot or main flame fails.
AIR FAILURE:	Illuminates RED whenever combustion air is lost during the operating cycle.

2. **FLAME SAFEGUARD CONTROL**. If there is an ignition failure or a safety shutdown, the flame safeguard shuts down the vaporizer and activates an alarm. Both the manual reset button on the flame safeguard and the master control switch must be reset to restart the vaporizer. Please ***refer to the VERI-FLAME SAFEGUARD MANUAL*** for further information as well as the maintenance check list and troubleshooting guides in ***Sections 6 and 7***.

RESETTING FLAME SAFEGUARD

To reset the flame safeguard, push the reset button on the Veri-Flame in twice. It should be in the **OUT** position when complete. Pushing once puts it in **PILOT TEST MODE**.

FLAME ROD

FLAME RODS use the flame as a current path to complete a circuit to the flame relay. An AC signal passed through the flame rod is rectified to a DC signal by the flame and transmitted to metal parts of the burner, completing the circuit. The flame rod is an electrical conductor and must be free from excessive dirt and soot, which act as insulators.

UV SCANNER (Q1650V models)

The UV scanner detects the radiant energy from the flame. The current passing through the detector is amplified by the combustion safeguard and interlocks the safeguard safety circuit. The UV scanner lens must be clear of debris to properly view flame.

AIR FLOW SWITCH ADJUSTMENT

The **AIR FLOW SWITCH** is used to verify the flow of combustion air from the blower assembly. If combustion air is inadequate, the gas valve will close and an alarm will display.

The air flow switch is wired in series with the flame safeguard. When the blower starts, creating an air flow through the burner housing, the switch closes delivering electricity to the flame safeguard. ***See Data Sheet*** for factory settings.

Waterbath Circulation System

WATERBATH

The waterbath is normally a mixture of water and glycol in varying mixture ratios plus corrosion inhibiting additives. Since the QM system is vented to the atmosphere, corrosion protection is very important. Glycol is used for freeze protection, but will also lessen the amount of makeup water required due to its lower evaporation rate.

WATERTRAIN

The water train is composed of a pump and piping to circulate the waterbath solution and maintain a constant overall temperature. Circulation also increases heat transfer by the scrubbing action on the heat exchanger. The water pump is very important to the overall effectiveness of the unit and should be maintained properly.

Optional Equipment

ACCUMULATOR TANK

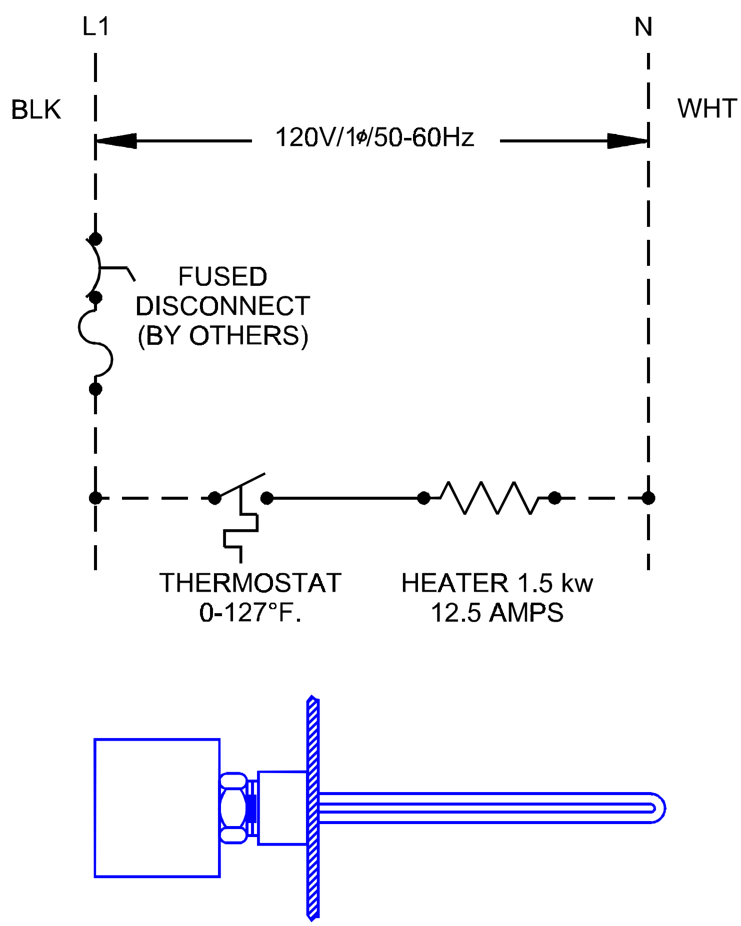
Algas-SDI can provide a mixed gas accumulator tank. The tank comes with all the necessary hardware for field installation. ***See Installation, Section 3 for mounting and sizing criteria.***

STANDBY ELECTRIC BATH HEATER

The standby electric bath heater is typically recommended when the ambient temperature commonly drops below 0°F (-17.8°C). This heater will maintain the waterbath temperature at 0°F (-17.8°C). If there is a system shutdown.

The immersion heater has an integral thermostat set to turn the heater on at 0°F (-17.8°C). But may be set as high as 127°F (52.8°C). A 120V 12.5 and independent service is required for the heater.

Figure 24 *- Optional Backup Heater.*



Backup Heater.wmf

QM REMOTE CONTROL AND MONITOR PACKAGE

SYSTEM ELECTRONIC INTERFACE FOR REMOTE OPERATION

REQUIRED OPERATING SYSTEM:

Personal computer running Windows 95, 98, or NT

Procomm Version 3.0 or better (provided with the option)

OPTIONS FOR CONNECTING TO A PC:

1. Direct Connect

   Connection Type: RS232C (RJ12 phone jack)
   will communicate up to 50 ft.

   RS422 (with 232C to RS422 converter)
   will communicate up to 4000 ft.

2. Modem Connect

   Connection Type: 9600 baud Hayes Compatible Modem

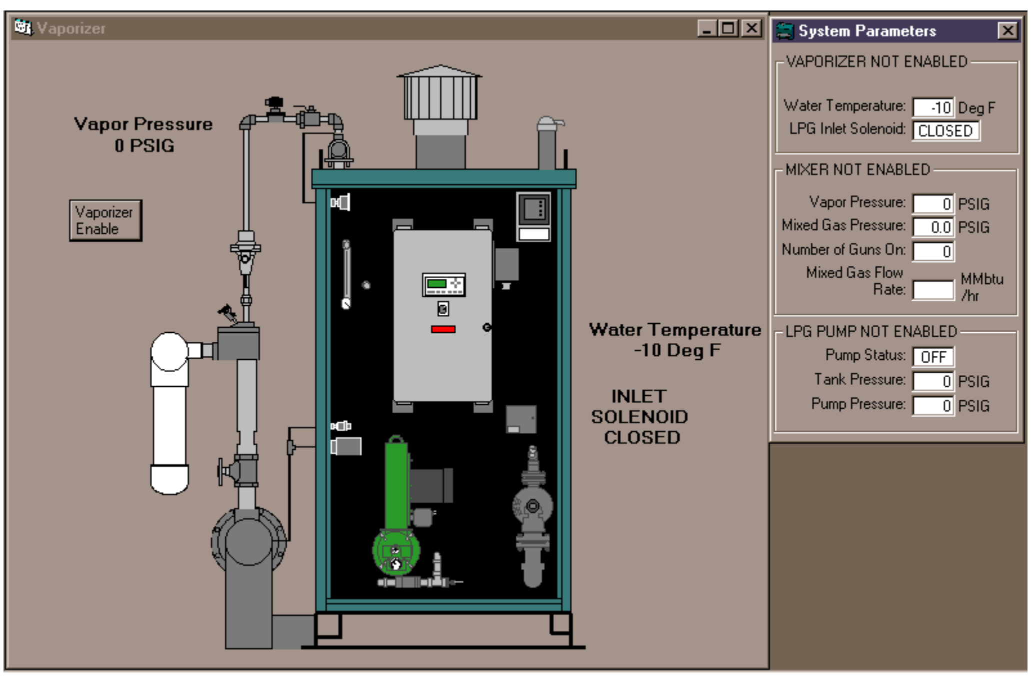
FUNCTIONS AVAILABLE:

The software is a fully functional Remote Control and Monitoring package. Operators can realize start/stop control, set point manipulation, and real time machine parameters including pressures, run time gas metering parameters, and machine alarms.

Multiple machines can be monitored by setting up additional parameter files for each machine.

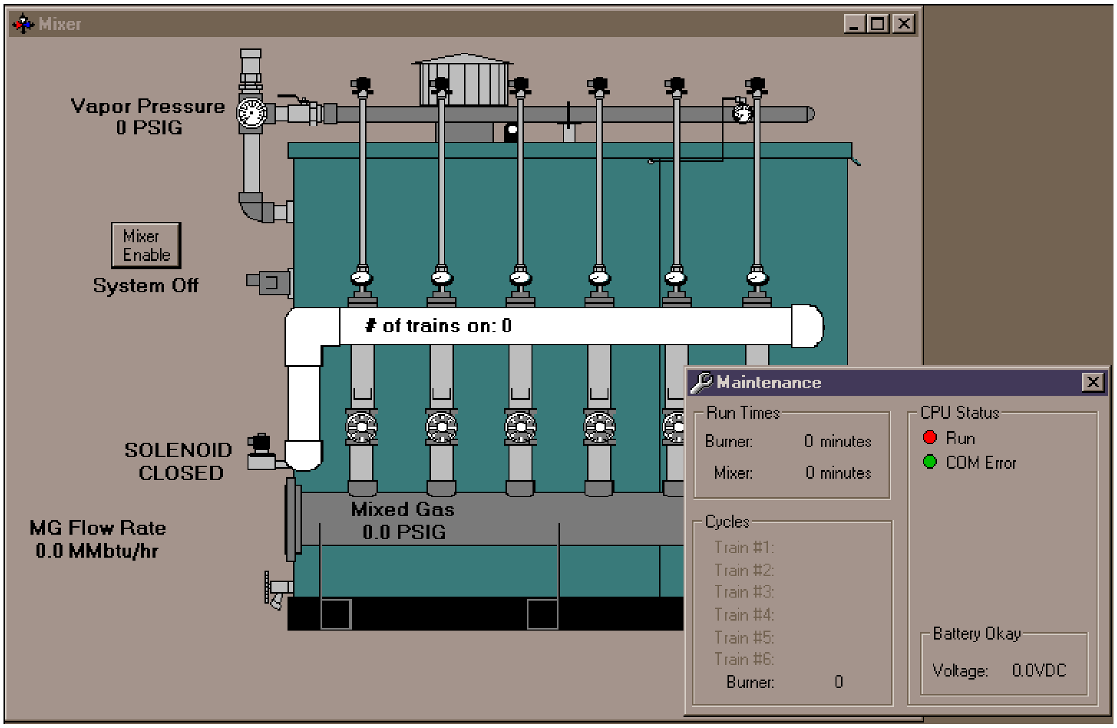
Contact the factory for further details.

Figure 25 – *Electronic Interface – Front View*



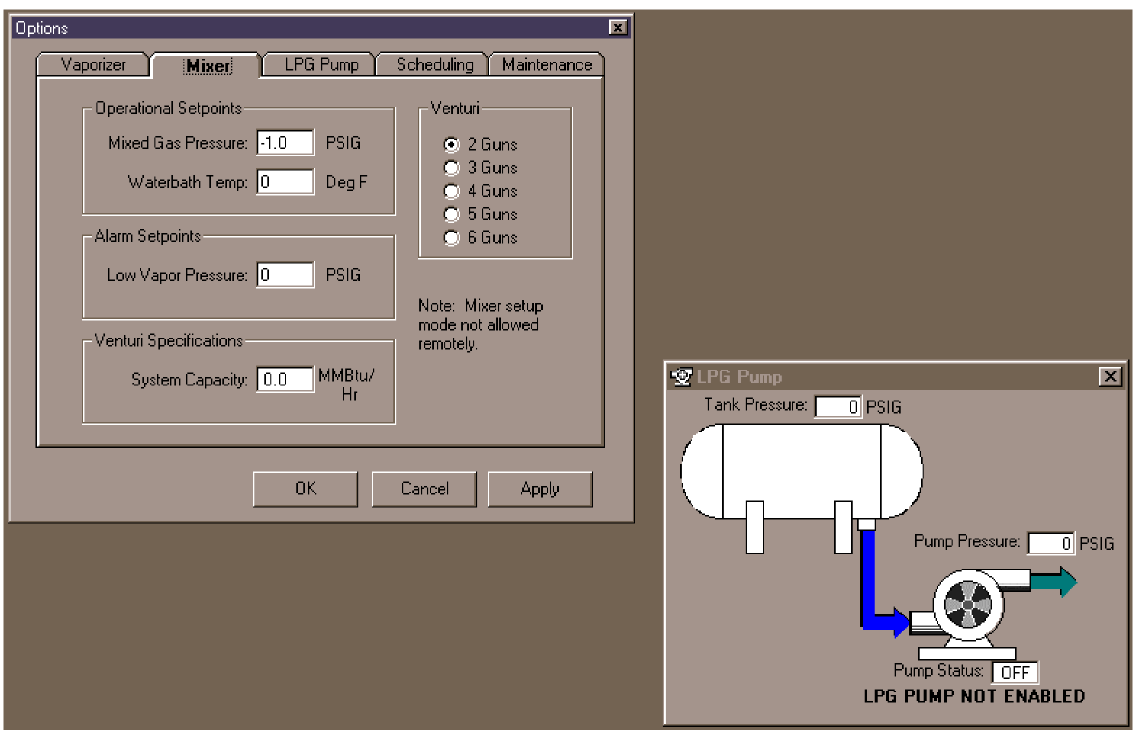
EI Front.gif

Figure 26 – *Electronic Interface – Side View*



EL Side.gif

Figure 27 – *Electronic Interface – Pump View*



EL Pump.gif

Maintenance 6

MAINTENANCE CHECKLIST

Check these items weekly to ensure safe proper operation:

- The presence of LPG vapor.
- Glycol/water level.
- Verify water pump operation.
- Gas valve operation.
- Flame safeguard status.
- Smooth lightoff and smooth burner operation.
- Venturi motive pressure.
- Mixed gas pressure.

HOW TO FIND INFORMATION

- To locate component on unit, ***See Major Component Drawing, Section 2.***
- For an overview of component operation in system and minor adjustments, ***See Operations, Section 5***.
- For more specific information on component, ***See Appendix A.***

Table 5 - *Maintenance Schedule.*

DESCRIPTION	WEEKLY	EVERY MONTH	EVERY SIX MONTHS	EVERY YEAR
Blower wheel				Check that wheel is tight on shaft . Check for dirt.
Blower air flow switch			Check adjustment. Test shutdown.	
Burner fuel supply lines				Pressurize and check for leaks.
Burner				Check bolts on mounting flange.
Flame safeguard		Flame failure test.	Check spark electrode and gap. Flame signal strength test.	Visually check ignition cable and connector. Check burner nozzle, spark plug, flame sensor.
Operating controls and safety set points.				Check settings, operation and set point..
Strainer.				Remove and clean.
Water/glycol	Check fluid level.		Check PH inhibitor level and solution ratio.	
Wiring			Check supply voltage. (100-130 VAC)	Check for broken or loose wires.
Burner regulators		Check settings, operation.		Clean and rebuild if required.
Burner gas valves.			Perform leak test.	
Float chamber				Remove drain plug, drain oils & residue.
Pumps and pump motors		Check operation.		
High-Low gas pressure interlocks				Check settings, operation.
LPG pump (if used)		Test & check for leaks.		
High mixed gas pressure switch.				Check setting, operation.
Venturi and inlet solenoid valves.			Inspect and clean internal parts, replace worn or damaged parts.	Clean. Replace all internal parts if required.
Venturi regulators		Check settings and operation.	Inspect disk assembly, seat ring, diaphragm, replace if necessary.	Replace disk assembly, replace diaphragm if necessary.
Control box electrical components			Open box. Check for corrosion and moisture damage.	Replace moisture desiccant packet.

Maintenance Schedule continued...

DESCRIPTION	WEEKLY	EVERY MONTH	EVERY SIX MONTHS	EVERY YEAR
Unit connections (all).				Leak test w/soap solution.
CPU battery condition			From operator screen check battery status. It will indicate “CPU battery OK” or “replace CPU battery”	
Venturi check valve		Check for leaks.		Inspect clevis assy., clevis screw, valve arm & valve surface. Replace as needed.

Some electric motors for the blower and water pump have sealed bearings and do not require lubrication.

NOTE

Maintenance is based on continuous operation Refer to the burner manual for additional maintenance checks.

CAUTION

Whenever any component or fitting in the system is removed and replaced or reinstalled, the complete system must be leak tested. NO LEAKS ARE TOLERABLE!

Safety Shutoff Valve Leak Test Procedure

FOR DUNGS DMV

The burner must be **OFF** to perform a leak test on the safety gas valves.

- Remove power connection at valve by loosening hold down screw and pulling off connector.
- Shut off the **MAIN GAS SUPPLY HAND VALVE**. This is the ball valve in the gas train just before the burner.
- Open the **BURNER SUPPLY VALVE** at the back of the unit. This is the ball valve supplying the regulator.
- To leak test the first valve loosen plug #2 three turns with a 3 mm hexagon socket wrench. ***See Section 5, Figure 22 #1***.
- Spray soapy water around the plug If bubbles appear, the valve is leaking. Follow manufacturer's instructions for corrective action. Close plug #2 after testing.
- To leak test the second valve apply 120 VAC to terminals on the valve from L1 and N on the terminal strip located in the control panel. This will open the first valve. Check visual indicator on the first valve to verify it opened.
- Loosen plug #3 three turns.
- Spray soapy water around the plug. If bubbles appear, the valve is leaking. Follow manufacturer's instructions for corrective action. Close plug #3 after testing.

FOR Q1120V – Q1650V MINNESOTA OPTION

These two models use the same basic procedure with the exception that the two valves are separate, the first valve in the gas train is a solenoid type and the second valve in the gas train is a motorized type. Test as follows:

The burner must be off to perform a leak test on the safety gas valves.

- Remove the power connection at the first valve (solenoid type).
- Shut off the **MAIN GAS SUPPLY HAND VALVE**. This is the ball valve in the gas train just before the burner.
- Open the **BURNER SUPPLY VALVE** at the back of the unit. This is the ball valve supplying the regulator.
- Leak test the first valve by removing the plug from the upstream pressure tap in the motorized valve body and installing a compression fitting and short hose.
- Immerse the hose end just below the surface in a container of water. If bubbles appear, the valve is leaking. Follow manufacturer's instructions for corrective action. Reinstall plug after testing.
- Remove plug from the downstream pressure tap in the second valve and install a compression fitting and short hose.

- Immerse the hose end just below the surface of a container of water. If bubbles appear, the valve is leaking. Follow manufacturer's instructions for corrective action. Reinstall plug after testing.

Leak Testing the Pilot Train

The burner must be off to perform a leak test on the safety gas pilot solenoid valve.

- Shut off the **PILOT ADJUSTMENT HAND VALVE**. This is the valve in the pilot gas train just before the burner.
- Open the **BURNER SUPPLY VALVE** at the back of the unit. This is the ball valve supplying the regulator.
- Remove the plug from the body of the **GAS PILOT SOLENOID VALVE** and install a compressor fitting and short hose.
- Immerse the hose end just below the surface of a container of water. If bubbles appear, the valve is leaking. Follow manufacturers instructions for corrective action. Reinstall plug after testing.

Water/Glycol Maintenance

In addition to maintaining proper coolant level, PH and corrosion inhibitor control are also necessary.

Water loss by evaporation is natural and depends on system use and ambient conditions. Monitor for a month when in use to determine a pattern of loss. Also, check coolant level before using if the unit has been idle for awhile.

PH CONTROL is important because glycols oxidize into acidic end products, which are very corrosive. Dow and CH20 products have additives in them to neutralize these acids which may become depleted over time and use. PH should be checked with a PH monitor or indicating paper. Supplies are available from Omega or Misco Products (S*ee Ordering Section* for address information). The necessary PH range to check is 7 to 9 when ordering paper.

The PH range should be kept between 8.0 and 10.0. Adjustments need to be made if it falls below 8.0, which indicates the coolant is approaching the acidic range. If using Dow products adjustments can be made by adding a 50% solution of sodium hydroxide to potassium hydroxide to bring the PH level to an acceptable level. If using **CH20 HYDRO-TREAT**, adding about 25% of the initial fill amount, per Table 1, should correct the problem.

Dow provides a free fluid analysis to determine **INHIBITOR CONDITION** for systems containing 250 gallons or more of **DOWTHERM** or **DOWFROST**, and a small fee for lesser amounts. The kit consists of several four ounce containers to fill with fluid samples and labels to send to Dow. It is recommended that you order the kit in time to take a sample after the unit has been initially filled and circulated for 24 hours. The test results will include inhibitor and glycol levels and any necessary recommendations.

The inhibitor used in **CH20 HYDRO-TREAT** is molybdenum based and can be checked using Omega's Molybdate/Molybdenum Test Kit #WTMO-3632. The kit costs about $40 (US) and will do 20-30 tests. The test consists of withdrawing a small sample of coolant and adding drops of the reacting reagent from a calibrated dropper until a color change occurs. Counting the number of drops and multiplying by a conversion factor yields the PPM concentration. All necessary equipment for the test is included in the kit. The molybdenum level should be 125 PPM minimum. If it is less, add about 25% of the initial fill amount, ***See Table 1***.

A rigorous PH and inhibitor monitoring and maintenance schedule is essential but not always easy to establish, as the rate of change is dependent on system use. A good method to establish a pattern for a schedule is to analyze PH an inhibitor level (for Hydro-treat) immediately after installation, after 2 months or 200 hours use, whichever occurs first, and after 6 months or 500 hours use, whichever comes first.

Water Pump Removal

On Q1120V through Q1650V models the water train can be completely isolated with the two shutoff valves. Other models have only a bottom shutoff valve so some of the waterbath must be drained in order to remove the water pump. The water train continues inside the unit exiting at approximately the same height as the bottom of the sight gauge. Algas-SDI recommends draining the waterbath an inch below the bottom of the sight gauge on models Q320V through Q960V. From the COLD FILL LINE this is a total of 15 gallons on Q320V and Q480V models and 35 gallons on Q640V, Q800V, and Q960V models.

Blower Motor Replacement

- Disconnect electrical connections to blower motor and air flow switch.
- Remove entire blower housing by removing the four bolts at the base of the housing where it attaches to the burner; then lift out of cabinet.
- Remove motor and blower wheel from housing.
- Loosen blower wheel set screw and remove.
- Remove blower motor mounting plate.
- To **INSTALL**, reverse steps. Before re-attaching housing assembly to burner it is very important to check for correct blower motor rotation. Connect power to the motor and ensure that blower wheel rotates in a counterclockwise direction as viewed facing the housing inlet screen.

Venturi Check Valve Replacement Instructions

This instruction set is to be used for the Venturi Check Valve Kit- P/N - 40490.

A. Check Valve Assembly
B. Housing Lid
C. Housing Gasket
D. Venturi Housing
E. O-Ring
F. Seating Surface
G. Acorn Nut
H. Sealing Washer
I. Clevis
K. Check Valve Arm
L. Pivot Screw
M. Check Valve

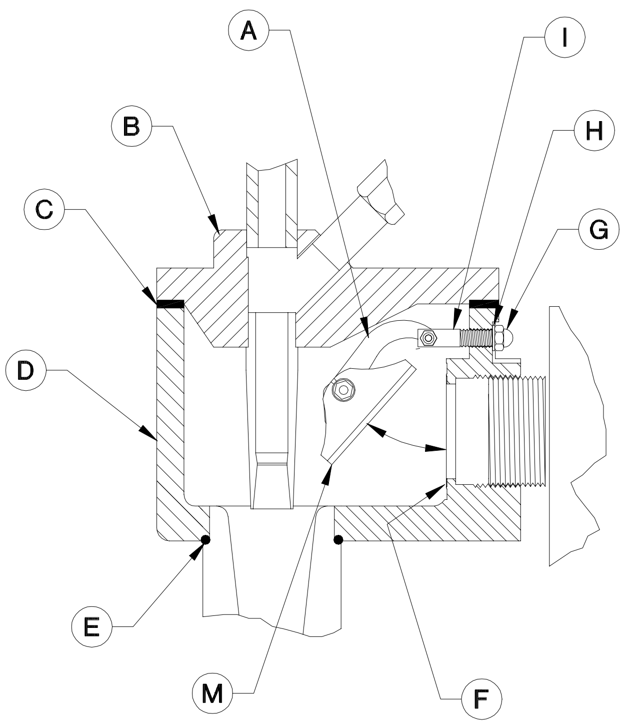
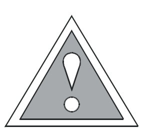


Figure 28 - *Venturi Check Valve Replacement Diagram*



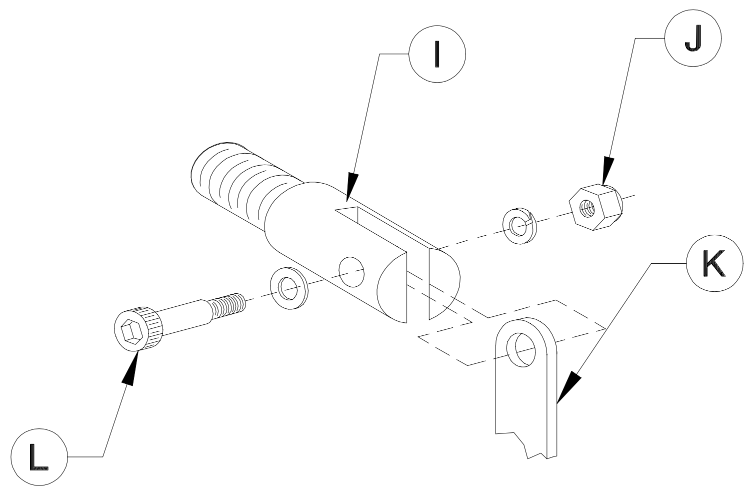
CAUTION

If the venturi check valve leaks or the pivot arm mechanism operates poorly the venturi check valve assembly must be replaced. Follow the procedure to replace the venturi check valve and pivot arm.

1) After the existing Check Valve Assembly (A) has been removed, examine the machined Seating Surface (F) on the venturi housing (D) to be sure the surface is clean and without flaws.

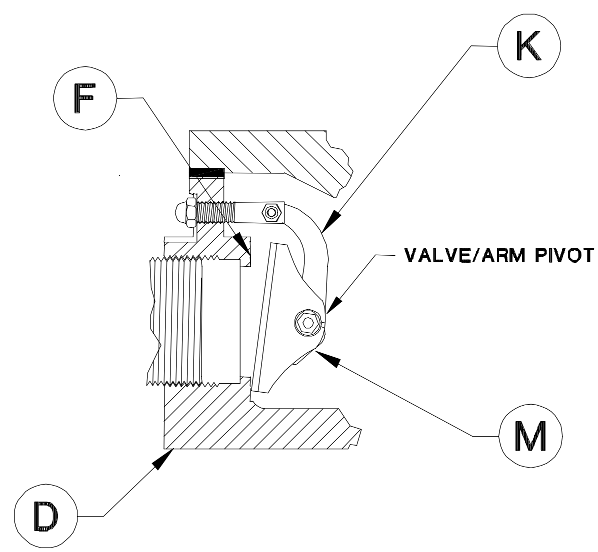
2) Screw the Clevis (I) into the Venturi Housing, until 1 – 2 threads are left inside of the housing (D). Do not use a screwdriver or other prying device to install the clevis.

3) Insert the Check Valve Arm (K) into the slot of the Clevis (I) and connect the two pieces with the clevis/arm Pivot Screw (L) through the aligned holes. Be sure that the flat washers are inserted on either side of the clevis. Tighten the Lock Nut (J) allowing for free swing of the arm.

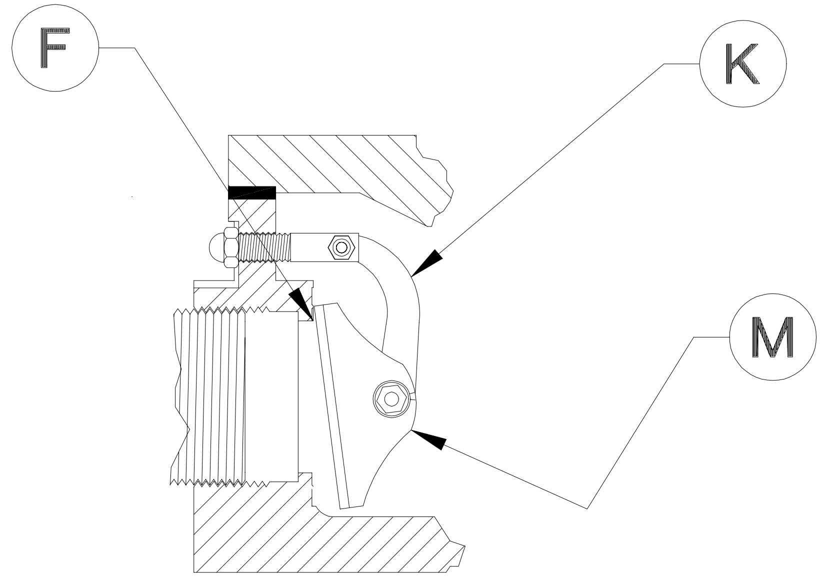


4) Check for proper Clevis installation as follows:

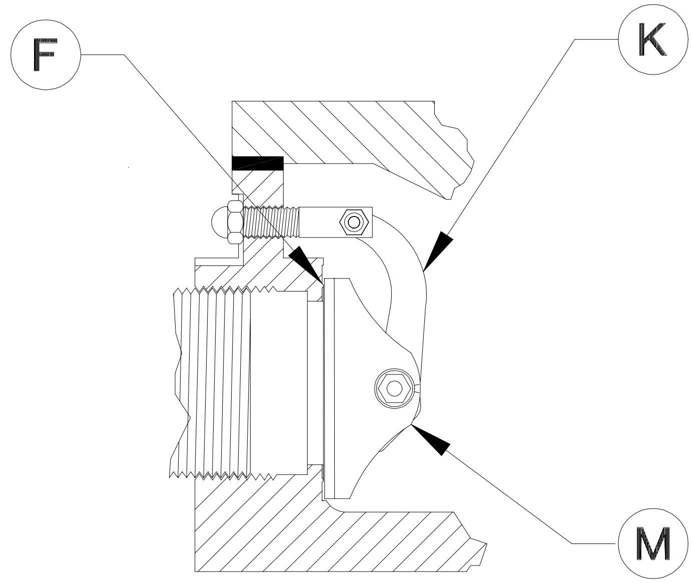
a) With the arm (K) raised, rotate the Check Valve (M) around the valve/arm pivot so that the edge of the valve nearest the clevis is lowered without allowing the Check Valve (M) to turn around the valve/arm pivot, only the lower part of the valve should contact the Seating Surface (F).



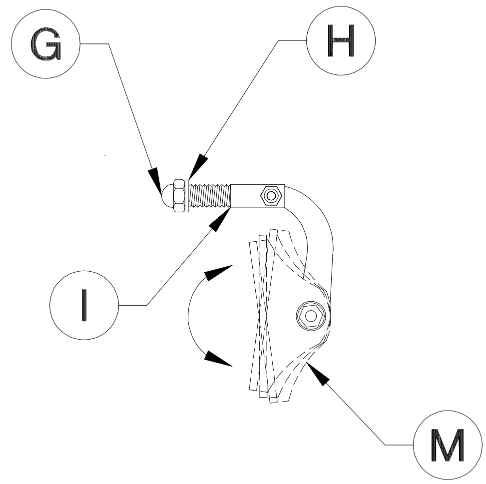
b) With the Check Valve (M) rotated to the other extreme position around the valve/arm pivot, lowering the Check Valve Arm (K) should cause only the upper part of the Check Valve (M) to contact the Seating Surface (F).



c) Lower the arm (K) a third time, allowing free rotation of the Check Valve (M). The Check Valve (M) should be able to contact the seating surface (F) uniformly all around.



d) If the valve does not contact the seat as described above, reposition the Clevis (I) in the Housing (D). At least three threads must be exposed for proper installation of the acorn nut (G).



5. Place Sealing Washer (H) onto Clevis (I) then tighten the Acorn Nut (G) onto the Clevis (I) outside the Housing (D), making sure that when the nut is tight, the valve is centered. Do not use any tools on the clevis inside the housing, or on the arm or valve. It may be helpful to start with the valve offset to the side and allow it to rotate to its centered position while tightening the acorn nut.

6. Tighten the Lock Nut (J) on the clevis/arm pivot screw until the arm is tight in the clevis. Then slowly loosen the lock nut just until the arm can swing freely. Check that the valve is centered and clears the housing on both sides.

7. Install the Venturi Housing Lid (B), using a new Gasket (G). Apply white Lithium grease to gasket & threads.

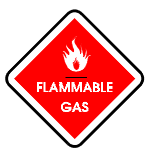
8. Apply pressure to the unit and check for leaks around the lid and around the check valve. Initially a small leak may occur around the check valve, but after a few cycles the leak should correct itself. If it persists, remove the lid and re-check the seating surfaces and the alignment.

NOTE

As with all components containing materials subject to deterioration, the venturi check valves should routinely be checked and replaced as necessary. A minimum annual inspection should be conducted.

LEAK CHECK PROCEDURE FOR VENTURI CHECK VALVES

- Remove **AIR INLET HEADER (See Figure 4, Item 7)** from venturi.
- Build-up pressure in accumulator to the system operating pressure, shut off the system, close the **INLET VALVE**, and disconnect all power.
- Use either a gas detector or a soapy solution applied to the check valve and seat to determine if there is a leak.
- If there is a slight leak from the venturi check valve, tapping the valve open quickly with the handle of a screwdriver or suitable blunt tool may dislodge a small particles on the lip of the valve. Do not use objects with a sharp pointed ends to open check valve. Otherwise the venturi must be disassembled and the check valve and valve face cleaned and the valve arm pivot adjusted as outlined earlier.



WARNING

LPG is heavier than air and LPG vapor either mixed with or without air will "pool" in low areas without ventilation or wind. Check potential "pooling" areas with a gas detector if gas is suspected.

PLC Sequencer

The ASDI sequencer is accessed by opening the door of the control cabinet.

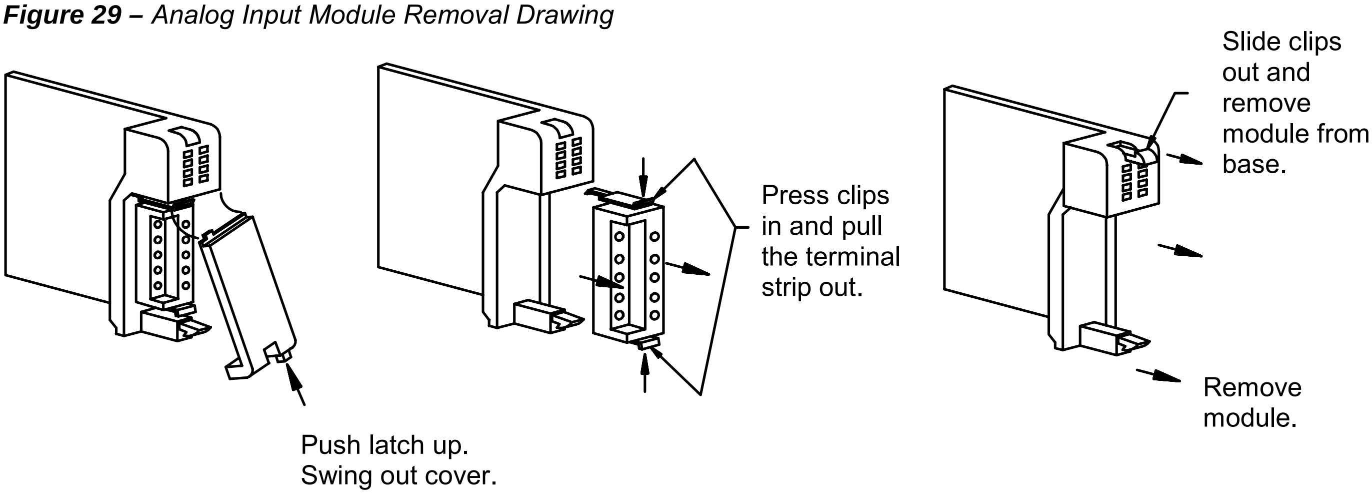
NOTE

Do not attempt to repair the sequencer modules. If the module is defective, the entire module should be replaced.

REPLACING ANALOG INPUT MODULE (SLOT 0):

- Turn off power at the disconnect. **MODULES** must not be removed with power applied to the sequencer.
- Press the small tab on the right located under the cover and pull the cover out from the bottom.
- Squeeze the tabs on the top and bottom of the terminal block and pull it out.
- Pull outward on the retaining clips, located at the top and bottom, to unlock the module.
- Remove the module by grasping the top and bottom and sliding it outward.
- Replace the module by sliding it into the slot. Align the PC board(s) on the module with the grooves on the top and bottom of the base. Push the module straight into the base until it is firmly seated in the backplane connector.
- Once the module is inserted into the base, push the retaining clips located at the top and bottom to firmly secure the module.
- Replace the terminal block. Replace the cover by inserting the tab in the top and push in the cover.

Figure 29 – *Analog Input Module Removal Drawing*



Analog Input Module Removal.wmf

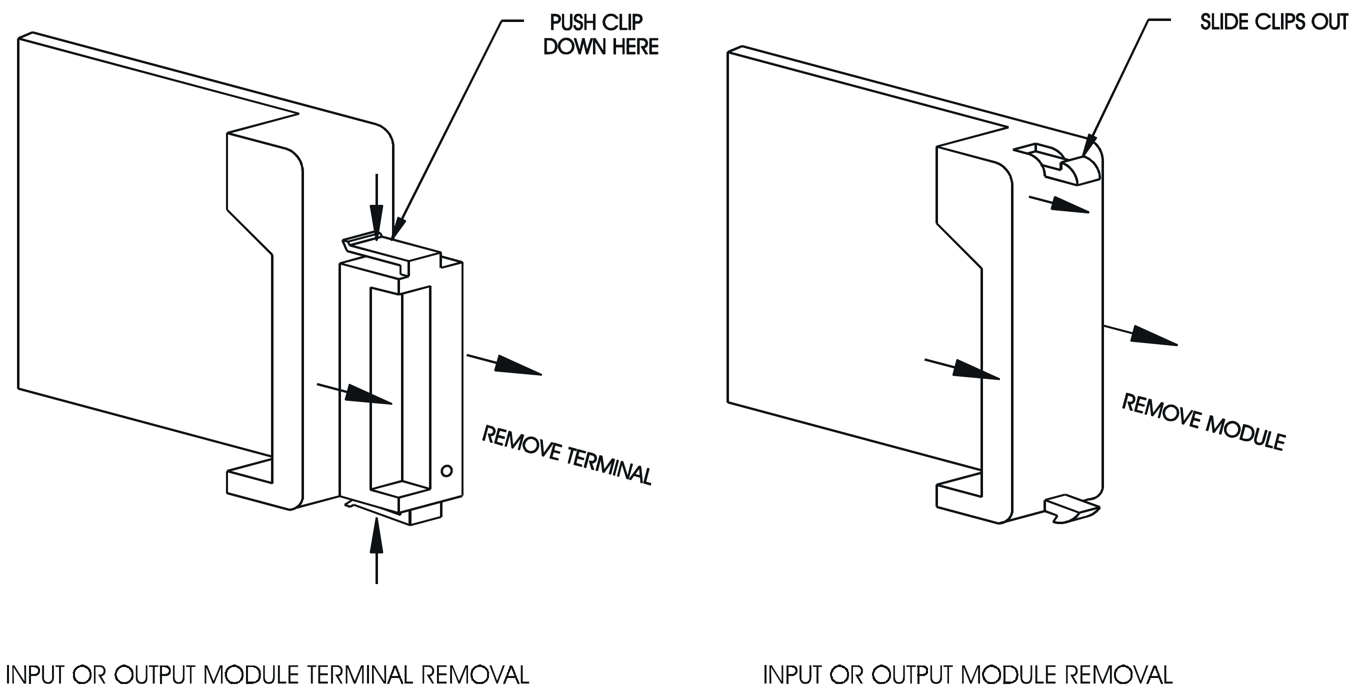
REPLACING AC INPUT AND OUTPUT MODULES (SLOT 1 AND 2):

- Turn off power at the disconnect. Modules must not be removed with power applied to the sequencer.
- Squeeze the tabs on the top and bottom of the terminal block and pull it out.
- Pull outward on the retaining clips, located at the top and bottom, to unlock the module.
- Remove the module by grasping the top and bottom and sliding it outward.
- Replace the module by sliding it into the slot. Align the PC board(s) on the module with the grooves on the top and bottom of the base. Push the module straight into the base until it is firmly seated in the backplane connector.
- Once the module is inserted into the base, push the retaining clips located at the top and bottom to firmly secure the module.
- Replace the terminal block.

NOTE

After making the necessary exchanges turn on the power, check and adjust the system output pressure, if necessary, before resuming system operation.

Figure 30 – *Replacing AC Input Output Modules*

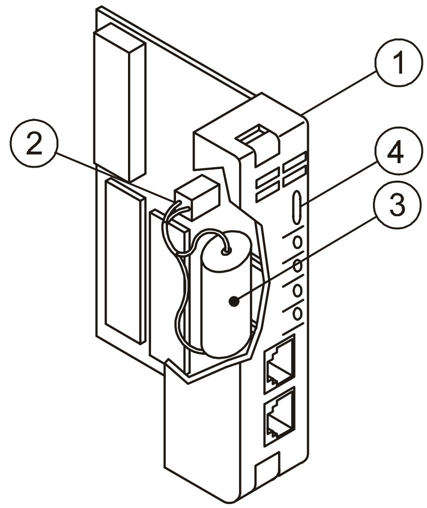


Module Removal.wmf

TO REMOVE CPU BATTERY

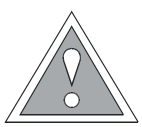
- Remove the battery terminal clip from the circuit board connector.
- Gently remove the battery from the battery holder.

Figure 31 – *CPU Battery Removal*



CPU Battery Removal.wmf

1. CPU module	**3. CPU battery**
2. Battery connector	**4. Run/Term switch**



WARNING

Do not attempt to recharge the battery or dispose of an old battery by fire. The battery may explode or release hazardous materials.

TO INSTALL CPU BATTERY

- Gently push the battery connector on to the circuit board connector.
- Push the battery into the retaining clip. (Don't use excessive force. You may break the retaining clip.).
- Make a note of the date the battery was installed.

CONTROL BOX HEATER

The **CONTROL BOX** is equipped with a heater to prevent condensation and to insure that all the electrical components operate within their allowed temperature range. The heater is mounted on the back side of the control panel and is not visible. The heater is controlled by two thermostats. One thermostat (#1) (heater operating thermostat) is mounted on the enclosure door and the second thermostat (#2) overtemp safety is mounted directly on the control panel (***See Section 2, Figure 6 #13 and 14***).

TESTING THE CONTROL BOX HEATER

If the heater is not on due to ambient temperature being higher than the thermostat settings, the heater can be checked by the following procedure:

The operating thermostat is on at 45° F and off at 60° F. The high temperature limit thermostat opens at 150° F.

- Turn off the control box power at the disconnect.
- Open the control box.
- Jumper the thermostat #1 mounted on the enclosure door.
- Turn on the power at the disconnect.
- Monitor the control panel temperature to determine if it is heating up.

CAUTION

Control Panel will get hot!

- Turn off the control box power at the disconnect.
- Remove the thermostat jumpers.
- Close the control box door.
- Turn on the power.

Troubleshooting 7

WARNING

At all times make absolutely sure that no LPG vapor is present around the electric enclosure. The electrical arcing that occurs when the various switches and relays within the enclosure operate is a possible source of explosive ignition.

CAUTION

When making any burner adjustments or tests, follow the instructions of the manufacturer in the appendix. Read all notes and follow all WARNINGS and CAUTIONS.

NOTE

Whenever a problem with the mixing system occurs check the fuses in the control box and wiring first. See the diagram for the location of the fuses. See Section 2, Figure 6 #8.

The troubleshooting table is given in the following order:

- High LPG level
- Low water level
- Flame failure
- High water temperature
- High/low gas pressure
- High mixed gas pressure
- Low LPG vapor pressure
- Reset/power failure
- Burner blower
- Regulator
- Carbon monoxide formation
- Venturi check valve leaks
- CPU troubleshooting
- Operator interface panel

Table 6 – *Troubleshooting, Causes and Solutions*

TROUBLE	PROBABLE CAUSE	SOLUTION
ANNUNCIATED OPERATOR PANEL		
HIGH LPG LEVEL		
HIGH LPG LEVEL	Float chamber filled with LPG or contaminants.	Drain LPG or contaminants. *See Figure 4*.
	LPG pump pressure set too high.	Lower LPG pump pressure. *See Data Sheet*.
	Vaporizer capacity exceeded.	Lower motive pressure on venturi trains. *See Data Sheet*.
	Operating temperature setting too low.	Reset temperature control. *See Data Sheet*.
	Water pump failure.	Replace or repair water pump, check wiring.
	Burner input too low.	Reset burner pressure. *See Data Sheet*.
	High LPG level switch damaged or defective.	Remove wires from liquid level switch. Jumper wires together, then recycle the burner. If the burner starts, check the high liquid level switch using an ohm meter. Replace the liquid high level switch.
LOW WATER LEVEL		
LOW WATER LEVEL	Water level low.	Fill vaporizer.
	Malfunction of float switch.	Check wiring and float - replace wiring, clean and/or replace float.
FLAME FAILURE/See Veri-Flame manual for additional information		
LOCKOUT OF FLAME FAILURE	Interrupted fuel supply.	Establish fuel supply to burner.
	Weak flame signal.	Check flame signal strength. Check that flame rod is straight, no cracks in ceramic insulator. Clean.
	Flame UV scanner lens dirty.	Clean lens.
STARTUP SEQUENCE RUNS BUT GAS PILOT DOES NOT IGNITE	No gas being supplied to pilot.	Check the manual pilot gas valve to insure that it is open.
		Make sure gas line has been purged of air.
	Insufficient gas flow to pilot.	Open manual gas valve.
		Check regulator for proper adjustment.
		Checked solenoid valve coil for proper operations. Replace if necessary.
		Increased gas flow to pilot. Check for crushed or blocked pilot supply lines.
	No spark.	Clean spark plug. Check or replace.
		If ceramic insulator is cracked, replace.
	No ignition.	Repair or replace wiring to the spark plug.
		Replace ignition transformer.
	Improper ground circuit.	Check for voltage on neutral wire to panel ground. Voltage must not be more than 5 volts.
	Flame rod defective.	Check that flame rod is straight, no cracks in ceramic insulator. Clean.
	Flame sensor defective.	Replace flame sensor.

TROUBLE	PROBABLE CAUSE	SOLUTION
MOTOR RUNS, GAS PILOT ESTABLISHES, MAIN GAS FLAME DOES NOT IGNITE	Manual valve closed.	Open valve.
	Manifold gas pressure too low.	Adjust pressure regulator to valve at setting shown on Data Sheet,
	Main and/or secondary gas valve does not open.	Check voltage to coil or gas valve. Replace cold or valve body as needed.
HIGH WATER TEMPERATURE		
HIGH WATER TEMPERATURE	Temperature control not set correctly.	Reset control pre Data Sheet.
	Temperature control malfunction.	Check wiring and repair or replace transmitter.
	Water pump not circulating.	Check fuse. Replace if needed.
		Replace pump cartridge if needed.
HIGH/LOW GAS PRESSURE		
HIGH GAS PRESSURE	Switch not reset.	Reset annunciator and switch.
	Regulator not set correctly.	Check Data Sheet for proper setting.
	Regulator failed.	Repair or replace regulator.
	High gas switch setting too low.	Increase setting minimal amount.
	High pressure switch malfunctioning.	Replace switch.
LOW GAS PRESSURE	Low LPG pressure in vaporizer.	Check inlet solenoid valve and outlet valve on storage tank.
	Switch not set.	Reset annunciator and switch.
	Regulator not set correctly.	Check Data Sheet for correct setting.
	Regulator failure.	Repair or replace regulator.
	Low gas switch setting is too high.	Decrease setting a minimal amount.
	Low pressure switch malfunctioning.	Replace switch.
HIGH MIXED GAS PRESSURE		
HIGH MIXED GAS PRESSURE	Mixed gas pressure set too high.	Reset mixed gas pressure per Data Sheet.
	Overshoot on startup.	Bleed off pressure and restart.
	Leaking solenoid valve.	Remove foreign material lodged in valve. Rebuild leaking solenoid valve.
	High LPG/air mixer gas switch malfunctioning.	Check setting with Data Sheet.
		Replace switch.
LOW LPG VAPOR PRESSURE		
LOW LPG VAPOR PRESSURE	Outlet valve on storage tank not open.	Open liquid valves.
	LPG pump not on.	Turn on pump.
	LPG pump not set properly.	Reset to minimum LPG requirements.
	Low vapor setting too high.	Check setting with Data Sheet.
	Liquid inlet solenoid valve not opening.	Check, clean or replace the liquid inlet solenoid.

TROUBLE	PROBABLE CAUSE	SOLUTION
RESET/POWER FAILURE		
RESET/POWER FAILURE	Power switch off.	Turn switch on and start system.
	Power outages longer than three seconds.	Restart system.
	Blown fuse.	Check cause of problem, replace fuse.
BURNER BLOWER		
AIR FLOW FAILURE ON FLAME SAFEGUARD AND BURNER BLOWER MOTOR FAILS TO START	Lockout reset tripped on flame safeguard unit.	Reset flame safeguard.
	Overload tripped out on blower motor.	Reset. Check motor current for possible overload.
	No voltage to blower.	Check fuses. Replace fuse.
	Defective blower motor.	If voltage at motor terminals is correct, replace the motor.
	Defective flame safeguard unit	Check and replace flame safeguard. Refer to manufacturer's instructions in appendix
CARBON MONOXIDE FORMATION		
CARBON MONOXIDE FORMATION DURING OPERATION.	Regulator incorrectly set.	Reset regulator per Data Sheet.
	Fuel composition has changed.	Reduce regulator pressure per Data Sheet and check high gas switch setting.
	Air flow insufficient.	Check for air blockage.
		Check blower rotation.
VENTURI CHECK VALVE LEAKS		
CHECK VALVE LEAKS	Tank pressure setpoint too low (below 4 PSIG / 0.28 kg/cm^2).	Adjust pressure setpoint per Data Sheet.
	Debris on valve surface.	Clean valve surfaces and adjust check valve if necessary.
		Replace valve if re-facing not effective.
	Worn check valve pivot	Replace valve mechanism.
CPU TROUBLESHOOTING		
CPU (ON).	Electrical noise interference.	Major power surges can damage the CPU and the power supply. If power surges are suspected, a line conditioner which removes damaging voltage spikes should be used for the CPU power supply. Improper grounding may also cause the CPU to come on.
	CPU defective.	The only reliable way to determine a faulty CPU is to replace it with a known good one.
RUN WILL NOT COME ON.	CPU programming error.	CPU is defective; must be replaced.

TROUBLE	PROBABLE CAUSE	SOLUTION
PWR INDICATOR OFF	Incorrect voltage to sequencer.	Perform basic power checks - check voltage, disconnect power and check wiring for loose connections, check all connections in panels.
	Faulty power supply or CPU	Measure voltage at the base terminal strip. Return power supply for repair or replace CPU if all wiring and voltages are OK.
	I/O module shorted out	Check connector pins and connector, replace module if connector, OK.
BATT INDICATOR ON	Battery defective.	Replace battery.
OPERATOR INTERFACE PANEL		
NO DATA IS DISPLAYED ON THE OPERATOR INTERFACE PANEL SCREENS OR THE FLT LIGHT IS LIT	No communications between operator interface panel and the sequencer.	Make sure cable is plugged into Port #2 of the CPU.
		Switch not in term position on CPU, move switch to term.
		Check communications cable for proper connections.
	No data displayed on operator panel.	Check fuse on the operator interface panel.
	Faulty internal components.	Replace the 240 processor.
THE DL LED IS BLINKING	Communications error.	Make sure cable is plugged into Port #2 of the CPU.
		Switch not in term position on CPU, move switch to term.
		Check power to the PLC.
		Check operator interface panel to PLC communications cable.
	Faulty internal components.	Replace the operator interface panel.
OPERATOR PANEL WILL NOT RETAIN SETPOINT	Check if BATT indicator is on.	If light is on replace battery on CPU.

OPTIONS

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ACCUMULATOR / SURGE TANK

Contact Algas-SDI international for Accumulator Surge Tank Packages.

FLARE STACK

Contact Algas-SDI international for Flare Stack Packages.

LIQUID PUMP

Contact Algas-SDI international for Stabilaire Pump Packages.

STANDBY ELECTRIC BATH HEATER

Contact Algas-SDI international for Standby Electric Bath Heater Packages.

QM REMOTE CONTROL and MONITORING PACKAGE

Allows remote control and monitoring using a computer, supplied by end user.
Algas-SDI International Part Number: 10075

FILTAIRE - CONTAMINANT SEPARATOR

Contact Algas-SDI international for Filtaire Packages.

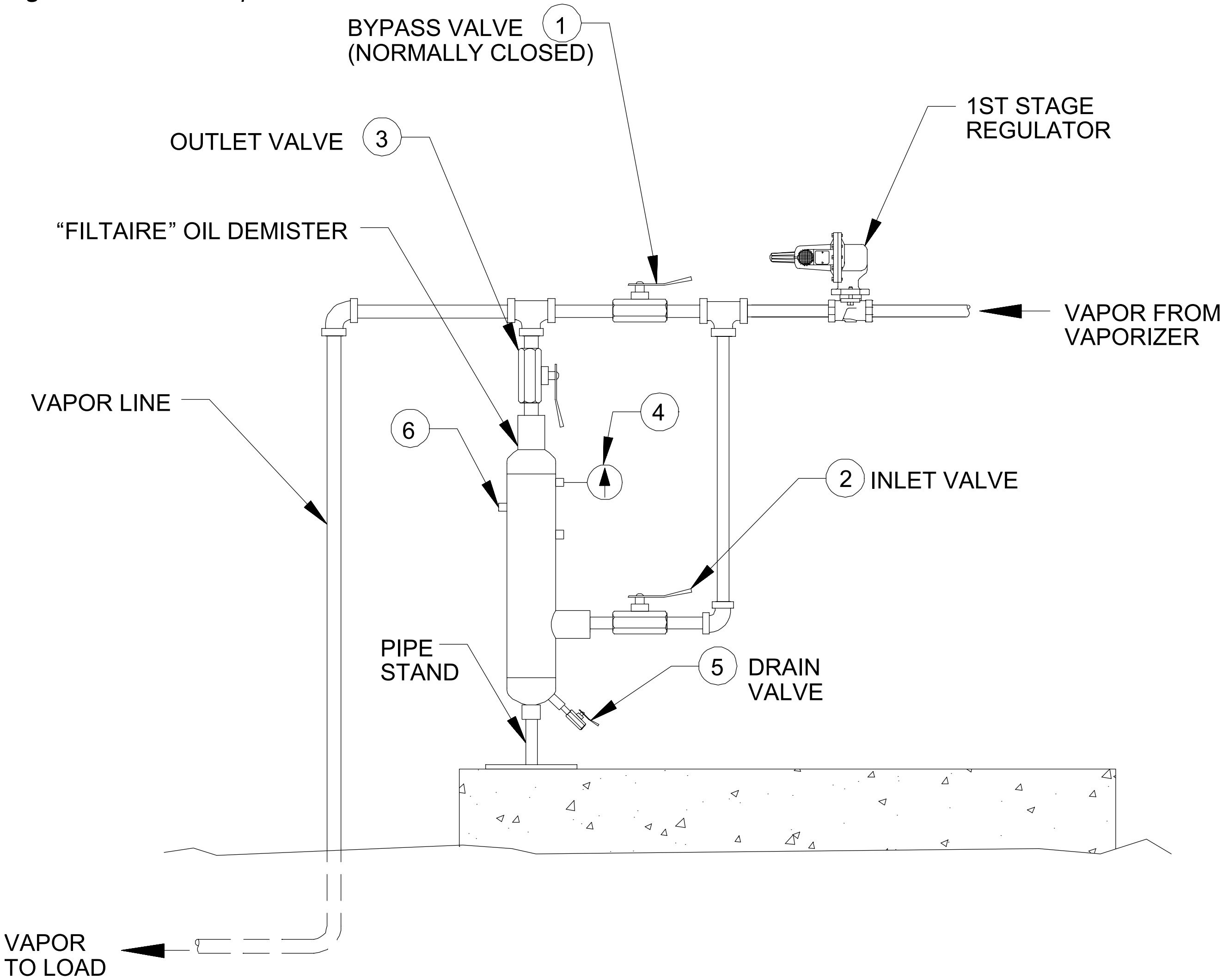
The **FILTAIRE** is a filtering device designed to trap heavy hydrocarbons commonly present in LPG gas vapor. It also traps other materials, which may be in the gas due to storage conditions and internal condition of the equipment.

Impurities are collected in the system and periodically removed through the system blow down drain. Residual heavy end hydrocarbons with boiling points higher than pure LPG are trapped by the filter and fall to the bottom for removal.

A complete **FILTAIRE** system consists of inlet and outlet connections, a blow-down drain (5), a pressure gauge (4), a vent which is normally plugged (6), and a bypass valve system for cleaning (1, 2, and 3). The bypass valves enable the system to continue operating when the **FILTAIRE** is removed for cleaning **(*See Figure 32*).**

Note: Items 4,5 and 6 are included with **FILTAIRE** assemblies.

***Figure 32** – Filtaire Operation*



Filtaire.wmf

LEAK TEST

CAUTION

The entire installation must be leak tested prior to operating the system.

1. Close outlet valve.
2. Slowly open inlet valve and allow pressure to equalize in the vaporizer.
3. Apply a liberal amount of soap/water solution to ALL pipe connections.
4. Check for any leaks by observing new bubble formation in the soap/water solution.

Repair any leaks before continuing.

APPENDIX A

TECHNICAL INFORMATION

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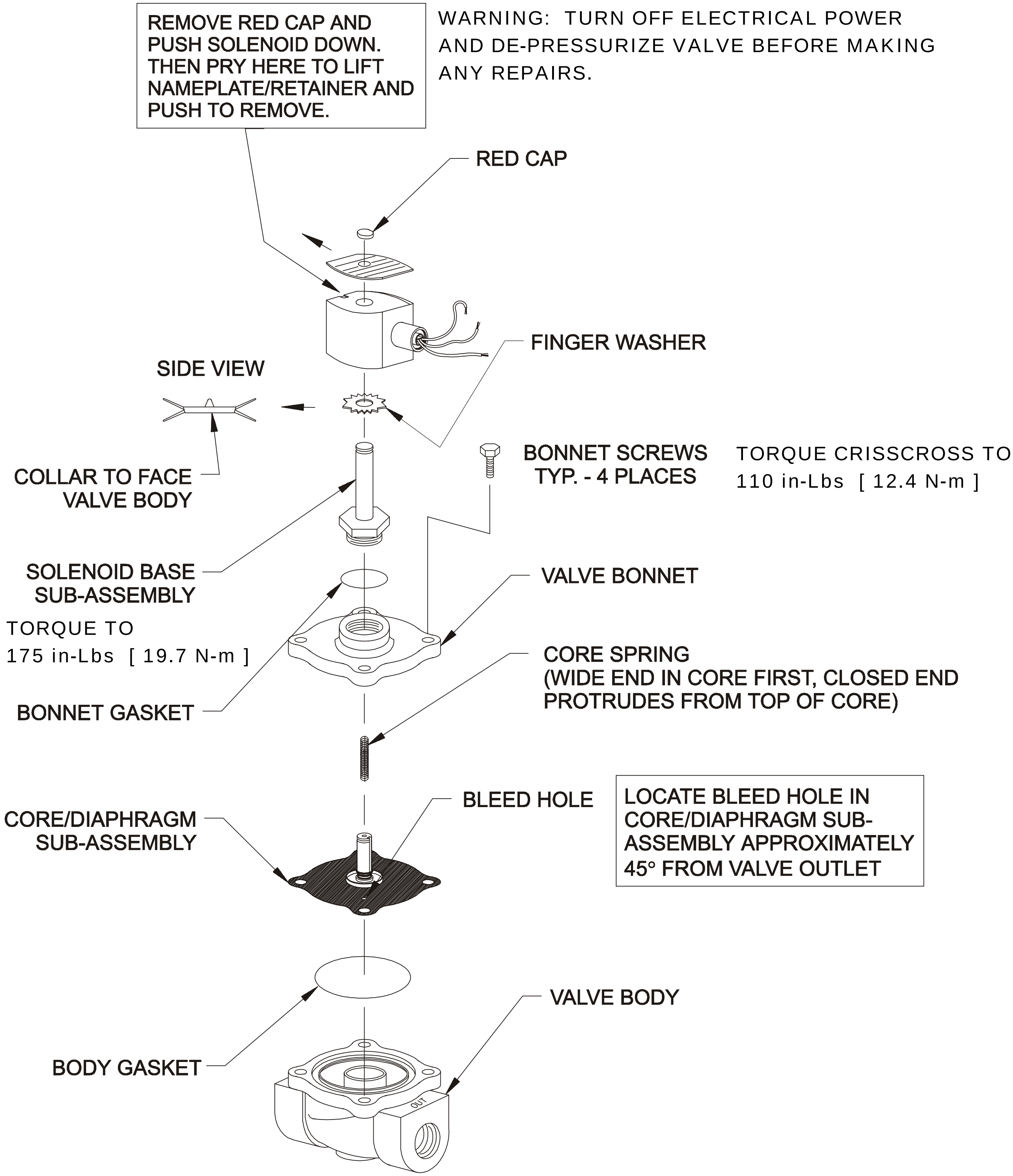
Figure 20 *- ASCO Valve used by Algas-SDI 2.9.98*



Algas-SDI ASCO Valve Draw.wmf

SOLENOID NOISE

Solenoid valves emit a sound when operated. When energized, they emit a clicking sound. Also, accompanying the operation of most AC valves, is AC hum. Whether or not AC hum is objectionable actually depends on the requirements and opinion of the user. Normal AC hum is the result of the constantly reversing magnetic field produced by alternating current. The constantly reversing magnetic field can cause vibrations in the solenoid parts.

1. Solenoid noise due to damage solenoid parts such as bent solenoid base assembly, stretched return springs, loose parts, etc.

   Solution: Inspect valve internals and exterior. Replaced damaged parts.

2. Solenoid noise due to foreign matter between the core and plug-nut. When foreign matter is trapped between the core and plug-nut, the core assembly will rock back and forth at 60 hertz. Eventually, the core and plug-nut face will be distorted, at which time the noise can continue even though the foreign material may have been flushed or removed from the valve.

   Solution: Replace damaged parts entirely, clean and reassemble.

3. Solenoid noise due to damaged coil. On rare occasions, a severe voltage spike or over voltage can potentially short a small portion of the coil winding. This shorting can cause solenoid noise and coil overheating. However, it would normally lead to rapid coil burnout. The solenoid parts, however, could be damaged enough that the noise would continue even after the coil was replaced due to the deformation produced during the peening process.

4. Missing solenoid parts can severely weaken the magnetic circuit. This can produce a solenoid noise condition. As discussed above, it will probably also result in coil burn-out.

   Solution: Replace damaged parts, replace lost parts, clean and re-assemble.

In general, when a noise condition has been encountered, the source of the problem should be determined and eliminated. The valve should then be thoroughly inspected to insure that it is yet repairable. Most times, simple installation of a spare parts kit and a solenoid base sub assembly can restore a valve to like new condition. The restored and reinstalled solenoid valve should be tested to insure proper operation, and a voltage check should be made at the solenoid valve while the valve is energized. In addition, a current reading can be obtained and compared with catalog specifications to verify normal solenoid and coil operation.

Note: The coil may have been damaged due to excessive current draw of at damaged shading coil within the solenoid valve. A partial rebuilding of a valve damaged by a noise condition can prove useless as the noise condition would continue. The entire valve should be dismantled and inspected and cleaned. All parts supplied in a spare parts kit should be installed. Further, and additional solenoid parts damaged by a noise condition such as a solenoid base sub assembly, should be replaced. Examine valve seating, pistons and the valve body to verify that they have not been damaged. Damage to major portions of the valve may make repairing the valve uneconomical.

Should a noise condition be encountered, immediate action may prevent any damage to the solenoid valve itself.

ASCO® General Controls
50-60 Hanover Rd, Florham Park, NJ 07932

AH2B and AH13B Hydramotor® Actuator

INSTALLATION AND SERVICE

SDI: AH2B/AH13B
Effective: 12-96
Supersedes: 10-96

DESCRIPTION

AH2B and AH13B Hydramotors® are self-contained linear, push-type actuators which extend when powered and retract by spring force upon power interruption.

The AH actuator is typically used for control of gas-fired heating equipment, commonly to open and close a valve or both a valve and damper. AH2B actuators position V710 series valve assemblies. AH13B actuators power short-stroke HO series gas valves. Stroke length is the only difference between the AH2B and AH13B Hydramotors®.

The AH2/13 Hydramotor® features increased force output, improved piston/cylinder sealing, faster opening time, and a standardized 3/8" damper shaft accommodating left or right mounted damper arms. The duplex pump/motor mechanism is completely immersed in oil, greatly reducing the need for maintenance or service. The AH Hydramotor® may be equipped with optional damper arm and shaft, raintight enclosure, auxiliary switch and/or proof-of-closure switch.

OPERATION

Application of electrical power simultaneously drives an electric pump and closes a normally-open dump valve, exerting up to 200 pounds of hydraulic pressure against a spring-loaded piston. This extends the actuator shaft and attached valve poppet, to open the valve and/or damper.

Upon reaching the fully extended position, a safety travel limit switch interrupts power to the electric motor while maintaining power to the dump valve, thus stabilizing hydraulic pressure to hold shaft position. Position indicators on both sides of the actuator show the actual position of the valve stem.

Upon power interruption, an internal spring opens the dump valve, which controls the release of hydraulic pressure for fast or slow operation, allowing the return spring to retract the shaft and close the valve fully. Closing time is one second or less.

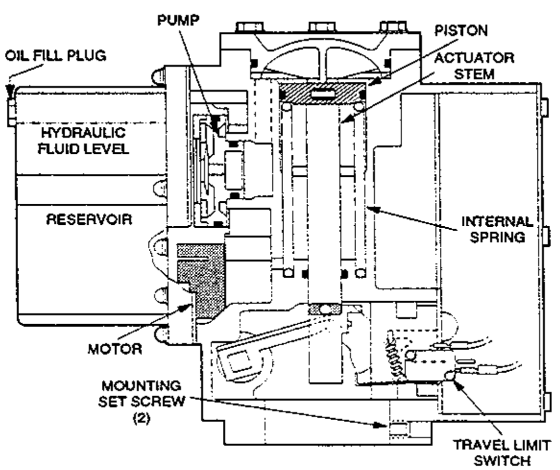


Figure 2. Cutaway Schematic (Deenergized Position)

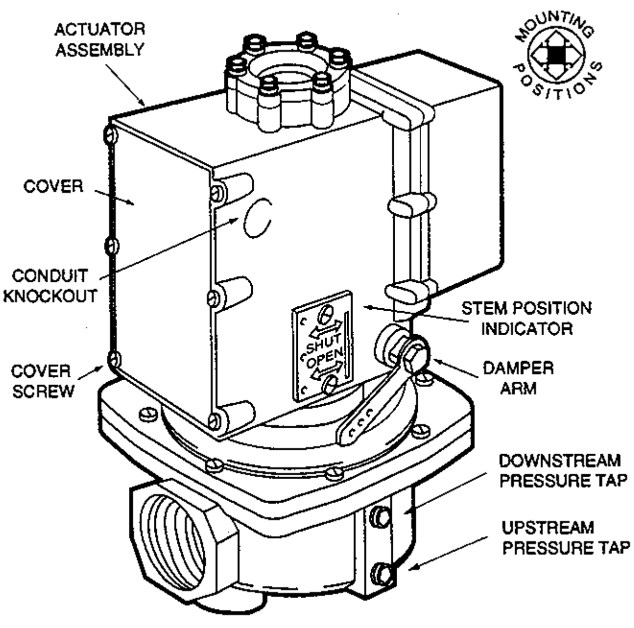


Figure 1. AH2B Actuator (shown mounted on V710 gas valve)

SPECIFICATIONS

Force Output: 200 lb.

Stroke: AH2B: 1 1/4" AH13B: 5/8"

Current (ampere)	Voltage	Inrush	Running	Holding
	24	28.0	8.0	0.73
	120	5.6	1.6	0.14
	240	2.8	0.8	0.05

Opening Time*: (seconds) Fast: AH2B: 7 to 12; AH13B: 3 to 6
Slow: AH2B: 14 to 24; AH13B: 7 to 12

* not field adjustable

Maximum Closing Time: One second

Ambient Temperature: -40° to 150° F [-40° to 66° C]

SAFETY WARNINGS AND PRECAUTIONS

- **Actuator and valve should only be installed or serviced by a trained, experienced service technician.**
- **Check nameplate and verify actuator selected is appropriate for application.**
- **Test all functions and check out the complete system after installing the actuator.**
- **Verify conformance to valve manufacturer's instructions and all applicable codes and ordinances.**

INSTALLATION

Follow the valve and/or damper manufacturer's instructions when installing the Hydramotor®.

1. Position the actuator to operate the valve (and damper if appropriate), and secure with the two mounting set screws (Figure 2). AH2B and AH13B actuators can be installed to operate in any position.
2. For damper applications, connect the damper arm and linkage so the damper will return to the desired position on power failure. The maximum damper arm travel is 2 inches. Applied load should not exceed 10 pounds.

WIRING

WARNING

Electrical shock hazard. To avoid serious personal injury, death, or property damage due to electrical shock, turn off power supply and disconnect power wiring prior to servicing actuator.

CAUTION

- **Wiring must conform to all applicable local and national electrical codes and ordinances.**
- **Limit controls must conform to actuator rating (voltage, amperage, hertz). Wire limit controls in the hot side of power supply.**

1. Remove six screws and electrical cover.
2. Route wiring through one of the conduit knockout openings. Install appropriate electrical fittings.
3. Connect the power wiring to terminals 1 and 2, and splice the ground wire to the green wire beside the terminal strip (Figure 3).
4. Connect auxiliary or proof of closure switch wiring to the common and normally open or normally closed switch terminals.
5. Reinstall electrical cover and gasket (raintight models).
6. Operate system through five cycles to purge hydraulic circuits of air and to verify proper operation.

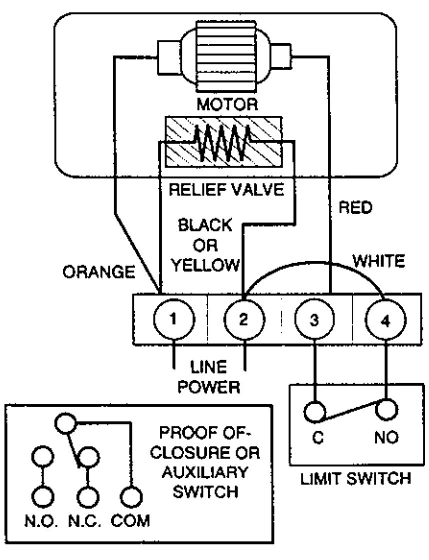


Figure 3. Typical AH2B/AH13B Actuator Wiring

SWITCH ADJUSTMENT

The optional proof of closure switch is set at the factory to provide a positive indication of valve closure. **This switch is not adjustable.** Auxiliary switches may be located on either side and may be field adjusted as follows:

1. Remove the window (Figure 4).

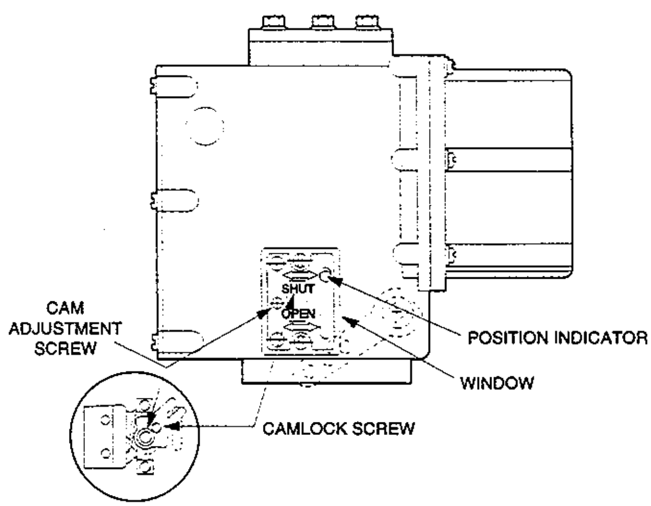


Figure 4. Auxiliary Switch Adjustment

2. Loosen the camlock screw no more than 1/2-turn.
3. Reset the cam adjustment screw to the desired switching point.
4. Tighten the camlock screw. Cycle the actuator to verify the switch setting, and readjust as required.
5. Reinstall the window.

SERVICE

WARNING

Shock, fire, or explosion hazard. Servicing powered actuators could cause personal injury or property damage. Turn off electrical power before servicing actuator.

Service should include periodic inspection and cleaning. Use a cleaning fluid compatible with actuator components to remove dirt and oil. Organize a maintenance schedule based on the environment and frequency of use. Include a leak check on every inspection. Check for loose electrical and mechanical connections, and replace damaged lead wires. Watch for excessive oil leaks on the actuator shaft and around the seals.

Field service of AH2B/AH13B Actuators is limited to the following:

1. Limit switch replacement kit S109450A (AH2B) or S109450B (AH13B).
2. Addition of left-hand auxiliary switch kit S107721A.
3. Addition of right-hand auxiliary switch kit S107721B.
4. Replacement of proof-of-closure switch kit S108621A.
5. Addition of raintight kit S109557A.
6. Addition of damper shaft kit S109556A.

7. Addition of damper arm kit S109555A (with spring and spring plug) or S109555B (without spring and spring plug).
8. Oil kit S156202A.

To order, specify the kit or part number, as well as the actuator model and serial numbers.

LIMIT SWITCH REPLACEMENT

1. **Turn off power supply.** Remove the six cover screws and the cover plate (Figure 1).
2. Disconnect actuator and switch wiring. Remove two mounting screws and the limit switch (Figure 2).
3. Install the new switch. Wire and adjust the switch to actuate at end of stroke by bending switch lever.
4. Turn on power. Reinstall the cover plate and screws.

AUXILIARY SWITCH INSTALLATION

NOTE: The right-hand auxiliary switch, kit S107721B, cannot be used with AH2B variations equipped with proof-of-closure switch.

1. **Turn off power.** Remove six cover screws and the cover plate (Figure 1). Remove window (Figure 4).
2. Disconnect switch wiring. Remove two mounting screws and old switch, and install new switch.
3. Wire and adjust switch as instructed under "Switch Adjustment." Turn power on, reinstall cover plate window and screws.

RAINTIGHT KIT INSTALLATION (Figure 5)

1. **Turn off power supply.** Remove six cover screws and the cover plate (15). Install cover plate gasket (16), cover plate, and screws.
2. Remove windows (18). Install window gaskets (17), windows (18), and screws.
3. Loosen the two mounting set screws (Figure 2) and lift the actuator from the valve.

STEPS 4 THROUGH 8 APPLY ONLY TO ACTUATORS EQUIPPED WITH THE OPTIONAL DAMPER SHAFT.

4. Remove the retaining ring (9), optional spring plug (13), return spring (12), and damper arm (11). Slide the damper shaft (2) out of the actuator.
5. Assemble the retaining ring (1) on the end of the damper shaft (2). Install O-ring (6) on bushing (7) and slide the bushing onto the end of the shaft so the bushing shoulder faces the retaining ring (1). Slide gasket (8) onto the shaft and against the bushing.
6. Slide the damper assembly into the actuator body.
7. Install O-ring (5) on bushing (3). Slide gasket (4) and bushing (3) onto the shaft and against the actuator housing.
8. Install the optional damper arm (11), return spring (12), and spring plug (13). Secure the assembly with retaining ring (9).
9. Install the gasket (14) to the bottom of the actuator, attach the valve, and tighten the mounting set screws.

NOTE: Installer must provide raintight conduit fittings to complete the raintight modification.

10. Restore electrical power and cycle the actuator to verify proper operation.

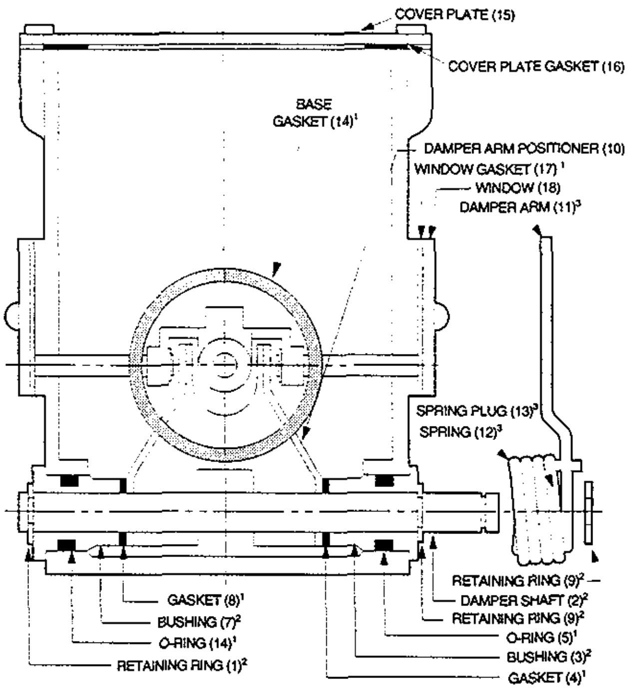


Figure 5. Raintight, Damper Shaft, and Damper Arm Kits

DAMPER SHAFT INSTALLATION (Figure 5)

The damper shaft can be installed with the damper arm on either side of the actuator.

1. **Turn off power supply.** Loosen the two mounting set screws (Figure 2) and lift the actuator from the valve.
2. Install the retaining ring (1) and bushing (7) on the damper shaft (2).
3. Install the damper arm positioner (10), then slide the damper shaft (2) through the actuator and positioner.
4. Install bushing (3) and secure with retaining ring (9).
5. Reconnect the wiring, restore power, and cycle the actuator to verify proper operation.

DAMPER ARM INSTALLATION (Figure 5)

S109555A (with return spring and plug)
S109555B (without return spring and plug)

1. **Turn off power supply.** Remove retaining ring (9).
2. Install damper arm (11).
3. Install return spring (12) and spring plug (13) if required (S109555A only).
4. Secure the assembly with the retaining ring removed in step 1, above.
5. Reconnect the wiring and cycle the actuator to verify proper operation.

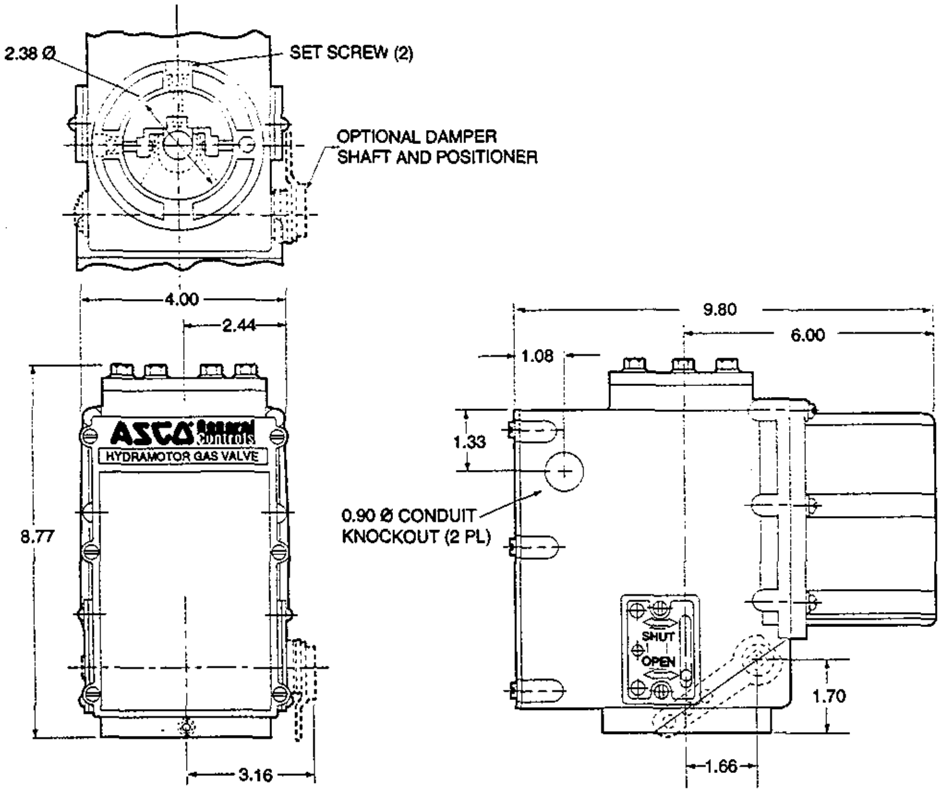


Figure 6. Dimensions (inches)

REPLACEMENT OIL

Standard units are filled with MIL-H-5606 oil (kit no. S156202A), available from ASCO General Controls.

FILLING WITH OIL

1A. *With actuator mounted upright* (Figure 2), remove oil fill plug and fill to bottom of fill port. Replace the fill plug.

1B. *With actuator on its side, and oil fill plug uppermost*, remove the oil fill plug. The oil level should be 5/8-inch from the top of the pump cover. Replace the fill plug.

2. Power the actuator on and off five times, through its full stroke, to purge air from the system. Remove the oil fill plug.

3. Check the oil level and add oil if necessary. Replace the oil fill plug, and return the unit to its normal orientation.

4. Cycle the actuator to verify proper operation.

INSTALLATION AND MAINTENANCE INSTRUCTIONS

TRI-POINT® switches

FIXED DEADBAND COMPACT LINE SWITCHES OPEN FRAME, GENERAL PURPOSE OR WATERTIGHT SWITCH ENCLOSURES

SERIES

**PB10, PB11, PB16
PB20, PB21, PB26
PB30, PB31, PB36**

Form No. P7034—T88

DESCRIPTION

The Fixed Deadband Compact Line Switch is of rugged aluminum alloy construction. The switch may be provided with a General Purpose NEMA Type 1 Switch Enclosure, a Watertight NEMA Type 3 and 4 Switch Enclosure or an open-frame switch.

The compact line switch may be supplied as a complete unit, that is, the switch assembly unit and transducer are completely assembled or as separate units to be assembled upon installation. The actuation (set) point is adjustable over the full range of the switch. The reactuation (reset) point is fixed relative to the actuation point and cannot be adjusted. The switch assembly can be mated with a wide selection of interchangeable pressure, temperature and mechanical transducers to cover a broad range of pressures, fluids, temperatures and mechanical movements. The switch will control electrical circuits in response to changes in pressure, temperature or mechanical signals.

IMPORTANT: This sheet is designed to cover the installation and use of this switch on pressure transducers, temperature transducers and mechanical transducers. Review this sheet and select the paragraphs that apply to your particular installation and application. Throughout the sheet, the word "signal" will be used in place of pressure, temperature or mechanical changes.

INSTALLATION

Check the nameplate for the correct catalog number, pressure range, temperature range, media and rated over range pressure or temperature. Nameplates are located on side cover and on the bottom of the transducer. Check to be sure the third digit in each number is the same. If not, the unit should not be used. (Refer to Figure 2)

IMPORTANT: All internal adjustments have been made at the factory. Any adjustment, alteration or repair to the internal parts of the switch other than stated herein voids all warranties. Signal setting adjustments required are made by adjusting nut on the top of the switch.

TEMPERATURE LIMITATIONS

Ambient temperature limits are −4°F (−20°C) to 122°F (50°C). To determine fluid temperature limitations, see Form No.P7035 for Pressure Tranducer catalog numbers and construction materials, then refer to chart below.

TRANSDUCER CONSTRUCTION MATERIALS	RATINGS FLUID TEMPERATURE
Buna N or Neoprene	−4°F (−20°C) to 179°F (82°C)
VITON*	−4°F (−20°C) to 250°F (121°C)
316 Stainless Steel	−50°F (−45°C) to 300°F (149°C)
All Nylon	Maximum 179°F (82°C)
All Nylon For Water Service	Maximum 130°F (55°C)

For steam service, the fluid temperature with a pigtail (siphon tube or condensate loop) installed directly into the transducer will be below 179°F (82°C).

ASSEMBLY OF SWITCH AND TRANSDUCER UNITS (Refer to Figure 2)

IMPORTANT: The switch unit and transducer unit may be provided as a complete assembly or as separate units. If separate units are provided, refer to Form No. P7035 for a complete listing of switch unit and transducer unit combinations. Form No. P7035 is provided to insure that the proper switch unit be assembled to the proper transducer unit.

Pay careful attention to exploded view provided in Figure 2 for assembly of switch unit and transducer unit. Proceed in the following manner:

1. CAUTION: The third digit in the catalog number on both the switch unit and the transducer unit must be identical. If not, do not assemble to each other. If the same, proceed.
2. Remove bolts (4) from base of switch unit. On general purpose and watertight constructions, remove switch cover.
3. Remove instruction label and pressure, temperature or mechanical switch range scale from the transducer unit.
4. Place transducer unit on base of switch unit and assemble. Start bolts (4) approximately two turns by hand to avoid the possibility of cross threading. After initial engagement, torque bolts (4) in a crisscross manner to 80 ± 10 inch-pounds.
5. Remove backing paper from range scale and install on the front of the switch body over the opening for the adjusting indicator point.

POSITIONING

Switch may be mounted in any position.

MOUNTING

For mounting dimensions for open-frame switch, refer to Figure 2. For mounting dimensions for general purpose switch enclosures, refer to Figure 3. For all switches, an optional mounting bracket is available. For mounting bracket dimensions, refer to Figure 6.

PIPING/TUBING (PRESSURE TRANSDUCER)

Adequate support of piping and proper mounting of switch should be made to avoid excessive shock or vibration. To minimize the effect of vibration on a switch, mount perpendicular to vibration. Connect piping or tubing to switch at base of transducer. It is recommended that flexible tubing be used whenever possible. Apply pipe compound sparingly to male pipe threads only. If applied to transducer threads, it may enter the transducer and cause operational difficulty. Pipe strain on switch should be avoided by proper support and alignment of piping. When tightening pipe, do not use switch as a lever. Wrenches applied to transducer body or piping are to be located as close as possible to connection point. **IMPORTANT: For steam service, install a condensate loop (pigtail or steam syphon tube) directly into the pressure transducer.**

CAUTION: To avoid damage to the transducer body, DO NOT OVERTIGHTEN PIPE CONNECTIONS. If TEFLON* tape, paste or similar lubricant is used, use extra care due to reduced friction.

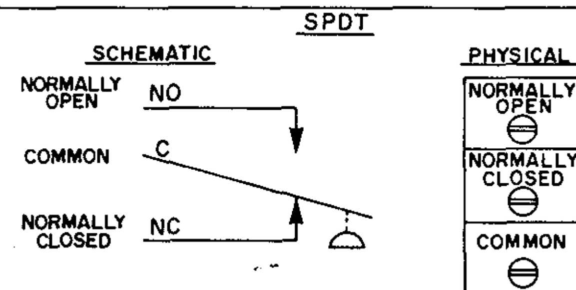
IMPORTANT: To eliminate the effect of undesirable pressure fluctuations in the system, install a surge suppressor.

WIRING

Wiring must comply with local codes and the National Electrical Code. The general purpose switch enclosure is provided with a 7/8" diameter hole to accommodate 1/2" electrical hub or connector. It is recommended that a flexible conduit connection be used. If rigid conduit is used, do not consider it or use it as a means of supporting (mounting). For watertight switch enclosure, a watertight conduit hub must be installed in the 7/8" diameter hole; use conduit hub Part No. [illegible] or equivalent. IMPORTANT: Electrical load must be within range stated on nameplate. **Failure to stay within the electrical range of the switch rating may result in damage to or premature failure of the electrical switch. Use No. 14 AWG copper wire rated for 60°C minimum. CAUTION: Do not exert excessive screwdriver force on snap switch when making terminal connections. When connections are made, be sure there is no stress on the wire leads. Either condition may cause malfunction of switch.**

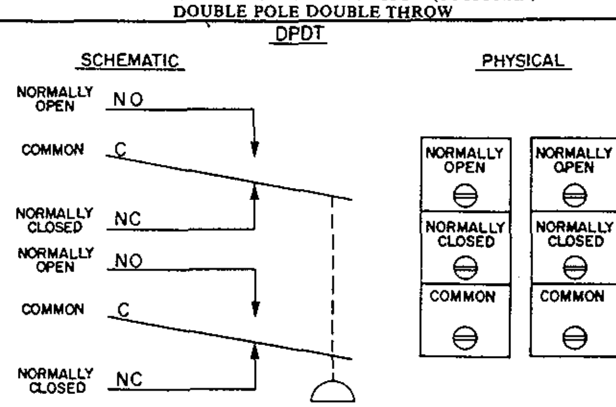
Electrical Ratings For Standard & Suffix J or K Switches	
Ratings for Limit Controls and Pressure Operated Switches:	Ratings for Industrial Controls and Temperature Indicating and Regulating Equipment:
5 Amps Res., 125 or 250 VAC 1/8 HP or 90 Watts, 125 VAC 1/4 HP or 180 Watts, 250 VAC 1/2 Amp Res., 125 VDC 1/4 Amp Res., 250 VDC	15 Amps Res., 125 VAC 10 Amps Res., 250 VAC 1/8 HP or 90 Watts, 125 VAC 1/4 HP or 180 Watts, 250 VAC 1/2 Amp Res., 125 VDC 1/4 Amp Res., 250 VDC

SCHEMATIC FOR STANDARD AND SUFFIX "J" SWITCHES



(SEE NOTE)

SCHEMATIC FOR SUFFIX "K" SWITCH (OPTIONAL)
DOUBLE POLE DOUBLE THROW



(SEE NOTE)

NOTE: Terminal Connections (C, NC & NO) on snap switch are located differently then shown in schematic above. Common "C" is located at the bottom. Normally Closed "NC" is located in the center. Normally Open "NO" is located at the top.

*DuPont Co. Registered Trademark

ASCO

INSTALLATION OF TEMPERATURE TRANSDUCERS
(Refer to Figure 5)

DIRECT PROBE
The Direct Probe (local) Temperature Transducer is provided with 1/2 inch N.P.T. connection. When installing, do not use switch unit as a lever for tightening. Use wrenching flats provided at base of transducer for tightening.

CAPILLARY AND BULB
The Capillary and Bulb (remote) Temperature Transducers are provided with a length of capillary and a 3/8 inch diameter sensing bulb. CAUTION: Do not bend capillary at sharp angles. For proper operation, be sure sensing bulb is completely immersed in fluid and not in contact with heating element or anything that would directly affect the temperature of the fluid being sensed.

THERMAL WELL (Optional Feature)
A Thermal Well may be used for Capillary and Bulb (remote) or Direct Probe (local) Temperature Transducers. The thermal well affords protection for the sensing bulb and allows removal of the sensing bulb while maintaining a pressure-tight vessel. When installing sensing bulb in thermal well, be sure that it is fully inserted. Where a thermal well already exists, jam nuts may be obtained to adapt the capillary and bulb to the existing thermal well. The existing thermal well must be for a 3/8 diameter sensing bulb.

UNION CONNECTOR (Optional Feature)
A union connector will allow direct mounting of the sensing bulb in the fluid being controlled. Install union into piping connection before tightening union onto bulb. For maximum performance, the bulb should be inserted in the union connection so that the end of the sensing bulb is even with the end of the union connector nut. Do not apply excessive torque when tightening union connector nut.

ADJUSTMENT (SIGNAL SETTING) OF FIXED DEADBAND SWITCH
To make adjustments, (signal setting) a 1/4 inch wrench and a pressure or temperature gage (within suitable range) are required. If electrical connection (to line of final application) of the switch is not desirable, a battery powered test lamp or ohm meter may be used. Pressure, temperature or mechanical range scales should be used for initial signal setting. These will be accurate within 5%. Adjust switch until pointer is in the middle of the solid red line below the desired range. For exact signal setting, proceed as follows:

ADJUSTMENT (SIGNAL SETTING) OF NORMALLY CLOSED AND AND NORMALLY OPEN FIXED DEADBAND SWITCH, INCREASING SIGNAL (Refer to Figure 1)

1. If the fixed deadband switch is in the line of final application when adjustment (signal setting) is made, be sure switch can be test operated without affecting other equipment.
2. On general purpose and watertight constructions, remove switch cover.
3. Turn adjustment nut until signal setting indicator is fully up. Use a 1/4 inch wrench for adjusting nut. CAUTION: **Adjusting nut will turn easily until it hits a stop. Do not over torque; over torquing may cause damage.**
4. Follow steps in chart below to make signal setting.

Steps of Adjustment	Normally Closed		Normally Open	
	Electrical Connection To Switch	Position Of Test Lamp On-Off	Electrical Connection To Switch	Position Of Test Lamp On-Off
1. Starting with zero signal connect test lamp to common and . . .	Normally Closed Terminal	On	Normally Open Terminal	Off
2. Apply desired actuation signal. Then back off signal adjusting nut until switch actuates.	Normally Closed Terminal	Off (Switch Open)	Normally Open Terminal	On (Switch Closed)
3. Lower signal to check reactuation signal.	Normally Closed Terminal	On (Switch Closed)	Normally Open Terminal	Off (Switch Open)

5. Cycle between actuation and reactuation signals and make minor adjustment to nut as required to achieve the exact signal setting.
6. After setting has been made, make permanent electrical connections. **WARNING: Be sure power is off when electrical connections are made.**

ADJUSTMENT (SIGNAL SETTING) OF NORMALLY CLOSED AND NORMALLY OPEN FIXED DEADBAND SWITCH, DECREASING SIGNAL (Refer to Figure 1)

1. If the fixed deadband switch is in the line of final application when adjustment (signal setting) is made, be sure switch can be test operated without affecting other equipment.
2. On general purpose and watertight constructions, remove switch cover.
3. Turn adjustment nut until signal setting indicator is fully down. Use a 1/4 inch wrench for adjusting nut. **CAUTION: Adjusting nut will turn easily until it hits a stop. Do not over torque; over torquing may cause damage.**
4. Follow steps in the chart below to make signal setting.

Steps of Adjustment	Normally Closed		Normally Open	
	Electrical Connection To Switch	Position Of Test Lamp On-Off	Electrical Connection To Switch	Position Of Test Lamp On-Off
1. Starting with initial signal above desired actuation setting, connect test lamp to common and . . .	Normally Closed Terminal	Off	Normally Open Terminal	On
2. Decrease signal to desired actuation signal. Then advance signal adjusting nut until switch actuates.	Normally Closed Terminal	On (Switch Closed)	Normally Open Terminal	Off (Switch Open)
3. Increase signal to check reactuation signal.	Normally Closed Terminal	Off (Switch Open)	Normally Open Terminal	On (Switch Closed)

5. Cycle between actuation and reactuation signals and make minor adjustment to nut as required to achieve the exact signal setting.
6. After setting has been made, make permanent electrical connections. **WARNING: Be sure power is off when electrical connections are made.**

TESTING OF INSTALLATION
If the adjustment of the switch has been made outside of the line of final application, the switch should be retested when installed in the line of final application. Follow adjustment instructions. Be sure switch can be test operated without affecting other equipment.

MAINTENANCE
WARNING: Turn off electrical power supply and line pressure to switch before removal or inspection.

IMPORTANT: Repair of the switch shall never be attempted in the field. The switch must be returned to the factory (Automatic Switch Company, Florham Park, New Jersey) or serviced only by an authorized factory representative. Address all service inquires to Automatic Switch Company, 50-56 Hanover Road, Florham Park, New Jersey 07932. The only adjustment which may be performed on the switch is changing the position of signal setting adjusting nut and replacement of the transducer unit. Replacement of transducer should be done if external leakage is evident.

PREVENTIVE MAINTENANCE
1. While in service, operate (cycle between two desired signals) the fixed deadband switch at least once a month to insure proper operation. If necessary, electrical wiring and pipe connection should be made so that switch can be test operated without affecting other equipment.
2. Periodic inspection of the switch, external surfaces only, should be carried out. Switch should be kept clean and free from paint, foreign matter, corrosion, icing and freezing conditions.
3. Keep the medium entering the switch as free from dirt and foreign material as possible.

IMPROPER OPERATION
Switch will not actuate or actuates and reactuates undesirably.

1. **Incorrect Electrical Connection:** Check leads to switch. Be sure they are properly connected. Switch is marked "NO" for Normally Open, "NC" for Normally Closed and "C" for Common.
2. **Faulty Control Circuit:** Check electrical power supply to switch. Check for loose or blown-out fuses, open-circuited or grounded wires, loose connections at terminal block or switch. See nameplate for electrical rating and range.
3. **Incorrect Pressure:** Check pressure in system with suitable pressure gage. Pressure must be within range specified on nameplate.
4. **Incorrect Adjustment:** Check adjusting nut for proper setting. Refer to adjustment instructions.
5. **External Leakage:** Check to see that bolts (4) holding transducer to pressure switch are properly torqued (80 ± 10 inch-pounds). If bolts are tight and leakage is still evident, replace transducer. Refer to paragraph on "Assembly of Switch Unit and Transducer Unit."
6. **Excessive Vibration or Surges Causing Switch to Actuate and Reactuate:** Check for fluctuations in system and install pressure surge suppressor. Check switch mounting and be sure there is no excess vibration.
7. **Incorrect Temperature:** Check temperature in system with suitable thermometer. Temperature must be within range specified on nameplate. Check location of capillary and bulb for incorrect mounting. Refer back to paragraphs on "Installation of Temperature Transducers."

If the operation of the fixed deadband switch cannot be corrected by the above means, the entire switch unit should be replaced or an authorized factory representative consulted.

FOR SERVICE, REPLACEMENT OR NEW TRANSDUCER
Consult Factory or Authorized Factory Representative or Distributors

ORDERING INFORMATION
For Fixed Deadband Switch or New Transducer
When Ordering, Specify Catalog Numbers, Fluid, Pressure Range, Temperature Range, Serial Numbers and Maximum Sustained Pressure or Temperature.

NAMEPLATES ARE LOCATED ON SWITCH COVER AND BOTTOM OF TRANSDUCER.

ASCO Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932 Form No. P7034 PRINTED IN U.S.A. 1978

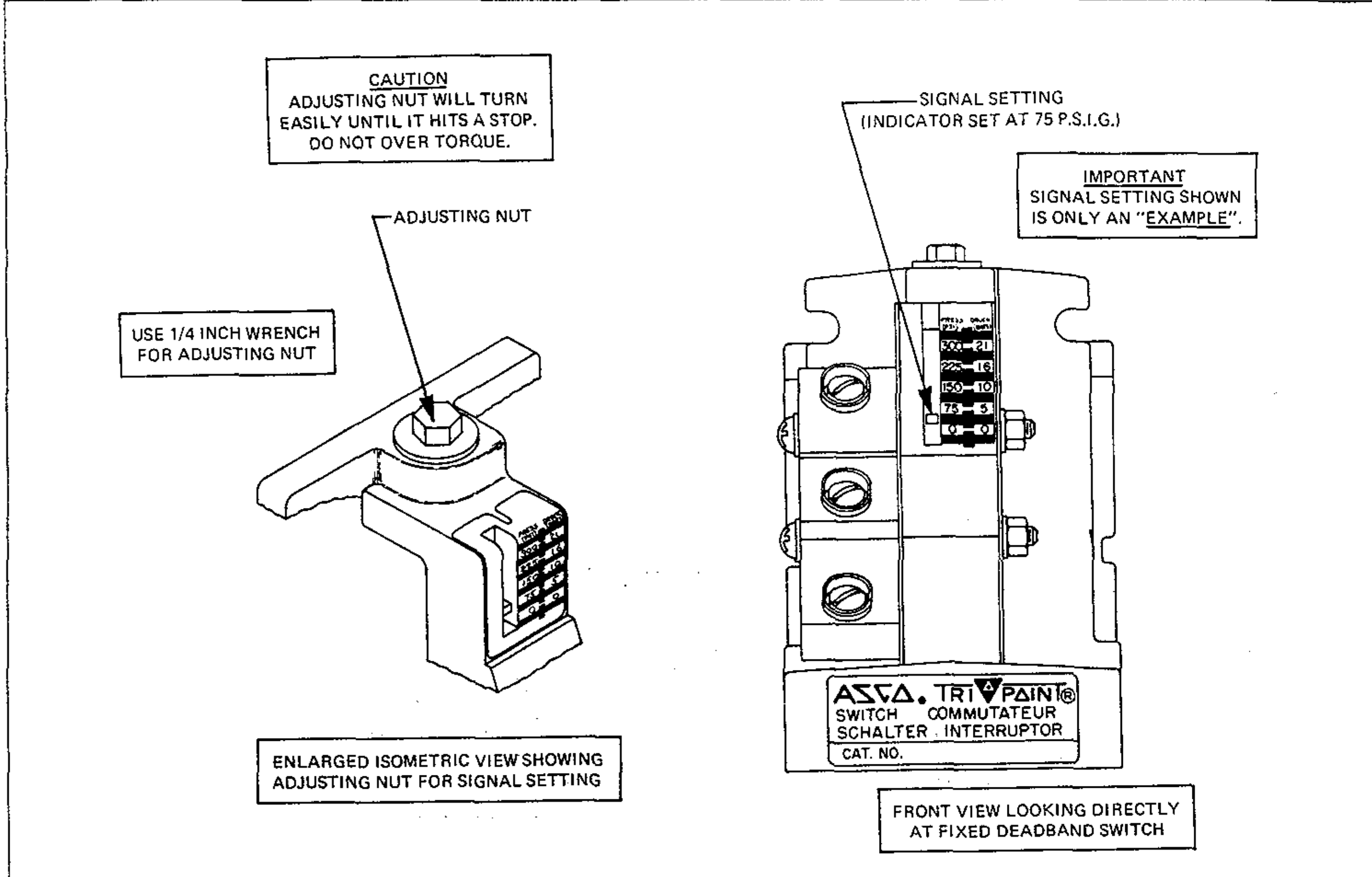


Figure 1. **Adjustment (Signal Setting) of Fixed Deadband Switch**

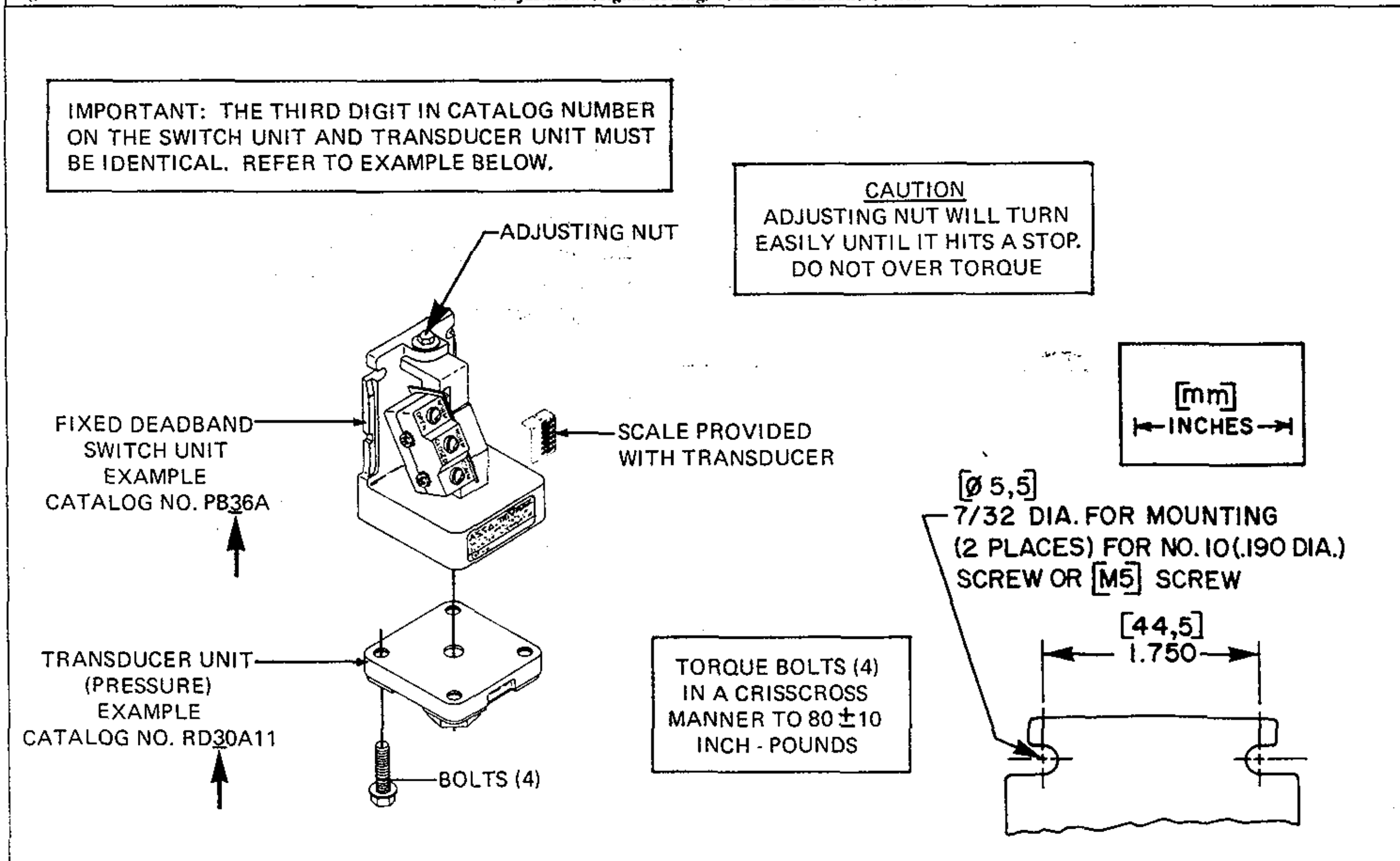


Figure 2. **Open Frame Switch and Mounting Dimensions (Switch Unit and Transducer Unit to be Assembled)**

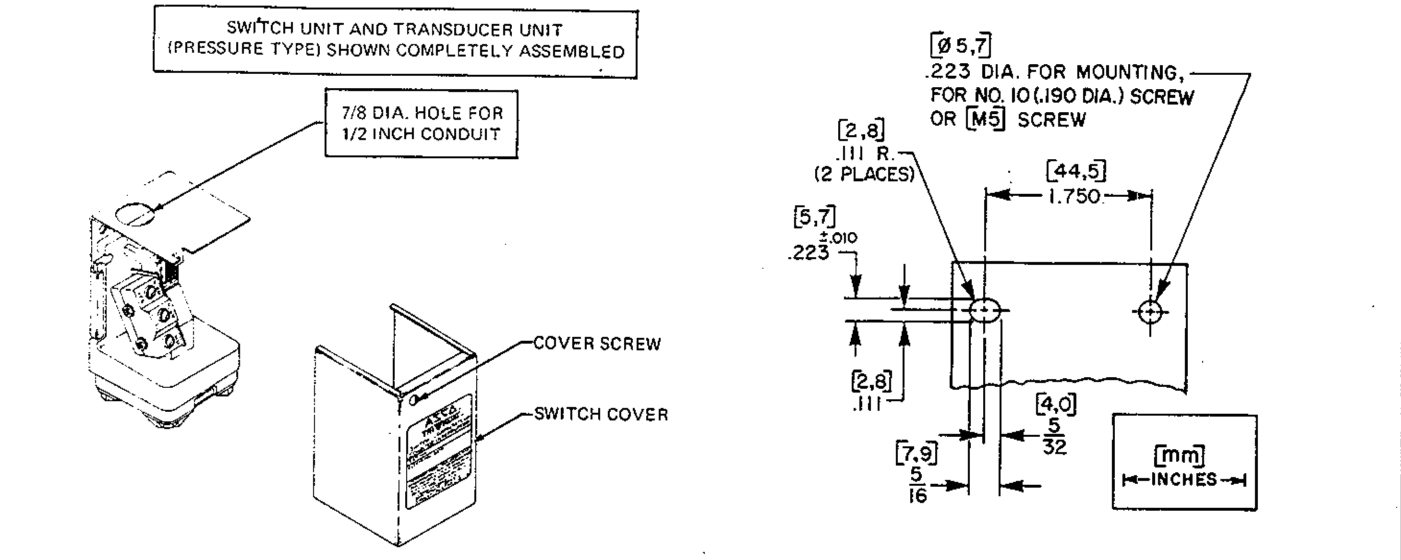


Figure 3. General Purpose Switch Enclosure With Mounting Dimensions

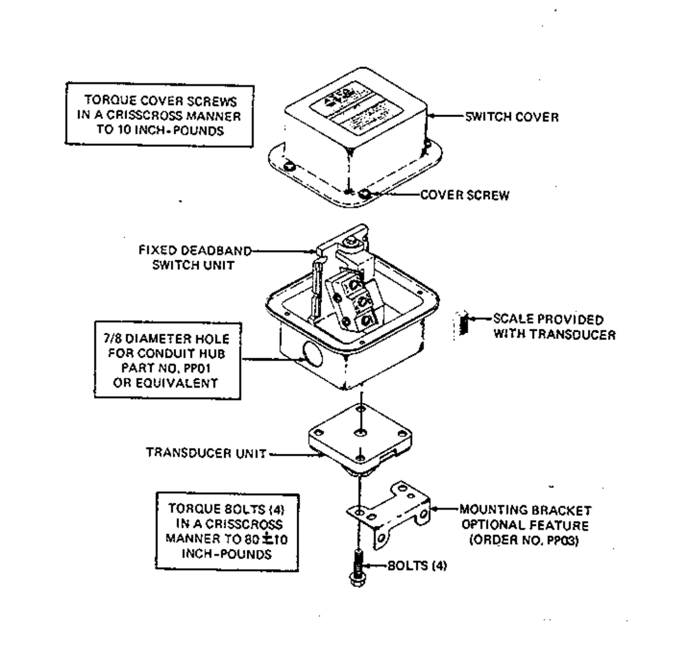


Figure 4. Watertight Switch Enclosure

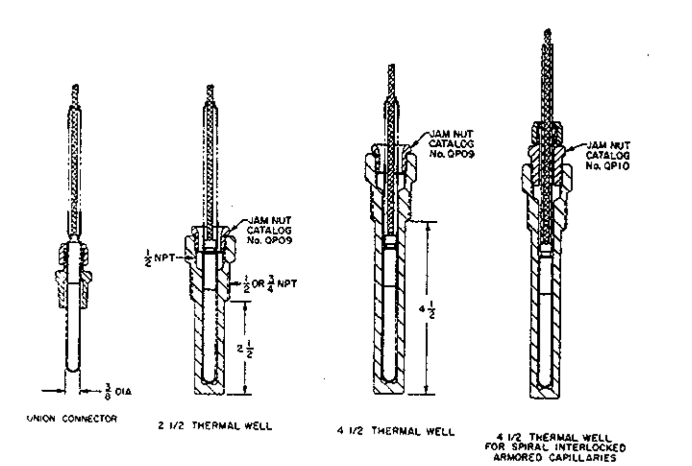


Figure 5. Union Connector and Thermal Wells (Optional Feature)

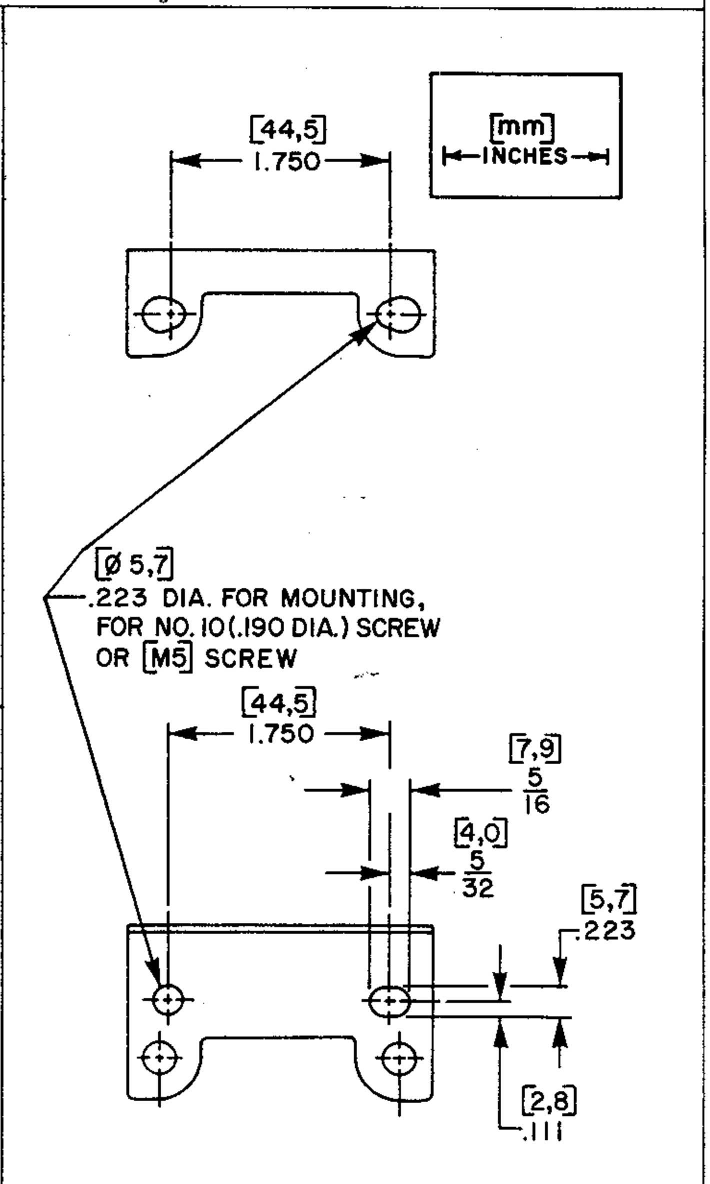


Figure 6. Mounting Bracket (Optional Feature)

ASCO TRIPOINT® pressure switches

SERIES

PB10, PB11, PB16
PB20, PB21, PB26
PB30, PB31, PB36

SWITCH UNIT AND TRANSDUCER UNIT COMBINATIONS
FIXED DEADBAND COMPACT LINE PRESSURE SWITCHES
OPEN FRAME, GENERAL PURPOSE OR WATERTIGHT SWITCH ENCLOSURES

Form No. P7035R1

DESCRIPTION

This sheet is a listing of switch unit and transducer unit combinations. The chart below is provided to insure that the proper switch unit is assembled to the proper transducer unit, thus providing a complete fixed deadband pressure switch.

In the chart below, locate the switch unit catalog number being used. Then going to the right on the same line (as the switch unit catalog number) find the transducer unit catalog number which may be used with this particular switch unit. IMPORTANT: The third digit in both the switch unit and transducer unit catalog numbers must be identical. For example, a Switch Unit Catalog No. PB30A can be used with Transducer Unit Catalog No. RD30A11. The mating produces a complete fixed deadband pressure switch, Catalog No. PB30A/RD30A11. Note third digits in both catalog numbers are identical. If the third digit is not identical, it is an incorrect mate and the units should not be assembled.

NOTE: Switch units to left may be used with any transducer units listed to right provided they are on the same horizontal line.

SWITCH UNITS			RANGE		TRANSDUCER UNITS				
GENERAL PURPOSE ENCLOSURE	WATERRIGHT ENCLOSURE	OPEN FRAME	ADJUSTABLE OPERATING RANGE	RATED OVER-RANGE PRESSURE (psig)	ALUMINUM AND BUNA N CONSTRUCTION	POLYESTER, BRASS AND BUNA N CONSTRUCTION	BRASS AND BUNA N CONSTRUCTION	303 STAINLESS STEEL AND VITON* CONSTRUCTION	316 STAINLESS STEEL WELD DIAPHRAGM AND BODY CONSTRUCTION
PB30A	PB31A	PB36A	0 - 30" Hg (VAC)	50	RV34A11	–	RV34A21	RV34A32	–
PB20A	PB21A	PB26A	30" Hg(V) -15 psig	50	RV24A11	–	RV24A21	RV24A32	–
PB30A	PB31A	PB36A	0 - 9 psig	60	RD30A11	RD30A71	RD30A21 (2)	RD30A32 (2)	–
PB20A	PB21A	PB26A	2 - 18 psig	60	RD20A11	RD20A71	RD20A21 (2)	RD20A32 (2)	–
PB30A	PB31A	PB36A	2 - 18 psig	100	–	–	–	–	RE30A44
PB20A	PB21A	PB26A	4 - 36 psig	150	RE20A11	RE20A71	RE20A21 (2)	RE20A32 (2)	RE20A44
PB10A	PB11A	PB16A	6 - 60 psig	150	RE10A11	RE10A71	RE10A21 (2)	RE10A32 (2)	RE10A44
PB10A	PB11A	PB16A	10 - 100 psig	200 (1)	RF10A11	RF10A71 (1)	RF10A21 (2)	RF10A32 (2)	RF10A44
PB10A	PB11A	PB16A	20 - 200 psig	400 (1)	RG10A11	RG10A71 (1)	RG10A21 (2)	RG10A32 (2)	RG10A44
PB10A	PB11A	PB16A	30 - 300 psig	450	RH10A11	–	RH10A21 (2)	RH10A32 (2)	RH10A44
PB10A	PB11A	PB16A	40 - 400 psig	500	RJ10A11	–	RJ10A21 (2)	RJ10A32 (2)	RJ10A44
PB20A	PB21A	PB26A	60 - 600 psig	2000	–	–	RL20A21	RL20A42 (3)	–
PB10A	PB11A	PB16A	100 - 1000 psig	2000	–	–	RL10A21	RL10A42 (3)	–
PB20A	PB21A	PB26A	180 - 1800 psig	4500	–	–	RN20A21	RN20A42 (3)	–
PB10A	PB11A	PB16A	300 - 3000 psig	4500	–	–	RN10A21	RN10A42 (3)	–
PB10A	PB11A	PB16A	600 - 6000 psig	7500	–	–	–	RQ10A42 (3)	–

IMPORTANT: All units listed above are suitable for air and hydraulic oil service. For water service, all units are suitable except aluminum.

NOTES:

(1) Rated overrange pressure on RF10A71 is 150 psig and on RG10A71 is 300 psig.

(2) These transducers are acceptable for steam service if used with pigtail (condensate loop) between steam line and transducer.

(3) Transducers ending in 42 have 316 S.S. bodies, not 303 S.S.

*DuPont's registered trademark.

ASCO

ASCO TRIPOINT® temperature switches

SERIES

PB10, PB11, PB16

SWITCH UNIT AND TRANSDUCER UNIT COMBINATIONS
FIXED DEADBAND COMPACT LINE TEMPERATURE SWITCHES
OPEN FRAME, GENERAL PURPOSE OR WATERTIGHT SWITCH ENCLOSURES

Form No. P7035R1

DESCRIPTION

This sheet is a listing of switch unit and transducer unit combinations. The chart below is provided to insure that the proper switch unit is assembled to the proper transducer unit, thus providing a complete fixed deadband temperature switch.

In the chart below, locate the switch unit catalog number being used. Then going to the right on the same line (as the switch unit catalog number) find the transducer unit catalog number which may be used with this particular switch unit. IMPORTANT: The third digit in both the switch unit and transducer unit catalog numbers must be identical. For example, a Switch Unit Catalog No. PB10A can be used with Transducer Unit Catalog No. KA10A1. The mating produces a complete fixed deadband temperature switch, Catalog No. PB10A/KA10A1. Note third digits in both catalog numbers are identical. If the third digit is not identical, it is an incorrect mate and the units should not be assembled.

NOTE: Switch units to left may be used with any transducer units listed to right provided they are on the same horizontal line.

SWITCH UNITS			RANGE		TEMPERATURE TRANSDUCER UNITS					
GENERAL PURPOSE ENCLOSURE	WATERTIGHT ENCLOSURE	OPEN FRAME	ADJUSTABLE OPERATING RANGE	RATED OVERRANGE TEMPERATURE (IN°)	DIRECT MOUNT		6' CAPILLARY AND BULB		12' CAPILLARY AND BULB	
					COPPER	316 S.S.	COPPER	316 S.S.	COPPER	316 S.S.
PB10A	PB11A	PB16A	−60 – 20°F −51 – −7°C	200°F 93°C	KA10A1	KA10A4	KA11A1	KA11A4	KA11A1D	KA11A4D
PB10A	PB11A	PB16A	−30 – 60°F −34 – 16°C	250°F 121°C	KB10A1	KB10A4	KB11A1	KB11A4	KB11A1D	KB11A4D
PB10A	PB11A	PB16A	0 – 90°F −18 – 32°C	300°F 149°C	KD10A1	KD10A4	KD11A1	KD11A4	KD11A1D	KD11A4D
PB10A	PB11A	PB16A	50 – 160°F 10 – 71°C	350°F 177°C	KF10A1	KF10A4	KF11A1	KF11A4	KF11A1D	KF11A4D
PB10A	PB11A	PB16A	100 – 220°F 38 – 104°C	450°F 232°C	KJ10A1	KJ10A4	KJ11A1	KJ11A4	KJ11A1D	KJ11A4D
PB10A	PB11A	PB16A	160 – 260°F 71 – 127°C	500°F 260°C	KL10A1	KL10A4	KL11A1	KL11A4	KL11A1D	KL11A4D
PB10A	PB11A	PB16A	225 – 340°F 107 – 171°C	600°F 316°C	–	–	KN11A1	KN11A4	KN11A1D	KN11A4D
PB10A	PB11A	PB16A	300 – 450°F 149 – 232°C	700°F 371°C	–	–	KT11A1	KT11A4	KT11A1D	KT11A4D
PB10A	PB11A	PB16A	350 – 510°F 177 – 266°C	800°F 427°C	–	–	KU11A1	KU11A4	KU11A1D	KU11A4D

NOTE: Rated overrange temperatures are limited as follows:
For copper capillary units – 550°F (288°C).
For direct mount units – 260°F (127°C).

ASCO

UNDERWRITERS LABORATORIES, INC. LISTED AND/OR RECOGNIZED COMPONENTS

ASCO® TRIPOINT® Compact Line Pressure Switches

Form No. P7047R1

UL LISTINGS

This sheet is a listing of switch unit and transducer unit combinations that are Listed and/or Component Recognized by Underwriters Laboratories, Inc. The table below is provided to insure that the proper switch unit (section) is assembled to the proper transducer unit (section), thus providing a complete, UL Listed and/or Recognized Component pressure switch. Only completely assembled combinations are UL Listed and/or Recognized Component. See table below for UL complementary product category listing and guide card numbers.

INSTALLATION INSTRUCTIONS

To determine the proper switch and transducer combinations, first locate the switch unit catalog number in the table below. Then going to the right on the same line (as the switch unit catalog number) find the transducer unit catalog number which may be used with this particular switch unit.

IMPORTANT: The third digit in both the switch unit and transducer unit catalog numbers must be identical. For example, a switch unit Catalog No.PA3̲1A can be used with transducer unit Catalog No.RV3̲4A11. The mating produces a complete pressure switch Catalog No.PA3̲1A/RV3̲4A11.

SWITCH UNITS See Note ④						PRESSURE TRANSDUCER UNITS See Notes ①,②&③			
Series: PA, PB, PC & PG Followed by Numbers Below									
General Purpose Enclosure Type 1		Watertight Enclosure Types 3 & 3S	Watertight Enclosure Types 3, 3S, 4 & 6	Open-Frame (No Enclosure)	Applicable Options	Air Non-Hazardous Oil & Gas Aluminum/Buna N Construction	Air - Water Non-Hazardous Gas & Oil Polyester, Brass & Buna N Construction	Air - Water Non-Hazardous Gas, Oil & Steam Brass, Buna N & VITON* Construction	Corrosive Fluids Air - Water Non-Hazardous Gas & Oil 303 Stainless Steel & VITON* Construction
40A	41A	44A	48A	46A	Series PA, PB, PC & PG__4A with Suffix 1 Enclosure Types 4, 4X & 6 Optional Suffixes 1, 2, 3, J & K.	RD40A11	RD40A71	RD40A21	RD40A32
30A	31A	34A	38A	36A		RV34A11	—	RV34A21	RV34A32
20A	21A	24A	28A	26A		RV24A11	—	RV24A21	RV24A32
30A	31A	34A	38A	36A		RD30A11	RD30A71	RD30A32 ②	RD30A32 ②
20A	21A	24A	28A	26A		RD20A11	RD20A71	RD20A21 ②	RD20A32 ②
30A	31A	34A	38A	36A		—	—	—	—
20A	21A	24A	28A	26A		RE20A11	RE20A11	RE20A21 ②	RE20A32 ②
10A	11A	14A	18A	16A		RE10A11	RE10A71	RE10A21 ②	RE10A32 ②
10A	11A	14A	18A	16A		RF10A11	RF10A71	RF10A21 ②	RF10A32 ②
10A	11A	14A	18A	16A		RG10A11	RG10A71	RG10A21 ②	RG10A32 ②
10A	11A	14A	18A	16A		RH10A11	—	RH10A21 ②	RH10A32 ②
10A	11A	14A	18A	16A		RJ10A11	—	RJ10A21	RJ10A32 ②
								316 St.St. & VITON*	
20A	21A	24A	28A	26A		—	—	RL20A21	RL20A42
10A	11A	14A	18A	16A		—	—	RL10A21	RL10A42
20A	21A	24A	28A	26A		—	—	RN20B21	RN20B42
10A	11A	14A	18A	16A		—	—	RN10B21	RN10B42
10A	11A	14A	18A	16A		—	—	—	RQ10B42

NOTES:

(1a) All transducers used with general purpose and watertight switch units are UL Listed as Industrial Control Equipment—Enclosed, Motor Controllers —Pressure Operated, Guide NKPZ. Transducers which end in 11, 21, 32 or 42 and used with General Purpose and Watertight Switch Units are also UL Listed as Switches for Heating and Cooling Appliances, Guide MFHX.

(1b) All transducers used with open-frame (no enclosure) switch units are considered UL Recognized Components as Industrial Control Equipment, Motor Controllers — Pressure Operated, Guide NKPZ2. Transducers which end in 11, 21, 32, or 42 and used with open-frame (no enclosure) switch units are also considered UL Recognized Components as Switches for Heating and Cooling Appliances, Guide MFHX2.

* DuPont's registered trademark.

(2a) When used for steam service, these transducers with general purpose and watertight switch units are also UL Listed as Limit Controls, Guide MBPR.

(2b) Transducers used with open-frame (no enclosure) switch units are considered UL Recognized Component Limit Controls, Guide MBPR2.

③ Suffix B is an applicable option.

④ Series PC10A, PC11A, PC16A, PC20A, PC21A, PC26A, PC30A, PC31A & PC36A are UL Recognized Components for use as Motor Controller — Pressure Operated (NKPZ2).

Printed in U.S.A.

ASCO

Automatic Switch Co. 50-60 Hanover Road, Florham Park, New Jersey 07932

UNDERWRITERS LABORATORIES, INC. LISTED AND/OR RECOGNIZED COMPONENTS

ASCO® TRIPOINT® Compact Line Temperature Switches

Form No.P7047R1

UL LISTINGS

This sheet is a listing of switch unit and transducer unit combinations that are Listed and/or Component Recognized by Underwriters Laboratories, Inc. The table below is provided to insure that the proper switch unit (section) is assembled to the proper transducer unit (section), thus providing a complete, UL Listed and/or Recognized Component temperature switch. Only completely assembled combinations are UL Listed and/or Recognized Component. See table below for UL complementary product category listing and guide card numbers.

INSTALLATION INSTRUCTIONS

To determine the proper switch and transducer combinations, first locate the switch unit catalog number in the table below. Then going to the right on the same line (as the switch unit catalog number) find the transducer unit catalog number which may be used with this particular switch unit.

IMPORTANT: The third digit in both the switch unit and transducer unit catalog numbers must be identical. For example, a switch unit Catalog No.PA1̲0A can be used with transducer unit Catalog No.KB1̲0A4. The mating produces a complete temperature switch Catalog No. PA1̲0A/KB1̲0A4.

SWITCH UNITS						TEMPERATURE TRANSDUCER UNITS See Notes ① and ②				
Series: PA, PB, PC, & PG Followed by Numbers Below						Direct Probe		6′ Capillary & Bulb		
General Purpose Enclosure Type 1		Watertight Enclosure Types 3 & 3S	Watertight Enclosure Types 3, 3S, 4 & 6	® UR Open-Frame (No Enclosure)	Applicable Options	Copper	316 Stainless Steel	Copper (Armored Capillary)	316 Stainless Steel (Plain Capillary)	Applicable Options
10A	11A	15A	19A	16A	Series PA, PB, PC & PG __ 4A with Suffix 1 Enclosure Types 4, 4X & 6 Optional Suffixes 1, 2, 3, J & K.	KA10A1	KA10A4	KA11A1	KA11A4	Suffixes D, E, F, & G
10A	11A	15A	19A	16A		KB10A1	KB10A4	KB11A1	KB11A4	
10A	11A	15A	19A	16A		KD10A1	KD10A4	KD11A1	KD11A4	
10A	11A	15A	19A	16A		KF10A1	KF10A4	KF11A1	KF11A4	
10A	11A	15A	19A	16A		KJ10A1	KJ10A4	KJ11A1	KJ11A4	
10A	11A	15A	19A	16A		KL10A1	KL10A4	KL11A1	KL11A4	
10A	11A	15A	19A	16A		—	—	KN11A1	KN11A4	
10A	11A	15A	19A	16A		—	—	KT11A1	KT11A4	
10A	11A	15A	19A	16A		—	—	KU11A1	KU11A4	

NOTES:

(1a) All transducers used with general purpose and watertight switch units are UL Listed as Temperature — Indicating and Regulating Equipment, Guide XAPX.

(1b) All transducers used with open frame (no enclosure) switch units are considered UL Recognized Components as Temperature — Indicating and Regulating Equipment Guide XAPX2.

② Optional features, armored capillary, and capillary length identified by the seventh, eighth, and ninth digit codes respectively of the transducer catalog number are also UL Listed.

Printed in U.S.A.

ASCO

Automatic Switch Co. 50-60 Hanover Road, Florham Park, New Jersey 07932

Lubricating Specialties Company

ASCO General Controls
Form No. V8527R2

MATERIAL SAFETY DATA SHEET

Dear Customer,

You are probably aware of recent developments regarding worker "Right-to-Know" laws and the OSHA Hazard Communication Standard. While these laws and the OSHA Standard have numerous requirements, the development of a Material Safety Data Sheet and its dissemination to the purchaser of the chemical product are among the principal means of achieving an effective hazard communication program and of satisfying the "Right-to-Know" need. For the MSDS to serve its purpose as an effective means of hazard communication, the information contained therein must be passed along to all those who handle or use the product and/or are involved with the design, implementation of control of operations involving the product. We strongly urge you to forward the MSDS to all parties who have a need for the information contained therein.

"EMPTY" CONTAINER WARNING
"Empty" containers retain residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. All precautions detailed on the container label applies to partially full or "Empty" containers. Do not attempt to clean since residue is difficult to remove. "Empty" drums should be completely drained, properly closed and promptly returned to a drum reconditioner to be commercially cleaned. All other containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. For work on tanks refer to Occupational Safety and Health Administration regulations, ANSI Z49.1, and other governmental and industrial references pertaining to cleaning, repairing, welding, or other contemplated operations.

When a Lubricating Specialties Company product is resold in the original container with an original label, the reseller has the responsibility for ensuring that the proper Material Safety Data Sheet is provided to its purchaser.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, Lubricating Specialties Company makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its safety and suitability for their purposes prior to use. In no event will Lubricating Specialties Company be responsible for damages of any nature whatsoever resulting from the use or reliance upon information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH THE INFORMATION REFERS.

(This MSDS complies with 29CFR 1910.1200)

Lubricating Specialties Company

8015 Paramount Blvd.
Pico Rivera, CA 90660-4888
Telephone (562) 928-3311

MATERIAL SAFETY DATA SHEET

(Essentially similar to Form OSHA-20) <Complies with 29CFR 1910.1200>

DAY: (562) 928-3311
EMERGENCY 24 HOURS:
CHEMTREC: 800/424-9300

SECTION 1

CODE NUMBER: A0600

DATE 970917

TRADE NAME: MIL-H-5606G HYD FLUID #MLS 96-99

SUPERCEDES 970915

CHEMICAL FAMILY: PETROLEUM

CARCINOGENIC INGREDIENTS/OSHA/NTP/IARC: NONE

C.A.S. NO.: "MIXTURE"

TSCA INFORMATION: COMPONENTS OF THIS PRODUCT ARE LISTED

SECTION II — HAZARDOUS INGREDIENTS

COMPONENTS	C.A.S. NO.S.:	TLV/PEL PPM	TLV/PEL mg/m³	PERCENT BY WEIGHT/VOLUME
TRI CRESYL PHOSPHATE	115-86-6		3	<1%W

THIS PRODUCT DEFINED AS NON-HAZARDOUS EXCEPT AS STATED ABOVE. DISCLOSURE OF INGREDIENTS AVAILABLE TO PHYSICIAN OR NURSE IN EVENT OF MEDICAL EMERGENCY.

SECTION III — FIRE AND EXPLOSION HAZARD DATA

HAZARDOUS THERMAL DECOMPOSITION
CARBON MONOXIDE AND ASPHYXIANTS

FLAMMABLE LIMITS: LEL — UEL N/A

FLASH POINT: ASTM D93 (PMCC) 82 °C (182 °F)

EXTINGUISHING MEDIA: CARBON DIOXIDE, DRY CHEMICAL, FOAM, WATERFOG

DOT INFORMATION: COMBUSTIBLE LIQUID, N.O.S.

UNUSUAL FIRE AND EXPLOSION HAZARDS: SLIGHTLY COMBUSTIBLE, WHEN HEATED ABOVE FLASH POINT WILL RELEASE FLAMMABLE VAPORS WHICH CAN BURN IN OPEN OR BE EXPLOSIVE IN CONFINED SPACES IF EXPOSED TO SOURCE OF IGNITION.

SPECIAL FIRE FIGHTING PROCEDURES: DO NOT ENTER ANY ENCLOSED OR CONFINED AREA WITHOUT PROPER PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS.

SECTION IV — PHYSICAL DATA

BOILING RANGE: 175° C SOLUBILITY NEG PH: N/D

VOC, 1HR @ 110 DEG C (D2369), NON-EXEMPT = NIL

VAPOR PRESSURE: <0.01mm Hg @ 20 °C APPEARANCE AND ODOR: RED, OILY LIQUID PETROLEUM ODOR

VAPOR DENSITY	EVAPORATION RATE	SPECIFIC GRAVITY	WEIGHT PER GALLON	% VOLATILE BY VOLUME
HEAVIER THAN AIR	LESS THAN ETHER	0.868	7.24	NIL

SECTION V — REACTIVITY DATA

INCOMPATIBILITY <MATERIALS TO AVOID>: STRONG OXIDIZING AGENTS

STABILITY: STABLE

CONDITIONS TO AVOID: DO NOT HEAT ABOVE FLASH POINT.

HAZARDOUS DECOMPOSITION PRODUCTS:
CARBON MONOXIDE AND ASPHYXIANTS

HAZARDOUS POLYMERIZATION
NONE

OCCUPATIONAL EXPOSURE LIMIT
TLV = 5mg/m³ AS OIL MIST

SECTION VI — HEALTH HAZARD DATA

ROUTE OF EXPOSURE	ADVERSE EFFECTS:	FIRST AID PROCEDURES:	NFPA
ING	NOT NORMALLY EXPECTED TO CAUSE ANY ILL EFFECTS EXCEPT IN VERY SENSITIVE INDIVIDUALS	DO NOT INDUCE VOMITING. CONSULT PHYSICIAN	
INH	NO SIGNIFICANT ADVERSE HEALTH EFFECTS ARE EXPECTED TO OCCUR ON SHORT TERM EXPOSURE	REMOVE FROM CONTAMINATED AREA. APPLY ARTIFICIAL RESPIRATION. IF UNCONSCIOUS CONSULT PHYSICIAN	
EYE CON	NOT NORMALLY EXPECTED TO CAUSE ANY ILL EFFECTS EXCEPT IN VERY SENSITIVE INDIVIDUALS	FLUSH WITH COPIOUS AMOUNTS OF WATER. IF IRRITATION DEVELOPS CONSULT PHYSICIAN	
ACUTE SKIN CON	NOT NORMALLY EXPECTED TO CAUSE ANY ILL EFFECTS EXCEPT IN VERY SENSITIVE INDIVIDUALS	WASH WITH SOAP AND WATER. CONSULT PHYSICIAN IF IRRITATION OR INFLAMMATION DEVELOPS	
CHRONIC SKIN CON	PROLONGED AND/OR REPEATED CONTACT MAY PRODUCE MILD SKIN IRRITATION AND INFLAMMATION. PERSONNEL WITH PRE-EXISTING SKIN DISORDER SHOULD AVOID CONTACT	WEAR PROTECTIVE CLOTHING TO AVOID SKIN CONTACT. CONSULT PHYSICIAN IF IRRITATION OR INFLAMMATION DEVELOPS	

< DOT > SECTION VII — SPILL OR LEAK PROCEDURES < EPA >

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: STOP FLOW. WIPE OR MOP UP OR ABSORB WITH DIATOMACEOUS EARTH OR OTHER INERT MATERIAL. STORE IN APPROPRIATE CONTAINER FOR DISPOSAL.

WASTE DISPOSAL METHOD:

IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

TRANSPORTATION INFORMATION: CONSULT 49 CFR PARTS 1-300 AND REFER TO SECTION III OF THIS MSDS FOR ADDITIONAL RECOMMENDATIONS CONCERNING PLACARDING.

SECTION VIII — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: NONE NORMALLY REQUIRED

PROTECTIVE GLOVES: RECOMMENDED **EYE PROTECTION:** REQUIRED

OTHER PROTECTIVE EQUIPMENT: CHEMICALLY RESISTANT BOOTS AND APRONS RECOMMENDED.

VENTILATION: SUFFICIENT TO MAINTAIN ATMOSPHERE BELOW TLV LIMIT

SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN WHEN HANDLING OR STORING:

AVOID STORAGE NEAR OPEN FLAME OR OTHER SOURCES OF IGNITION.
EXCESSIVE MISTING MAY CAUSE SLIPPERY FLOORS. PROPER FOOTWEAR REQUIRED.

PERSONAL HYGIENE: WASH HANDS WITH SOAP AND WATER BEFORE EATING, DRINKING, OR SMOKING.

OTHER PRECAUTIONS: WASH OR TAKE SHOWER IF GENERAL CONTACT OCCURS. REMOVE OIL-SOAKED CLOTHING AND LAUNDER BEFORE REUSE. DISCARD CONTAMINATED LEATHER GLOVES AND SHOES.

APPROVED BY: PATRICK KAINES
REGULATORY MANAGER

DATE: 980615

LSC Lubricating Specialties Company

MIL-H-5606G HYD FLUID #MLS 96-99

Manufactured By TECHNOLUBE PRODUCTS DIVISION

CODE NUMBER A0600

HEALTH 1 FIRE 1 REACTIVITY 0 PERSONAL PROTECTION (NFPA) 0

DEFINITIONS

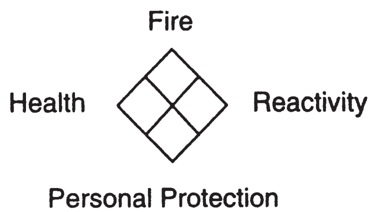
ACGIH: American Conference of Governmental Industrial Hygienists

DOT: Department of Transportation

LC50: Lethal Concentration Fifty: A calculated concentration of a substance which is expected to cause death of 50% of an entire defined experimental animal population.

LD50: Lethal Dose Fifty: A calculated dose of a substance expected to cause death of 50% of an experimental animal population.

LEL: Lower Explosive Limit



Hazard Category Scheme: This scheme rates health, fire, reactivity and special hazards on a scale of 0 to 4.

0 = no significant hazard
1 = slight hazard
2 = moderate hazard
3 = high hazard
4 = extreme hazard.

PEL: Permissible Exposure Limit

N/A: Not Applicable

N/D: Not Determined

NFPA: National Fire Protection Association

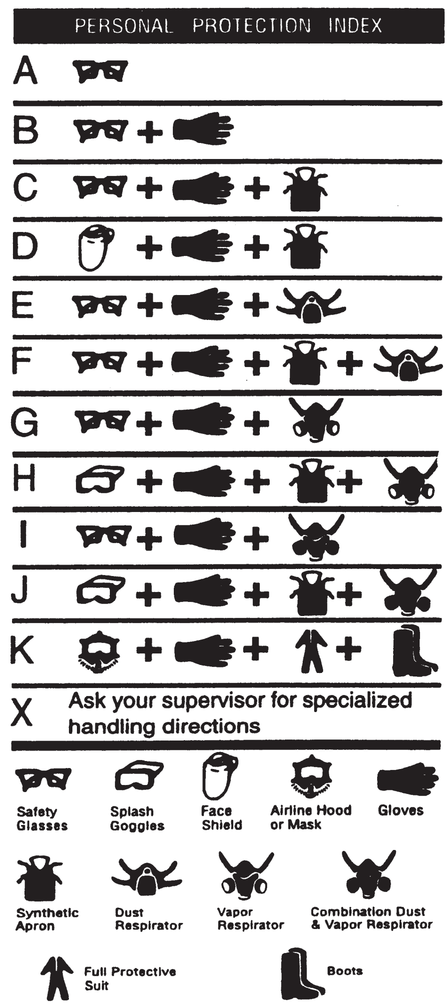
TLV: Threshold Limit Value. A recommended upper limit or TWA concentration of a substance to which most workers can be exposed with out adverse effect.

TWA: Time Weighted Average

ING: Ingestion

INH: Inhalation

CON: Contact



Lubricating Specialties Company

8015 Paramount Blvd.
Pico Rivera, CA 90660-4888
Telephone (562) 928-3311

Installation & Maintenance Instructions

2–WAY NORMALLY CLOSED GAS VALVES

3/4″, 1″, 1 1/4″, 1 1/2″, 2″, 2 1/2″ OR 3″ NPT — FUEL GAS SERVICE

V710

GAS VALVES

Form No.V8708R1

⚠ WARNING

To prevent the possibility of death, serious injury or property damage, the V710 Series Gas Valve must be installed and serviced (tested) only by a qualified service technician avoiding the following hazards:

- **Electrical Hazard. Turn off all electrical power to Hydramotor® Actuator. More than one circuit may exist.**
- **Pressure Hazard. Depressurize valve and vent hazardous or combustible fluid to a safe area before inspection or removing the valve from service.**
- **Explosion/Fire Hazard. Extinguish all open flames and avoid any type of sparking or ignition when leakage testing.**

Service Notices

Except for actuator replacement or repair, V710 Series Gas Valves are not repairable. When any performance problems are detected during routine inspection, replace valve immediately.

See separate AH Series Hydramotor® Actuator Installation and Maintenance Instructions for information on: Actuator Specifications, Installation, Positioning/Mounting, Wiring and Field Service of Actuator.

DESCRIPTION

V710 Series Gas Valves are 2–way normally closed, soft–seated poppet–type valves for safety shutoff service on commercial or industrial gas burners. The V710 was designed exclusively for use with AH Series Hydramotor® Push–Type Actuators available in ON–OFF, LOW–HIGH–OFF and proportional positioning configurations.

The valves are equipped with aluminum seats and Nitrile seals. A quick–opening poppet is standard. Both overtravel seals and linear trim are available as options, i.e. ***Quick Opening With Overtravel Seal, Linear Opening or Linear Opening With Overtravel Seal.***

⚠ CAUTION: Use V710 Gas Valves only with natural, mixed, manufactured or liquefied petroleum (propane) gases.

Provisions for Pressure and Seat Leakage Testing

V710 Series valves are provided with four 1/4″ NPT tapped and plugged holes (pressure taps). Each side of the valve body is provided with an upstream and downstream pressure tap for testing. The taps closest to the valve bonnet are upstream, while the taps closest to the bottom of the valve body are downstream. Leakage testing frequency shall be at least annually in accordance with NFPA–86 or original equipment manufacturer recommendations. For instructions, refer to section on ***Testing for Internal (Seat) Leakage*** and Figures 1 and 2.

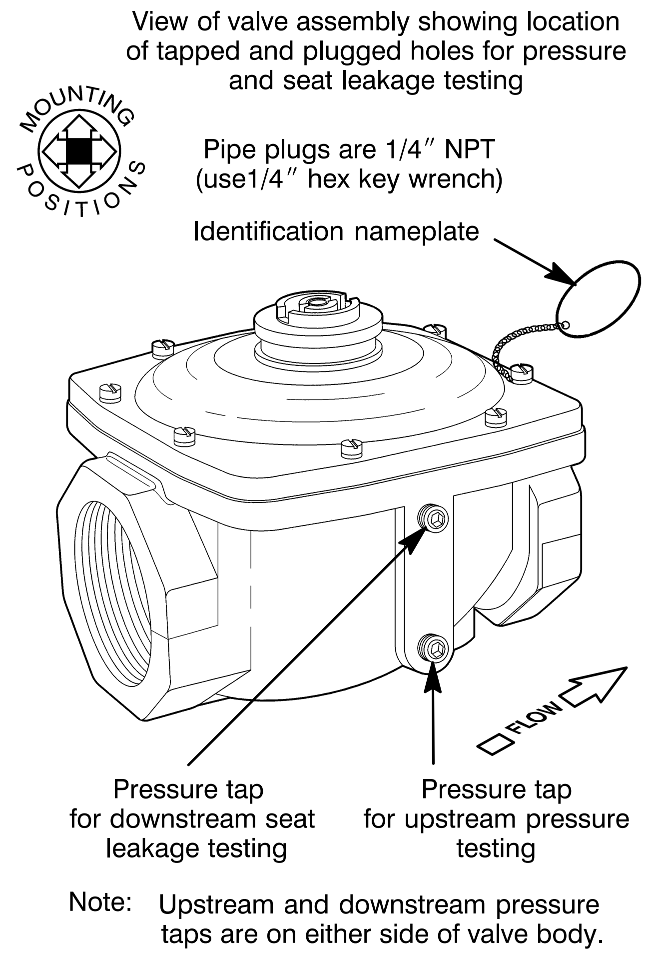


Figure 1. Provisions for pressure and seat leakage testing.

OPERATION

V710 Series is a normally closed, push–to– open valve which opens when the valve stem is depressed by an AH Actuator. An internal return spring closes the valve when its actuator is de–energized or removed. The actuator is retracted by its own internal return spring.

Maximum Operating Pressure Differentials:

- 3/4″, 1″, 1 1/4″ and 1 1/2″ NPT – 15 psi
- 2″, 2 1/2″ and 3″ NPT – 10 psi

INSTALLATION

Check nameplate for correct catalog number, pressure, and service. Check the catalog number against Table 1 to ensure that the valve meets the requirements of the application. Never apply incompatible fluids or exceed pressure rating of the valve.

Table 1. V710 Catalog System

V710 BASIC SERIES – Model D

SIZE
E = 3/4 ″
F = 1 ″
G = 1 1/4 ″
H = 1 1/2″
J = 2 ″
K =2 1/2 ″
L = 3 ″

BODY MATERIAL, END CONNECTION
AS = Aluminum body, NPT connections

OPTIONS
NONE =Quick opening (standard)
V15 = Linear trim
V22 = Quick opening plus overtravel seal
V25 = Linear plus overtravel seal

V710GASV15 Typical Catalog Number

Temperature Limitations

Ambient and Fluid Temperature: −40F (−40°C) to 150°F (65°C).

Positioning

Valve body may be mounted in any position.

⚠ CAUTION: Valve bonnet has a protective cap over the stem connection, do not remove protective cap until actuator is installed on valve body.

Piping

⚠ CAUTION: Piping must comply with applicable local and national codes and ordinances, including the National Fuel Gas Code ANSI Z223.1/NFPA No. 54.

Connect piping to valve according to flow arrow on valve body. The use of a drip leg is recommended. 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 actuator as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point. Valve should be checked for external leakage at piping connections after installation, see ***Testing for External Leakage*** section.

⚠ CAUTION: To avoid damage to the valve body DO NOT OVERTIGHTEN PIPE CONNECTIONS. If Teflon* tape, paste, spray, or similar lubricant is used, use extra care when tightening due to reduced friction.

⚠ CAUTION: To protect the 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.

Testing for External Leakage

⚠ WARNING: Explosion/Fire Hazard. To prevent the possibility of death, serious injury or property damage from the possible release of combustible gas to the atmosphere, extinguish all open flames and avoid any type of sparking or ignition.

1. Block gas flow on downstream side of valve.
2. Apply pressure to valve within nameplate rating and energize actuator.
3. Apply a soapy solution or a commercially available leak detecting solution to the pipe connections and check for bubbles.
4. If leakage exists. depressurize valve and turn off electrical power supply. Tighten connections and retest following the above steps.

MAINTENANCE

Preventive Maintenance

- Prepare and follow a routine inspection schedule based on the media, environment, and frequency of use. This should include periodic internal and external leakage checks.
- Keep the medium flowing through the valve as free from dirt and foreign material as possible. Depending on medium and service conditions, clean valve strainer, filter or drip leg as required to keep the valve free of contamination. In the extreme case, contamination will cause faulty valve operation and the valve may fail to open or close.
- While in service, the valve should be operated at least once a month to ensure proper opening and closing.

Testing for Internal (Seat) Leakage (Refer to Figures 1&2)

⚠ WARNING: Explosion/Fire Hazard. To prevent the possibility of death, serious personal injury or property damage from the release of combustible gas to the atmosphere, extinguish all open flames and avoid any type of sparking or ignition.

⚠ CAUTION: Be sure valve can be tested without affecting other equipment.

1. Shut off both the upstream and downstream manual gas cocks. The downstream manual gas cock should remain closed throughout the entire test procedure.
2. Program the control system to operate the valve through five cycles.
3. Open the upstream manual gas cock. Program the control system to energize and maintain the valve in the open (energized) position. Check all valve and piping connections for external leaks with rich soap and water solution or a commercially available leak detecting solution.

*DuPont's Registered Trademark

4. Shut off the upstream manual gas cock and de−energize valve. Remove the plug from the leak test tap or downstream pressure tap in the valve body. Connect leak test equipment with the test petcock in the closed position, see Figure 2.
5. Open the upstream manual gas cock. Program the control system to energize the valve to the full open position, then immediately de−energize it to seat the valve during operation.
6. Immerse the 1/4″ leak test tubing vertically into the plastic container of water to a depth of about 1/2″. Slowly open the test petcock. Bubbles may appear in the water as the pressure equalizes.
7. After the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing in a 10 second period. The allowable leakage in 10 seconds for an orifice diameter of 1 inch (25.4 mm) or less is 6 bubbles (3 cc/min).
   For valves with an orifice diameter over 1 inch (25.4 mm) the allowable leakage rate is 6 bubbles (3 cc/min.) per inch (25.4 mm) of orifice diameter. If leakage exceeds this rate, replace valve.

NOTE: The leakage rate above recognizes that some wear and contamination from use can result in a slight amount of leakage. The allowable leakage rate is well within the leakage limits as recognized by applicable approval agencies.

8. Close the upstream manual gas cock and the test petcock. Then remove the test equipment. Apply a small amount of Loctite Corporation's PST® Pipe Sealant 567 (or equivalent) to the pipe plug threads. Reinstall pipe plug and torque to 12 ft−lbs (16.3 Nm).
9. Open the upstream manual gas cock. Program the control system to energize and maintain the valve in the open (energized) position. Check 1/4″ NPT pipe plug connection for external leaks with rich soap and water solution or a commercially available leak detecting solution.
10. De−energize the valve. Open the downstream manual gas cock.
11. Restore the system to normal operation.

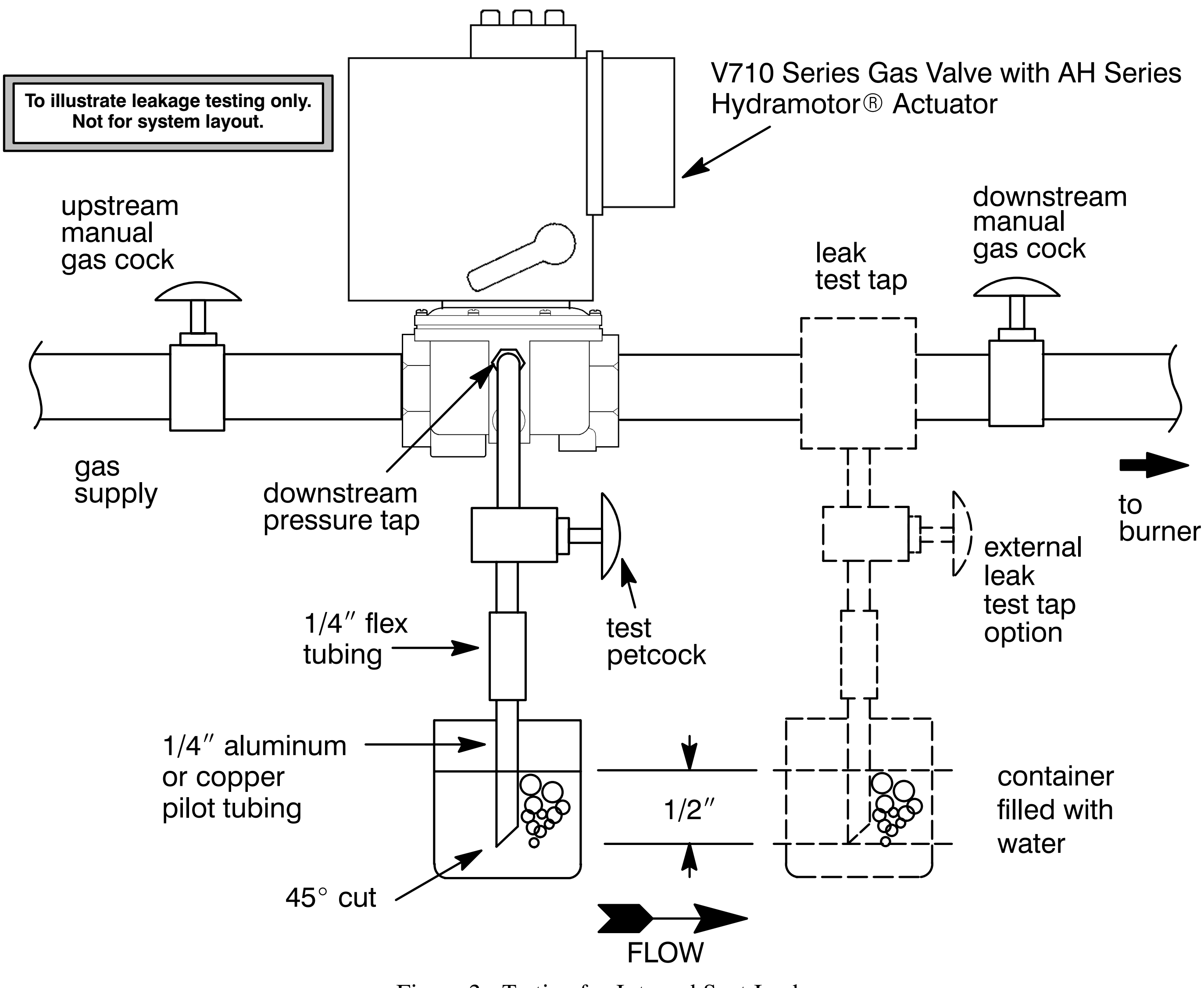
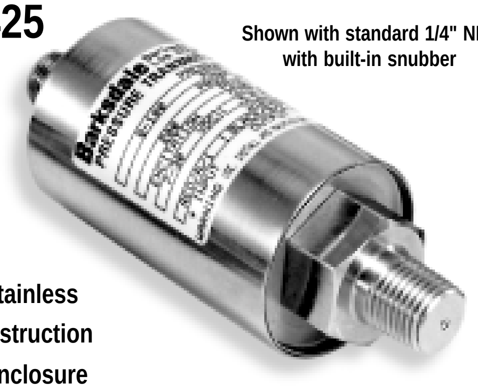


Figure 2. Testing for Internal Seat Leakage.

Automatic Switch Co. 50−60 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

Barksdale

Series 425
4-20 mA



Shown with standard 1/4" NPT with built-in snubber

CE Qualified

Features
- Welded Stainless Steel Construction
- Nema 4 Enclosure
- EMI, ESD & RFI Protection
- Reverse Polarity Protected
- Stable, Diffused Silicon Sensor
- Surface Mounted Conformal Coated Circuit
- High Pressure Snubber
- 0.25% Accuracy

Performance Characteristics*

Accuracy (LH & R)	±0.25% FSO
Long Term Stability	±0.5% FSO of calibration curve
Typical Life	100 million cycles
Proof Pressure	2 times rated pressure or 13000 psi max. (884 bar), whichever is less
Warranty	3 years

Input

Excitation Voltage	6 to 30 VDC (unregulated)
Loop Resistance	1500 ohms (max.)**

Output

Output	4 to 20 mA
Full Scale Output	16 mA ± 0.4%
Zero Output	4 mA ± 0.2%

Physical

Weight	7.4 oz. (210 grams) to 1000 psi 9.4 oz. (266 grams) from 1000 psi
Wetted Parts	17-4 PH & 300 series stainless steel
Enclosure	NEMA 4, 304 stainless steel
Pressure Connection	1/4-18 NPT male
Electrical Connection	2 conductor, 22 awg, PVC jacketed, shielded cable, 3 ft. (1m) long with integral strain relief and ground

Environmental

Temperature Ranges

Operating	0 to 160ºF (-18 to 71ºC)
Compensated	30 to 160ºF (1 to 71ºC)
Storage	-40 to 185ºF (-40 to 85ºC)

*Definitions are in accordance with ANSI/ISA S37.1-75

Pressure Range (psi)	425 Series 4-20 mA Catalog Number	
	Gauge	Absolute
0-15	425H3-01	425H3-01-A
0-30	425H3-21	425H3-21-A
0-50	425H3-03	425H3-03-A
0-60	425H3-22	425H3-22-A
0-100	425H3-04	425H3-04-A
0-150	425H3-05	425H3-05-A
0-200	425H3-06	425H3-06-A
0-300	425H3-07	425H3-07-A
0-500	425H3-08	
0-1000	425H3-10	
0-2000	425H3-12	
0-3000	425H3-13	
0-4000	425H3-14	
0-5000	425H3-15	
0-6000	425H3-16	
0-7500	425H3-17	
0-10000	425H3-18	

Note: Bar pressure ranges available. Consult factory.

Temperature Shift	
Zero & Span	±1.0% FSO (max.) over compensated range
Vibration	15 g's, 10-2000 Hz, MIL-STD 202
Shock	50 g's, 11 mS, MIL-STD 202 Method 213, Cond. G.

Built-in Protection (with H-3 cable)
- Conducted & Radiated RF emissions/interference to EN 55011
- IEC 801-2 Level 3 ESD (6 kV contact, 8 kV air)
- IEC 801-3 Level 3 Radiated RF field (80-1000 MHz at 10 V/m)
- IEC 801-4 Electrical fast transient/burst (1 kV)
- IEC 801-6 Level 3 conducted susceptibility 150 kHz-80 MHz -10 V rms
- Pressure snubber standard on 2000 psi & above

Standard Options
S - Voltage surge protection, IEC 801-5 level 4 surge to 4 kV
T2 - 4-pin Bendix PT02A-8-4P less mating electrical connector
H4 - Subminiature DIN connection 43650 type
T4 - Hirschman ELST 412 PG9 less mating electrical connector
P1 - 7/16-20 UNF female process connector
NX4 - NEMA 4X enclosure

See page 13 for information on ordering standard options.
Consult factory for other options and design variations not listed.

**See inside cover for loop resistance curve

BELL & GOSSETT

INSTRUCTION MANUAL

P06451A

Series 60® In Line Centrifugal Pump

INSTRUCTIONS FOR:

- INSTALLATION
- OPERATION
- SAFETY
- SERVICE

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

DESCRIPTION

The Series 60 pump is the culmination of compact design, quiet operation, low maintenance and, of course, Bell & Gossett quality. The compact design of the Series 60 centrifugal pump facilitates direct in-line mounting. The sleeve bearings, flexible couplers and rubber ring mounted motors provide smooth operation with minimal noise. The back pull-out assembly feature provides ease to all service operations. The combination of these features make the Series 60 ideal for many primary and secondary applications.

The Series 60 is available in sizes from 1" to 2.5" to meet a range of system pipe specifications. Equally versatile is the Series 60's availability at several power levels – ranging from 1/4 to 3 HP at 1750 RPM in BF, AI and AB construction. Combining these parameters makes possible the achievement of flow rates to 180 gpm and heads to 62 feet.

OPERATIONAL LIMITS

B&G Series 60 Pumps are designed to pump liquids compatible with their iron or bronze body construction at working pressures up to 175 psi and a maximum temperature of 225°F. Do not exceed these values.

Pump Construction:
- Bronze Fitted or All Bronze or All Iron
- Standard Mechanical Seal

Motors:
- 208-230/460 Volts – Three Phase
- 115/230 Volts – Single Phase (w/built-in overload protection).

Mechanical Seal:
- Standard: BUNA – PH Limitations 7-9; Temperature Range –40 to + 225°F
- Optional: EPT – PH Limitations 7-11; Temperature Range –40 to + 250°F

PUMP APPLICATION

Bell & Gossett Centrifugal Pumps may be used for hydronic heating and cooling systems, domestic water, industrial applications and general service operations. Bell & Gossett recommends that bronze constructed pumps be used for pumping potable water. This pump is for indoor use only.

SAFETY INSTRUCTIONS

This safety alert symbol will be used in this manual and on the pump instructions decal to draw attention to safety related instructions. When used, the safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.

Your Series 60 Pump should have this warning label affixed to the pump near the conduit box cover. If this warning is missing or illegible, contact your local Bell & Gossett Representative for a replacement.

ITT Bell & Gossett
Morton Grove, IL, U.S.A.

SAFETY REQUIREMENTS

ELECTRICAL SAFETY

WARNING: ELECTRICAL SHOCK HAZARD. Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances and good practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: ELECTRICAL SHOCK HAZARD. Three phase motors must have properly sized heaters to provide overload and under voltage protection. Single phase motors have built-in overload protectors. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

THERMAL SAFETY

WARNING: EXTREME TEMPERATURE HAZARD. If the pump, motor, or piping are operating at extremely high or low temperature, guarding or insulation is required. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: HOT WATER HAZARD. When disassembling a gasketed joint, always use a new gasket upon reassembly. NEVER RE-USE OLD GASKETS. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

MECHANICAL SAFETY

WARNING: UNEXPECTED START-UP HAZARD. Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: EXCESSIVE SYSTEM PRESSURE HAZARD. The maximum working pressure of the pump is listed on the nameplate – DO NOT EXCEED THIS PRESSURE. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

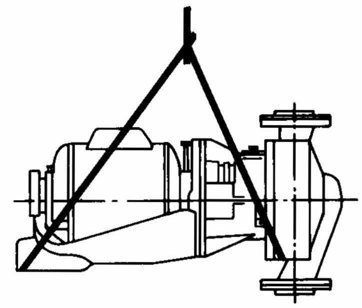
WARNING: EXCESSIVE PRESSURE HAZARD – VOLUMETRIC EXPANSION. The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release high temperature fluids. This can be prevented by installing properly sized and located compression tanks and pressure relief valves. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

PUMP INSTALLATION

PUMP SUPPORT AND LOCATION

The Bell & Gossett Series 60 pump should be installed where there will be sufficient room for future inspection, maintenance and service. It is highly recommended that service valves (shut-off) also be installed on each side of circulator pumps to facilitate servicing or replacing the pump without draining the system. Special precautions should be taken to avoid sound and vibration transmission. If the pump is to be located near a noise sensitive area, consult a sound specialist.

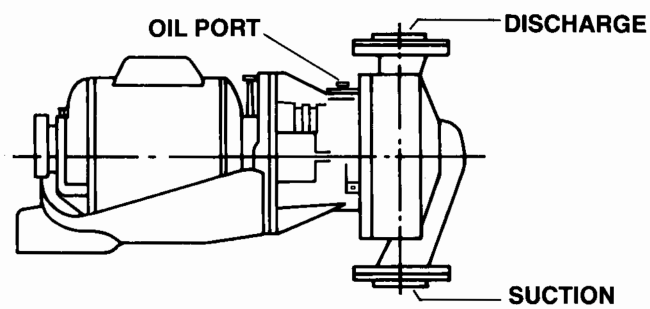
If it is required to lift the entire pump, do so with slings placed around the pump assembly as shown.

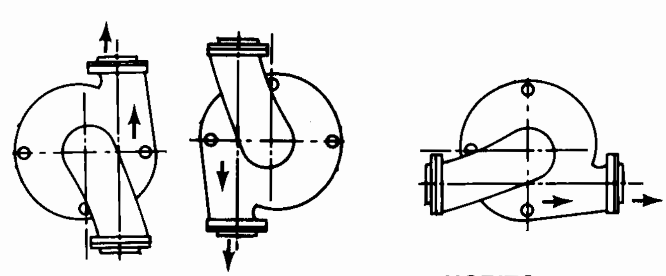


IMPORTANT: In closed systems, do not install and operate Bell & Gossett pumps, 3D valves, suction diffusers, etc., without properly sized safety and control devices. Such devices include the properly sized and located pressure relief valves, compression tanks and pressure, temperature, and flow controls. If the system is not equipped with these devices, consult the responsible engineer or architect before operating.

MODE OF DISCHARGE

B&G Series 60 In-Line pumps can be installed to discharge up, down, left or right. The oiling ports must always be in the twelve o'clock position (on top) with the motor and bearing assembly in a horizontal position. THE ARROW ON THE PUMP BODY MUST POINT IN THE DIRECTION OF THE FLOW.





OPERATIONAL INSTRUCTIONS

SYSTEM PREPARATION

Prior to pump start up, closed heating and cooling systems should be flushed and drained with clean water. The system should then be filled with clean water having a PH between 7 and 9.

LUBRICATION

All new B&G pumps are test run at the factory, but must be lubricated thoroughly before being placed in operation. Bell & Gossett supplies a high quality lubricant specifically for this purpose which can be purchased from any B&G Representative (Part No. L23401), Proper lubrication procedures are as follows:

1. PUMP BEARINGS –
   Fill the bearing frame according to the oiling instruction decal. At the time of installation or start of each heating season, add approximately 1 oz. of B&G #20 weight non-detergent oil. A SAE 20 (non-detergent) or 10W-30 oil may be substituted. More frequent lubrication may be required under adverse conditions such as high ambient temperatures.

2. MOTOR BEARINGS –
   Sleeve Bearings: Lubricate through the motor oil cups per the lubrication decal once every four months or more often under adverse conditions. Use eight to ten drops in each oil cup.

   Ball Bearings: Lubricate every six months to two years depending on conditions with soda soap or lithium base grease.

   For Non-Bell & Gossett Motors, lubrication should be in accordance with the motor manufacturer's instructions on the nameplate.

ROTATION

Pump rotation is clockwise when viewed from the back of the motor. An arrow is provided to show the rotational direction.

PRIMING AND STARTING

> ⚠ **CAUTION:** SEALED DAMAGE HAZARD.
> Do not run the pump dry – seal damage may occur. Failure to follow these instructions could result in moderate personal injury and/or property damage.

Before starting, the Series 60 pump must be filled with water. Manual priming may be necessary if the system does not fill the pump body automatically. Vent plugs are provided on the pump body to vent the air.

> ⚠ **WARNING:** HOT WATER LEAKAGE HAZARD.
> Pressurize the pump body slowly while checking for leaks at all joints with gaskets. Failure to follow these instructions could result in serious personal injury and/or property damage.

The pump should be started with the discharge valve closed and the suction valve fully open. After the pumps is at operating speed, the discharge valve should be opened gradually.

SERVICE INSTRUCTIONS

GENERAL INSTRUCTIONS

1. Keep the pump and motor properly lubricated.
2. If the pump is to be exposed to freezing temperature, drain the pump.

PERIODIC INSPECTION

Inspect the pump regularly for leaking seals, worn gaskets, and loose or damaged components. Replace or repair as required.

REPLACING THE SEAL

DISCONNECT THE ELECTRICAL SUPPLY

> ⚠ **WARNING:** ELECTRICAL SHOCK HAZARD.
> Disconnect and lockout the power before servicing. Failure to follow these instructions could result in serious personal injury or death.

The electrical supply must be turned off and the pump service valves must be closed before servicing procedures begin. If no service valves are installed, the city water supply valve should be closed.

> ⚠ **WARNING:** ELECTRICAL SHOCK HAZARD.
> Be certain the electrical power is not present at the motor leads before continuing. Failure to follow these insructions could result in serious personal injury or death.

> ⚠ **WARNING:** UNEXPECTED START-UP HAZARD.
> Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

Loosen the conduit box cover screws and remove the cover. Follow this procedure with the removal of the wire nuts and flexible conduit connector.

REMOVE THE MOTOR AND BEARING ASSEMBLY

> ⚠ **WARNING:** HOT WATER HAZARD.
> Before draining the system, allow water to cool to at least 100°F, open the drain valve (take precautions against water damage) and leave the drain valve open until servicing is complete. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

The system should be drained by opening the boiler drain valve and the vent near the top of the system. If a Flo-control valve is installed and there are balance valves on the returns, then the balance valves may be closed to isolate the boiler from the system. The Flo-Control valve will act as a check valve on the supply and only the boiler will need to be drained. Open a vent between the boiler and the system.

SYSTEM PIPING

Always install a section of straight pipe between the suction side of the pump and the first elbow. The length of this pipe should be equal to five times the diameter of the suction pipe size. This reduces turbulence of the suction by straightening the liquid flow path prior to pump entry.

Air must be kept out of the system. On an open system always place the end of the suction pipe at least three feet (3') below the surface of the water in the suction well to prevent air from being drawn into the pump. Avoid air pockets in the suction line and ensure that each section of the suction pipe is absolutely air tight.

If high temperature variation is anticipated, expansion fittings should be installed such that they reduce pump strain.

Install the suction and discharge flanges on the pipe ends using teflon tape sealer or high quality thread sealant. Minimize strain on the pump by supporting the suction and discharge piping with pipe hangers near the pump. Line up the vertical and horizontal piping so that the bolt-holes in both the pump and pipe flanges are aligned. DO NOT ATTEMPT TO SPRING THE SUCTION OR DISCHARGE LINES INTO POSITION. THIS MAY RESULT IN UNWANTED STRESS IN THE PUMP BODY, FLANGE CONNECTIONS AND/OR PIPING. The code for pressure piping, ANSIB31.1, lists types of supports available for various applications.

Ordinary wire or band hangers are not adequate to maintain alignment. It is very important to provide strong, rigid support for the suction and discharge lines.

New Bell & Gossett flange gaskets must be installed between the flanges of the pump body and suction and discharge pipes. The gaskets should be clean and grease-free; old gaskets should never be reused. Suitable fasteners for this connection are supplied in the B&G fastener pack. Apply a torque of 8-11 ft. lbs. to each of the flange bolts. Both the suction and discharge flanges must be torqued to the same level.

WARNING: HOT WATER LEAKAGE HAZARD. Make certain that the flange bolts have been adequately torqued. Failure to follow these instructions could result in serious personal injury and/or property damage.

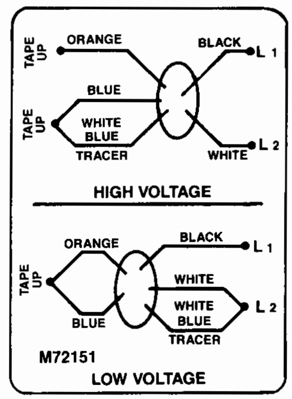
WIRING INSTRUCTIONS

WARNING: ELECTRICAL SHOCK HAZARD. Disconnect and lockout the power before making electrical connections. Failure to follow these instructions could result in serious personal injury or death.

Remove the screws securing the conduit box cover (wiring compartment) and lift off the cover. Attach the appropriate size connector to the hole in the side of the conduit box.

I. SINGLE PHASE MOTORS

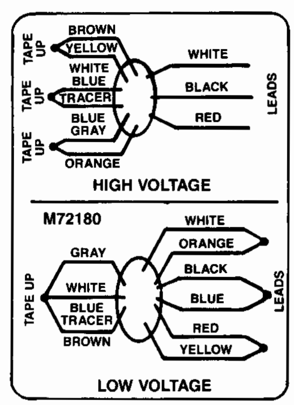
The single phase motor can operate at low voltage (115V) as well as at high voltage (230V). Determine the voltage at which you choose to operate your B&G pump and make wiring connections according to the following diagrams (these diagrams are also found in the conduit box cover):



NOTE: Bell & Gossett Single Phase Motors are protected with inherent overheating devices and do no require external overload protection.

II. THREE PHASE MOTORS

The Series 60 three phase motors can operate at either low voltage (208-230V) or at high voltage (460V). Determine the voltage you choose to operate your B&G pump. Wiring instructions for each option is listed below and is also found in the conduit box cover.



WARNING: Be certain that all connections are secure and the conduit box cover is closed before electrical power is connected. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

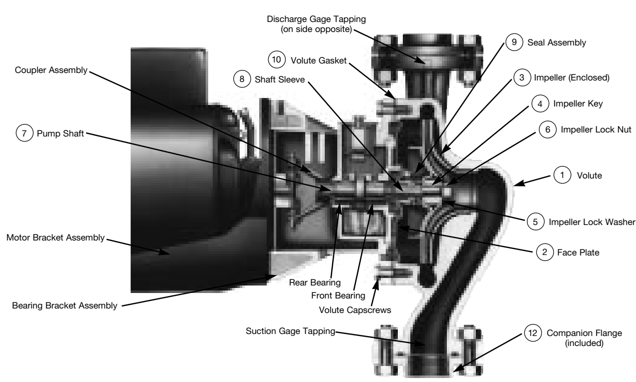
⚠ WARNING: HIGH PRESSURE HAZARD.
Pressure may be present in the pump body. This pressure can be relieved by loosening the eight volute capscrews and shifting the bearing assembly slightly to allow the pressurized water to escape. Failure to follow these instructions could result in serious personal injury or death.

Separate the bearing assembly and motor from the pump body by removing the eight volute capscrews from the cover-plate (see diagrams below).

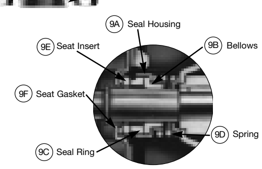
DETERMINE THE SEAL TYPE

Cut away diagrams have been provided to illustrate the components of the Series 60 bearing assemblies. The primary feature distinguishing the mechanical seals of the AA type pumps from the A and F types is the addition of a retainer cup seated atop the spring of all AA type pumps. Refer to these diagrams whenever seal replacement becomes necessary.

PUMP BODY DIAGRAM
1AA, 1¼"AA, 1½"AA and 2"AA

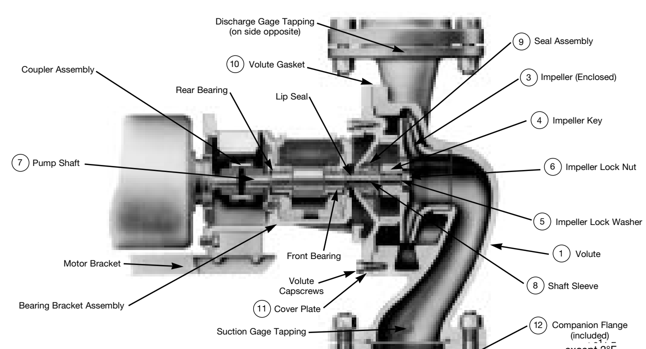


1AA, 1¼"AA, 1½"AA and 2"AA construstion details



Mechanical Seal

PUMP BODY DIAGRAM
1½"A, 2"A, and 2½"F



1½"A, 2"AA, and 2½"F construction details

REPLACEMENT PROCEDURE

With the bearing assembly and motor removed from the system, use the following instructions to facilitate the replacement.

1. Use a strap wrench or rag to prevent the impeller from turning with one hand and loosen the impeller nut with the other.
2. Lift the spring retainer (for AA type motors only) and the seal spring from the shaft. Remove the compression ring from the seal collar by inserting a small screwdriver underneath the ring a carefully applying an upward prying force. Remove the ring, collar and the remaining seal components from the shaft.

NOTE: Bell and Gossett seal assemblies consist of an insert retainer, rubber gasket, ceramic insert, carbon seal ring, rubber collar, brass collar and compression ring. Each of these components must be replaced when replacing the mechanical seal. NEVER REPLACE INDIVIDUAL COMPONENTS SEPARATELY.

3. Using a clean, lint free rag, remove any debris that may have accumulated in the seal recess.
4. Place the new retainer in the bearing assembly's seal recess. Seat the thin rubber gasket in the recess and set the ceramic insert atop the gasket. The ceramic has a top side and bottom side. The bottom is identifiable by its slightly recessed grooves. These grooves should face downward toward the rubber gasket.
5. Before proceeding, place the shaft end on a wooden block; the wooden block should push the shaft to its forward-most position (there should not be any end-play in the shaft).
6. Lubricate the rubber seal collar with soapy water. The entire rotating seal assembly, which includes the carbon seal ring, rubber collar, brass collar and compression ring, is to be pushed onto the shaft as one unit. Do not attempt to assemble the seal by placing the components on the shaft individually. The notches in the brass collar should be aligned with the recesses found on each side of the carbon insert.
7. Press the brass compression ring tightly against the upper end of the rubber collar. A screwdriver can be used at several points along its periphery to provide a tight and even fit. Press with the screwdriver – do not tap. Tapping on the seal may break the ceramic or carbon insert.
8. With shaft resting on the wooden block, place the seal spring on the shaft (and cup retainer for AA size pumps). Next, place the impeller and lockwasher. Thread the impeller nut to the shaft and tighten with 96-144 in-lbs of torque. Consult the TORQUE CHART on next page. Do not overtighten.

⚠ WARNING: HOT WATER HAZARD.
Whenever the bearing assembly is removed from the piping, use a new gasket when re-installing. Failure to follow these instructions could result in serious personal injury and/or property damage.

9. Clean the pump body of excess debris. Place a new gasket in the recess of the pump body; ensure that it sits flush against the gasket surface.

SEAL REPLACEMENT (continued)

10. Replace the motor and bearing assembly by inserting the impeller in the pump body and evenly tighten the eight capscrews. Refer to the TORQUE CHART below.
11. Refer to the WIRING INSTRUCTIONS section in this manual to properly configure all electrical connections.
12. Follow the OPERATIONAL INSTRUCTIONS in this manual to:

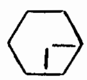
    a. check the PH of the system water,
    b. to check the rotation of the pump and,
    c. to prime the system prior to starting.

ADDITIONAL PUMP REPAIR

Refer to the following manual for further repair instructions for the Bell & Gossett Series 60 pump:

Coupler & Motor Mount Replacement. . . .#P06452

TORQUE CHART

Capscrew Type	Head Marking	CAPSCREW TORQUE (FOOT-POUND) Capscrew Diameter 1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
SAE Grade 2		6	13	25	38	60	120	190	210	300
Brass Stainless Steel	 or 	4	10	17	27	42	83	130	200	300
SAE Grade 5		10	20	35	60	90	180	325	525	800

DEALER SERVICING

If your pump requires further repair, contact your local B&G Representative. Having the following information at hand will facilitate your representative's ability to assist you:

1. Complete data from nameplate.
2. Suction and discharge pipe pressure gauge readings.
3. Ampere draw of motor.
4. A sketch of the pumping system (include pipes, valves, etc.)

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For further information, contact ITT Bell & Gossett, 8200 N. Austin Avenue, Morton Grove, IL 60053, Phone (847) 966-3700 – Facsimile (847) 966-9052.

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ITT Bell & Gossett
Morton Grove, IL, U.S.A.

BELL & GOSSETT

INSTRUCTION MANUAL

P81629

REVISION C

Series 80®
In-Line Mounted Centrifugal Pump
Installation, Operation & Service Instructions

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

DESCRIPTION

The Series 80 centrifugal pump is a close coupled pump which features — high efficiency, rugged construction, and in-line mounting. These features make installation, operation and service easy to perform.

PUMP APPLICATION

The standard Series 80 centrifugal pump's bronze fitted construction make it ideal for service with the following liquids: unheated domestic and fresh water, boiler feed water, condensate, hydronic cooling or heating, pressure boosting, general pumping and benign liquids.

For other applications contact your local B&G Representative.

OPERATIONAL LIMITS

Unless special provisions have been made for your pump by ITT Bell & Gossett, the operational limits for Series 80 Pumps are as follows:

MAXIMUM WORKING PRESSURE

Listed on pump nameplate.

SEAL OPERATING LIMITS

STANDARD SEALS

BUNA–PH Limitation 7-9; Temperature Range −40 to +225°F

EPT–PH Limitations 7-11; Temperature Range −40 to +250°F

For use on closed or open systems which are relatively free of dirt and/or other abrasive particles.

FLUSHED SINGLE SEALS

PH Limitations 7-9; Temperature Range 0 to +250°F*

For use on closed or open low pressure systems which may contain a high concentration of abrasives. An external flush is required.

FLUSHED DOUBLE SEALS

PH Limitations 7-9; Temperature Range 0 to +250°F*

For use on closed or open low pressure systems which may contain a high concentration of abrasives. An external flush is required.

PACKING

PH Limitations 7-9; Temperature Range 0 to +200°F

For use on open or closed systems which require a large amount of makeup water, as well as systems which are subjected to widely varying chemical conditions and solids buildup.

**For operating temperatures above 250°F a cooled flush is required and is recommended for temperatures above 225°F for optimum seal life. On closed systems cooling is accomplished by inserting a small heat exchanger in the flush line to cool the seal flushing fluid.*

Flush-line Filters and Sediment Separators are available on special request.

ITT Bell & Gossett
Morton Grove, IL, U.S.A.

⚠ SAFETY INSTRUCTION

This safety alert symbol will be used in this manual and on the pump safety instruction decals to draw attention to safety related instructions. When used the safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.

Your Series 80 Pump should have the following safety instruction decals located approximately as shown. If the decals are missing or are illegible contact your local B&G representative for a replacement.

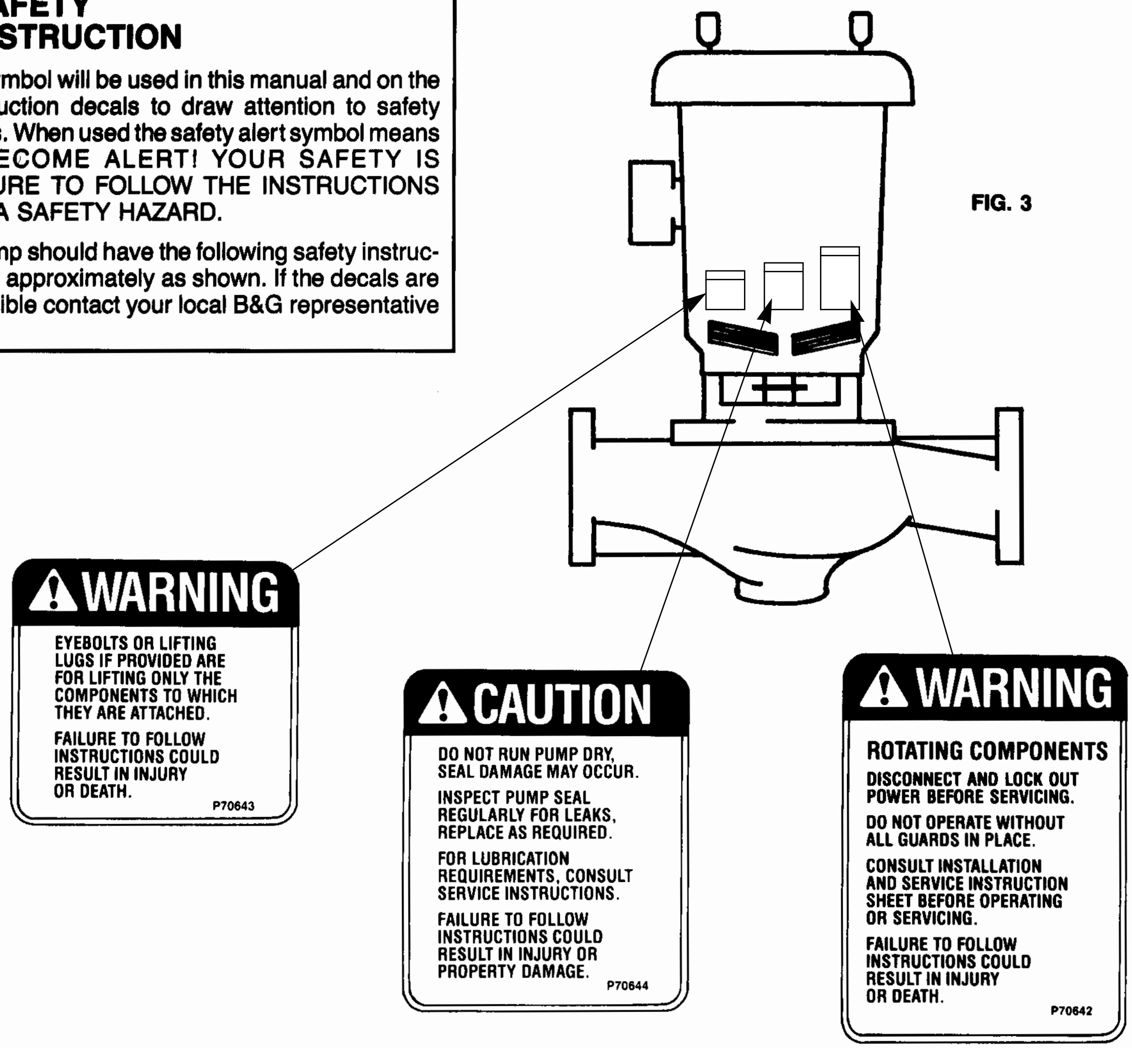


FIG. 3

ADDITIONAL SAFETY REQUIREMENTS:

ELECTRICAL SAFETY:

⚠ **WARNING: Electrical Shock Hazard**
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, and property damage.

⚠ **WARNING: Electrical Overload Hazard**
Three phase motors must have properly sized heaters to provide overload and under voltage protection. Single phase motors have built-in overload protectors. Failure to follow these instruction could result in serious personal injury or death, and property damage.

THERMAL SAFETY:

⚠ **WARNING: Extreme Temperature Hazard**
If pump, motor, or piping are operating at extremely high or low temperature, guarding or insulation is required. Failure to follow these instructions could result in serious personal injury or death, and property damage.

MECHANICAL SAFETY:

⚠ **WARNING: Unexpected Startup Hazard**
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, and property damage.

⚠ **WARNING: Excessive System Pressure Hazard**
The maximum working pressure of the pump is listed on the nameplate, do not exceed this pressure. Failure to follow these instructions could result in serious personal injury or death, and property damage.

⚠ **WARNING: Excessive Pressure Hazard Volumetric Expansion**
The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release of high temperature fluids. This will be prevented by installing properly sized and located compression tanks and pressure relief valves. Failure to follow these instructions could result in serious personal injury or death, and property damage.

PUMP LOCATION

Locate the pump so there is sufficient room for inspection, maintenance and service. If the use of a hoist or tackle is needed, allow ample head room.

> **WARNING: Falling Object Hazard**
> Eyebolts or lifting lugs if provided are for lifting only the components to which they are attached. Failure to follow these instructions could result in serious personal injury or death, and property damage.

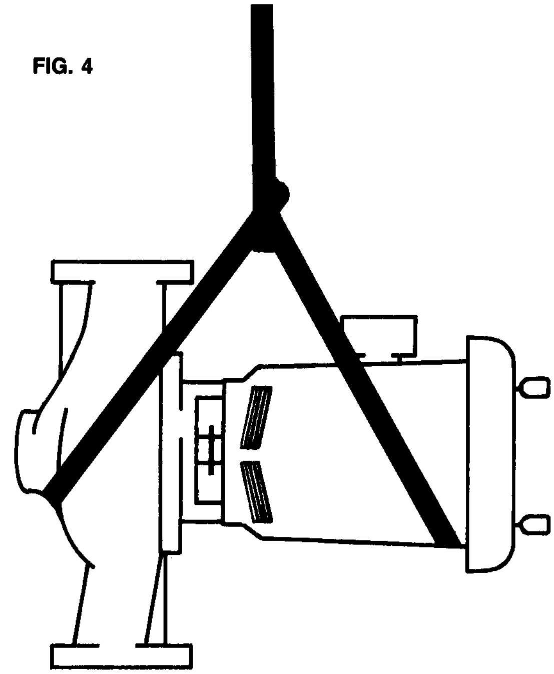
If lifting of the entire pump is required, do so with slings placed around the pump assembly as shown.

Special precautions to avoid sound and vibration transmission should be taken if the pump is to be located near a noise sensitive area, a sound specialist should be consulted.

If the pump is not on a closed system, it should be placed as near as possible to the source of the liquid supply, and located to permit installation with the fewest number of bends or elbows in the suction pipe.

The installation must be evaluated to determine that the Net Positive Suction Head Available (NPSHA) meets or exceeds the Net Positive Suction Head Required (NPSHR), as stated by the pump performance curve.

FIG. 4



IMPORTANT: Do not install and operate ITT Bell & Gossett Pumps, 3D Valves, Suction Diffusers, etc., in closed systems unless the system is constructed with properly sized safety devices and control devices. Such devices include the use of properly sized and located pressure relief valves, compression tanks, pressure controls, temperature controls, and flow controls as appropriate. If the system does not include these devices, consult the responsible engineer or architect before making pumps operational.

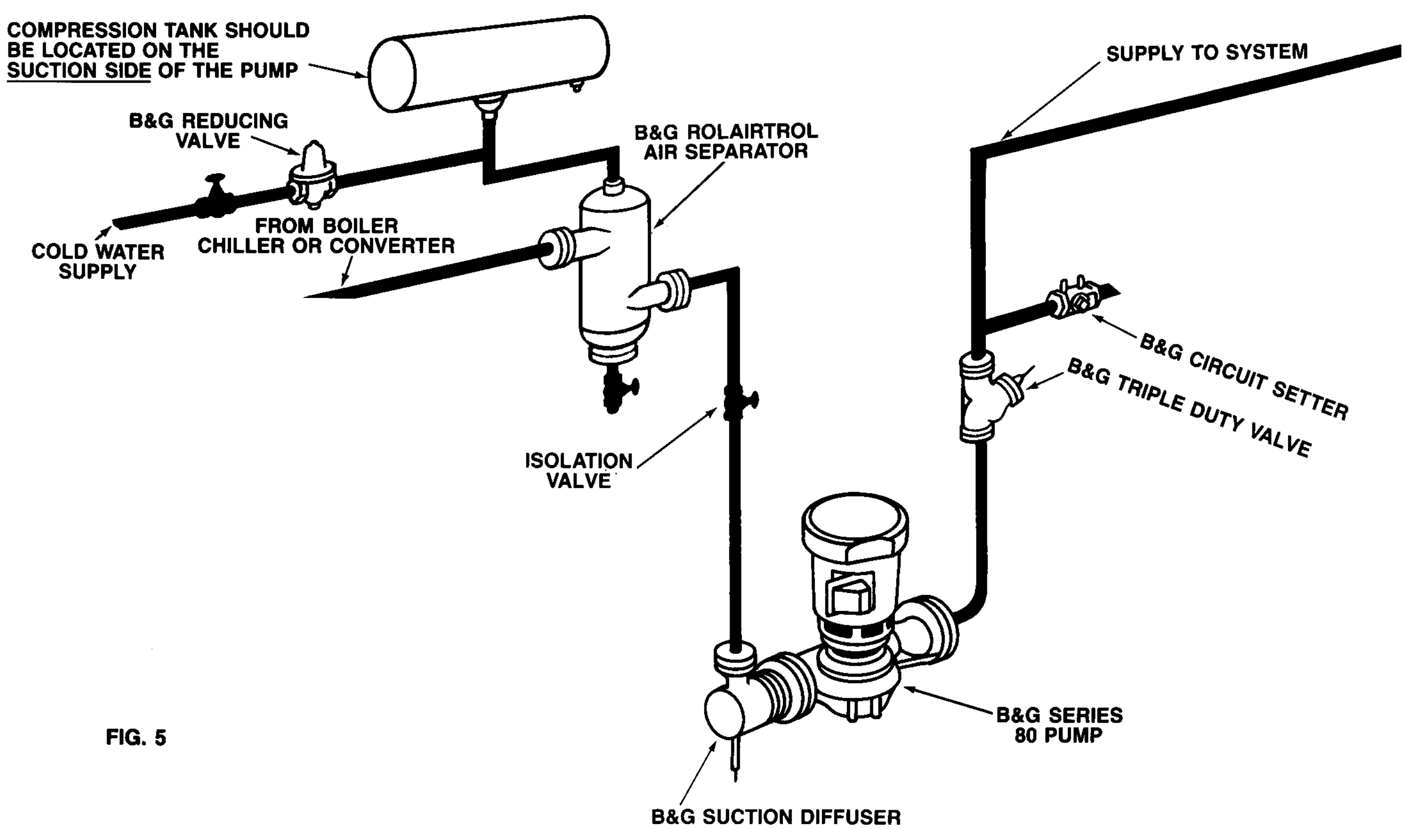


FIG. 5

PIPING

Always install a section of straight pipe between the suction side of the pump and first elbow or install a B&G Suction Diffuser. This reduces turbulence of the suction by straightening out the flow of liquid before it enters the pump. The length should be equal to five times the diameter of the pipe.

Be sure to eliminate any pipe-strain on the pump. Support the suction and discharge pipes independently by use of pipe hangers or ground supports close to the pump. A support can be bolted to the underside of the pump body but it must be so constructed as to allow freedom of movement with the normal expansion of the piping.

If the pump is to be mounted in vertical piping with the motor in the horizontal position provide adequate support to prevent strain on pump parts and piping. It is not recommended that pump be mounted with the motor vertically downward. Do not use motor lift rings as a means of suspending the pump.

Line up the piping so that the bolt-holes in the pump flanges match the bolt-holes in the pipe flanges. DO NOT ATTEMPT TO SPRING THE SUCTION OR DISCHARGE LINES INTO POSITION. Bearing wear will result if suction or discharge lines are forced into position. The code for Pressure Piping (A.S.A.B. 31.1) lists many types of supports available for various applications.

As a rule, ordinary wire or band hangers are not adequate to maintain alignment. It is very important to provide a strong, rigid support for the suction and discharge lines.

Where considerable temperature changes are anticipated, fittings for absorbing expansion should be installed in the system in such a way as to avoid strain on the pump.

On an open system with a suction-lift, use a foot-valve of equal or greater area than the pump suction piping. Prevent clogging by using a strainer at the suction inlet next to the foot-valve. The strainer should have an area three times that of the suction pipe with a mesh hole diameter of no less than ¼".

A Bell & Gossett Triple Duty Valve installed in the discharge line will serve as a check valve to protect the pump from water hammer, as an isolation valve for servicing and for throttling.

NOTES:

1. The pipeline should have isolation valves around the pump and have a drain valve in the suction pipe.

ROTATION

Pump rotation is clockwise when viewed from back of the motor. An arrow is provided to show direction of rotation.

LUBRICATION

Your Series 80 pump has been lubricated at the factory, future lubrication should be in accordance with the motor manufacturers instructions.

GENERAL INSTRUCTIONS

1. Keep the motor properly lubricated.
2. When there is a danger of freezing, drain the pump.
3. Inspect pump regularly for leaky seals or gaskets and loose or damaged components. Replace or repair as required.

PRIMING AND STARTING

> **CAUTION: Seal Damage Hazard**
> Do not run pump dry, seal damage may occur. Failure to follow these instructions could result in property damage and/or moderate personal injury.

Before starting the pump, the pump body must be full of liquid. Manual priming may be required if the system does not automatically fill the pump body with liquid. Vent plugs are provided on the pump body to vent the air. While venting the air from the pump body, the pump shaft should be rotated a few time by hand.

The pump should be started with the discharge valve closed and the suction valve fully open. After the pump is up to operating speed the discharge valve should be opened slowly.

IMPORTANT: The pump should never be operated with the suction valve closed or throttled. This could result in cavitation.

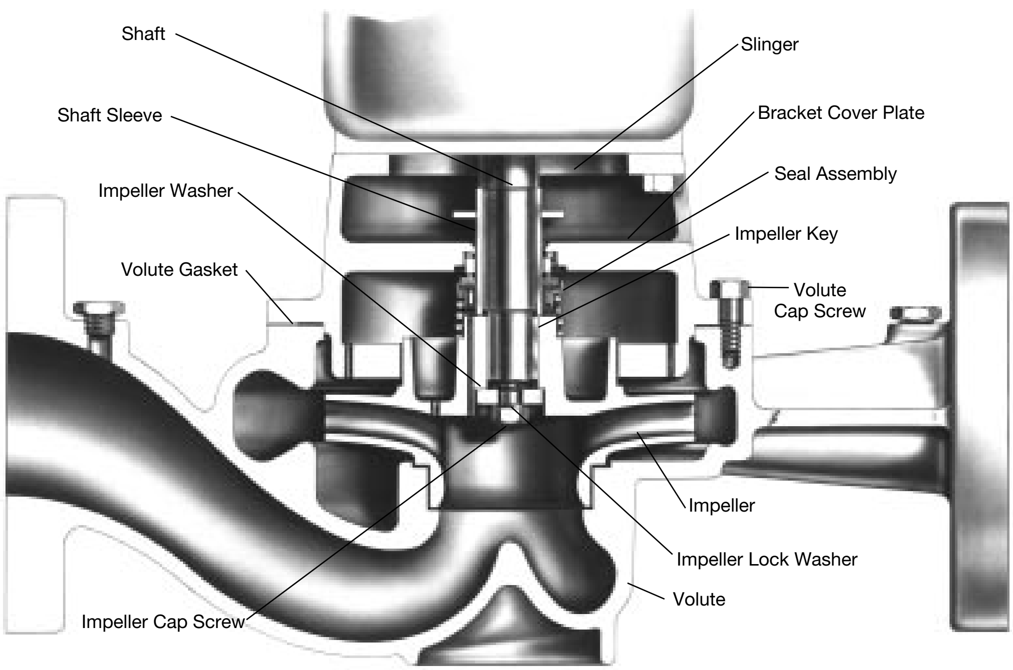


FIG. 7
SERIES 80 WITH MECHANICAL SEAL

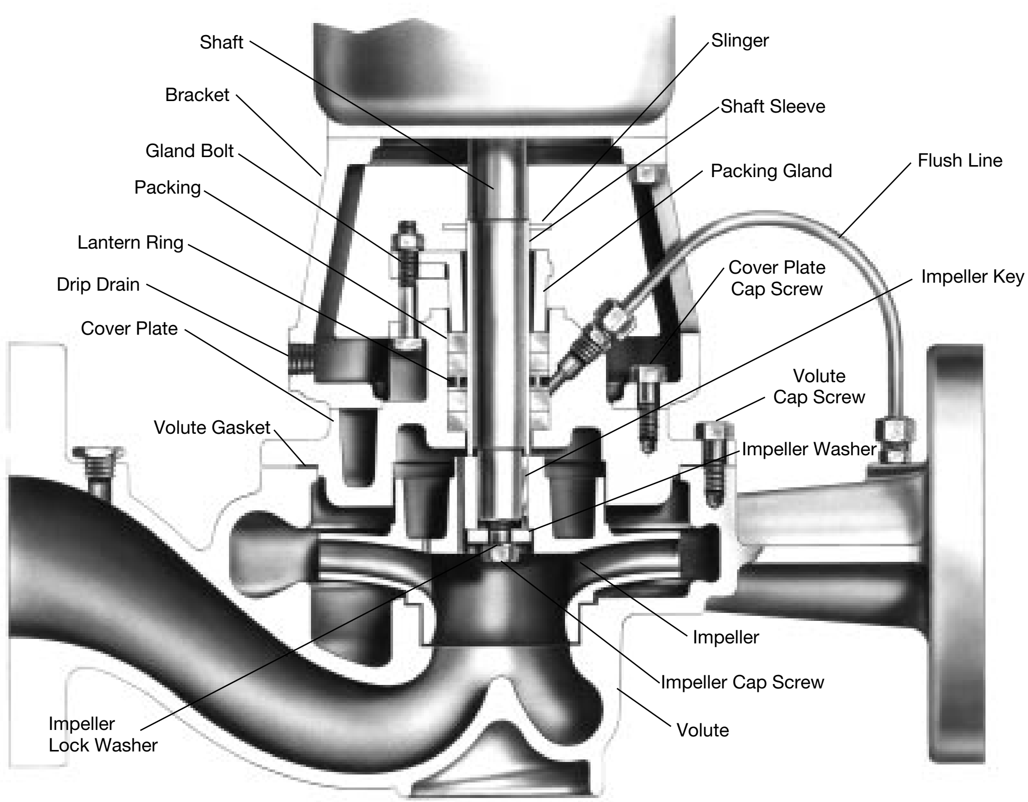


FIG. 8
STUFFING BOX CONSTRUCTION

FIG. 9
SERIES 80-S

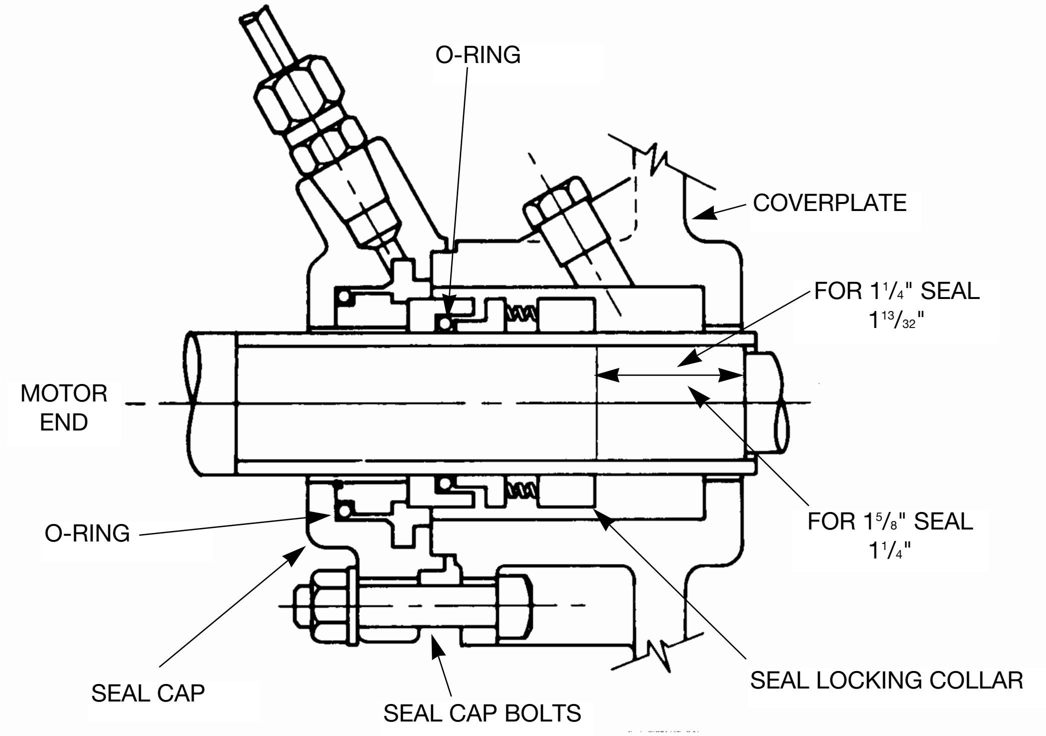
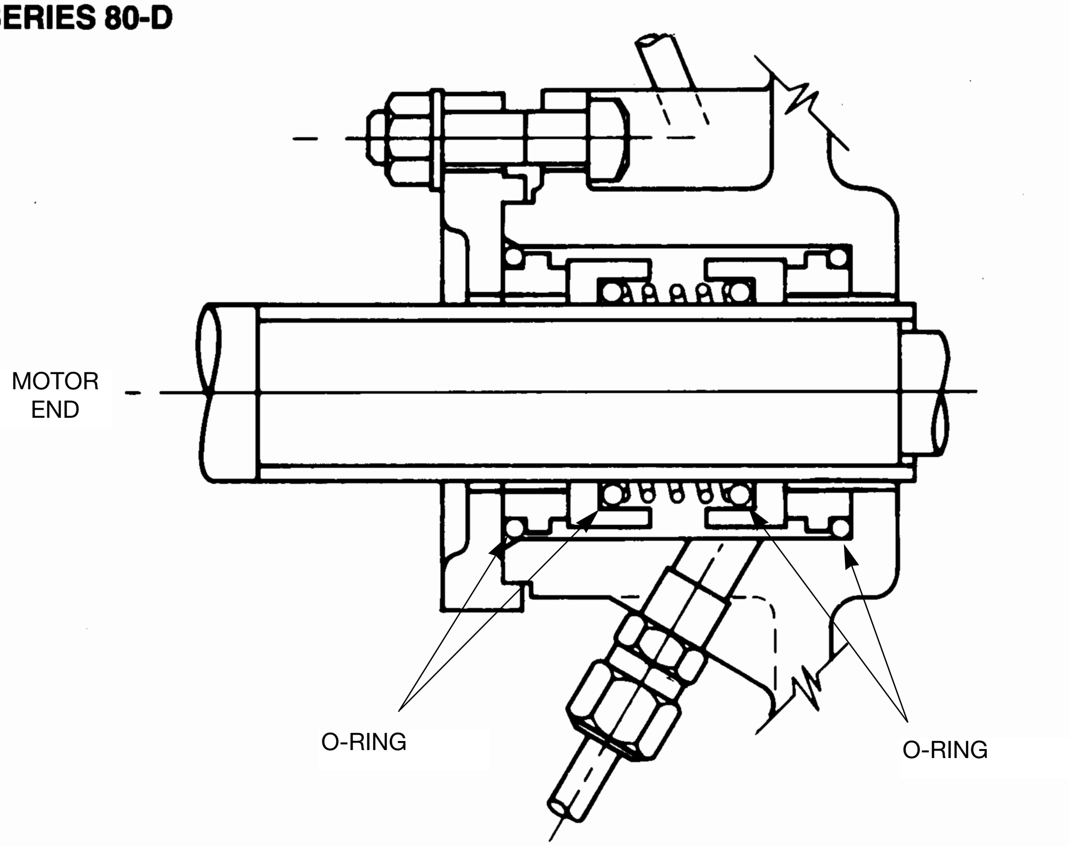


FIG. 10
SERIES 80-D



SERVICE INSTRUCTIONS

> **WARNING: Unexpected Startup Hazard**
> Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death, and property damage.

1. Close valves on suction and discharge sides of pump. (If no valves have been installed, it will be necessary to drain the system).

> **CAUTION: Extreme Temperature Hazard**
> Allow pump temperature to reach acceptable level before proceeding. Open drain valve, do not proceed until liquid stops coming out of drain valve. If liquid does not stop flowing from drain valve isolation valves are not sealing and should be repaired before proceeding. After liquid stops flowing from drain valve, leave drain valve open and continue. Remove the drain plug located on the bottom of the pump volute. Do not reinstall plug or close drain valve until reassembly is completed. Failure to follow instructions could result in moderate personal injury or property damage.

2. Loosen volute capscrews, do not remove them. Using capscrews in the jack screw holes start to remove the pump assembly from the volute.

> **WARNING: Excessive System Hazard**
> Make certain the internal pressure is relieved before continuing. Failure to follow these instructions could result in serious personal injury or death and property damage.

3. Remove seal flushing tube, if used.

   Remove the volute capscrews and remove the pump assembly from the volute.

4. Remove the impeller capscrew, lock washer and washer. Remove the impeller.

80 and 80-F
With Standard Mechanical Seal – Figure 7

5. Remove the rotating portion of the seal, use a screwdriver to loosen the compression ring.
6. Remove the seal insert along with the insert gasket and retainer (if used).
7. Thoroughly clean the shaft sleeve and the coverplate seal cavity. Inspect for surface damage like pitting, corrosion, nicks or scratches. Replace if necessary.
8. Lubricate the shaft sleeve and coverplate seal cavity with soapy water (Do not use petroleum lubricant) install a new cup gasket and a new seal insert with indentation side down into the cup.
9. Slide a new rotating seal assembly onto the shaft sleeve. With a screwdriver push on the top of the compression ring until the seal is tight against the seal insert. Install seal spring.
10. Install impeller, impeller washer, lock washer and capscrew, then tighten capscrew (per torque chart).
11. Install new volute gasket then install pump assembly into volute. Tighten volute capscrews (per torque chart). Install seal flushing tube, if used. Install drain plug, close drain valve.
12. Open isolation valves, inspect pump for leaks. If not leaking return pump to service.

80-S Stuffing Box
With Special Single Mechanical Seal – Figure 8 and 9

5. Remove hex nuts from seal cap bolts and remove coverplate capscrews. Remove coverplate from bracket.
6. Remove seal assembly. Thoroughly clean and inspect seal sleeve and seal cap, replace if required.
7. Lubricate shaft sleeve and seal cap with soapy water (Do not use petroleum lubricant). Insert stationary seal with O-ring into the seal cap and slide onto the shaft. Replace the seal cap gasket. Slide rotating portion of the seal assembly on to shaft sleeve and lock in place. For 1¼″ seals, the collar should be 1 13/32″ from the impeller end of the shaft sleeve. For 1⅝″ seals, the distance should be 1¼″ (see Figure 9).
8. Assemble coverplate to bracket, tighten capscrews (per torque chart). Assemble seal cap to coverplate, tighten hex nuts on seal cap bolts (per torque chart).

   Go to Step 10 of 80 Instructions.

80-D Stuffing Box
With Special Double Mechanical Seal – Figure 8 and 10

5. Remove hex nuts from seal cap bolts and remove coverplate capscrews. Remove coverplate from bracket.
6. Remove seal assembly. Thoroughly clean and inspect shaft sleeve, seal cap, and coverplate seal cavity, replace if required.
7. Lubricate shaft sleeve, seal cap, and coverplate cavity with soapy water (Do not use petroleum lubricant). Insert one stationary seal and O-ring into seal cap and the other into the coverplate.* Slide the seal cap onto the shaft. Replace seal cap gasket.* Slide rotating portion of seal assembly on to shaft sleeve.
8. Assemble coverplate to bracket, tighten capscrews (per torque chart). Assemble seal cap to coverplate, tighten hex nuts on seal cap bolts (per torque chart).

   Go to Step 10 of 80 instructions.

**For 1¼″ seal both parts will be housed in the coverplate as shown in Fig. 10. Seal cap gasket is not used.*

80-PF Stuffing Box
With Packing – Figure 8

5. Remove hex nuts from packing gland and remove coverplate capscrews. Remove coverplate from bracket.
6. Remove packing rings from the stuffing box.
7. Check condition of shaft sleeve and replace if scored or otherwise damaged.
8. Insert two packing rings in the stuffing box followed by the lantern ring and then the remaining two pieces of packing. Make certain that the packing joints are staggered 90 degrees.
9. Install, but do not tighten the packing gland.
10. Install coverplate over the pump shaft, tighten capscrews (per torque chart).
11. Tighten packing gland to compress packing.
12. Install impeller, impeller washer, lock washer and capscrew, then tighten (per torque chart).
13. Install new volute gasket then install pump assembly into volute. Tighten volute capscrews (per torque chart). Install seal flushing tube. Install drain plug, close drain valve.
14. Open isolation valves, inspect pump for leaks, if not leaking return pump to service. (See note for packing adjustment.)

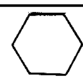
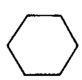
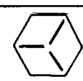
NOTE:

Before starting pump, back off packing gland nuts or screws until glands are loose. Re-tighten with fingers until glands are just snug against the first packing ring. After pump is running at first start, water may run freely from packing. This is normal and should be allowed to continue for a period of time before further tightening of the glands. Take up gland bolts uniformly, one flat at a time.

An adequate leakage rate is not one single valve for all pumps and installations, but is the amount required to provide adequate cooling and lubrication. The required leakage will be largely influenced by operating pressure, fluid temperature, shaft speed, etc.

For fluid temperatures in the range of 32° to 190°F, average leakage rates of 60 to 80 drops per minute are recommended. However, each individual pump and installation will have unique operating conditions that will result in broadly variable leakage rate requirements.

At fluid operating temperatures near the upper limit of 190°F, the maximum temperature rise of the leakage is particularly important. A packed pump should never operate with steam forming at the gland. This necessarily limits the temperature rise to a maximum of about 20°F. If the formation of steam persists at higher leakage rates, cooling water must be provided by means of an external supply, or a heat exchanger used to cool the by-pass flush.

		CAPSCREW TORQUE (FOOT-POUND)								
Capscrew Type	Head Marking	Capscrew Diameter								
		¼	5/16	⅜	7/16	½	⅝	¾	⅞	1
SAE Grade 2		6	13	25	38	60	120	190	210	300
Brass Stainless Steel	 or 	4	10	17	27	42	83	130	200	300
SAE Grade 5		10	20	35	60	90	180	325	525	800

DEALER SERVICING

If trouble occurs that cannot be rectified contact your local B&G representative. He will need the following information in order to give you assistance.

1. Complete nameplate data of pump and motor.
2. Suction and discharge pipe pressure gauge readings.
3. Ampere draw of the motor.
4. A sketch of the pump hook-up and piping.

For further information, contact ITT Bell & Gossett, 8200 N. Austin Avenue, Morton Grove, IL 60053,
Phone (847) 966-3700 – Facsimile (847) 966-9052.

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ITT Bell & Gossett
Morton Grove, IL, U.S.A.

BELL & GOSSETT

INSTRUCTION MANUAL

P81547
REVISION A

Series 90 In Line Centrifugal Pump

INSTRUCTIONS FOR:

- INSTALLATION
- OPERATION
- SAFETY
- SERVICE

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

DESCRIPTION

The Series 90 In-Line Mounted Centrifugal Pump is a close coupled, space saving, low maintenance pump capable of performing a wide range of fluid applications. The Back Pull-Out feature allows the pump to be serviced without disturbing system piping. The Series 90 pumps are available for pipe sizes from 1" to 2".

PUMP APPLICATION

Series 90 Pumps may be used for hydronic heating & cooling, domestic hot water, cooling towers, machinery cooling, pressure boosting, industrial fluid transfer, refrigeration & heat exchanger circulation. Bell & Gossett recommends that bronze constructed pumps be used for pumping potable water. For other applications contact your local B&G Representative.

OPERATIONAL LIMITS

B&G Series 90 Pumps are designed to pump liquids compatible with their iron or bronze body construction. Unless special provisions have been made by ITT Bell & Gossett, the operational limits for Series 90 Pumps are listed below.

Do not exceed these values.

Maximum Working Pressure: 175 psi

Mechanical Seal: Buna – PH limitations 7-9;
Temperature Range –40 to +225°F
EPT – PH Limitations 7-9
Temperature Range –40 to +250°F

ITT Bell & Gossett
Morton Grove, IL, U.S.A.

SAFETY INSTRUCTIONS

This safety alert symbol will be used in this manual and on the pump instructions decal to draw attention to safety related instructions. When used, the safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.

Your Series 90 Pump should have the following warning labels affixed to the pump in the approximate positions shown. If these warnings are missing or illegible, contact your Bell & Gossett Representative for a replacement.

SAFETY REQUIREMENTS

ELECTRICAL SAFETY

WARNING: ELECTRICAL SHOCK HAZARD. Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances and good practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: ELECTRICAL OVERLOAD HAZARD. Three phase motors must have properly sized heaters to provide overload and under voltage protection. Single phase motors have built-in overload protectors. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

THERMAL SAFETY

WARNING: EXTREME TEMPERATURE HAZARD. If the pump, motor, or piping are operating at extremely high or low temperature, guarding or insulation is required. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: HOT WATER HAZARD. When disassembling a gasketed joint, always use a new gasket upon reassembly. NEVER RE-USE OLD GASKETS. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

MECHANICAL SAFETY

WARNING: UNEXPECTED START-UP HAZARD. Disconnect and lockout power before servicng. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: EXCESSIVE SYSTEM PRESSURE HAZARD. The maximum working pressure of the pump is listed on the nameplate – DO NOT EXCEED THIS PRESSURE. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

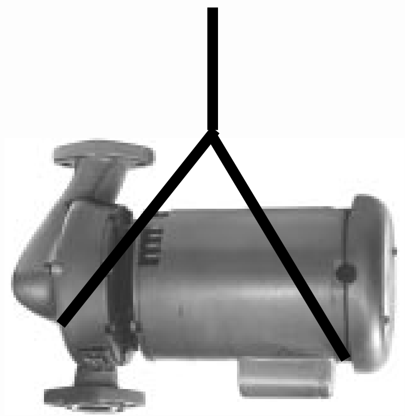
WARNING: EXCESSIVE PRESSURE HAZARD – VOLUMETRIC EXPANSION. The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release high temperature fluids. This can be prevented by installing properly sized and located compression tanks and pressure relief valves. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

PUMP INSTALLATION

PUMP SUPPORT AND LOCATION

The Bell & Gossett Series 90 pump should be installed where there will be sufficient room for future inspection, maintenance and service. It is highly recommended that service valves (shut-off) also be installed on each side of the pump to facilitate servicing or replacing without draining the system. Special precautions should be taken to avoid sound and vibration transmission. If the pump is to be located near a noise sensitive area, consult a sound specialist.

If it is required to lift the entire pump, do so with slings placed around the pump assembly as shown.



Install the suction and discharge flanges on the pipe ends using teflon tape sealer or high quality thread sealant. Minimize strain on the pump by supporting the suction and discharge piping with pipe hangers near the pump. Line up the vertical and horizontal piping so that the bolt-holes in both the pump and pipe flanges are aligned. DO NOT ATTEMPT TO SPRING THE SUCTION OR DISCHARGE LINES INTO POSITION. THIS MAY RESULT IN UNWANTED STRESS IN THE PUMP BODY, FLANGE CONNECTIONS AND/OR PIPING. The code for pressure piping, ANSI B31.1, lists types of supports available for various applications.

Ordinary wire or band hangers are not adequate to maintain alignment. It is very important to provide strong, rigid support for the suction and discharge lines.

New Bell & Gossett flange gaskets must be installed between the flanges of the pump body and suction and discharge pipes. The gaskets should be clean and grease-free; old gaskets should never be reused. Suitable fasteners for this connection are supplied in the B&G fastener pack. Apply a torque of 8-11 ft. lbs. to each of the flange bolts. Both the suction and discharge flanges must be torqued to the same level.

> ⚠ **WARNING:** HOT WATER LEAKAGE HAZARD.
> Make certain that the flange bolts have been adequately torqued. Failure to follow these instructions could result in serious personal injury and/or property damage.

IMPORTANT: In closed systems, do not install and operate Bell & Gossett pumps, 3D valves, suction diffusers, etc., without properly sized safety and control devices. Such devices include properly sized and located pressure relief valves, compression tanks and pressure, temperature, and flow controls. If the system is not equipped with these devices, consult the responsible engineer or architect before operating.

MODE OF DISCHARGE

B&G Series 90 In-Line pumps may be installed to discharge vertically or horizontally. THE ARROW ON THE PUMP BODY MUST POINT IN THE DIRECTION OF THE FLOW.

The pump may be installed with the motor vertical or horizontal. Do not install with the motor below the pump body.

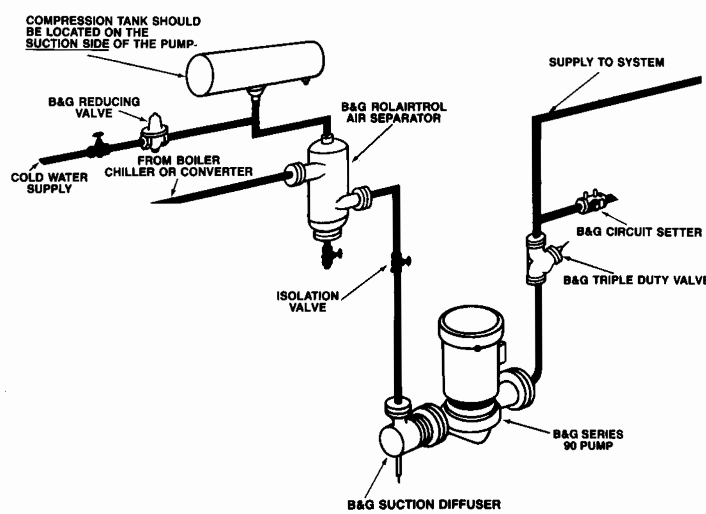
SYSTEM PIPING

Always install a section of straight pipe between the suction side of the pump and the first elbow. The length of this pipe should be equal to five times the diameter of the suction pipe size. This reduces turbulence of the suction by straightening the liquid flow path prior to pump entry.

Air must be kept out of the system. On an open system always place the end of the suction pipe at least three feet (3') below the surface of the water in the suction well to prevent air from being drawn into the pump. Avoid air pockets in the suction line and ensure that each section of the suction pipe is absolutely air tight.

If high temperature variation is anticipated, expansion fittings should be installed such that they reduce pump strain.

PIPING SCHEMATIC



WIRING INSTRUCTIONS

WARNING: ELECTRICAL SHOCK HAZARD.
Disconnect and lockout the power before making electrical connections. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

Remove the screws securing the conduit box cover (wiring compartment) and lift off the cover. Attach the appropriate size connector to the hole in the side of the conduit box.

WARNING: ELECTRICAL OVERLOAD HAZARD
Three phase motors must have properly sized heaters to provide overload and under voltage protection. Single phase motors have built-in overload protectors. Failure to follow these instructions could result in serious personal injury or death.

WARNING: ELECTRICAL SHOCK HAZARD.
Be certain that all connections are secure and the conduit box cover is closed before electrical power is connected. Failure to follow these instructions could result in serious personal injury or death.

OPERATIONAL INSTRUCTIONS

SYSTEM PREPARATION

Prior to pump start up, closed heating and cooling systems should be flushed and drained with clean water. The system should then be filled with clean water having a PH between 7 and 9.

LUBRICATION

Series 90 Pumps with 5 HP and smaller motors are permanently lubricated. Pumps with 7½, 10 and 15 HP motors are furnished with grease fittings and should be lubricated in accordance with the manufacturer's nameplate instructions. For future lubrication, Bell & Gossett supplies a high quality lubricant specifically for this purpose which can be purchased from any B&G representative (Part No. L23401).

ROTATION

Pump rotation is clockwise when viewed from the back of the motor. An arrrow is provided to show the rotational direction.

PRIMING AND STARTING

CAUTION: SEAL DAMAGE HAZARD.
Do not run the pump dry – seal damage may occur. Failure to follow these instructions could result in moderate personal injury and/or property damage.

Before starting, the Series 90 pump must first be filled with water. Manual priming may be necessary if the system does not fill the pump body automatically. Vent plugs are provided on the pump body to vent the air.

WARNING: HOT WATER LEAKAGE HAZARD.
Pressurize the pump body slowly while checking for leaks at all joints with gaskets. Failure to follow these instructions could result in serious personal injury and/or property damage.

The pump should be started with the discharge valve closed and the suction valve fully open. After the pump is at operating speed, the discharge valve should be opened gradually

SERVICE INSTRUCTIONS

GENERAL INSTRUCTIONS

1. Keep motor properly lubricated if required.
2. If the pump is to be exposed to freezing temperatures, drain the pump.

PERIODIC INSPECTION

Inspect the pump regularly for leaking seals, worn gaskets, and loose or damaged components. Replace or repair as required.

REPLACING THE SEAL

WARNING: ELECTRICAL SHOCK HAZARD.
Disconnect and lockout the power before servicing. Failure to follow these instructions could result in serious personal injury or death.

The electrical supply must be disconnected and locked out of service. Loosen the conduit box cover screws and remove the cover. Disconnect conduit and wiring.

WARNING: UNEXPECTED START-UP HAZARD.
Disconnect and lockout power before servicng. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

Close the valves on the suction and discharge sides of the pump (if no valves have been installed, it will be necessary to drain the system).

CAUTION: EXTREME TEMPERATURE HAZARD.
Allow the pump temperature to reach an acceptable level before proceeding. Open the drain valve and do not proceed until the liquid has completely drained. If the liquid does not stop flowing from the drain valve, then the isolation valves are not sealing and should be repaired before continuing. After the liquid has stopped flowing, leave the drain valve open and continue. Remove the drain plug located on the bottom of the pump volute. Do not reinstall this plug or close the drain valve until the reassembly is complete. Failure to follow these instructions could result in moderate personal injury and/or property damage.

Loosen the volute capscrews but do not remove them. Shift the pump position slightly to allow the pressurized water to escape.

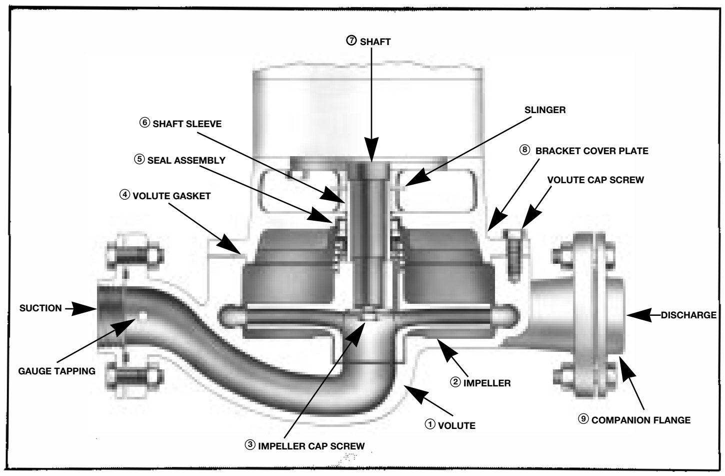
> **WARNING:** EXCESSIVE PRESSURE HAZARD.
> Make certain that the internal pressure is relieved before continuing. Failure to follow these instructions could result in serious personal injury and/or property damage.

Remove the volute capscrews and remove the pump assembly from the volute.

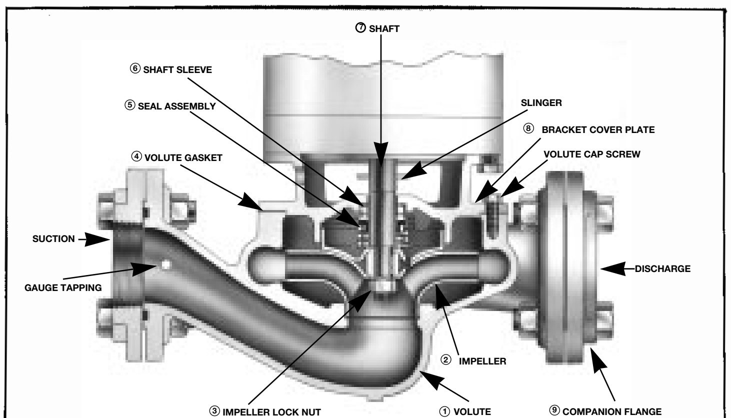
DETERMINE THE SEAL SIZE

Cut away diagrams have been provided to illustrate the components of the Series 90 pump assemblies. The primary feature distinguishing between the A and AA type pumps is size. Measure the diameter of the shaft sleeve to determine nominal seal size. Series 90 pumps have three nominal seal sizes: 1/2", 3/4" & 1 1/4". Most components of the A and AA pump seals are similar (but not interchangeable). All Series 90 seals, except the 1 1/4", require a spring retainer as part of the seal assembly. Refer to these diagrams whenever seal replacement becomes necessary.

PUMP BODY DIAGRAM – A Size



PUMP BODY DIAGRAM – AA Size



REPLACEMENT PROCEDURE

With the motor assembly removed from the system, use the following instructions to facilitate the replacement.

1. Use a strap wrench or rag to prevent the impeller from turning with one hand and loosen the impeller nut with the other.
2. Lift the spring retainer (not found in the 1 1/4" seal assembly) and the seal spring from the shaft. Remove the compression ring from the seal collar by inserting a small screwdriver underneath the ring and carefully applying an upward force.

NOTE: Bell and Gossett seal assemblies consist of a stationary seal insert assembly and a rotating seal assembly. Each of these components must be replaced when replacing the mechanical seal. NEVER REPLACE INDIVIDUAL COMPONENTS SEPERATELY.

3. Using a clean, lint free rag, remove any debris that may have accumulated in the seal recess.
4. For the 1/2" & 3/4" seals, place the new retainer in the face plate seal recess. Set the thin seat gasket in the recess and set the seat insert atop the gasket. A ceramic insert has a top side and bottom side. The bottom is identifiable by its slightly recessed grooves. These grooves should face downward toward the rubber gasket.

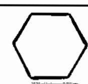
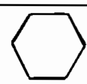
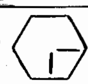
   For the 1 1/4 seals, set the seal insert into the elastomeric seat cup. Lubricate the seat cup with soapy water and set it into the face plate recess.
5. Lubricate the rubber seal collar with soapy water. The entire rotating seal assembly, which includes a seal ring, bellows and seal housing, is to be pushed onto the shaft as one unit. Do not attempt to assemble the seal by placing the components on the shaft individually. The notches in the collar should be aligned with the recesses found on each side of the carbon ring.
6. Press the seal housing tightly against the upper end of the rubber collar. A screwdriver can be used at several points along its periphery to provide a tight and even fit. Press with the screwdriver – do not tap. Tapping on the seal may break the ceramic or carbon insert.
7. Place the seal spring on the shaft and then the spring retainer (except for the 1 1/4" seal). Next, place the impeller and lock washer on the shaft. Thread the impeller nut onto the shaft and tighten according to: 3/8" nut to 8-12 ft. lbs. 7/16" nut to 17-22 ft. lbs. & 3/8 capscrews to 10-14 ft. lbs. Do not overtighten.

> **WARNING:** HOT WATER HAZARD.
> When disassembling a gasketed joint, always use a new gasket upon reassembly. NEVER RE-USE OLD GASKETS. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

(CONTINUED ON NEXT PAGE)

SEAL REPLACEMENT (continued)

8. Clean the pump body of excess debris. Place a new gasket in the recess of the pump body; ensure that it sits flush against the gasket surface.
9. Replace the motor assembly by inserting the impeller in the pump body and evenly tighten the eight cap screws. Refer to the TORQUE CHART below.
10. Refer to the WIRING INSTRUCTIONS section in this manual to properly configure all electrical connections.
11. Follow the OPERATIONAL INSTRUCTIONS in this manual to 1) check the PH of the system water, 2) to check the rotation of the pump and 3) to pressurize the system prior to starting.

Capscrew Type	Head Marking	CAPSCREW TORQUE (FOOT-POUND) Capscrew Diameter								
		1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
SAE Grade 2		6	13	25	38	60	120	190	210	300
Brass Stainless Steel	 or 	4	10	17	27	42	83	130	200	300
SAE Grade 5		10	20	35	60	90	180	325	525	800

DEALER SERVICING

If your pump requires further repair, contact your local B&G Representative. Having the following information at hand will facilitate your representative's ability to assist you:

1. Complete data from nameplate.
2. Suction and discharge pipe pressure gauge readings.
3. Ampere draw of motor.
4. A sketch of the pumping system (include pipes, valves, etc.)

YOUR BELL & GOSSETT REPRESENTATIVE IS ...

For further information, contact ITT Bell & Gossett, 8200 N. Austin Avenue, Morton Grove, IL 60053,
Phone (847) 966-3700 – Facsimile (847) 966-9052.

PRINTED IN U.S.A. 1-94

ITT Bell & Gossett
Morton Grove, IL, U.S.A.

Dual Safety Shutoff Valves
DMV-D/6, DMV-DLE/6

DUNGS®

Two normally closed safety shutoff valves in one housing; each with the following approvals.

UL Recognized
- **UL 429**
- **File # MH16727**

CSA Certified
- **ANSI Z21.21 • CSA 6.5**
- **C/I Automatic Valves**
- **File # 1010989**

FM Approved
- **Class 7411**
- **File # J.I.1Z6A0.AF**

EU Gas Appliance Directive
- **EN161**
- **CE-0087AU30**

US, Canadian and EU Models
- **DMV-D 701/6, 702/6, 703/6**
- **DMV-DLE 701/6, 702/6, 703/6**
- **1/2 in. NPT - 2 in. NPT**
- **Rp1/2 - Rp2**

DUNGS is an ISO 9001 manufacturing facility.

Description

The DUNGS Dual Modular Valve (DMV) combines two automatic shutoff valves in one compact housing, which can be wired independently or in parallel.

Valve 1 (V1) of the DMV-D and DMV-DLE series is fast opening and fast closing. Valve 2 (V2) of the DMV-D is fast opening, while V2 of the DMV-DLE is slow-opening for smoother light-off. Max. flow adjustment on V2 provides variable main flow on both models.

Internal profiles and compact design optimize flow and provide a low pressure drop. Three body styles reduce inventory.

Directly mounting the following DUNGS accessories creates a compact valve train without additional piping:
- Pressure regulator
- High and low gas pressure switches
- Valve proving system
- Vent line adapter

Application

The DUNGS DMV is recommended for industrial and commercial heating applications that require two safety shutoff valves. The DMV Dual Multi-Valve is suitable for natural gas, propane, butane, air and inert gases.

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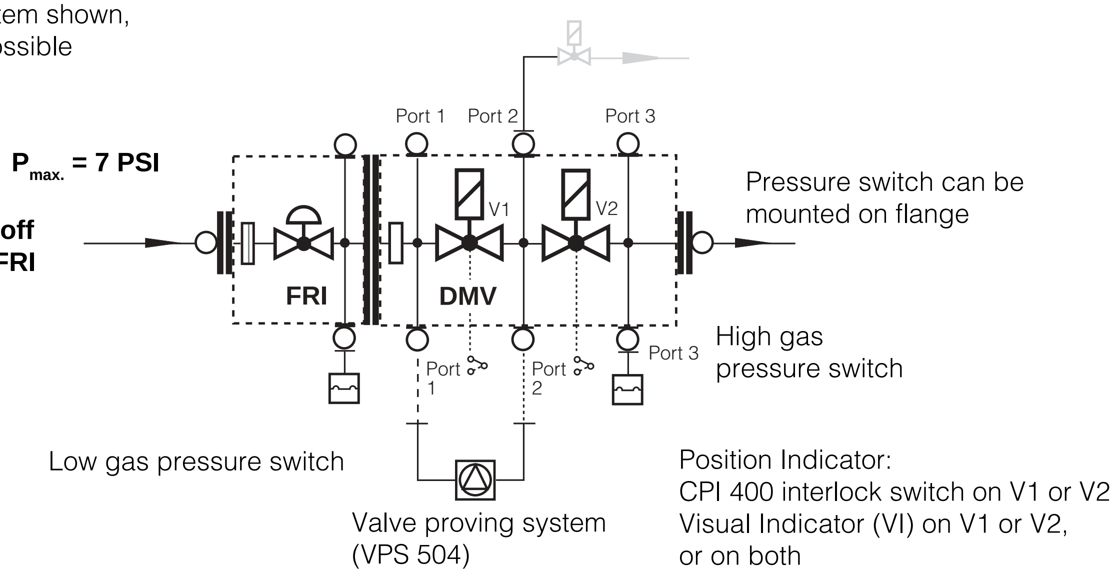
DMV-D…/6	Two normally closed safety shutoff valves in one housing. V1 and V2 are fast opening, fast closing. Adjustable max flow with V2.
DMV-DLE…/6	Two normally closed safety shutoff valves in one housing. V1 fast opening, fast closing. V2 is slow opening, fast closing. Adjustable max flow and Adjustable initial lift with V2.

Specifications

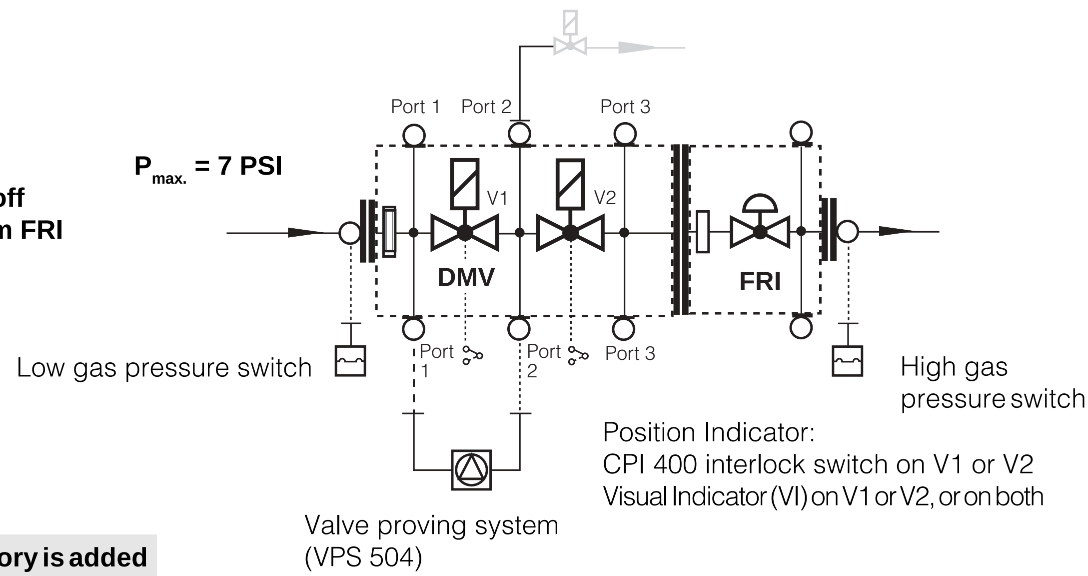
Body sizes pipe size / thread	DMV 701 1/2" - 1" NPT or Rp	DMV 702 1" - 2" NPT or Rp	DMV 703 1" - 2" NPT or Rp
Max. operating pressure	7 PSI (500 mbar) UL, FM, CE (Class A)	5 PSI (360 mbar) CSA	
Max. body pressure	15 PSI (1000 mbar)		
Max. close-off pressure	7 PSI (500 mbar) UL, FM, CE (Class A)	5 PSI (360 mbar) CSA	
Electrical ratings (+10% / -15%)	110 - 120 VAC/50 - 60 Hz 24 VAC/ 50 - 60 Hz	220 - 240 VAC/50 - 60 Hz 24 VDC	
Power ratings	DMV 701: 45 VA	DMV 702: 65 VA	DMV 703: 90 VA
	Ratings shown are total power consumption for both valves inclusive. Inrush and full load current have the same VA rating.		
Enclosure rating	NEMA Type 12		
Electrical connection	DIN-connector with 1/2" NPT conduit adapter		
Operating time	100 % duty cycle		
Closing time	< 1 s		
Opening time (to max. flow)	DMV-D…/6 DMV-DLE…/6	V1 & V2 < 1 s V1 < 1 s; V2 Adjustable to approx. 10 to 20 s at 70 °F	
Initial lift adjustment	Adjustable on V2	DLE only; 0 to 70 % of total flow; 0 to 35% of stroke	
Max. flow adjustment	Adjustable on V2	<10 to 100 % of total flow; <10 to 100% of stroke	
Materials in contact with gas	Housing: Sealings on valve seats:	Aluminium, Steel NBR-based rubber	
Ambient temperature rating	-40 °F to +150 °F (-40 °C to +65 °C)		
Installation position	Safety valve upright vertical to horizontal		
Test ports / Pressure switch mounting ports	G 1/8 ISO 228 ports available on both sides. Each side has one port upstream V1, one between V1 and V2, one downstream V2, and one on each flange.		
Gas filter (optional)	Replaceable integral gas filter (50 micron) in inlet of DMV or Pre-Mount Filter Block for DMV 702 and 703. (Cannot be used with FRI directly mounted to the DMV.)		
Gas strainer (standard)	Installed in the housing upstream V1 (23 mesh)		
Position indication (order separately)	CPI 400 with indication lamps and SPDT interlock switch or Visual indicator (VI)		
Valve proving system	Requires VPS 504; mounts directly to either side of DMV.		

DMV dual safety shutoff valve modular system
Optional mounting system shown,
other configurations possible

DMV dual safety shutoff valve with upstream FRI pressure regulator



DMV dual safety shutoff valve with downstream FRI pressure regulator



⚠ **When an accessory is added to the DMV, it may not be possible to mount other devices.**

FRI Gas pressure regulator
Mounting the FRI series gas pressure regulator directly to the DMV dual safety shutoff valve is possible with a mounting kit.
The FRI pressure regulator can be installed upstream or downstream of the DMV dual safey shutoff valve depending on application requirements.

FRI mounting kit for DMV
FRI 705 - 707/6 to DMV 701/6
Order No. 219 967
(Previously FRI 505-507/6)

FRI 710-712/6 to DMV 702/6 + 703/6
Order No. 219 968
(Previously FRI 505-507/6)

Additional Accessories

VPS 504
Valve proving system (approved by some authorities having jurisdiction in lieu of vent valve and “proof of closure”).

Integral gas filter (optional)
50 micron gas filter

Pre-Mount Filter (optional)
50 micron gas filter

GAO/GMH/GML A2 pressure switch

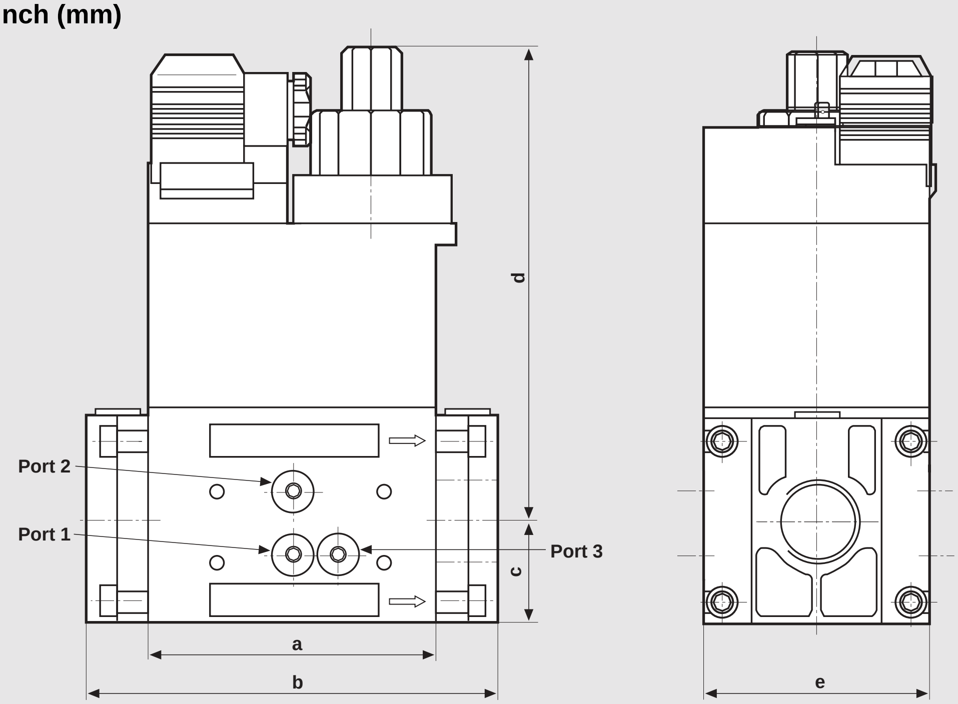
Position indication
CPI 400 with indication lamps and SPDT interlock switch, or visual indicator (VI)

DMK butterfly control valve
Mounts directly downstream of DMV to modulate gas flow. Requires actuator. Use DMA actuator with DMK butterfly valve.

DMV D(LE) 7xx/6 VL (with vent line adapter)
Factory installed vent line adapter which integrates a vent line connection with the DMV series.

Adapters
- 1/4” NPT adapter (D225047)
- 1/2” NPT Pilot gas adapter; Check flow requirements. (D225043)
- G 1/8” Test nipple (D219008)
- Port 3 Pressure switch mounting adapter (D214975)

Dimensions inch (mm)



Type	110-120 VAC 50-60 Hz Order No.	24 VAC 50-60 Hz Order No.	24 VDC Order No.	Power* [VA]	a	b**	c****	d	e	Weight [lbs] [kg]
					Dimensions [inch] Dimensions [mm]					
DMV-D 701/6	D224 842	D228 220	D226 990	45	**3.7**	**5.6**	**1.4**	**5.3**	**2.9**	**4.6**
					93	141	35	134	73	2.1
DMV-D 702/6	D224 843	D228 221	D226 991	65	**4.9**	**6.9 / 8.1**	**1.8**	**5.9**	**3.9**	**10.1**
					124	174 / 206	45	150	101	4.6
DMV-D 703/6	D224 844	D228 222	D226 992	90	**4.9**	**6.9 / 8.1**	**1.8**	**7.5**	**3.9**	**12.1**
					124	175 / 206	45	190	101	5.6
DMV-DLE 701/6	D224 845	D228 223	D226 993	45	**3.7**	**5.6**	**1.4**	**5.9**	**2.9**	**4.8**
					93	141	35	160	73	2.2
DMV-DLE 702/6	D224 846	D228 224	D226 994	65	**4.9**	**6.9 / 8.1**	**1.8**	**6.7**	**3.9**	**10.3**
					124	174 / 206	45	179	101	4.7
DMV-DLE 703/6	D224 847	D228 225	D226 995	90	**4.9**	**7.9**	**1.8**	**8.6**	**3.9**	**12.3**
					124	174 / 206	45	218	101	5.7

* Inrush current and full load current have the same VA rating.

** DMV 702/703 with 1” or 1 - 1/4” flange: 6.9” / DMV 702/703 with 1 - 1/2” or 2” flange: 8.1”

*** When using the CPI Closed Position Indicator switch add 3”. When using with the vent line adapter assembly, add 1.65” to dimension c. (see vent line adapter information sheet)

Valve	**Flange**	**NPT**	**Rp**
DMV-701/6	**1/2”**	D222 371	D222 341
DMV-701/6	**3/4”**	D222 368	D222 342
DMV-701/6	**1”**	D221 999	D222 001
DMV-702/6 & 703/6	**1”**	D222 369	D222 343
DMV-702/6 & 703/6	**1 1/4”**	D222 370	D222 344
DMV-702/6 & 703/6	**1 1/2”**	D222 003	D221 884
DMV-702/6 & 703/6	**2”**	D221 997	D221 926

DIN-Connector	D210 319
CPI 400	D224 253
Visual indicator	46000-6

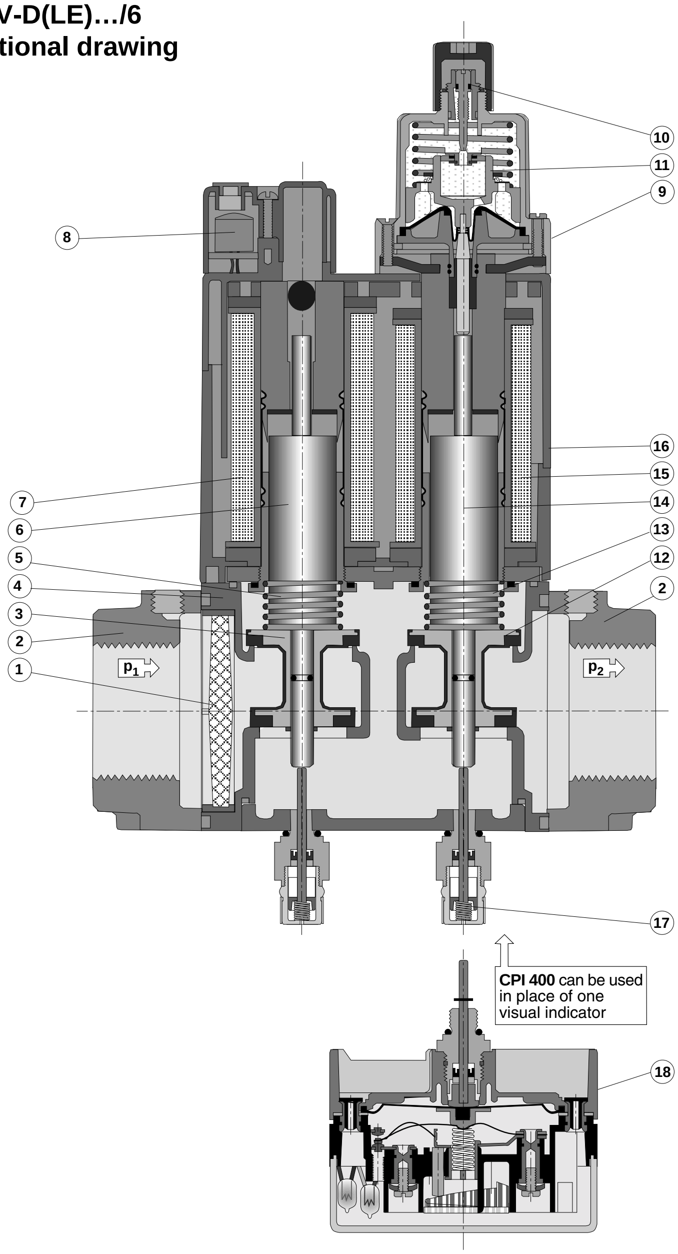
Please order flanges, position indicators and gas filters separately

Pre-Mount Filter	
DMV-701/6	D232 440
DMV-702/6	D226 342
DMV-703/6	D226 342

Pre-Mount replacement filter	
DMV-701/6	D238 653
DMV-702/6	D226 997
DMV-703/6	D226 997

Integral strainer replacement	
DMV-701/6	D214 276
DMV-702/6	D214 525
DMV-703/6	D214 525

DMV-D(LE)…/6
sectional drawing



1	Strainer
2	Flange
3	Valve V1
4	Housing
5	Closing spring V1
6	Plunger V1
7	Solenoid V1
8	Electrical connection
9	Max flow adjustment
10	Initial lift adjustment (DMV-DLE)
11	Hydraulic brake (DMV-DLE)
12	Valve V2
13	Closing spring V2
14	Plunger V2
15	Solenoid V2
16	Solenoid housing
17	Visual indicator (VI)
18	CPI 400 interlock switch

$$\mathring{V}_{\text{gas used}} = \mathring{V}_{\text{Natural Gas}} \times f$$

f = correction factor to determine flow through valves with other gases.

$$f = \sqrt{\frac{\text{Spec. gravity of Natural Gas}}{\text{Spec. gravity of gas used}}}$$

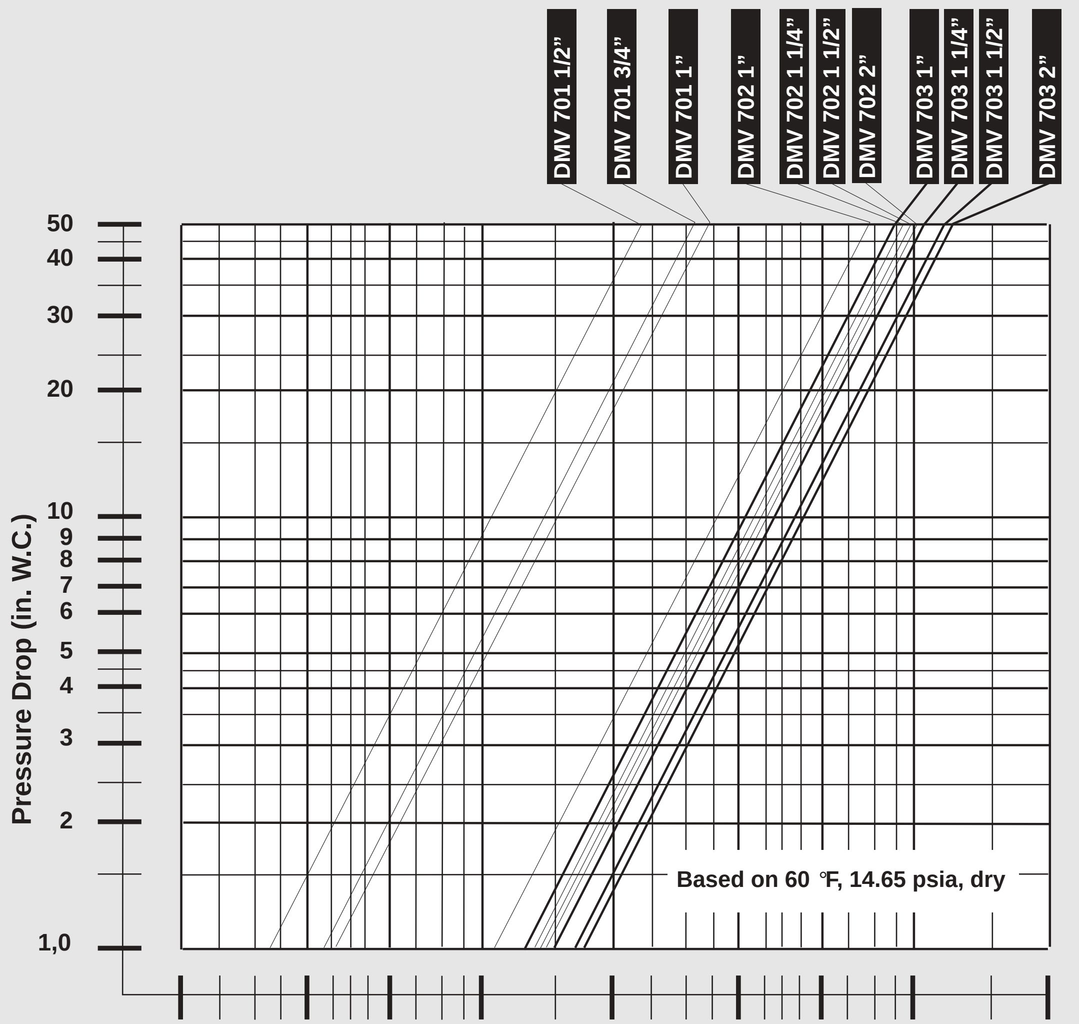
Type of gas	Density [kg/m³]	sg	f
Natural gas	0.81	0.65	1.00
Butane	2.39	1.95	0.58
Propane	1.86	1.50	0.66
Air	1.24	1.00	0.80

Flow (CFH) of natural gas, s.g. 0.65 at 60 °F with 1 in. W.C. pressure drop @ 1.25 psi inlet pressure

	1/2 "	3/4"	1"	1-1/4"	1-1/2"	2"
DMV 701	345	429	457	–	–	–
DMV 702	–	–	1065	1277	1368	1430
DMV 703	–	–	1230	1532	1698	1795

DUNGS®

Flow diagram



Flow (CFH) of natural gas s.g. 0.65 at 60 °F

20 in W.C.

We reserve the right to make any changes in the interest of technical progress.

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Pressure switch for dual modular valves

GAO-A2…
GMH-A2…
GML-A2…

DUNGS®

UL Listed
- **UL 353**
- **File # MH 16628**

CSA Certified
- **CSA C22.2 No. LR 53222**
- **Certification # 201527**

FM Approved
- **Class 3510, 3530**
- **File # J.I. 1T7A8.AF**

European models tested to EN1854 per Gas Appliance Directive 90/396/EEC and per Pressure Equipment Directive 97/23/EC.

DUNGS is an ISO 9001 manufacturing facility.

Description

The GAO-, GMH-, and GML-A2… pressure switches are compact pressure switches for DUNGS modular valve train components.

A2 pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. The set point can be set in the field by an adjustable dial with an integrated scale.

Application

The DUNGS GAO-, GMH-, and GML-A2… pressure switches are recommended for industrial and commercial heating applications with DUNGS DMV dual modular valves and DUNGS FRI modular pressure regulators. Various mounting options allow direct mounting on the housing.

The GAO-, GMH-, and GML-A2… pressure switches are suitable for natural gas, propane, butane, air and other inert gases.

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GAO-A2… SPDT pressure switch requires no auxiliary power. The GAO-A2… is suitable for making and/or breaking a circuit when the set point is exceeded or undershot. A tripped switch is indicated by a neon light after set point is exceeded or undershot. **Automatic reset** when pressure returns below or above set point.

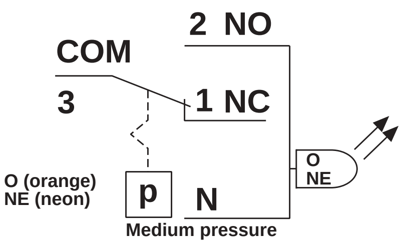
GMH-A2… SPDT pressure switch requires no auxiliary power. The GMH-A2… is suitable for making and/or breaking a circuit when the set point is exceeded. A tripped switch is indicated by a neon light after set point is exceeded. **Manual reset** is required to reset the switch.

GML-A2… SPDT pressure switch requires no auxiliary power. The GML-A2… is suitable for making and/or breaking a circuit when the set point is undershot. A tripped switch is indicated by a neon light after set point is undershot. **Manual reset** is required to reset the switch.

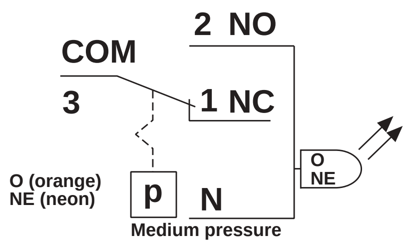
Specifications

Max. operating pressure	GAO-A2-4-2,3,5,6 GMH- and GML-A2-4-4,6 GAO-, GMH- and GML-A2-4-8	7 PSI (500mbar) 7 PSI (500mbar) 14 PSI (1000 mbar)
Pressure connection	O ring flange connection on underside of pressure switch	
Temperature range GAO-, GMH- and GML-A2-4	Ambient temperature Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C) -40 °F to +140 °F (-40 °C to +60 °C)
GAO-, GMH- and GML-A2-4-8	Ambient temperature Medium temperature	-22 °F to +140 °F (-30 °C to +60 °C) -22 °F to +140 °F (-30 °C to +60 °C)
Materials	Housing Switch Diaphragm Switching contact	Aluminium Polycarbonate NBR-based rubber Silver or Gold
Electrical ratings	AC eff. DC	min. 24 V max. 240 V min. 24 V max. 48 V
Nominal current	Silver (Ag) contact ratings AC 10A resistive @ 120 VAC AC 8A inductive @ 120 VAC DC min. 20 mA @ 24 VDC DC max. 1 A @ 48 VDC	Gold (Au) contact ratings DC max. 5m A @ 5 VDC DC max. 20m A @ 24 VDC
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA Type 4	
Setting tolerance	± 15% switching point deviation referred to set point. Adjusted as pressure rises or as pressure falls, vertical diaphragm position.	

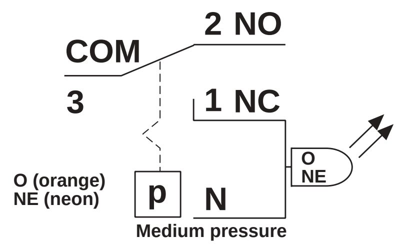
GAO switching function (upper)
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



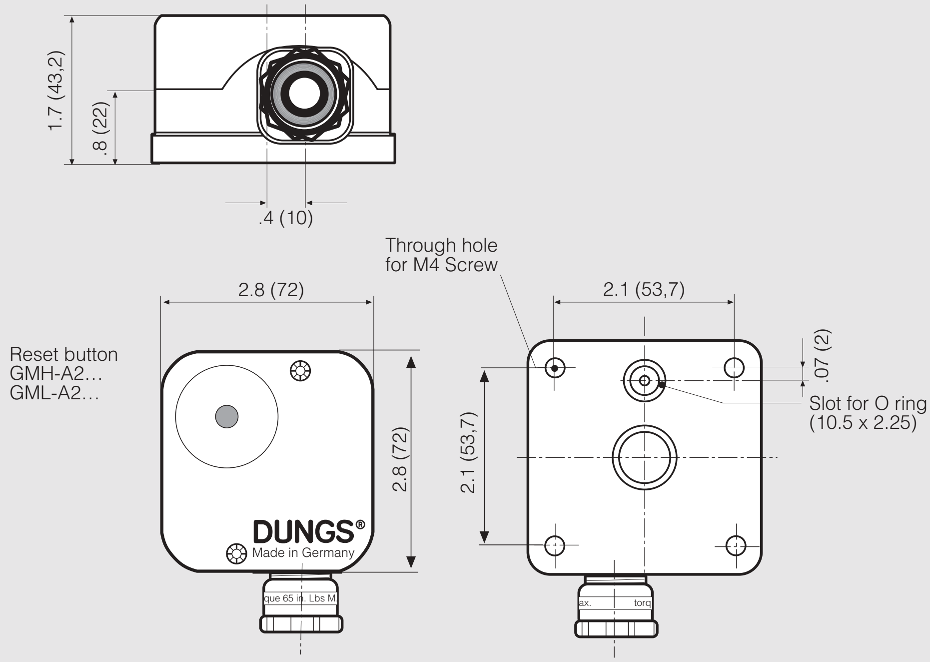
GMH switching function
As pressure rises
2 NO closes, 1 NC opens
Neon light ON, tripped.



GML switching function
shown in Operating state.
As pressure falls
2 NO opens, 1 NC closes
Neon light ON, tripped.

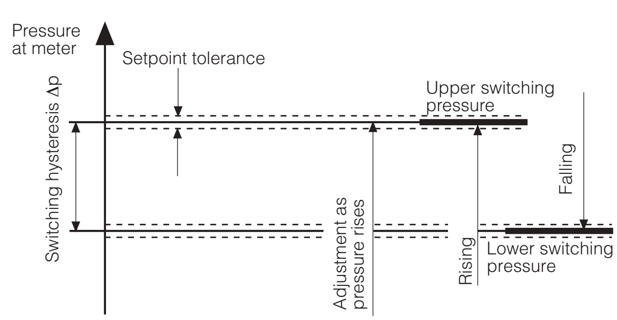


Dimensions inch (mm)
GAO-, GMH-, GML-A2…



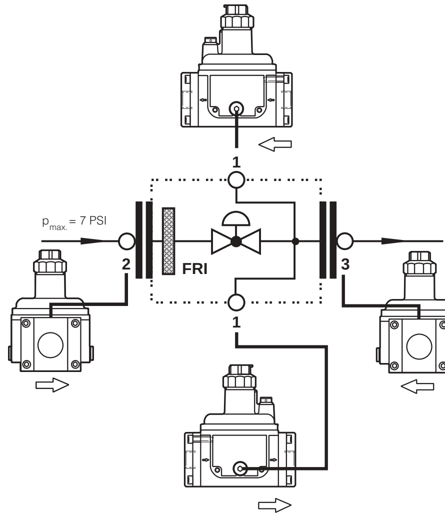
Adapters / replacement parts / Accessories	Order No.	For equipment	Notes
A2 Mounting kit (included)	D226 188	GAO, GMH, GML	M4 Screws, 10.5 x 2.25 O-ring
DMV Port 3 adapter (DMV side mount for high pressure switch)	D214 975	DMV-D(LE) 701 - 703	NPT 1/2“ - NPT 2“
Replacement conduit adapter	46000-14	GAO, GMH, GML	1/2“ NPT
Replacement cover	D228 732	GAO	
Replacement cover	D233 113	GMH, GML	
Replacement light	D244 156	GAO, GMH, GML	120 VAC, Red bulb
Replacement light	D244 157	GAO, GMH, GML Gold contact versions	24 V, Red bulb
Electrical plug for A2 (For use with D210318)	D219 659	GAO	N/A
Electrical plug for A2 (For use with D210318)	D227 644	GMH, GML	N/A
DIN Connector for A2 (For use with D219 659 & D227 644)	D210 318	GAO, GMH, GML	N/A

Definition of switching hysteresis Δp
The pressure difference between the upper and lower switching pressures



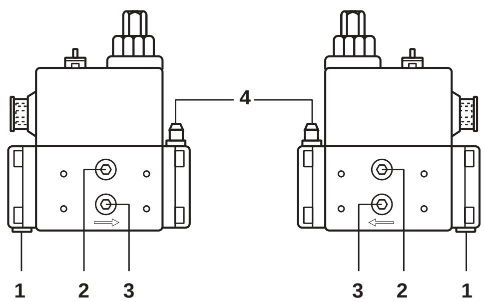
A2 mounting options
FRI gas pressure regulator

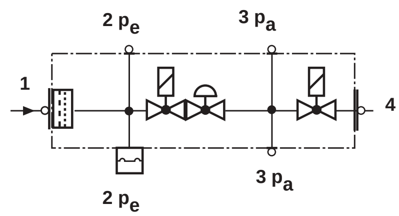
Pressure tap	mounting possible…
1	yes
2	yes
3	yes



A2 mounting options
MB 053-403 GasMultiBloc

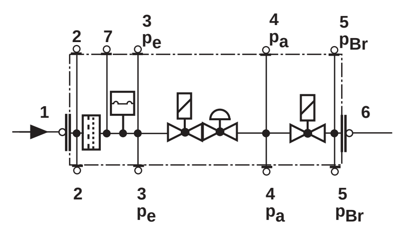
Pressure tap	mounting possible…
1	yes, with #D221 630
2	yes
3	yes
4	yes, with #D221 630

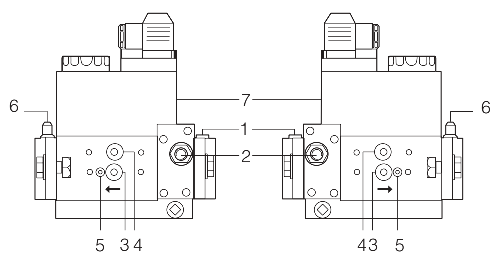


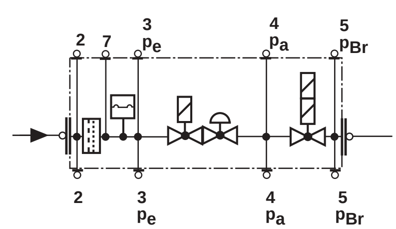


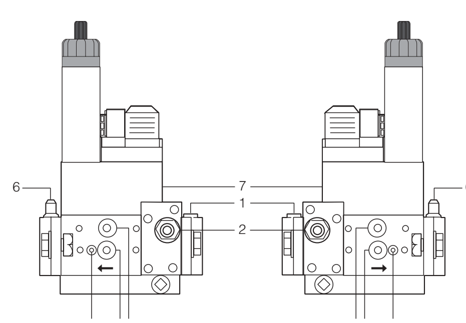
A2 mounting options
MB-D GasMultiBloc; MB-Z 405-412

Pressure tap	mounting possible…
1	alternativ to 7
2	no
3	yes
4	yes
5	yes, with #D214 975
6	yes, with #D221 630
7	yes



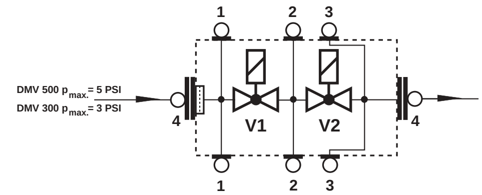


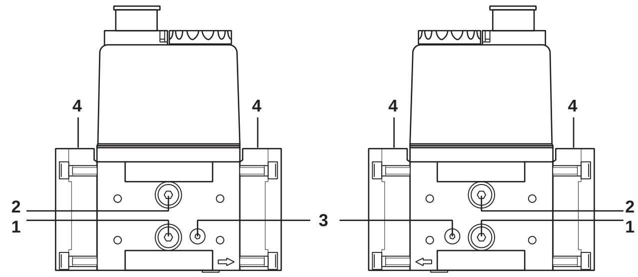




A2 mounting options
DMV 300/500 Dual modular valve

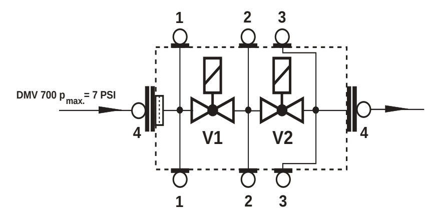
Pressure tap	mounting possible…
1	yes
2	yes
3	yes, with # D214 975
4	yes, horizontal yes, with # D221 630

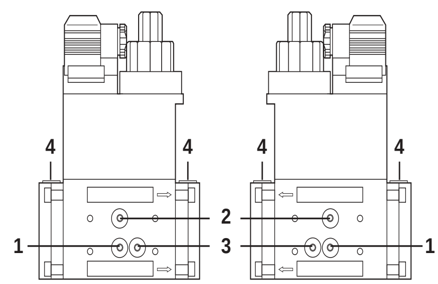




A2 mounting options
DMV 701-703 Dual modular valve

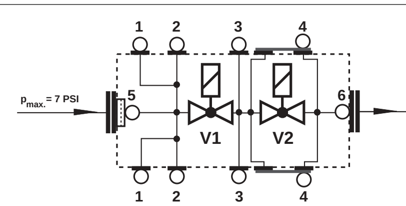
Pressure tap	mounting possible…
1	yes
2	yes
3	yes, with # D214 975
4	yes, horizontal yes, with #D221 630

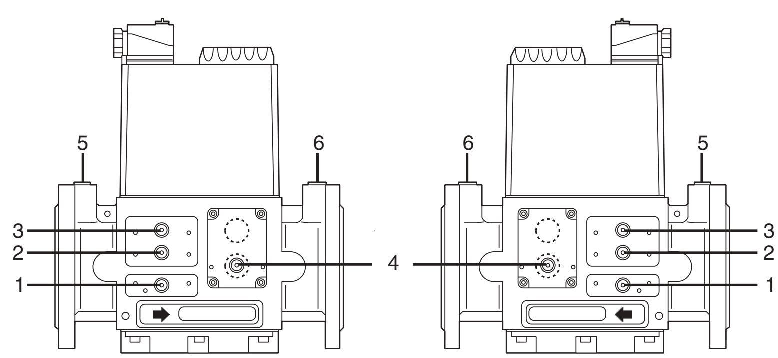




A2 mounting options
DMV 525,5040-5125/11 Dual modular valve

Pressure tap	mounting possible…
1	yes
2	yes
3	yes
4	yes
5	no
6	no





Pressure switch for dual modular valves

GAO-A2…
GMH-A2…
GML-A2…

DUNGS®

Technical data

Type	Version	Order No.	Setting range In. W.C	Switching hysteresis Δp In. W.C (calibrated at)
GAO-A2… pressure switch	GAO-A2-4-2	D217 085	0.16 - 1.20“	≤ 0.12“
	GAO-A2-4-3	D217 086	0.40 - 4.00“	≤ 0.20“
	GAO-A2-4-5	D217 087	2.00 - 20.00“	≤ 0.40“
	GAO-A2-4-6	D217 088	12.0 - 60.00“	≤ 1.20“
	GAO-A2-4-8	D217 089	40.00 - 200.00“	≤ 4.00“
GMH-A2… pressure switch	GMH-A2-4-4	D217 323	1.00 - 20.00“	--
	GMH-A2-4-6	D217 324	12.00 - 60.00“	--
	GMH-A2-4-8	D217 325	40.00 - 200.00“	--
GML-A2… pressure switch	GML-A2-4-4	D217 337	1.00 - 20.00“	--
	GML-A2-4-6	D217 338	12.00 - 60.00“	--
	GML-A2-4-8	D217 339	40.00 - 200.00“	--
All switches have 120 VAC neon lights factory installed				

We reserve the right to make any changes in the interest of technical progress.

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Safety Shutoff Valves
MVD/6, MVDLE/6

DUNGS®

Normally closed safety shutoff valve with the following approvals.

UL Listed
- **UL 429**
- **File # MH16727**

AGA / CGA Certified
- **ANSI Z21.21**
- **CGA 6.5**
- **CGA 3.9**
- **File # LM112901-04**

FM Approved
- **Class 7411**
- **File # J.I.0V9A8.AF**

US and Canadian Models
- **MVD 505/6 - MVD 530/6**
- **MVDLE 205/6 - MVDLE 230/6**
- **1/2 in. NPT - 3 in. NPT**

European models tested to EN161 per Gas Appliance Directive 90/396/ EEC.

DUNGS is an ISO 9001 manufacturing facility.

Description
The DUNGS MVD and the MVDLE electrically operated normally closed, automatic safety shutoff valves for gas burners and gas appliances.
- Closing time <1s.
- Max. operating pressure up to
  7 PSI (500 mbar) on MVD
  3 PSI (200 mbar) on MVDLE
- Max. close off pressure
  15 PSI (1000 mbar) on all models
- MVD: fast opening/fast closing
- MVDLE: slow opening with adjustable initial lift, fast closing
- Max flow is adjustable
- 120 VAC/ 60 Hz, 24 VAC/ 60 Hz(in some models)
- 1/2" NPT conduit connection
- Optional field installable visual indicator (VI) or CPI 400 with indication lamps and SPDT interlock switch for valve position.
- Reliable, quiet operation; rugged and low maintenance.

Application
The DUNGS MVD and MVDLE are recommended for industrial and commercial heating applications that require one safety shutoff valve or two safety shutoff valves in series. The MVD and MVDLE safety shutoff valves are suitable for natural gas, propane, butane, air and other inert gases.

Printed in Germany • Edition 02.00 • Nr. 226 354

MVD	Normally closed automatic safety shutoff valve, fast opening, fast closing. Adjustable max. flow.
MVDLE	Normally closed automatic safety shutoff valve, slow opening, fast closing. Adjustable initial lift. Adjustable max. flow.

Specifications

Pipe thread (NPT)	1/2" 3/4" 1" 1 1/4" 1 1/2" 2" 2 1/2" 3"
Max. operating pressure	MVD 7 PSI (500 mbar), MVDLE 3 PSI (200 mbar), see page 3
Max. body pressure	15 PSI (1000 mbar)
Max. close off pressure	15 PSI (1000 mbar)
Electrical ratings (-10 % to +15 %)	120 VAC, 24 VAC (available in some models) / 60 Hz; see page 3 and 4
Power ratings	Refer to type overview page 4
Enclosure rating	NEMA 1
Electrical connection	Screw terminals with 1/2" NPT conduit connection
Operating time	100 % duty cycle
Closing time	< 1 s
Opening time (to max. flow)	MVD < 1 s MVDLE Adjustable to approx. 10 to 20 s at 70 °F
Initial lift adjustment	MVDLE only - 0 to 70% of total flow; 0 to 25% of stroke
Max. flow adjustment	Adjustable from <10 to 100 % of total flow; <10 to 100 % of stroke
Materials in contact with gas	Aluminium, steel, brass / Seals: NBR-based rubber
Ambient temperature rating	-20 °F to +140 °F (-30 °C to +60 °C), depending on approval. See also page 3
Installation position	Safety shut off valve from vertically upright to horizontal
Test ports	Two 1/4" NPT upstream and two 1/4" NPTdownstream ports
Gas strainer (standard)	Installed in the housing upstream (23 mesh)
Position indication (order separately)	CPI 400 with indication lamps and SPDT interlock switch or Visual indicator (VI)
Valve proving system (requires two safety shutoff valves in system)	Type VDK 200, mounts externally using valve side ports or pipe "T"s.

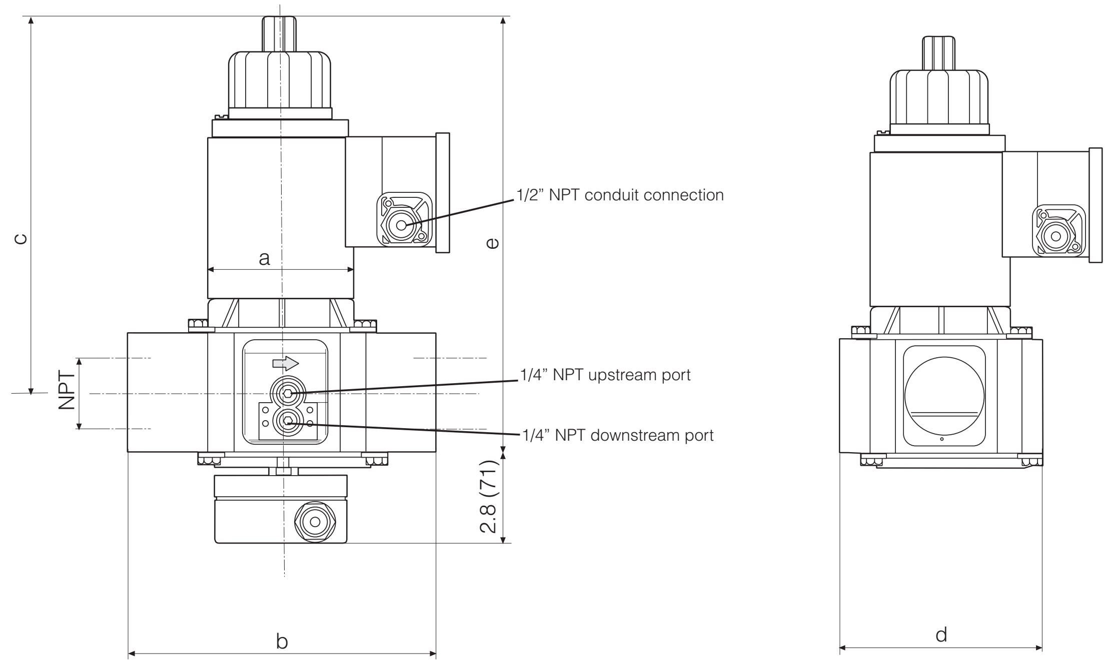
Approvals	Model	Temperature Rating	MOPD (PSI)**	Max. Close Off (PSI)	Electrical Ratings (Volts / Hz)
UL 429	D	-20 °F to 120 °F	7	7	120/60 (-10% +15%)
	DLE	-20 °F to 120 °F	3	7	120/60 (-10% +15%)
	D	-20 °F to 120 °F	7	7	24/60 (-10% +15%)*
	DLE	-20 °F to 120 °F	3	7	24/60 (-10% +15%)*
FM 7411	D	-30 °F to 140 °F	7	15	120/60, 24/60 (-10% +15%)*
	DLE	-30 °F to 140 °F	3	15	120/60, 24/60 (-10% +15%)*
Z21.21 6.5	D	-20 °F to 120 °F	5	5	120/60 (-10% +15%)
	DLE	-20 °F to 120 °F	2	5	120/60 (-10% +15%)
3.9	D	-20 °F to 120 °F	7	7	120/60 (-10% +15%)
	DLE	-20 °F to 120 °F	3	7	120/60 (-10% +15%)

* 24VAC available in some models (See page 4)
** Maximum Operating Pressure Differential

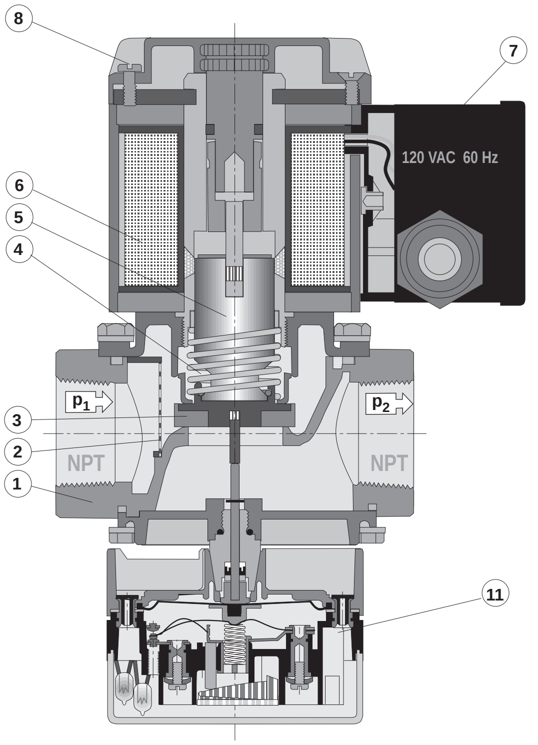
Type	PSI	NPT	Sole-noid No.	Order No.	Pmax.** [VA] Inrush and Full Load	Opening time to max flow	Dimensions [inch] Dimensions [mm] a	b	c	d	e	Weight [lbs] [kg]
MVDLE 205/6*	3	1/2"	100 100	46030-2 46031-2*	15	approx. 10 s	**1.97** 50	**2.95** 75	**5.31** 135	**2.76** 70	**6.10** 155	**2.43** 1,10
MVDLE 207/6*	3	3/4"	200 200	46030-3 46031-3*	25	approx. 10 s	**2.76** 70	**3.94** 100	**6.50** 165	**3.15** 80	**7.48** 190	**5.62** 2,55
MVDLE 210/6*	3	1"	200 200	46030-4 46031-4*	25	approx. 10 s	**2.95** 75	**4.33** 110	**6.50** 165	**3.54** 90	**7.68** 195	**6.06** 2,75
MVDLE 212/6	3	1 1/4"	300	46030-5	60	approx. 10 s	**3.74** 95	**5.91** 150	**8.07** 205	**4.57** 116	**9.65** 245	**9.70** 4,40
MVDLE 215/6	3	1 1/2"	300	46030-6	60	approx. 10 s	**3.74** 95	**5.91** 150	**8.07** 205	**4.57** 116	**9.65** 245	**12.13** 5,50
MVDLE 220/6	3	2"	300	46030-8	60	approx. 10 s	**4.53** 115	**6.69** 170	**8.07** 205	**5.12** 130	**9.84** 250	**13.67** 6,20
MVDLE 225/6	3	2 1/2"	400	46030-10	80	approx. 10 s	**5.12** 130	**9.06** 230	**11.61** 295	**6.50** 165	**13.78** 350	**25.13** 11,40
MVDLE 230/6	3	3"	500	46030-12	90	approx. 10 s	**5.91** 150	**10.43** 265	**14.21** 361	**7.87** 200	**16.97** 431	**38.14** 17,31
MVD 505/6*	7	1/2"	100 100	46040-2 46041-2*	15	< 1 s	**1.97** 50	**2.95** 75	**3.54** 90	**2.76** 70	**4.45** 113	**2.20** 1,00
MVD 507/6*	7	3/4"	200 200	46040-3 46041-3*	25	< 1 s	**2.36** 60	**3.94** 100	**5.31** 135	**3.15** 80	**6.30** 160	**5.29** 2,40
MVD 510/6*	7	1"	200 200	46040-4 46041-4*	25	< 1 s	**2.95** 75	**4.33** 110	**5.31** 135	**3.54** 90	**6.50** 165	**5.73** 2,60
MVD 512/6	7	1 1/4"	300	46040-5	60	< 1 s	**3.74** 95	**5.91** 150	**6.89** 175	**4.57** 116	**8.27** 210	**11.91** 5,40
MVD 515/6	7	1 1/2"	300	46040-6	60	< 1 s	**3.74** 95	**5.91** 150	**6.89** 175	**4.57** 116	**8.27** 210	**11.91** 5,40
MVD 520/6	7	2"	400	46040-8	100	< 1 s	**4.53** 115	**6.69** 170	**6.89** 175	**5.12** 130	**9.25** 235	**19.40** 8,80
MVD 525/6	7	2 1/2"	500	46040-10	80	< 1 s	**5.12** 130	**9.06** 230	**8.46** 215	**6.50** 165	**10.63** 270	**31.97** 14,50
MVD 530/6	7	3"	550	46040-12	100	< 1 s	**5.91** 150	**10.43** 265	**11.22** 285	**7.87** 200	**13.94** 354	**55.11** 25,00

* Designates model is also available in 24VAC/60 Hz. Part Number also shown.
** Inrush current and full load current have the same VA rating.

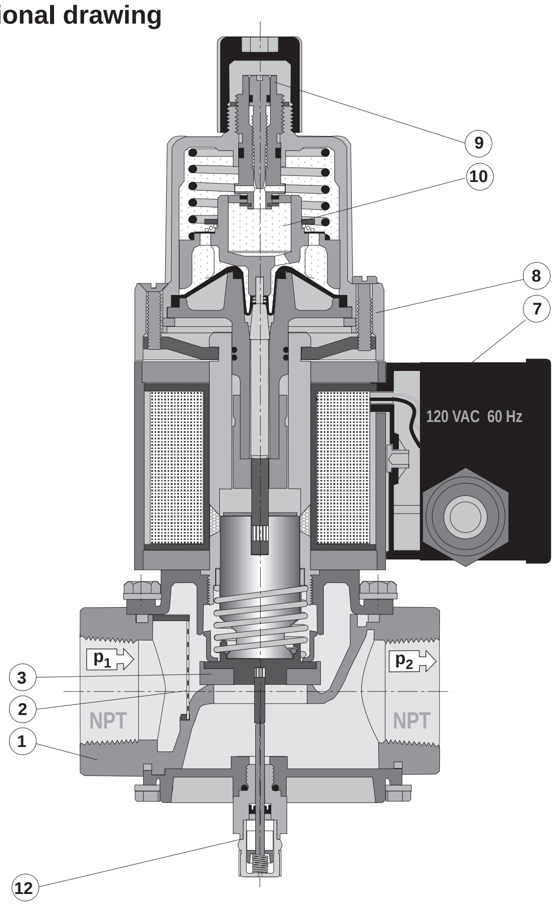
Dimensions inch (*mm*)



Type MVD sectional drawing



Type MVDLE sectional drawing



1	Housing	6	Solenoid	11	CPI 400 position interlock switch
2	Strainer	7	Electrical connection	12	Visual indicator (VI)
3	Valve disc	8	Max flow adjustment		
4	Closing spring	9	Initial lift adjustment MVDLE		
5	Plunger	10	Hydraulic brake MVDLE		

Functional description

The DUNGS MVD and MVDLE valves are automatic safety shutoff valves. The electromagnetic drive opens against the force of the closing spring 4.

The main flow through valve can be limited by the maximum flow adjustment 8.

On the MVDLE, the hydraulic brake 10 permits slow opening. Initial lift can be adjusted 9. If power is interrupted (operating voltage), closing spring 4 closes the valve within 1 second.

The valve position can be visually monitored by using the field installed visual indicator (VI) 12, or it can be visually and electronically monitored by a field installed CPI 400 with indication lamps and SPDT interlock switch 11.
(Order separately)

$$\mathring{V}_{\text{gas used}} = \mathring{V}_{\text{Natural Gas}} \times f$$

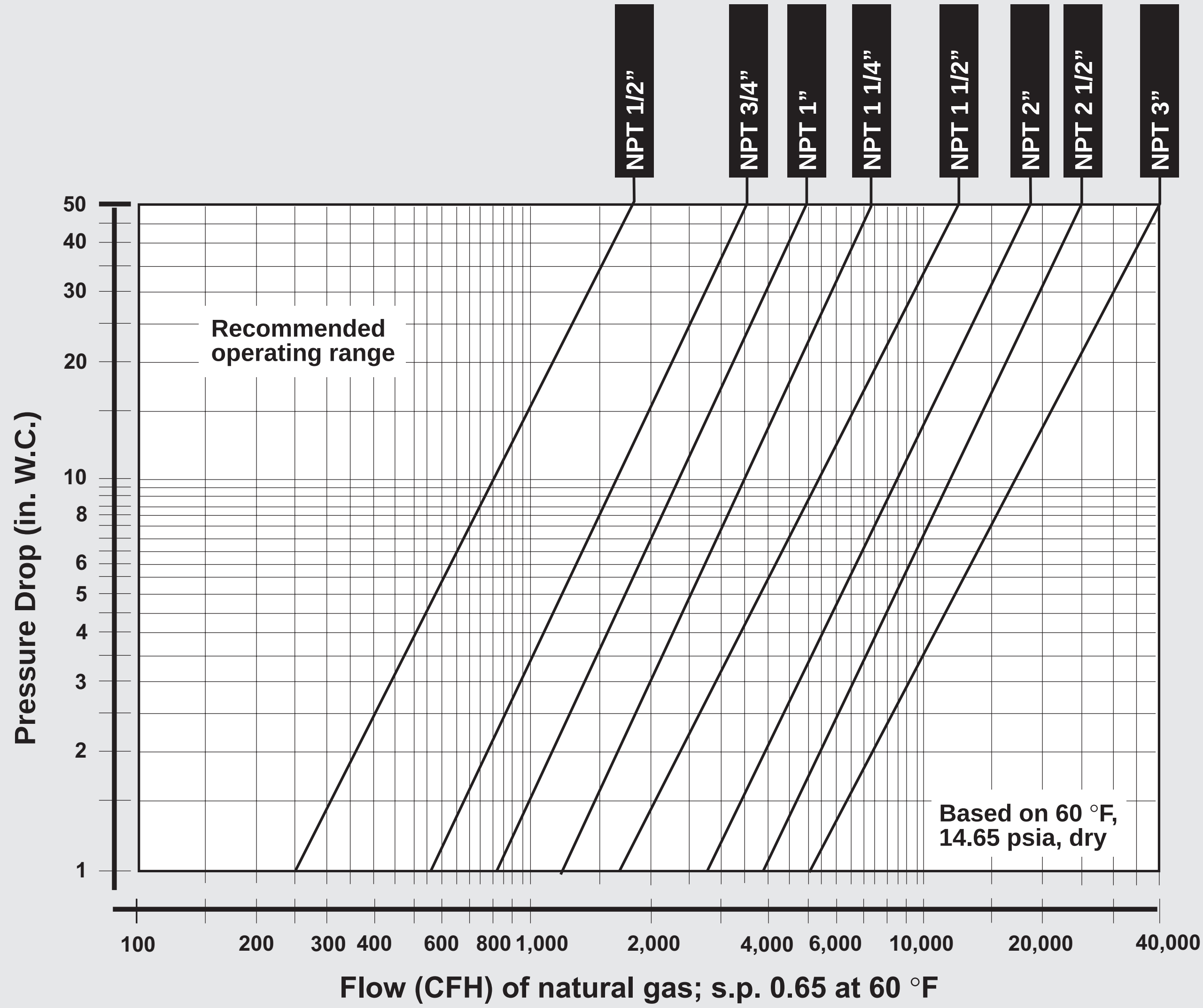
f = correction factor to determine flow through valves with other gases.

$$f = \sqrt{\frac{\text{Spec. gravity of Natural Gas}}{\text{Spec. gravity of gas used}}}$$

Type of gas	Density [kg/m³]	sg	f
Natural gas	0.81	0.65	1.00
Butane	2.39	1.95	0.58
Propane	1.86	1.50	0.66
Air	1.24	1.00	0.80

DUNGS®

Flow diagram



We reserve the right to make any changes in the interest of technical progress.

CERTIFIED DIN ISO 9001 DQS QUALITY SYSTEM
REG.NO 14 313

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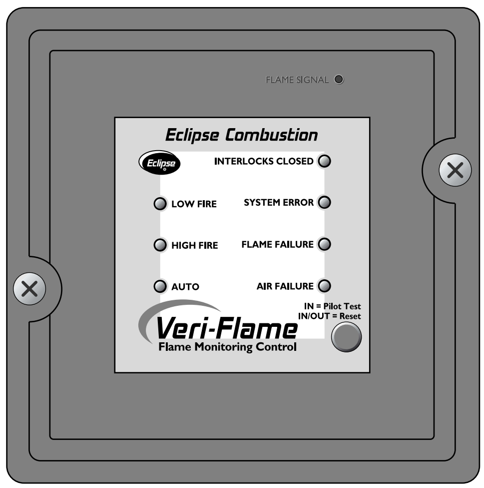
Instruction Manual 818
2/02

Eclipse Combustion

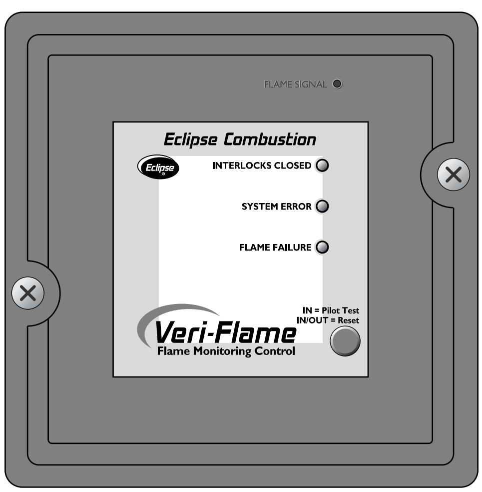
VeriFlame Single Burner Monitoring System

Model 5600

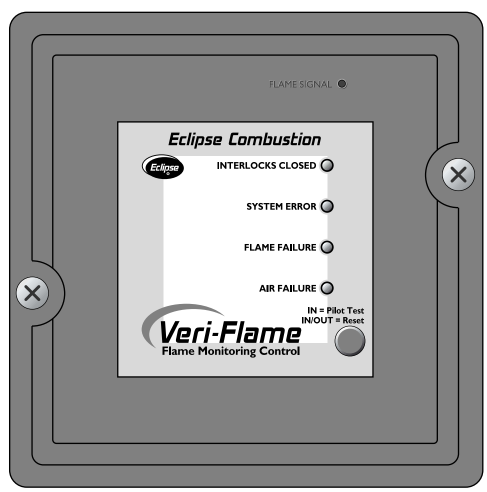
Version 1.21



Modulation Model



No Purge Model



Purge Model

ECLIPSE™
Innovative Thermal Solutions

Copyright

Disclaimer notice

In accordance with the manufacturer's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse Combustion, Inc. warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Marketing Communications Manager.

Liability and Warranty

It must be understood that Eclipse Combustion's liability for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing of burner monitoring system replacement parts and Eclipse Combustion will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income of, or damage to material arising in connection with the sale, installation, use of, inability to use or the repair or replacement of Eclipse Combustion's products.

Eclipse Combustion, Inc., for a period of one year from shipment, warrants each Veri-Flame burner monitoring system to the original purchaser to be free from defects in material and workmanship under normal use as defined hereafter. Any operation expressly prohibited in this Guide, any adjustment or assembly procedures not recommended or authorized in these instructions, shall void the warranty.

About this manual

Audience

This manual has been written for the people who select and install the product and the technicians who work on it. They are expected to have previous experience with this kind of equipment.

Scope

This manual contains essential information for the proper installation and operation of the Eclipse Veri-Flame Burner Monitoring System.

Following the instructions in this manual should assure trouble-free installation and operation of the monitoring system. Read this manual carefully. Make sure that you understand its structure and contents. Obey all the safety instructions.

Do not deviate from any instructions or application limits in this manual without written consent from Eclipse Combustion, Inc.

If you do not understand any part of the information in this manual, do not continue. Contact your Eclipse sales office or Eclipse Combustion, Inc., Rockford, Illinois.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows. Please read it thoroughly.

Danger:

Indicates hazards or unsafe practices which WILL result in severe personal injury or even death.
Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:
Indicates hazards or unsafe practices which could result in severe personal injury or damage.
Act with great care and follow the instructions.

Caution:
Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury.
Act carefully.

Note:
Indicates an important part of the text.
Read the text thoroughly.

How to get help

If you need help, you can contact your local Eclipse Combustion sales office. You can also contact Eclipse Combustion, Inc. at:

1665 Elmwood Road
Rockford, Illinois 61103 USA

Phone: 815-877-3031
Fax: 815-877-3336

E-mail: eclipse@eclipsenet.com
http://www.eclipsenet.com

Table of Contents

Introduction

1

Product Description

The Eclipse Combustion Veri-Flame Single Burner Monitoring System controls the start-up sequence and monitors the flame of single gas, oil, or combination gas/oil burners. There are three different models to the Veri-Flame line: the no purge, the purge and the modulation models. Each model features field selectable trial for ignition (TFI). Each model is also available for use with four types of flame sensor: ultraviolet (UV), self-check UV, infrared (IR) and flame rod.

The **Veri-Flame No Purge** and **Purge** models are available in three different series—5602, 5603 and 5605. The 5602 Series is UL listed, CSA certified, FM approved and IRI acceptable; the 5605 Series is UL listed, FM approved and IRI acceptable. The 5603 Series is for 240VAC applications not requiring US or Canadian certifications.

The **Veri-Flame Modulation** model is available in two different series: 5602 and 5603. Both series are capable of modulation (high and low fire purging). The 5602 Series is UL listed, CSA certified, FM approved and IRI acceptable. The 5603 Series is for 240VAC applications not requiring US or Canadian certifications.

Figure 1.1 **Veri-Flame Single Burner Monitoring System** (Purge Unit Shown)

Specifications

2

Introduction

This section gives a detailed overview of Veri-Flame specifications and dimensions.

Specifications

<table>
<tr><th>Parameter</th><th colspan="4">Description</th></tr>
<tr><td>Supply</td><td colspan="4">• Series 5602 & 5605: 120 VAC (+10%, -15%), 50/60 Hz standard.
Series 5603: 240 VAC (+10%, -15%), 50/60 Hz standard.
Internal power consumption: 12 VA (excluding external connected loads).</td></tr>
<tr><td rowspan="10">Temperature Ranges</td><td>Unit</td><td>Model Nos.</td><td colspan="2">Temperature Range</td></tr>
<tr><td>Veri-Flame</td><td>All Models</td><td>-40° to +60°C</td><td>(-40° to +140°F)</td></tr>
<tr><td>90° U.V. Scanner</td><td>5600-90A</td><td>-20° to +60°C</td><td>(0° to 140°F)</td></tr>
<tr><td>U.V. Scanner</td><td>5600-91</td><td>-20° to +125°C</td><td>(0° to +257°F)</td></tr>
<tr><td>NEMA4 UV Scanner</td><td>5600-91N4</td><td>-20° to +125°C</td><td>(0° to +257°F)</td></tr>
<tr><td>I.R. Scanner</td><td>5600-92B</td><td>-40° to +110°C</td><td>(-40° to +230°F)</td></tr>
<tr><td>UV/IR Scanner</td><td>5600-92SC</td><td>-20° to +80°C</td><td>(0° to +176°F)</td></tr>
<tr><td>Self-Check U.V.</td><td>5602-91</td><td>-20° to +60°C</td><td>(0° to +140°F)</td></tr>
<tr><td>Remote Display</td><td>5602DB</td><td>0° to 50°C</td><td>(32° to 122°F)</td></tr>
<tr><td>Remote Display</td><td>5602DBP</td><td>0° to 50°C</td><td>(32° to 122°F)</td></tr>
<tr><td>Flame Failure Response</td><td colspan="4">3 seconds ±0.5 seconds.</td></tr>
<tr><td>Trial For Ignition (TFI)</td><td colspan="4">No Purge & Purge Models:
Series 5602 & 5603: five or 10 seconds selectable.
Series 5605: ten or 15 seconds selectable.
Modulating Model: 5 or 10 seconds selectable</td></tr>
<tr><td>Pilot Interrupt (if selected)</td><td colspan="4">10 seconds.</td></tr>
<tr><td>Purge Time</td><td colspan="4">Selectable from 0-225 seconds in 15 second increments.</td></tr>
<tr><td rowspan="5">Output Ratings for 120 VAC (maximum total connected load not to exceed 15 amps)</td><td>Function</td><td>Terminals</td><td>UL, CSA Inductive Load</td><td>Relay Contact Rating Resistive Load</td></tr>
<tr><td>Gas Valve</td><td>3, 5</td><td>175VA, 1/10 HP</td><td>10 amps</td></tr>
<tr><td>Ignition</td><td>4</td><td>375 VA</td><td>10 amps</td></tr>
<tr><td>Motor or Contactor</td><td>8</td><td>470 VA, 1/2 HP</td><td>16 amps</td></tr>
<tr><td>Control Signal</td><td>A, 10, 11, 12, 13</td><td>175VA</td><td>10 amps</td></tr>
<tr><td rowspan="5">Output Ratings for 240 VAC (maximum total connected load not to exceed 15 amps)</td><td>Function</td><td>Terminals</td><td colspan="2">Relay Contact Rating Resistive Load</td></tr>
<tr><td>Valves, Ignition</td><td>3, 4, 5,</td><td colspan="2">5 amps</td></tr>
<tr><td>Motors or Contactor</td><td>8</td><td colspan="2">16 amps</td></tr>
<tr><td>Alarm</td><td>A</td><td colspan="2">5 amps</td></tr>
<tr><td>Control</td><td>10, 11, 12, 13</td><td colspan="2">5 amps</td></tr>
</table>

(continued onto next page)

Specifications *(continued)*

Parameter	Description
Approvals (See chart below.)	• *No Purge & Purge Models:* Series 5602: UL listed, CSA certified, FM approved and IRI acceptable. Series 5603: No approvals. Series 5605: UL listed, FM approved and IRI acceptable. • *Modulating Models:* Series 5602: UL recognized (must be mounted in panel), CSA certified, FM approved and IRI acceptable. Series 5603: No approvals.
Shipping Weight	• 1.4 kilograms (3 lbs.) for all Veri-Flame models. • 0.9 kilograms (2 lbs.) for Models 5602-10 & 5602-10-1 bases. • 1.2 kilograms (2.6 lbs.) for Model 5602-40 base.

Approval Information

UL Listed, Guide No. MCCZ, File MH12613

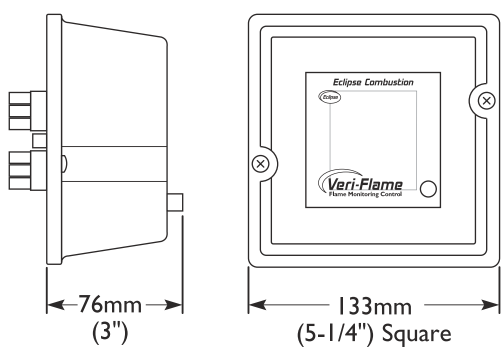
UL Recognized, Guide No. MCCZ2, File MH12613

CSA Certified, Class No. 2632 01, File 37456

FM Approved, Class No. 7610, Report 1Y2A4.AF

Dimensions

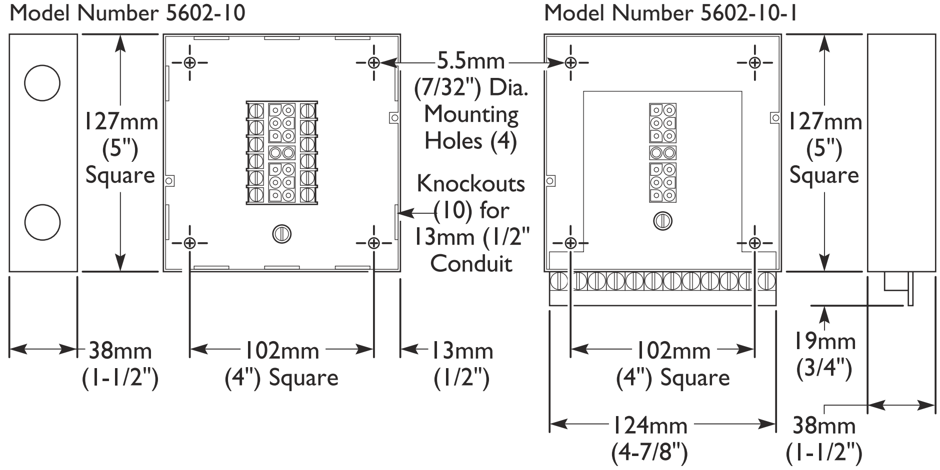
Veri-Flame Unit/All Models



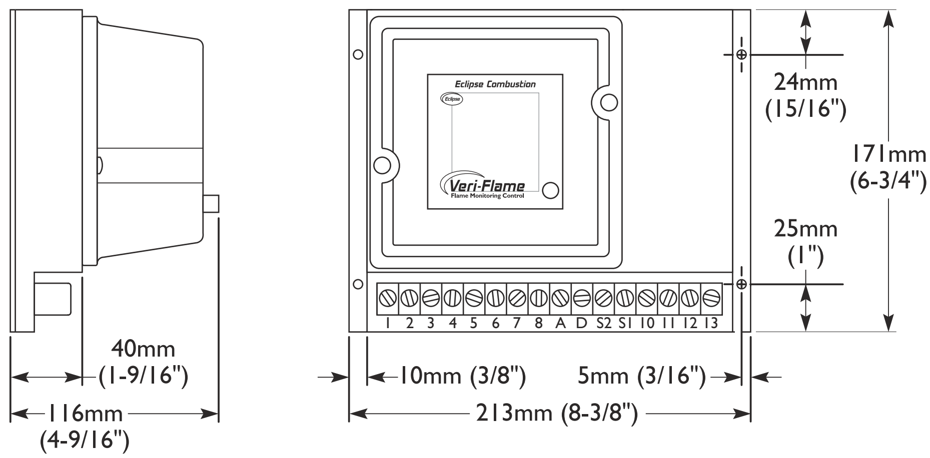
Veri-Flame Bases/Purge & No Purge Models

Model Number 5602-10

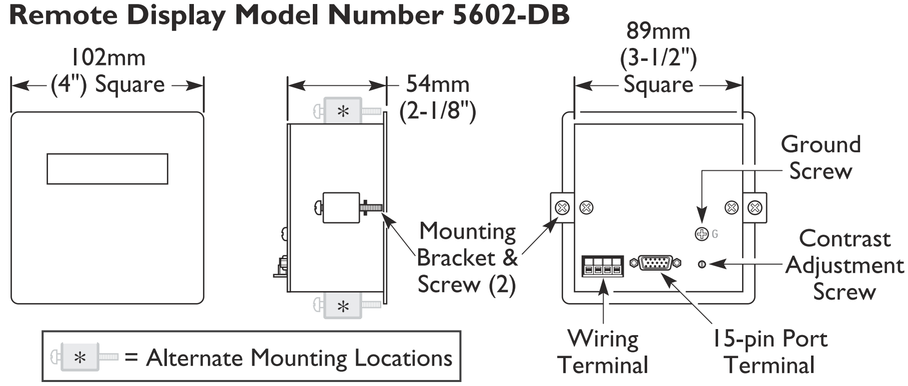
Model Number 5602-10-1



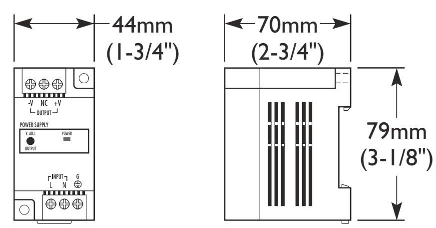
Veri-Flame/Modulating Model with Base Model Number 5602-40



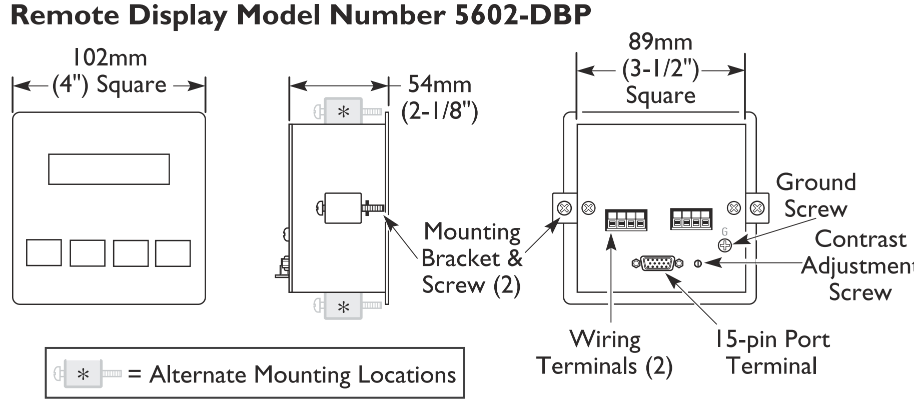
Remote Display Model Number 5602-DB



24VDC Power Supply for Remote Display 5602-DB



Remote Display Model Number 5602-DBP



DIP Switch Selection

3

Introduction

This section details the location, selection and description of the Veri-Flame DIP switches, which allow for sequence and timing functions as well as system configuration.

<u>*Caution*</u>
To avoid electric shock, shut off the power supply when installing or removing any control device. Flame monitoring systems must be installed by a qualified, licensed technician.

DIP Switch Location

All of the DIP switches are located in the back of each Veri-Flame unit (see Figure 3.1 on page 13, or the photograph on page 8).

DIP Switch Access

To gain access to the DIP switches, the Veri-Flame must be separated from the back box (for visual reference, please refer to "Dimensions" on page 10). This separation will expose the DIP switches on the back of the Veri-Flame unit.

No Purge DIP Switch Settings

No Purge models of the Veri-Flame only use three of the eight DIP switches, as shown in the labels in Figure 3.2 on page 13. They are as follows:

SW1: Recycling mode selection (On = Recycling; Off = Non-recycling)

SW2: Pilot selection (On = Intermittent, where pilot remains on during burner cycle; Off = Interrupted, where pilot valve closes after main burner is established).

SW3: Trial-for-ignition (TFI) range selection (For 5602/5603 units: On = 10 seconds; Off = 5 seconds. **For 5605 units**: On = 10 seconds; Off = 15 seconds).

Modulation & Purge DIP Switch Settings

Modulation and purge models of the Veri-Flame use all of the eight DIP switches, as illustrated in Figure 3.2 on page 13. They are as follows:

SW1: Recycling mode selection (On = Recycling; Off = Non-recycling)

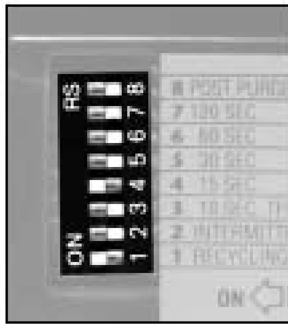
SW2: Pilot selection (On = Intermittent, where pilot remains on during burner cycle; Off = Interrupted, where pilot valve closes after main burner is established).

SW3: Trial-for-ignition (TFI) range selection (**For 5602/5603 units**: On = 10 seconds; Off = 5 seconds. **For 5605 units**: On = 10 seconds; Off = 15 seconds).

SW4 *through* 7: Purge time selection. Total purge time is the sum of each switch selected.

SW8: Post purge selection. (On=15 second post purge).

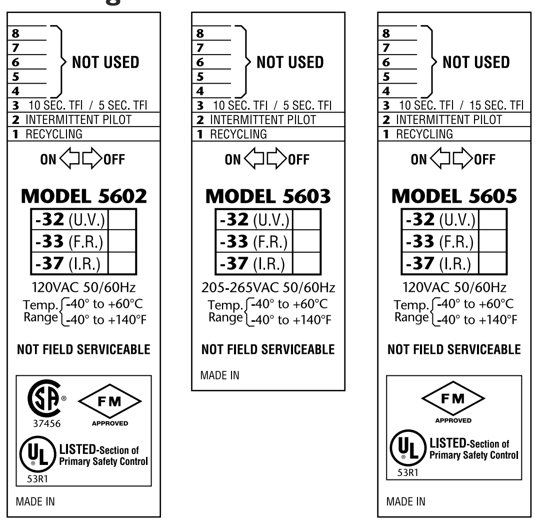
Figure 3.1 DIP Switch Location



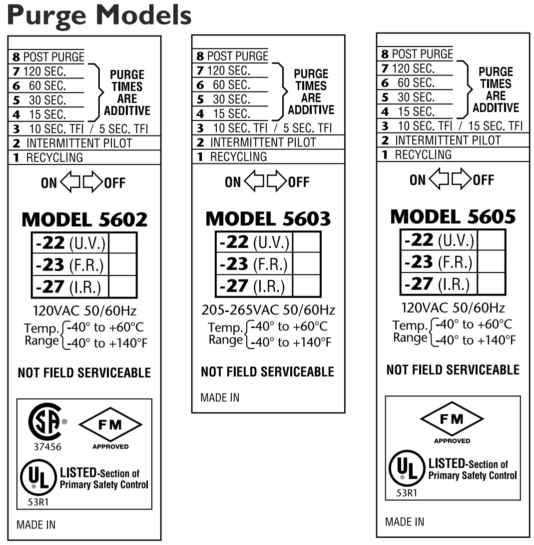
Close-up of DIP switches on back side of all Veri-Flame models.

Figure 3.2 DIP Switch Labels with Selections

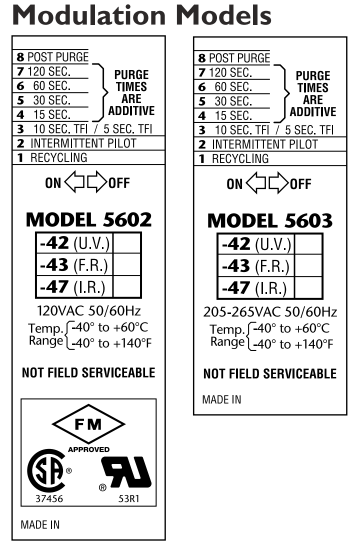
No Purge Models



Purge Models



Modulation Models



Function Summary

4

Introduction

This section describes the features of the Veri-Flame. It is broken into three categories: Standard features, Optional features and the LED Indicator Lights on the front cover. Refer to Figure 5.5 for sequence diagrams.

Standard features

The following function features are standard on the Veri-Flame models as noted:

Interlocks and Limit Switch Input (Terminal 7)

This input is considered the normal operation control or run input to the Veri-Flame system. Interlocks are generally pressure or temperature switches which, when activated, start the burner. Limit switches are generally pressure, temperature and other switches which, when activated, stop the burner. The interlocks and limit switches are wired in series. A break in this circuit will shut the burner down, but will not produce an alarm.

Combustion Air Switch Input (Terminal 6)

For purge and modulation models: This input is for monitoring the combustion air switch separately from other interlocks and limits. The Veri-Flame checks the air flow switch input is open before start-up, closed during operation, and open again at burner shutdown, thus preventing operation with an air switch that is defective, maladjusted or jumped. This input has about a 2 second delay to filter out and ignore a momentary interruption.

The input will be proven open before start-up and after shutdown. If the input is improperly powered before the fan output is energized, the system error light will blink. The input must de-energize within 30 seconds or the Veri-Flame will lockout.

After the fan output has energized, the air switch input must be made within 10 seconds. If not proven, then the system will lockout, the alarm output and the air failure light will come on. However, if the unit has the optional air switch input hold feature, the sequence is held indefinitely without causing a lockout. When the air switch input is made, then the sequence continues.

If the air switch opens during the main firing cycle, the system will either lockout or recycle, depending on the DIP switch recycle selection.

Main Fuel Valve Closed Switch (Terminal V)

Purge and No-Purge models: the Veri-Flame can be interlocked with the main valve closed switch. This feature checks the switch position before start-up and after shutdown to insure proper valve operation when the jumper on the base is cut.

Low Fire Start

For modulation models: when wired, the system checks for the low fire start position prior to light-off.

Main Fuel Valve Closed/ High Fire Purge Check (Terminal D)

For modulation models: This feature is enabled when the jumper on the base is cut. The system checks that the high fire position switch and the main valve closed switch are both made at the end of the high fire purge.

Recycle Mode

For all models: when selected, the Veri-Flame will restart the sequence after flame or air failure. The recycle mode allows the system to re-initiate the start-up sequence automatically provided the main burner has been operating for at least 35 seconds. If the pilot flame fails to light during recycling, the system will lock out and annunciate a pilot flame fail. If the recycle is successful and the main burner is operational for at least 35 seconds, the system is ready for another recycle. At no time will the system recycle in the event of pilot flame fail.

Pilot Test Mode

Test Mode
(Button In)

Run Mode
(Button Out)

For all models: this mode is entered by depressing the TEST/RESET button on the front cover. In the pilot test mode, the Veri-Flame will hold the sequence once the pilot flame is established (i.e., the main valve is not energized). When in the pilot test mode, the green "Interlocks Closed" light **blinks**.

To exit the pilot test mode, simply push the TEST/RESET button again and the Veri-Flame will exit the pilot test mode (the green "Interlocks Closed" light **stops blinking but remains lit**) and restart the sequence.

Interrupted or Intermittent Pilot

For all models: pilot mode is selected using the DIP switch SW2. An interrupted pilot shuts off 10 seconds after the main valve opens. An intermittent pilot continues during the entire main flame firing cycle.

Post Purge

For purge and modulation models: post purge is enabled by DIP switch SW8. A post purge maintains the combustion air fan output for 15 seconds after the interlocks and limit switch input have opened.

Spark, Pilot Flame & Main Flame Separation

For all models: during the trial for ignition period (TFI), the pilot valve and ignition coil remains energized. At the end of the TFI, the pilot flame remains on and the ignition coil is de-energized. After a five second delay to prove the pilot flame, the main gas valve is energized.

System Errors & Lockout Conditions

A ***system error*** (illuminated by the red "System Error" LED on the front cover) prevents gas ignition. The unit will continue its sequence after the error is cleared. A ***lockout condition*** energizes the alarm output and de-energizes the gas valve and ignition outputs. The unit must be reset to clear the alarm and start the sequence. To reset, the button must be pressed twice so that the button is in the out position.

The following system errors result in immediate lockout conditions:

1) Wiring error which puts external voltage on the output terminals **(for all models)**.
2) Welded internal contacts or other malfunctions in the Veri-Flame **(for all models)**.
3) Main fuel valve **(for all models)**–open after cycle shutdown or before start-up. The system error light blinks twice and then remains on. The fan output terminal 8 will energize.

System Errors & Lockout Conditions (Continued)

4) Low fire fail **(for modulating model)**–low fire switch open prior to trial for ignition.
5) High fire fail **(for modulating model)**–high fire switch is not closed at the end of high fire purge.

The following situations will result in a lockout condition:

6) Air failure **(for purge and modulation models)** – loss of combustion air anytime during the operational cycle. The Air Failure LED will be on for this condition. (See "Recycle Mode").
7) Pilot flame fail **(for all models)** loss of flame during the trial for pilot ignition period. The Flame Failure LED will be on for this condition.
8) Main flame fail **(for all models)** loss of flame during the main burner trial for ignition or run period (recycling not selected). The Flame Failure LED will be on for this condition.

The following result in lockout conditions after 30 seconds, the system error light blinks about 14 times and then remains on:

9) If a flame is detected out of sequence, which may be caused by:
   a) a faulty scanner **(for all models)**;
   b) electrical interference on the sensor wiring **(for all models)**;
   c) a flame exists in the burner or in the line of sight of a scanner, due to a gas leak, product fire or other condition **(for all models)**.
10) Air flow switch closed before start-up **(for purge and modulation models)**.

High to Low Fire Purge Modulation Capability with High to Low Fire Position Switch Interlocks

For modulation models: the modulation feature incorporates a high fire purge time and a low fire purge time into the purge sequence. This feature allows the Veri-Flame to sequence internal dry contacts which can be used by the customer requiring a high fire purge of the combustion chamber before ignition.

The high fire and low fire purge times are selectable by means of DIP switches (see Section 3, "DIP Switch Settings" on page 12):

SW4	15 seconds	SW6	60 seconds
SW5	30 seconds	SW7	120 seconds

The selected times are additive and apply to both the high fire and low fire purge times (that is, high and low fire times are always identical).

The modulation terminals will sequence as follows:

Sequence Step	Internal Contact Connections	
Power Off	Terminal 10 (Common)	Terminal 11 (Auto)
Power On, Limits Open	Terminal 10 (Common)	Terminal 12 (Low Fire)
Purge To High Fire	Terminal 10 (Common)	Terminal 13 (High Fire)
Purge To Low Fire	Terminal 10 (Common)	Terminal 12 (Low Fire)
Automatic Modulation	Terminal 10 (Common)	Terminal 11 (Auto)
Alarm and Lockout	Terminal 10 (Common)	Terminal 12 (Low Fire)

The Automatic step occurs when the burners are operating and allows the burner firing rate to be controlled by an automatic temperature controller.

OPTIONAL FEATURES

The following features are available on select models, or when optional equipment is purchased.

Air Switch Input Hold

For purge/modulation models: holds the sequence indefinitely until air switch input is confirmed without affecting the air failure function and causing a lockout.

Remote Display & Power Supply

Two models of remote display are available. The model 5602DB operates on 24VDC and has no keypad. The model 5602DBP operates on 120VAC and has a keypad for reset function. The display is door panel mounted and features a liquid crystal display in a ¼ DIN housing. The unit connects to the Veri-Flame by a cable to the flame signal test jack, and receives a serial communication on each sequence state change. The display incorporates the following functions:

1) Provides status messages for the Veri-Flame sequence (see section 9).
2) Indicates lockout conditions when they occur, as well as the amount of time into the sequence when the lockout occurred (see section 9).
3) Provides continuous monitoring of the burner's flame signal strength and run time during main burner operation.

Manual Reset on Power Outage

This optional feature requires a reset on initial application of power or after an interuption of power. The system error light blinks rapidly (about 4 times per second) and a remote display will show "PUSH RESET TO START". The reset button must be pressed in and out to start

STATUS LIGHTS & PUSH-BUTTON

All of the status lights and the TEST/RESET push-button are located on the front cover of the Veri-Flame. This section describes their respective functions.

Interlocks Closed

For all models: this green LED illuminates when the operation limits are made. These limits are wired in series to terminal 7. This input becomes energized to begin the burner sequence. When in the test mode, this LED blinks (see "Pilot Test Mode" on page 15).

Air Failure

For purge and modulation models: this red LED illuminates whenever combustion air is lost during the operational cycle of the Veri-Flame.

System Error

For all models: this red LED illuminates when a system error is detected (see "System Errors & Lockout Conditions" on pages 15-16).

Flame Failure

For all models: this red LED illuminates when a pilot or main flame fails.

Low Fire

For modulation models: this yellow LED illuminates during the low fire period of the purge cycle.

High Fire

For modulation models: this red LED illuminates during the high fire period of the purge cycle.

Auto

For modulation models: this green LED illuminates during the automatic period which occurs 20 seconds after the main valve is energized.

Test/Reset

For all models: this push-button is used to activate the pilot test mode or to reset the Veri-Flame unit.

Flame Signal

For all models: this red LED is located behind the signal test port and illuminates when a flame signal is present.

System Installation

5

Introduction

In this section, the necessary procedures are detailed to integrate a Veri-Flame into a burner system; Figures 5.1 and 5.2 illustrate the various terminal strips mentioned.

Note:
Shut off the power supply before the Veri-Flame is removed or replaced from the base.

Caution:
Installation and maintenance must conform with the National Electrical Code and all other national and local codes and authorities having jurisdiction. Flame monitoring systems must be installed by a qualified, licensed technician.

Interlocks and Limit Switch Input

Wire external interlock, control, and limit switches in series to this input. Guard against induced voltage levels to wiring connected to this input. In some extreme wiring runs, reduction of induced voltages may require a load (relay or light) connected to terminal 7 to avoid system error lockouts. This input is the power source for the valve and ignition output terminals. Be sure all switches wired to this input can handle the current required by the total of all loads connected to terminals 3, 4,and 5.

Combustion Air Switch Input

For purge and modulation models: Wire any switches and contacts in series to this terminal for proving air flow function and relating to the air failure light. Power must not be immediately present at terminal 6 when power is first applied to terminals 1 or 7.

If this terminal is not used, place a jumper between the combustion blower output (terminal 8) and the air switch input (terminal 6).

If the combustion air blower is controlled outside of the Veri-Flame system, then a three way solenoid valve must be connected between the air switch port and the blower sensing port. The valve de-energized state should vent the switch to ambient pressure. The energized state then connects the air switch to the blower sensing port. Power the valve from the blower ouput terminal 8. If accepted by local codes, the air switch could be wired between the combustion blower output and the air switch input. Connecting the air switch in this manner will satisfy the open contact (air short) check on the switch.

Ignition Wiring

Route ignition wiring a sufficient distance from all sensors and other low voltage wiring to avoid electrical interference, which may cause erratic operation of the Veri-Flame system. Keep the high voltage wire run from the ignition transformer as short as possible. The best condition is to mount the ignition transformer close to the burner and keep a low impedance path from the burner ground to the case of the transformer. Make sure the high voltage lead and ground return paths do not create a loop antenna around the Veri-Flame and sensor wiring.

Low Fire Input

For modulation models: it is possible to wire the system for checking low fire start position prior to pilot ignition. To use this feature, the low fire start switch must be connected between terminal 3 and the pilot valve (see Figure 5.2). On direct spark burners, a by-pass contact must be wired around the low fire switch, see relay and contact CR in Figure 5.3.

Main Valve Closed Switch

The system can be wired to check for the main valve closed switch on the main gas valve prior to start-up and after the end of the burner cycle.

For purge and no purge models: the main valve closed switch must be connected to Terminal V and **the jumper in the base must be cut** (see Figure 5.4 on page 22).

For modulation models: the main valve closed switch must be wired in series between the air flow switch and the high purge damper switch (see Figure 5.1 on page 20). **To use this feature, the jumper in the base must be cut.**

High Purge Input

For modulation models: the system can be wired to check for high purge position during the high fire purge portion of the sequence. **To use this feature, the red jumper in the base must be cut** and the high purge position switch must be connected from terminal 6 to D. If this feature is not used, the jumper in the base remains intact or a jumper must be installed between terminals 1 and D. Please note that the yellow jumper on the base has no effect whether cut or intact.

Remote Reset

This feature permits remote mounting of a switch to reset the Veri-Flame. To use this feature, a normally closed remote reset switch must be wired so power is interrupted to terminal 1. When it is depressed or actuated, the connection to terminal 1 is momentarily interrupted and resets the Veri-Flame.

Remote Display & Power Supply

Identify the model of remote display (see page 11) and wire according to figure 5.3. Mount through a ¼ DIN cutout using the two supplied brackets in either the top and bottom or the side slots. Locate the display and wiring to minimize electrical interference. Applying and disconnecting the display power supply should coincide with power to terminal 1 of the Veri-Flame. Use the appropriate cable (Eclipse part #20318) to connect to the test jack and to the S2 terminal of the Veri-Flame wiring base. Do not attempt to parallel the test jack signal to other devices when using a remote display. The LCD display contrast can be adjusted on the back with a small blade screwdriver.

Figure 5.1 No Purge and Purge Wiring Diagrams

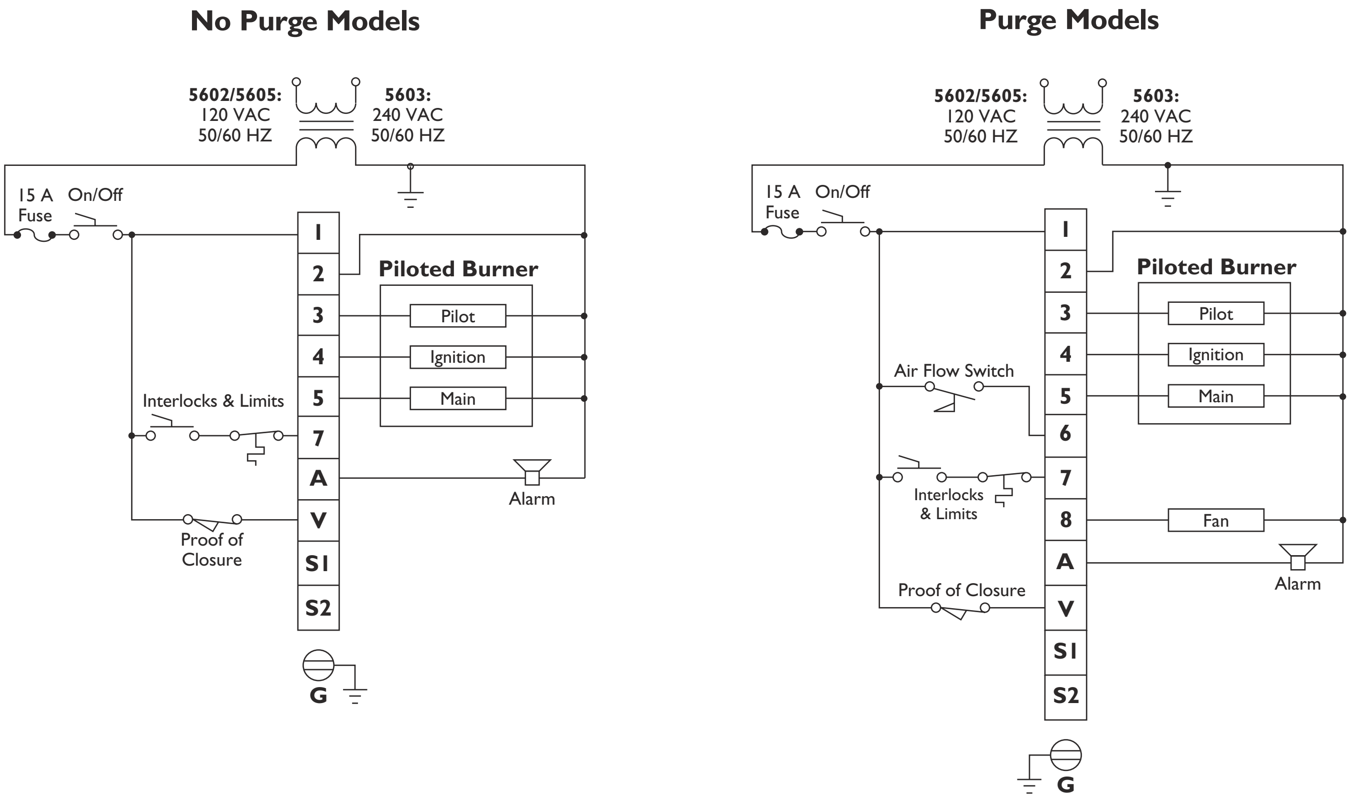


Figure 5.2 Modulation Wiring Diagram

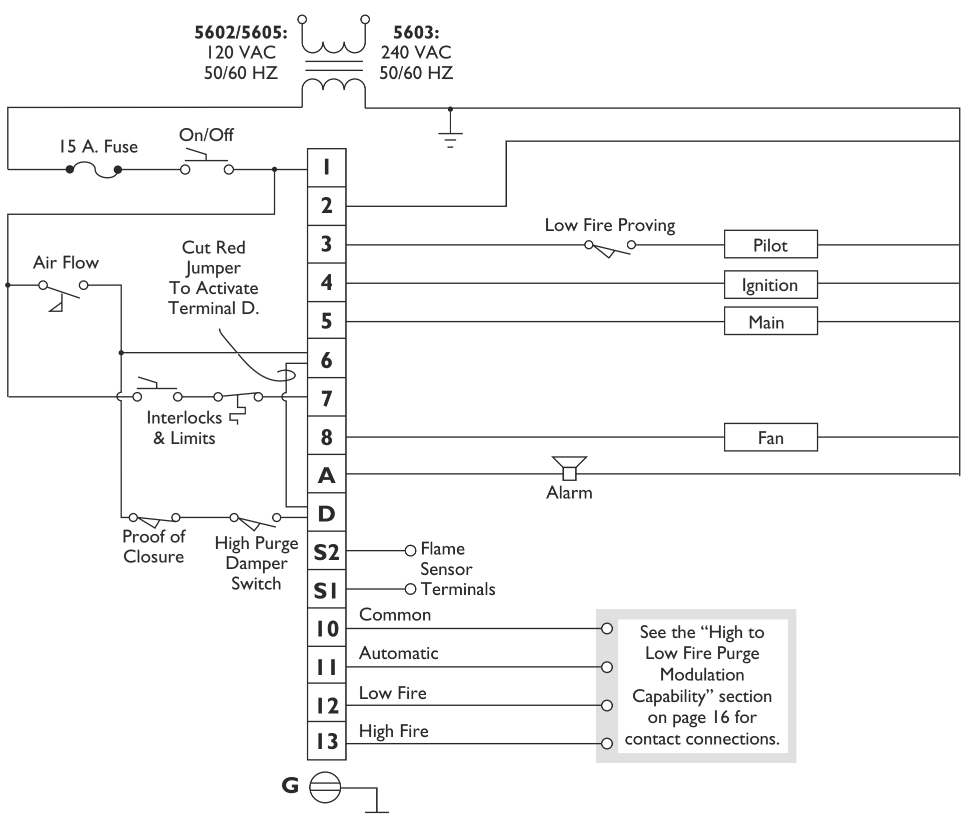
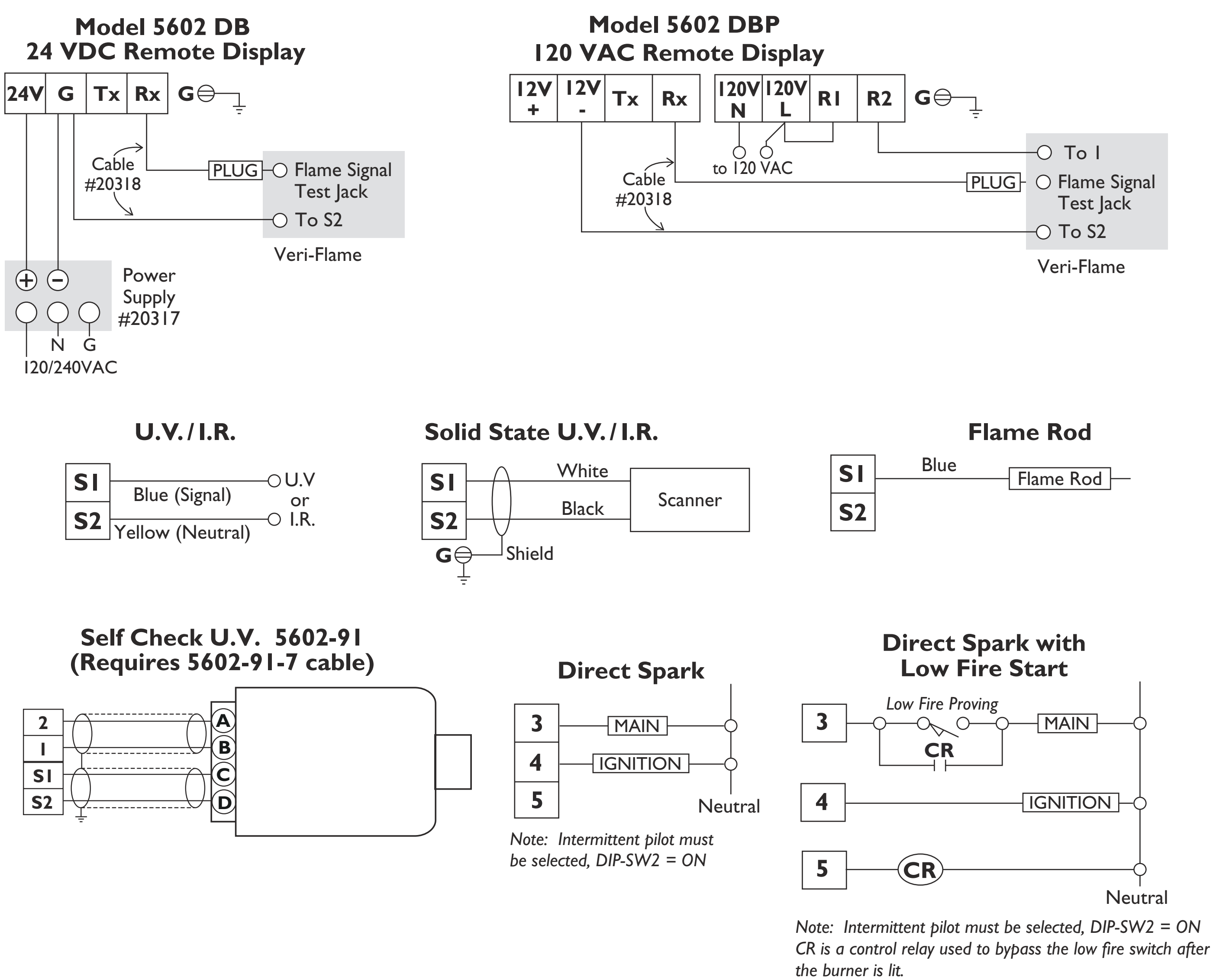


Figure 5.3 **Typical Connections For All Models**

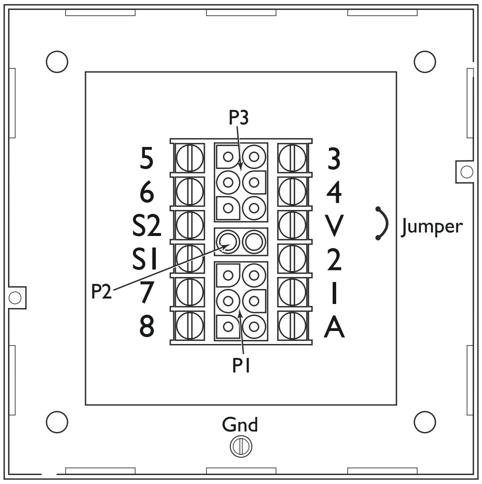


Notes for Figures 5.1, 5.2 & 5.3:

1. *Ground, shielding and conduit must not be connected to terminal S2.*
2. *Control circuit wires must meet 90°C (194°F) specification minimum and must be No. 16 AWG or larger and in accordance with all applicable codes.*
3. *Flame sensor wires must be individually run in their own separate conduit; flame sensor wires CANNOT be run together in a common conduit or wire-way (See Section 6).*
4. *Flame signal should read between 4 and 10 VDC with a digital volt meter. Drop off is approximately 4.0 VDC. Positive test jack point is on the cover marked "Flame Signal" with negative point being the ground.*
5. *Purge time, TFI, intermittent/interrupted pilot, and recycle/non-recycle selections are made with a DIP switch located on the rear plate of the control unit.*
6. *Neutral must be grounded.*

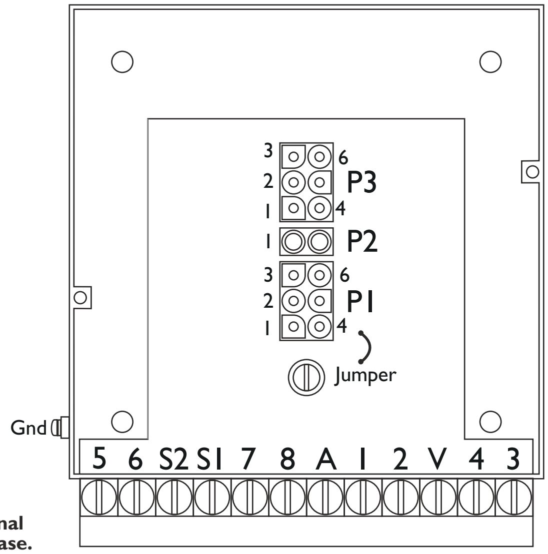
Figure 5.4 Purge and No Purge Bases

Model Number 5602-10

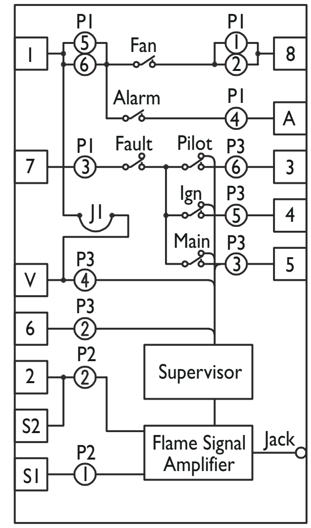


NOTE: Ground Terminal not present in plastic base.

Model Number 5602-10-1



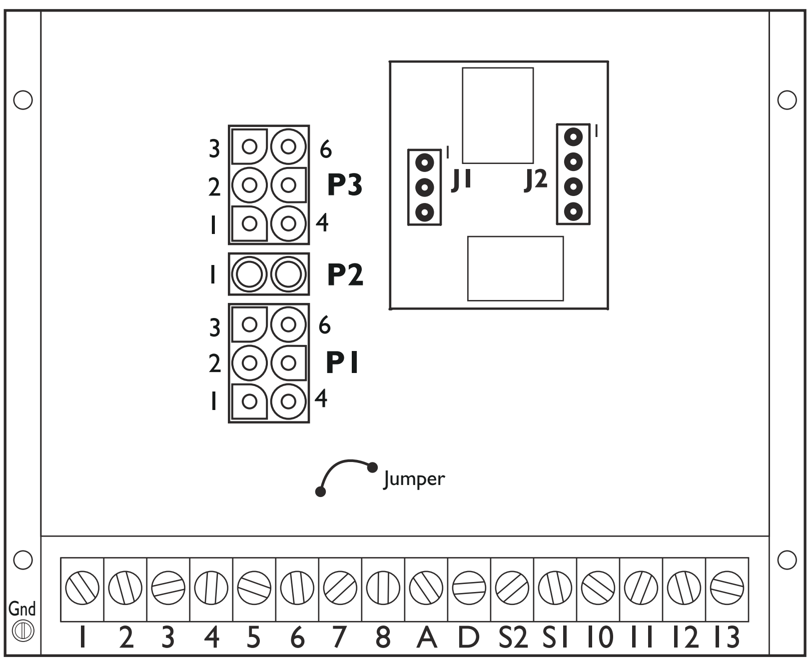
Internal Diagram Purge & No-purge



Note: No purge models do not use 6 & 8.

Modulating Base

Model Number 5602-40



Internal Diagram Modulation Model

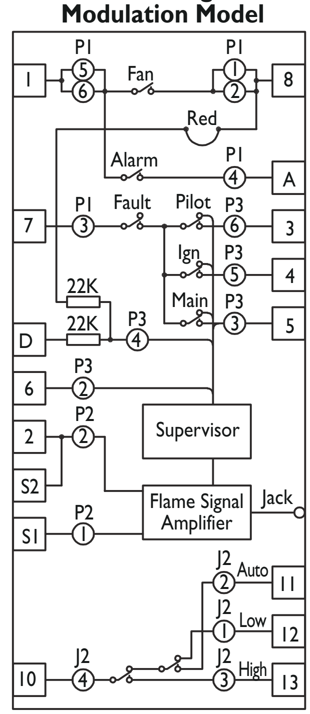
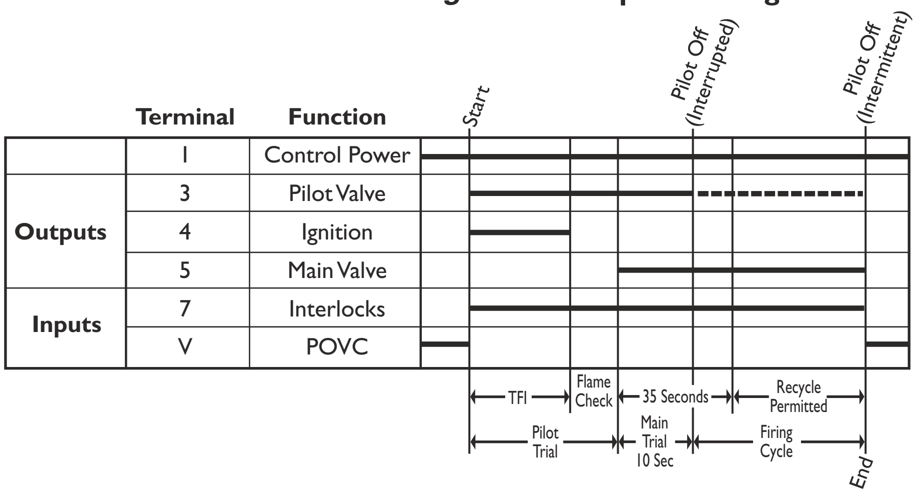
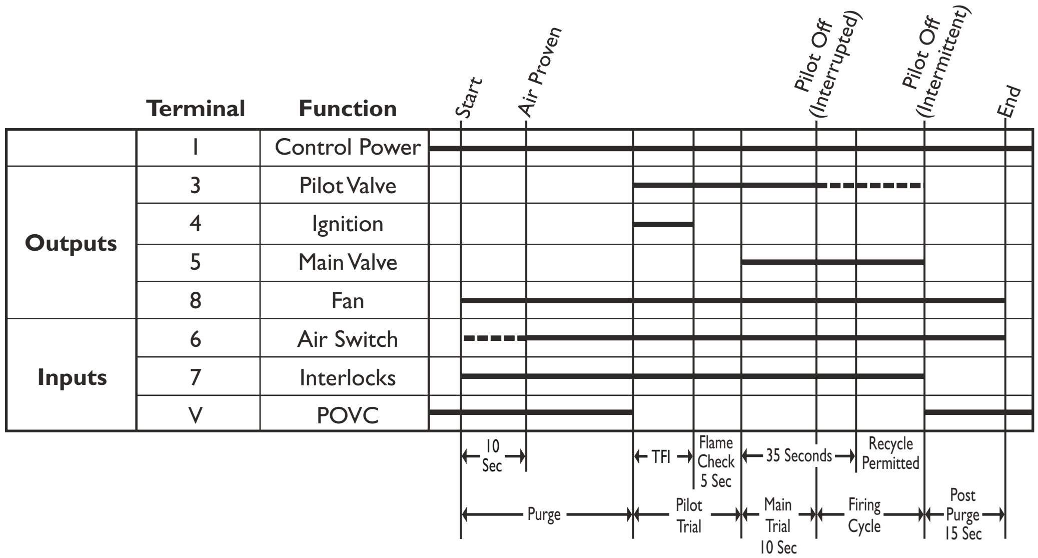
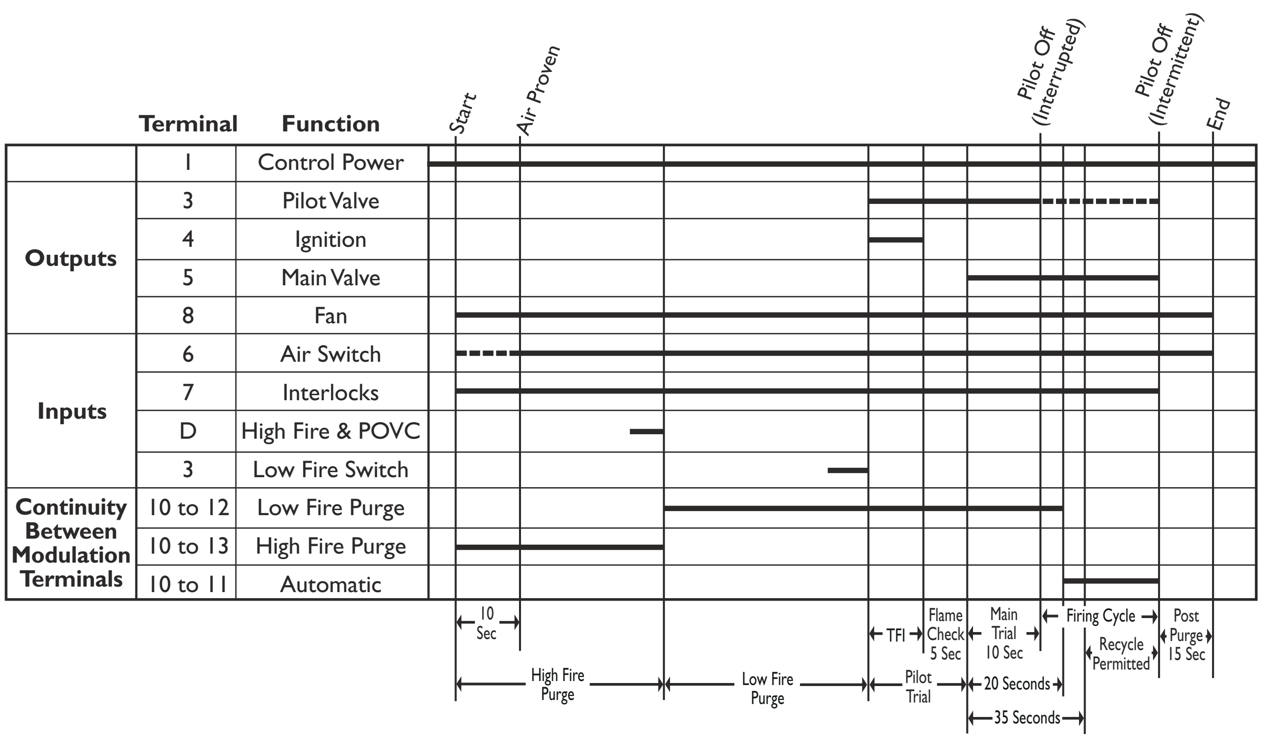


Figure 5.5 Sequence Diagrams







Sensor Installation

6

Introduction

This section describes the proper wiring, installation and sighting considerations for all sensors that can be used with a Veri-Flame.

<u>**Warning**</u>
Incorrect sensor installation may cause the sensor to generate a false flame signal, possibly resulting in the collection of unburned fuel in the combustion chamber. This unburned fuel creates the potential for explosions which can result in injuries, death and property damage. Be certain that the flame sensor detects acceptable pilot and main flames only.

Sensor Wiring

Route sensor wiring a sufficient distance from ignition and other high voltage or high current wiring to avoid electrical interference. Interference from ground currents, nearby conductors, radio-frequency emitters (wireless divices), and inverter drives can induce false flame signals. Shielded cables can help reduce interference with the shield connected to ground at the control end only. The wire type and its capacitance (picofarads or microfarads) to ground may cause low signal problems, so a grounded shield may decrease the signal due to the cable's internal capacitance. Multiple U.V. tube-type sensor leads run together without shielding may interfere or "cross talk", so the shield or flexible armor must be grounded to prevent this situation. For flame rod sensor runs approximately 100 feet (30 meters) or greater, use Eclipse part number 21741 coax cable. To achieve the maximum wiring distance, the shield should not be grounded (keep in mind that an ungrounded shield provides less protection against electrical interference).

<u>Note:</u>
Unshielded sensor wiring must not be run in common with other wires; it must be run in separate conduit. Use #14 to #18 AWG wire suitable for 90°C (194°F) and 600 volt insulation. Multiple unshielded flame sensor wiring must not be run together in a common conduit or wireway. Multiple shielded flame sensor cables can be run in a common conduit.

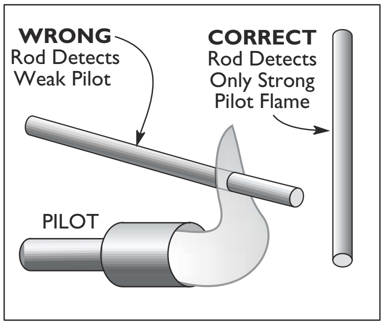
Flame Rods

Flame rods should be used only on gas burners. They accumulate soot on oil burners, causing nuisance shutdowns and unsafe operating conditions.

See the burner manufacturer's literature for flame rod mounting location. When installing flame rods, please consider the following:

1) Keep the flame rod as short as possible and at least 13 mm (1/2") away from any refractory.
2) Position the rod into the side of both the pilot and main flames, preferably at a descending angle to minimize drooping of the flame rod against burner parts, as shown in Figure 6.1. Flame rod position must adequately detect the pilot flame at all burner draft conditions. Extend the rod 13 mm (1/2") into nonluminous flames, such as blue flames from burning an air/gas mixture. For partially luminous flames, such as atmospheric air/gas mixtures, place the rod at the edge of the flame.
3) Provide a burner/flame grounding area that is at least four times greater than the flame rod area contacting the flame. The flame rod/burner ground ratio and position of the rod in the flame may need adjustment to yield maximum flame signal strength.
4) Ignition interference from the spark plug may increase or decrease the flame signal strength. Reversing the ignition transformer primary leads may reduce this effect. Changing the spark gap or adding grounding area between the flame rod and spark plug may eliminate the interference.

Figure 6.1 Flame Rod Position



Scanners

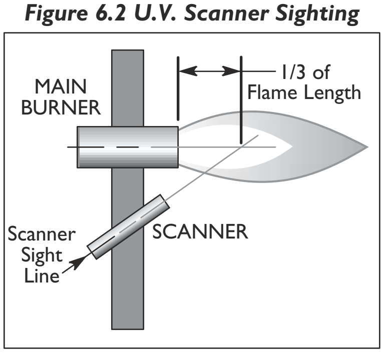
Warning
Use only Eclipse scanner models as listed in the Illustrated Parts List at the end of this document.

When installing scanners, please consider the following:

1) Position the scanner within 457 mm (18") of the flame. Consult factory for longer distances.
2) Bushing threads are 1/2 inch F.N.P.T. for all scanner models except 5602-91 which has 1 inch F.N.P.T. bushing threads.
3) The ambient temperature limits of each scanner varies; check the literature for the specific scanner model. For higher temperatures, use Eclipse heat block seal 23HBS for ½” N.P.T. scanners and if necessary, add cooling purge air.
4) An optional magnifying lens may also be used to increase the flame signal strength in difficult sighting situations.

Scanner Sighting Considerations

Figure 6.2 U.V. Scanner Sighting



Aim scanners at the third of the flame closest to the burner nozzle, as shown in Figure 6.2 (oil flames typically have less UV radiation in the outer flame). The scanner should view the intersection of the pilot and main flames. When sighting scanners, please consider the following:

1) Sight the scanner away from the ignition spark. Sighting the spark or its reflections from burner internals can cause nuisance shutdowns during burner ignition. If necessary, use a scanner orifice to reduce spark pickup.
2) Do not allow the scanner to detect a pilot flame that is too small to ignite the main burner.
3) Perform a minimum pilot test when installing or adjusting any pilot or main burner system; see “Minimum Pilot Test” on page 26.
4) I.R. scanner model 5600-92B is ideal for oil flame applications. When used, aim the I.R. scanner at the outer oil flame for flickering detection.

Test Procedures

7

Introduction

This section describes the test procedures that must be performed after installation to insure that the Veri-Flame is operating properly; these procedures are mandatory.

Flame Signal Strength

Insert the positive probe of a 0-15 VDC, digital volt meter into the test point on the front cover of the Veri-Flame; connect the negative probe to ground. A good flame signal strength will read between 6 and 11 VDC; anything below 4 VDC is inadequate. Also, the red LED inside the test point illuminates when a flame signal is indicated.

Minimum Pilot Test

Run the following test procedures to ensure that the sensor will not detect a pilot flame too small to reliably light the main flame:

1) Manually shut off the fuel supply to the burner, but not to the pilot.
2) Start the system normally.
3) To enter the pilot test mode, depress the test/reset button located in the lower right corner on the front cover.
4) The control will hold the operating sequence at the pilot flame step. Measure signal strength as described above.
5) Reduce pilot fuel until the flame relay drops out. Increase pilot fuel until the flame signal is greater than 4 VDC, and flame relay just manages to pull in. This is the minimum pilot. If you don't think this flame will be able to safely light the main burner, realign the sensor so that it requires a larger pilot flame and repeat steps 2 through 5.
6) Push the test/reset button located in the lower right corner on the front cover to exit the test mode (reset) and begin the normal start-up sequence again.
7) When the sequence reaches the main flame trial for ignition, smoothly restore the fuel supply to the burner. If the main burner does not light within five seconds, immediately shut off the burner supply to shut down the system. Realign the sensor so that it requires a larger pilot flame. Repeat steps 1 through 6 until the main burner lights off smoothly and reliably.

Pilot Flame Failure Test

1) Manually shut off the fuel supply to the pilot and the main burner.
2) Place system in pilot test mode (please refer to page 15).
3) Start the system normally. The controller should lock out*; if it doesn't, then the controller is detecting a false flame signal (see Section 6). Find the problem and correct it before resuming normal operation.

Main Flame Failure Test

(For Interrupted Pilot Systems)

1) Manually shut off the fuel supply to the main burner but not to the pilot.
2) Start the system normally. This should ignite the pilot and lock out* after pilot interruption. If the system does not lock out, the controller is detecting a false flame signal (see Section 6). Find the problem and correct it before resuming normal operation.

Spark Sighting Test

1) Manually shut off the fuel supply to the pilot and the main burner.
2) Start the system normally.
3) Measure the flame signal as described in "Flame Signal Strength" in this section.
4) If a flame signal greater than 4VDC is measured for more than three seconds during the trial for ignition, then the sensor is picking up a signal from the spark plug; see "Sensor Wiring" on page 24.

Limits & Interlock Tests

Periodically check all interlock and limit switches by manually tripping them during burner operation to make sure they cause the system to shut down.

Warning
Never operate a system that is improperly adjusted or has faulty interlocks or limit switches. Always replace faulty equipment with new equipment before resuming operation. Operating a system with defective safety equipment can cause explosions, injuries, and property damage.

* Indicated by the illuminated red "Flame Failure" LED on the Veri-Flame front cover.

Maintenance & Troubleshooting

8

INTRODUCTION

This section is divided into two parts:

- The first part describes the maintenance procedures.
- The second part describes troubleshooting procedures, from identifying problems to interpreting the operating conditions by the lit LEDs on the front cover.

MAINTENANCE

Preventative maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance program is a list of periodic tasks.

In the paragraphs that follow are suggestions for a monthly list and a yearly list.

Note:
The monthly list and the yearly list are an average interval. If your environment is dirty, then the intervals may be shorter.

Caution:
Turn off power before disconnecting or installing sensors, controls or modules.

Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness. Keep scanner lenses clean with a soft, damp cloth, since small amounts of dust will measurably reduce the flame signal strength. Wash the flame rod electrode and insulator with soap and water, then rinse and dry thoroughly.
2. Test all the alarm systems for proper signals.
3. Check ignition spark electrodes and check proper gap.
4. Test interlock sequence of all safety equipment as described on page 27: manually make each interlock fail, noting what related equipment closes or stops as specified by the manufacturer.

   Test flame safeguard by manually shutting off gas to the burner.

Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure setting and comparing with actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Make sure that the following components are not damaged or distorted:
   - the burner nozzle
   - the spark plugs
   - the flame sensors
   - the flame tube or combustion block of the burner

Troubleshooting

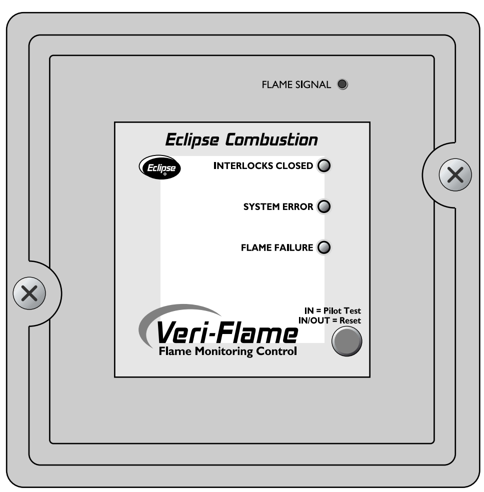
Problem	Possible Cause	Solution
Cannot initiate start sequence	Main valve is not closed.	Check main valve closed switch. No voltage on V (or D).
	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower. No voltage on 6 after 8 is on.
	High gas pressure switch has tripped.	Check incomming gas pressure; adjust gas pressure if necessary. Check pressure switch setting and operation. No voltage to 7.
	Low gas pressure switch has tripped.	Check incomming gas pressure; adjust gas pressure if necessary. Check pressure switch setting and operation. No voltage to 7.
	Malfunction of flame safeguard system such as a shorted-out flame sensor or electrical noise in the sensor line.	Have qualified electrician investigate and rectify.
	Purge cycle not completed.	Check switch settings. Check air switch.
	Main power is off.	Make sure power is on to control system.
	No power to control unit.	Call qualified electrician to investigate.
Scrambled messages on remote display.	Electrical interference.	Check grounding in system. Separate communication cable. Move ignition circuit.
"UNSAFE AIR SHORT" message appears on display.	Improperly adjusted air switch. Air switch either shorted or wired wrong.	Check air switch settings. Check wiring to air switch.
Burner flame fails but no flame failure indication occurs.	A faulty scanner.	Check scanner as explained in checklists in "Maintenance" portion of this Section.
	Improperly connected sensor wires.	Check wiring diagram on page 20 or 21 as well as appropriate sensor information in Section 6.
	Electrical interference from other current carrying wires.	Check Note information on page 24 regarding sensor wiring.
Voltage reading greater than 15VDC at "Test Point" on Veri-Flame faceplate.	Improper grounding.	Check grounding of neutral at control power transformer.

LED Status

This section describes the status of operating conditions based on the LED or combination of LEDs which are lit on the front cover of each Veri-Flame model.

Table 8.1 **LED Status & Conditions for Veri-Flame No Purge Models**

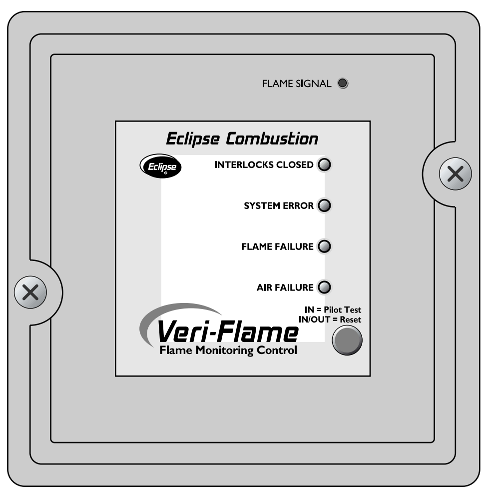
LED(s) Lit	Possible Causes
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal light is on. 4) Voltage wired into terminals 3, 4 or 5. 5) Internal relay contacts welded. 6) Internal controller failure. 7) Main valve closed switch defective, no power to V.
FLAME FAILURE	1) Pilot flame is not established in selected TFI. 2) Main flame is not established in selected TFI. 3) Main flame fails within 35 seconds of TFI. 4) Flame failed during operation in non-recycle mode. 5) Flame failed 35 seconds after TFI and was not established after try in recycle mode.



No Purge Model

Table 8.2 LED Status & Conditions for Veri-Flame Purge Models

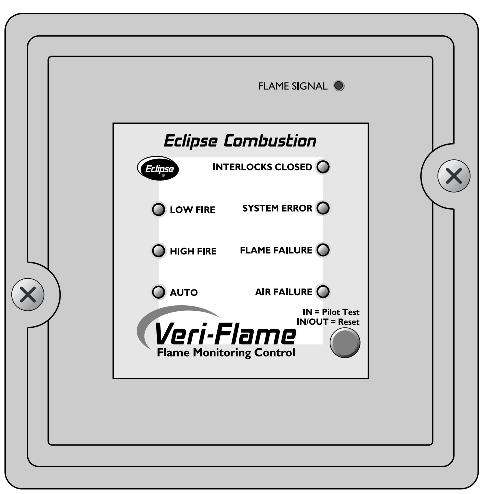
LED(s) LIT	POSSIBLE CAUSES
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal light is on. 4) Voltage wired into terminals 3, 4 or 5. 5) Internal relay contacts welded. 6) Internal controller failure. 7) Air flow switch closed before start-up. 8) Main fuel valve switch opens after shutdown or before start-up, no power to V.
FLAME FAILURE	1) Pilot flame is not established in selected TFI. 2) Main flame is not established in selected TFI. 3) Main flame fails within 35 seconds of TFI. 4) Flame failed during operation in non-recycle mode. 5) Flame failed 35 seconds after TFI and was not established after one try in recycle mode.
AIR FAILURE	1) Air flow switch not closed within ten seconds of start-up. 2) Air flow switch is open during timing cycle. 3) Air flow switch is open during firing cycle.



Purge Model

Table 8.3 LED Status & Conditions for Veri-Flame Modulation Models

LED(s) Lit	Possible Causes
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal light is on. 4) Voltage wired into terminals 3, 4 or 5. 5) Internal relay contacts welded. 6) Internal controller failure. 7) Air flow switch closed before start-up. 8) High purge damper switch and/or main fuel valve switch opens during start-up. 9) Low fire switch not made before TFI.
FLAME FAILURE	1) Pilot flame is not established in selected TFI. 2) Main flame is not established in selected TFI. 3) Main flame fails within 35 seconds of TFI. 4) Flame failed during operation in non-recycle mode. 5) Flame failed 35 seconds after TFI and was not established after try in recycle mode.
AIR FAILURE	1) Air flow switch not closed within ten seconds of start-up. 2) Air flow switch is open during timing cycle. 3) Air flow switch is open during firing cycle.
INTERLOCKS CLOSED and AUTO	1) Burner in run mode, firing rate determined by automatic controller (normal operation).
INTERLOCKS CLOSED and HIGH FIRE	1) Purge high sequence (normal operation).
INTERLOCKS CLOSED and LOW FIRE	1) Purge low sequence (normal operation).



Modulation Model

Remote Display Messages

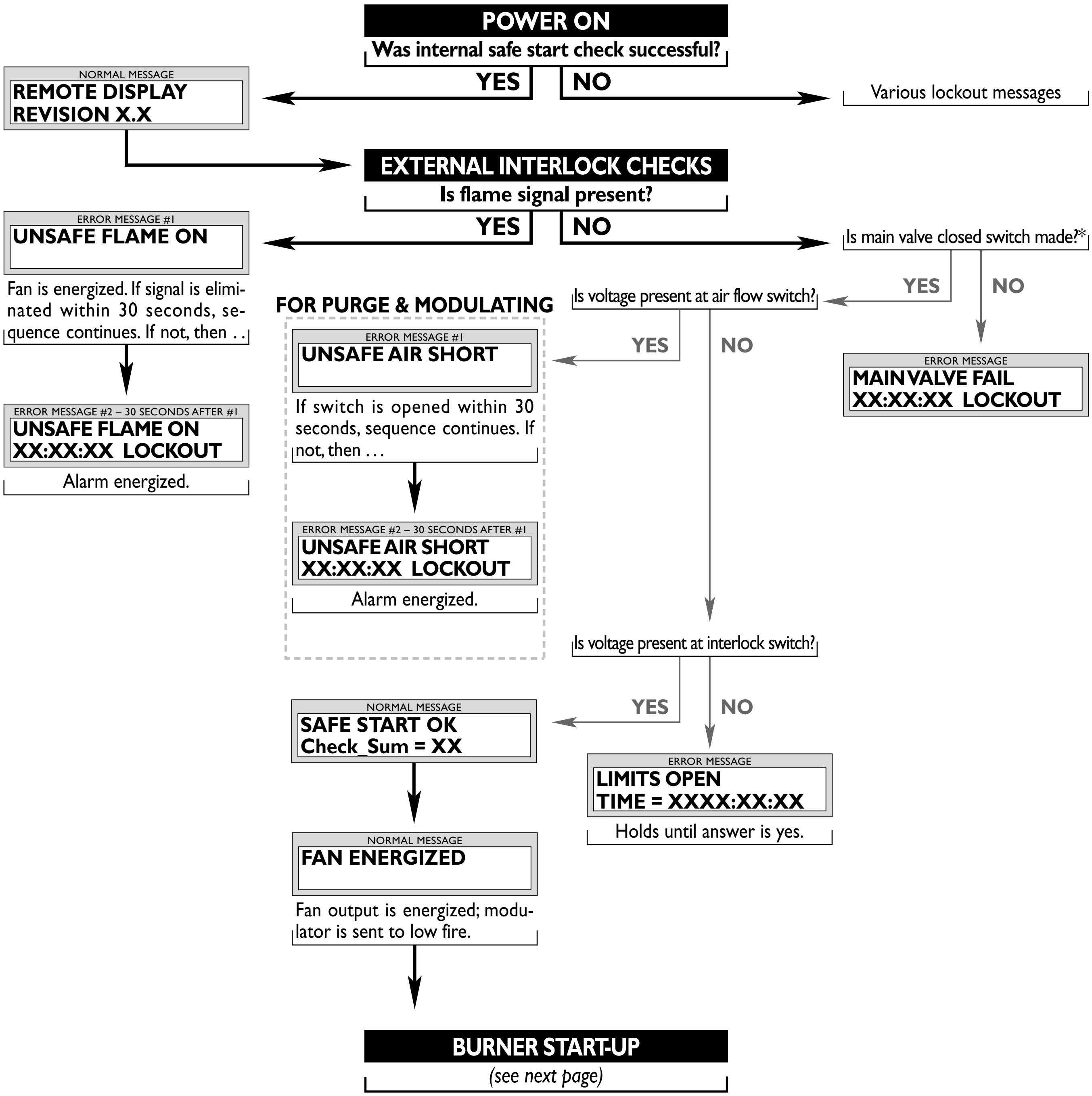
9

Introduction

This section covers how the optional remote display is used with the Veri-Flame. The remote display provides LCD messages which monitor the status of the Veri-Flame's functions as well as any lockout conditions. This section is divided into two parts or tables:

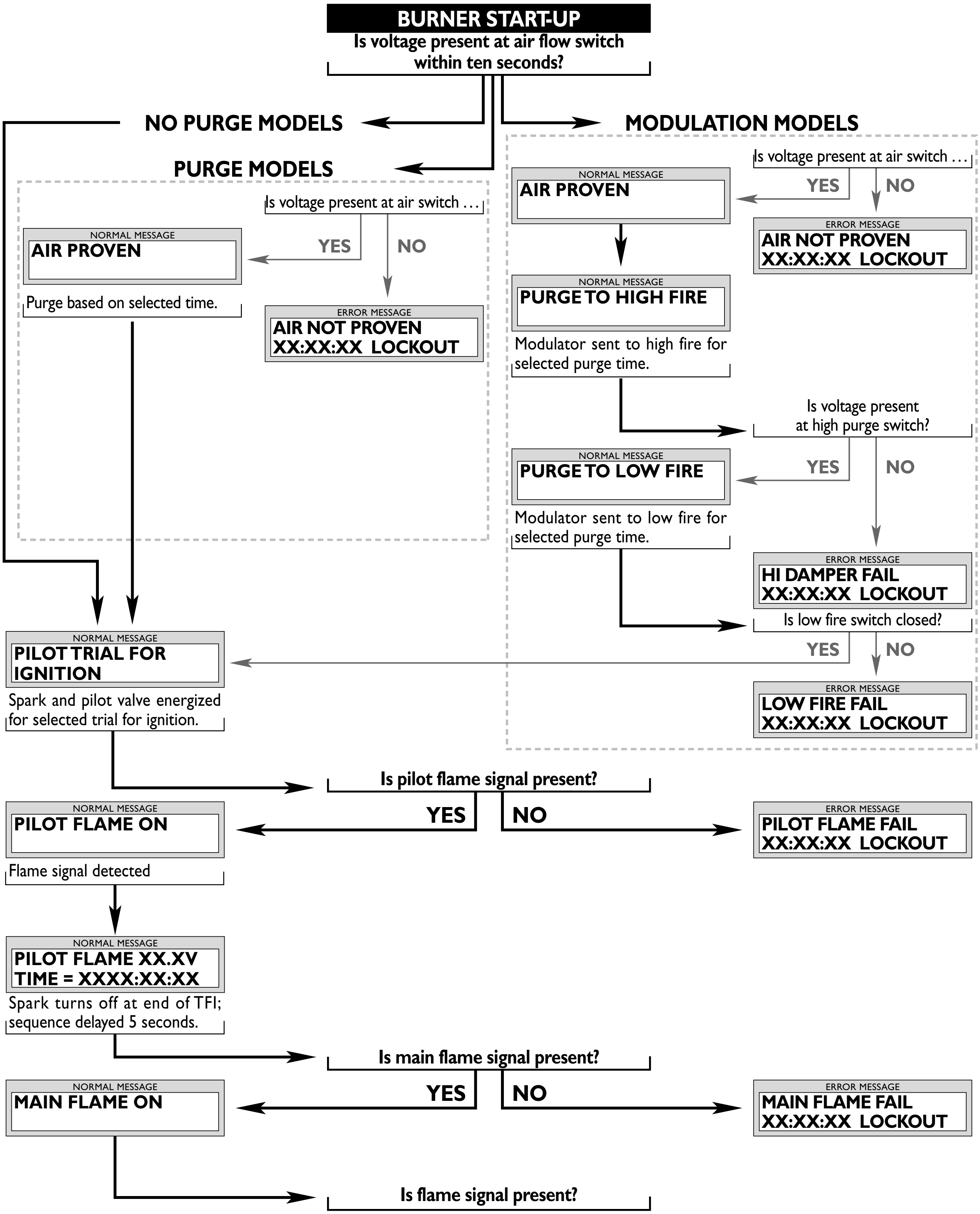
- The first table describes the start-up and shutdown monitoring sequences of the Veri-Flame and how the progress (or halt) of the sequence can be monitored by the messages on the remote display.
- The second table alphabetically lists and explains the diagnostic messages which can appear on the remote display.

Table 9.1 **Veri-Flame Operating Sequence**



* Applies to purge and no purge models only.

Table 9.1 **Veri-Flame Operating Sequence** (continued)



(see next page)

Table 9.1 **Veri-Flame Operating Sequence** (continued)

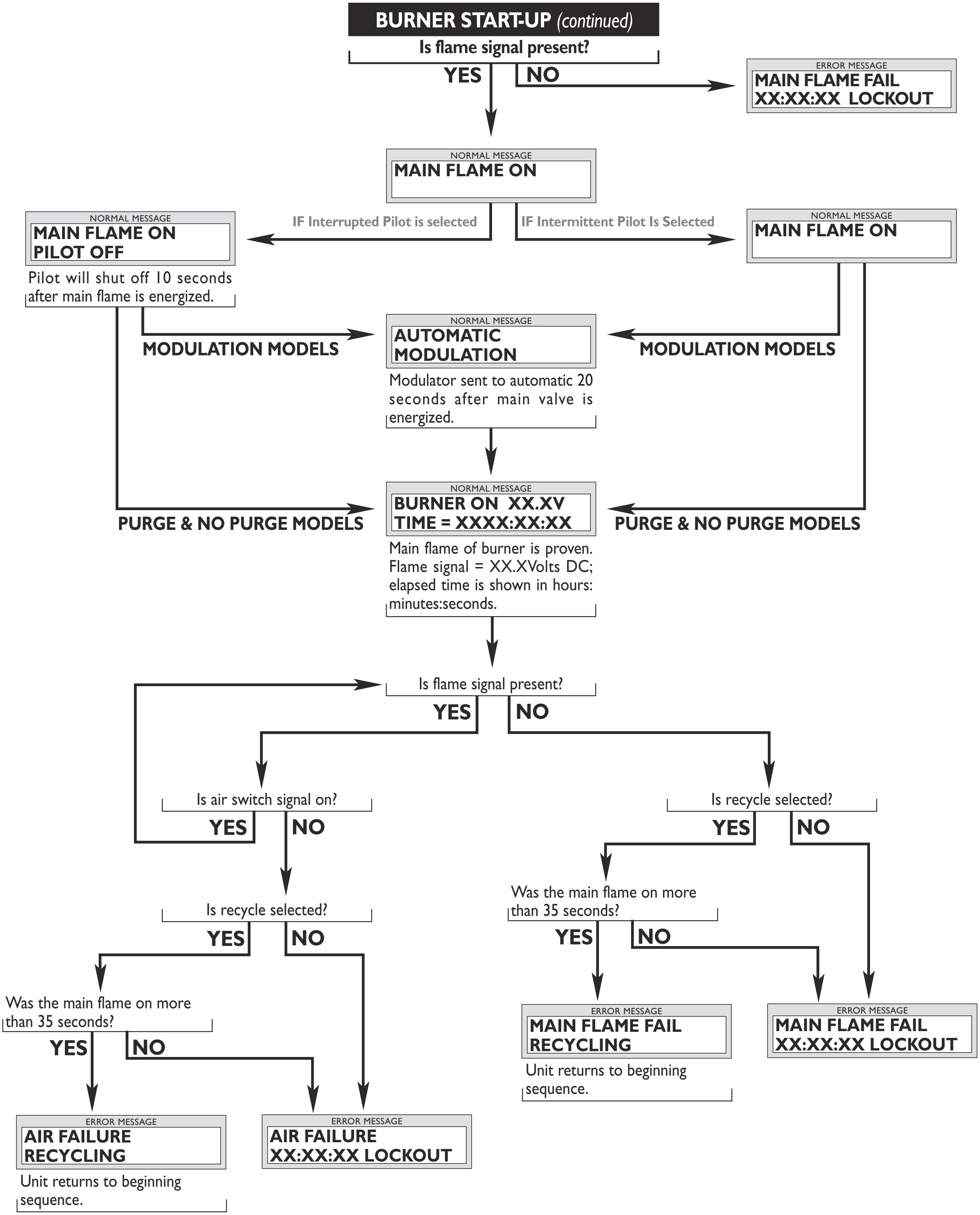
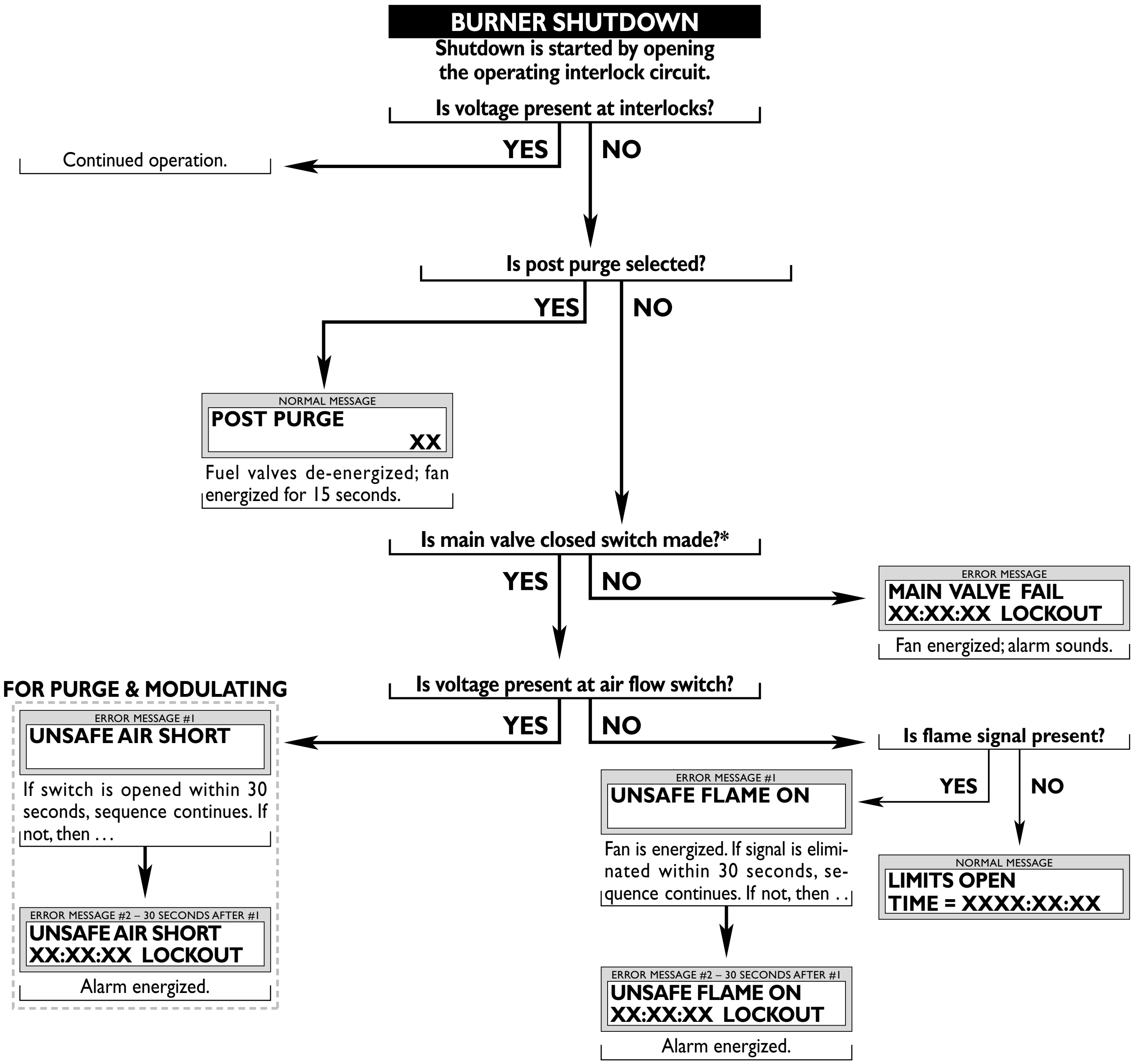


Table 9.1 **Veri-Flame Operating Sequence** (continued)



* Applies to purge and no purge models only.

Table 9.2 **Remote Display Diagnostic Messages (Listed Alphabetically)**

Message	Type	Explanation
AIR FAILURE XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Combustion air flow limit switch opened for more than two seconds once initially proven.
AIR FAILURE RECYCLING	Status	**For purge & modulation models:** Combustion air flow limit switch opened; if "recycle" has been selected, the Veri-Flame will restart the sequence after air failure (see "Recycle Mode" on page 14).
AIR NOT PROVEN XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Combustion air flow limit switch did not make within ten seconds of fan being energized.
AIR PROVEN	Status	**For purge & modulation models:** Combustion air flow limit switch closed within ten seconds of fan being energized.
AUTOMATIC MODULATION	Status	**For modulation models only:** Modulating motor is sent to automatic operation.
BURNER ON XX.XV TIME=XXXX:XX:XX	Status	Main flame of burner is proven in the automatic modulation mode; flame strength is XX.XV (volts DC). Elapsed time is shown in hours:minutes:seconds.
D-INTERNAL FAIL XX:XX:XX:XX LOCKOUT	Lockout	**For modulation models only:** Internal control failure; replace controller.
FAN ENERGIZED	Status	**For purge & modulation models:** Blower motor is energized at the start of pre-purge.
FLAME FAILURE XX:XX:XX LOCKOUT	Lockout	Main flame lost during operation in the automatic modulation mode. Burner number (X) given of failed unit.
HI DAMPER/POVC XX:XX:XX LOCKOUT	Lockout	**For modulation models only:** High damper or high purge rate switch did not make at the end of pre-purge to high fire.
K-INTERNAL FAIL XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
L-INTERNAL FAIL XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
LIMITS OPEN TIME=XXXX:XX:XX	Status	The controller has completed its internal checks and is standing by for the interlocks to close.
LOW FIRE FAIL XX:XX:XX LOCKOUT	Lockout	**For modulation models only:** Low fire switch is open just prior to pilot trial for ignition.
MAIN FLAME FAIL XX:XX:XX LOCKOUT	Lockout	Main flame was not established during the main burner trial for ignition.
MAIN FLAME FAIL RECYCLING	Status	Main flame lost during automatic modulation; control will recycle once if "recycle" has been selected.

Table 9.2 **Remote Display Diagnostic Messages** (continued)

MESSAGE	TYPE	EXPLANATION
MAIN FLAME ON	Lockout	Main valve has been energized and main flame proven during trial for ignition.
MAIN FLAME ON PILOT OFF	Status	Pilot valve is de-energized and main flame is on.
MAIN VALVE FAIL XX:XX:XX LOCKOUT	Lockout	**For purge and no purge models:** Main valve closed switch is open before start-up or after burner shutdown.
NO PURGE SELECT XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** No purge time was selected; lockout prior to purge to high fire.
PILOT FLAME FAIL XX:XX:XX LOCKOUT	Lockout	Pilot flame was not established during the pilot trial for ignition.
PILOT ON	Status	Pilot flame is proven; transformer is de-energized; remaining countdown for pilot trial for ignition is.
PILOT TRIAL FOR IGNITION	Status	Pilot valve and ignition transformer are energized; countdown for pilot trial for ignition begins.
POST PURGE	Status	**For purge & modulation models:** 15 second post purge is started on burner shutdown.
PROGM SWITCH ERR XX:XX:XX LOCKOUT	Lockout	DIP switch improperly set or changed during cycle.
PURGE TO HIGH FIRE	Status	**For modulation models only:** Modulating motor is sent to high fire.
PURGE TO LOW FIRE	Status	**For modulation models only:** Modulating motor is sent to low fire.
RELAY FAIL XX:XX:XX LOCKOUT	Lockout	Internal relay(s) fail initial check. Check ratings. If lockout still occurs after overload is eliminated, replace control.
SAFE START OK	Status	Control has completed internal safe-start check.
UNSAFE AIR SHORT	Status	**For purge & modulation models:** Combustion air switch is closed before start-up or after shutdown; control holds start-up until switch reopens; if interlocks close before switch opens, alarm is energized.
UNSAFE AIR SHORT XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Same conditions as above, except the interlocks close before the switch reopens, causing a lockout and the alarm being energized.

Table 9.2 **Remote Display Diagnostic Messages** (continued)

MESSAGE	TYPE	EXPLANATION
UNSAFE FLAME ON	Hold	Flame signal—actual, induced, or runaway scanner—is detected before start-up or after shutdown. The fan is energized. If the cause is corrected within 30 seconds, as in afterburn, the control will turn off the fan and continue the sequence.
UNSAFE FLAME ON XX:XX:XX LOCKOUT	Lockout	Same conditions as above, except the cause has not been corrected within 30 seconds, resulting in a lockout and the alarm being energized.
UNSAFE–FLM–PURGE	Hold	**For purge & modulation models:** Flame signal—actual, induced, or runaway scanner—is detected during the selected purge time period. The fan is energized. If the cause is corrected within 30 seconds, as in afterburn, the control will turn off the fan and continue the sequence.
UNSAFE–FLM–PURGE XX:XX:XX LOCKOUT	Lockout	**For purge & modulation models:** Same conditions as above, except the cause has not been corrected within 30 seconds, resulting in a lockout and the alarm being energized.
V–INTERNAL FAULT XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
WATCHDOG FAIL XX:XX:XX LOCKOUT	Lockout	Internal control failure; replace controller.
XXXXXXX XXXXXTESTXX	Status	In combination with other messages, shows the control is in the minimum pilot test mode.

Appendix

Conversion Factors

Metric to English.

From	To	Multiply by
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hour (m^3/h)	cubic foot/hour (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 1.8) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("wc)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}

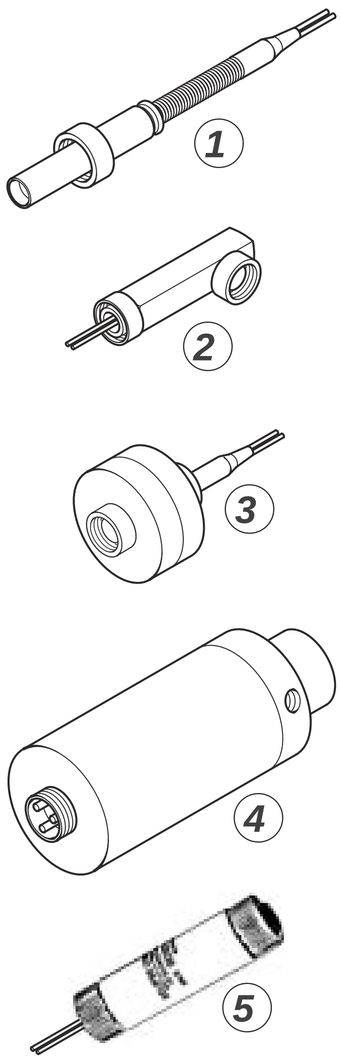
Metric to Metric.

From	To	Multiply by
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric.

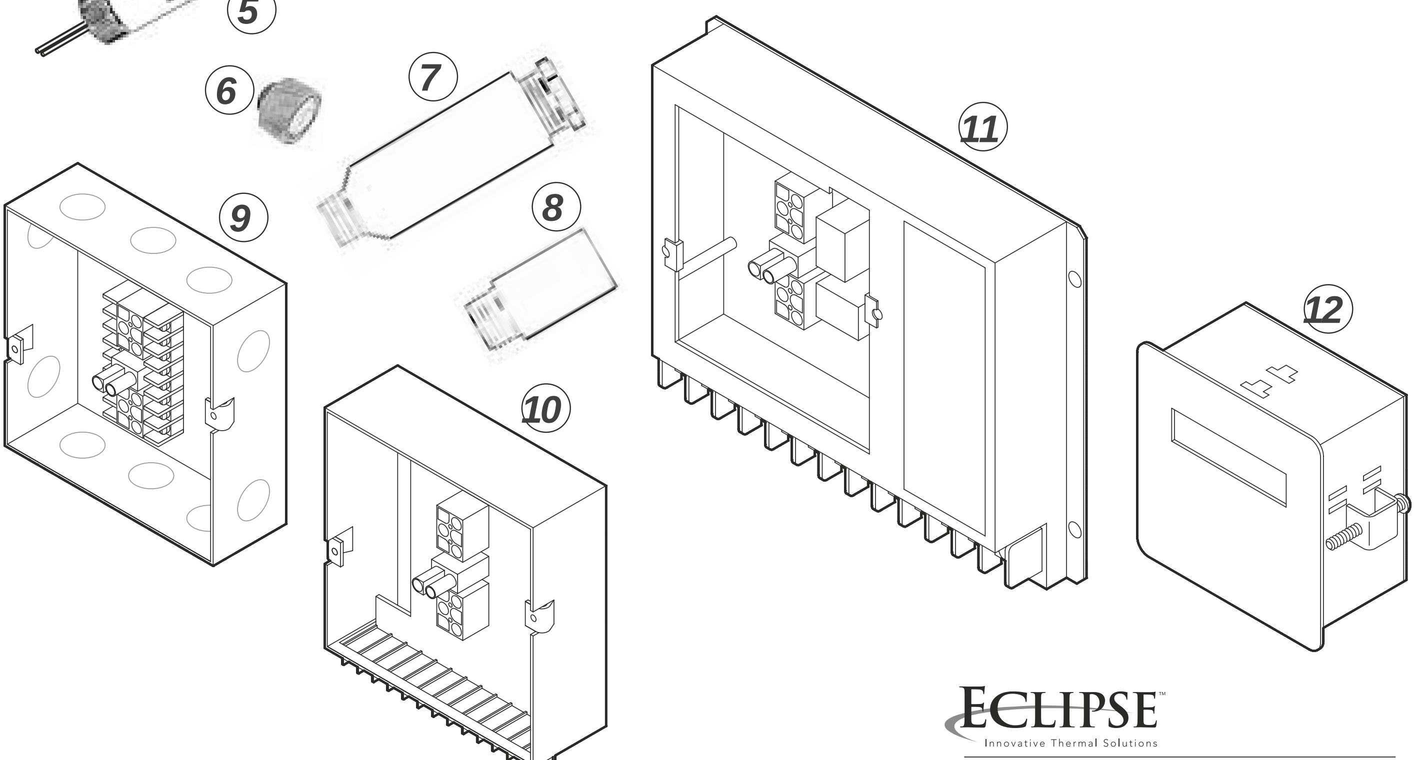
From	To	Multiply by
Btu/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F – 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column ("wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95

Illustrated Parts List



Category	Pos. No.	Description	Model Number	Part Number
Sensors	1	Straight U.V. scanner	5600-91	49600-91
	——	NEMA 4 U.V. scanner	5600-91N4	20898
	2	90˚ U.V. scanner	5600-90A	49600-90
	3	I.R. scanner	5600-92B	49600-92
	4	Self-check scanner	5602-91	49602-91
	5	Solid-state U.V./I.R. scanner	5600-92SC	21349
	——	10-foot cable for self-check scanner	5602-91-7	49602-91-7
	6	Scanner support (max. temp. 220˚F) (1)	5600-90A SS	20722
	6	Scanner support (max. temp. 475˚F) (1)	5600-90A SSH	20723
	7	Magnifying lens assembly	5600-98	49600-98
	——	Lens, magnifying		49600-99
	——	Lens, non-magnifying (2)		18165
	8	Insulated coupling	5600-99	49099
	——	Cable, coax, RG62A/U for flame rod		21741
Bases	9	Internal terminal base, metal	5602-10	49602-10
	10	Exposed terminal base, metal	5602-10-1	49602-10-1
	——	Internal terminal base, plastic	5602-10-P	22194
	——	Adapter Base RA890	5602-12	49602-12
	——	Adapter Base R4795	5602-14	49602-14
	11	Modulation base	5602-40	49602-40
	——	Screw, mounting to plastic base		22110
	——	Screw, mounting to metal base		22385
Test	——	Tester for Veri-Flame units	5602	49602
	——	Relay module (3)	5602-40-4	49240-2
Display	12	Remote display, 24V	5602 DB	20316
	——	Remote display, 120VAC with keypad	5602 DBP	20896
	——	Power supply, 24VDC (4)		20317
	——	Cable for remote display		20318

(1) For 90º U.V. scanner (Model No. 5600-90A), I.R. scanner (5600-92B), and solid state U.V./I.R. scanner (5600-92SC)
(2) For magnifying lens assembly (Model No. 5600-98), and self-check scanner (5602-91)
(3) Used to test modulation controls on tester (Model No. 5602) above.
(4) To be used with 20316 display only (not 20896).



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ThermAir Burners

Model TA075

Version 1.10

Main Specification – TA075

PARAMETER	BLOWER SIZE								
		3"w.c. Packaged				**6"w.c. Packaged**			
Maximum input (Btu/hr) *(To maintain 15% excess air with standard air orifice and standard combustion air blower)*	**Frequency**	**Capacity at Chamber Pressure**				**Capacity at Chamber Pressure**			
		BTU/hr	"w.c.	kW	mbar	BTU/hr	"w.c.	kW	mbar
	60 Hz Packaged Blower	805,000	-1.0	236	-2,5	814,000	-1.0	238	-2,5
		750,000	0.0	220	0,0	750,000	0.0	220	0,0
		691,000	1.0	202	2,5	705,000	1.0	206	2,5
	50 Hz Packaged Blower	**Not Available**				822,000	-1.0	241	-2,5
						771,000	0.0	226	0,0
						716,000	1.0	210	2,5

Parameter		3"w.c. Packaged		6"w.c. Packaged	
Minimum input		**BTU/hr**	**kW**	**BTU/hr**	**kW**
	Natural gas	14,000	4,1	25,000	7,3
	Propane	18,000	5,3	25,000	7,3
	Butane	23,000	6,7	25,000	7,3
Main Gas Inlet Pressure • *Fuel pressure at gas inlet (Tap "B")*		**" w.c.**	**mbar**	**" w.c.**	**mbar**
	Natural gas	6.6	16,4	6.5	16
	Propane	7.2	17,9	6.8	17
	Butane	8.0	19,9	6.9	17
High Fire Flame Length • *Measured from the outlet end of combustor*		**inches**	**mm**	**inches**	**mm**
	Natural gas	39	990	30	762
	Propane	43	1092	32	813
	Butane	43	1092	32	813

Parameter		**°F**	**°C**
Maximum Chamber Temperature	Alloy Tube	1500	820
	SIC Tube	1900	1038

Parameter	
Flame Detection	Flame rod or UV scanner
Fuel	Natural gas, Propane, or Butane. *For any other mixed gas, contact Eclipse Combustion for orifice sizing*

- All information is based on laboratory testing in neutral (0.0"w.c.) chamber with standard combustor design. Different chamber conditions and/or combustor design will affect the data.
- Maximum inputs are given for the standard combustion air blower without an air filter.
- All inputs based upon gross calorific values and standard conditions: 1 atmosphere, 70° F (21°C).
- Blower motor service factors greater than 1.0 may be required when firing into negative chamber pressure applications. For specific application questions, contact your Eclipse Combustion representative.
- Eclipse reserves the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

ECLIPSE™
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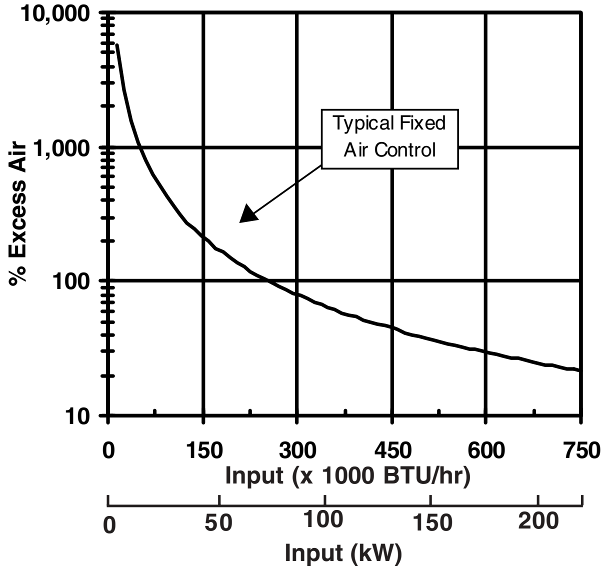
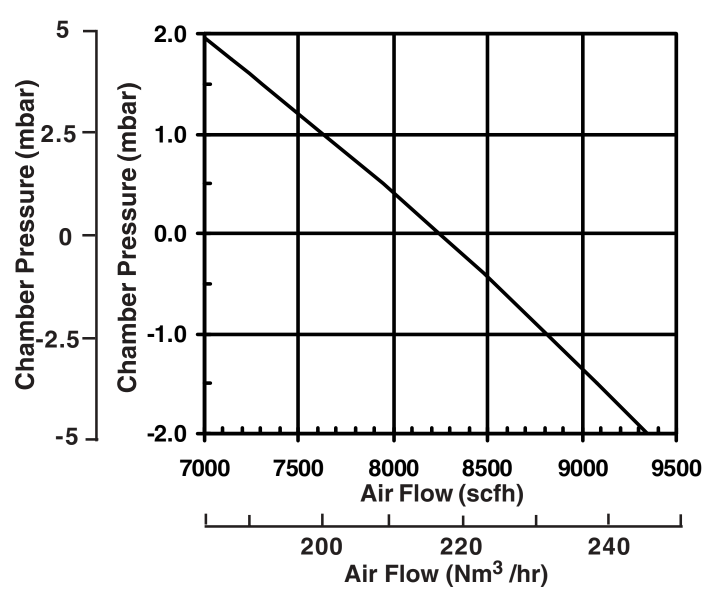
Performance Graphs

ThermAir TA075

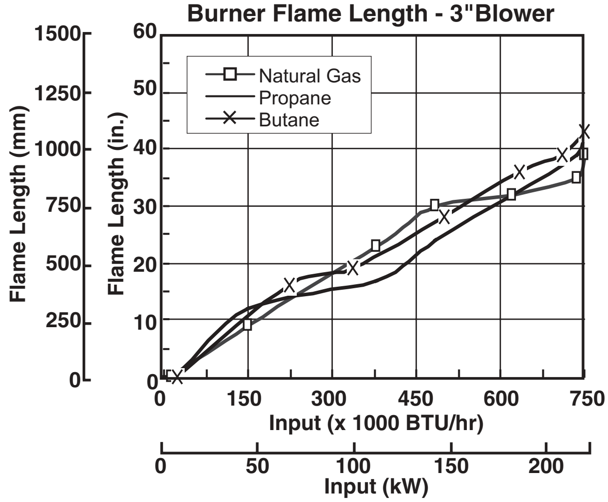
Control & Operation Zone



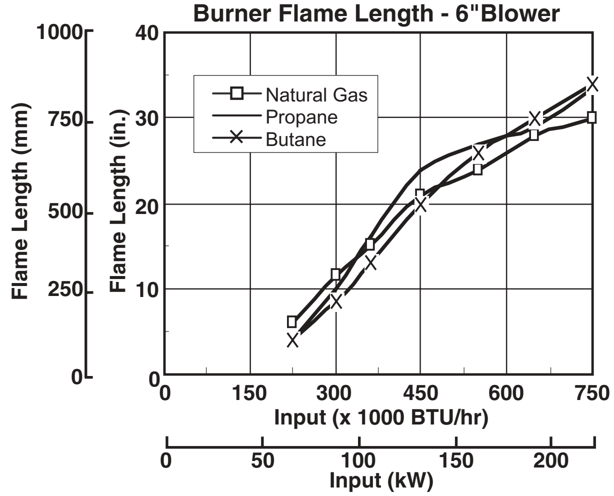
Air Flow vs. Chamber Pressure



Burner Flame Length - 3"Blower

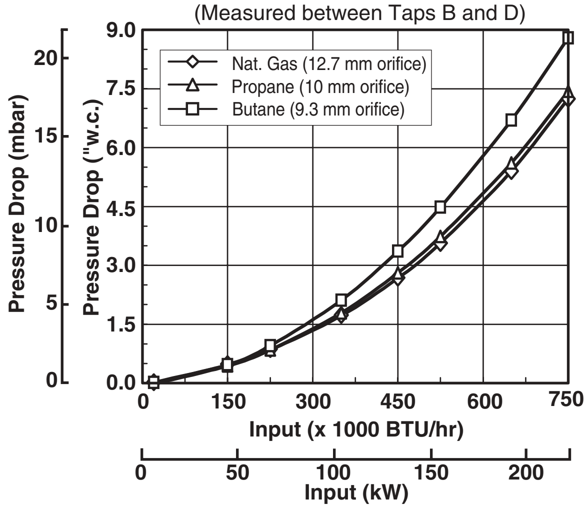


Burner Flame Length - 6"Blower



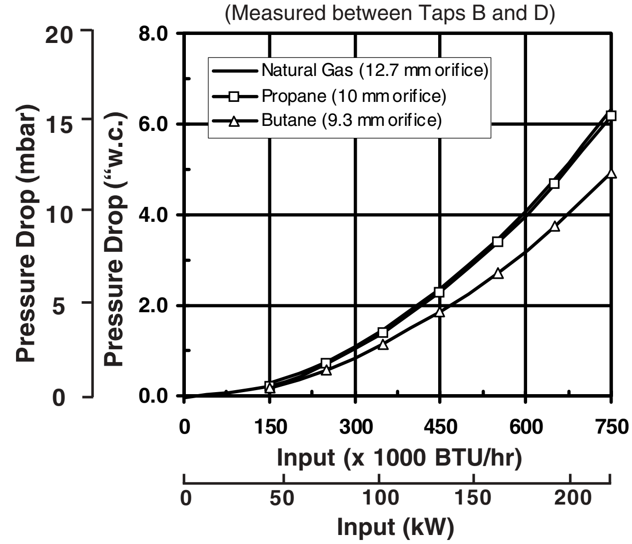
Fuel Orifice ΔP vs. Input - 3" Blower

(Measured between Taps B and D)



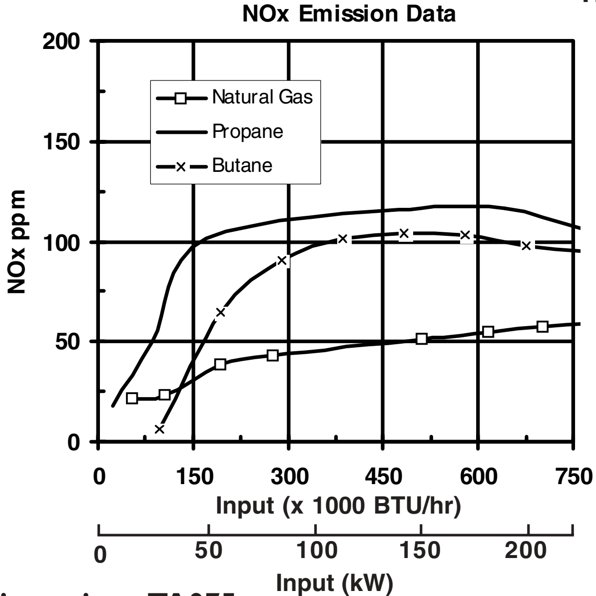
Fuel Orifice ΔP vs. Input - 6" Blower

(Measured between Taps B and D)



Performance Graphs (Continued)

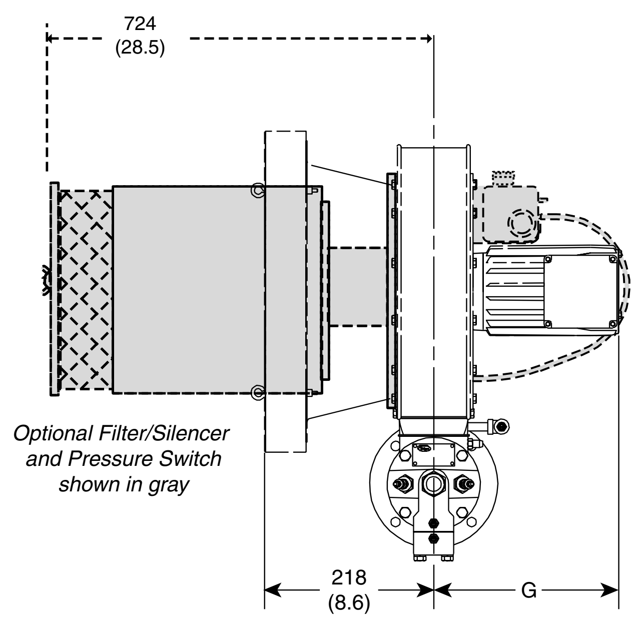
ThermAir TA075

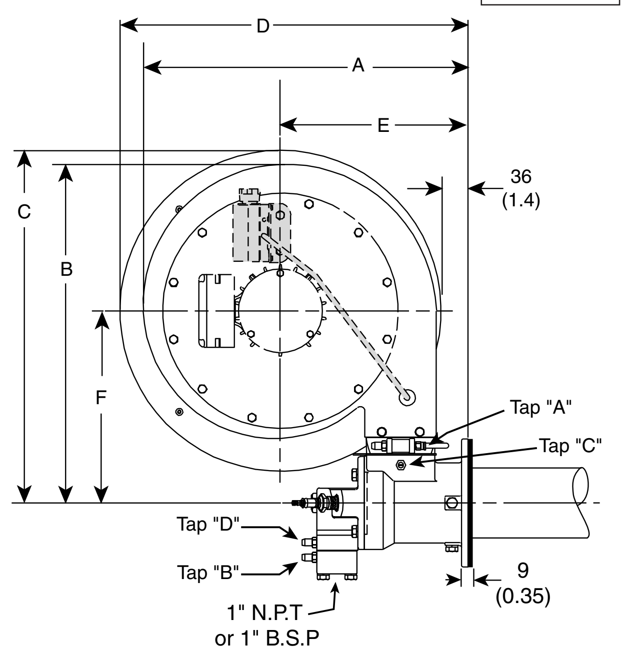


Notes on emission data
NOx emission data is given for: • Ambient combustion air ~70° F (20° C) • Minimal process air velocity • ppm volume dry at 3% O_2 • Neutral chamber pressure **Emissions are influenced by:** • Chamber conditions • Fuel type • Firing rate • Combustion air temperature
CO emission is largely influenced by chamber conditions. Contact your local Eclipse Combustion representative for an estimate of CO emission on your application.

Dimensions-TA075

mm (in)

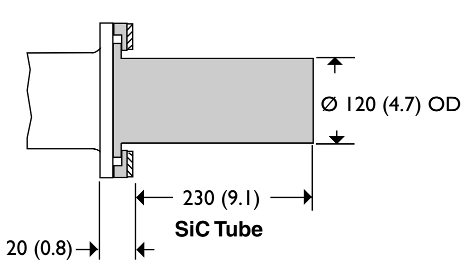




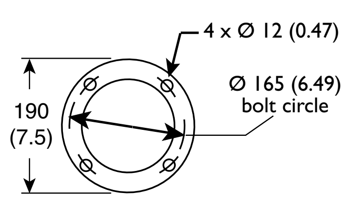
Port Connection	
Sparkplug	14mm
Flamerod or scanner	0.5" N.P.T.
Peepsight	0.75" N.P.T.

Weights	lb	kg
Burner, w/ blower	78	35
Burner, less blower	31	14
Filter/Silencer	41	19

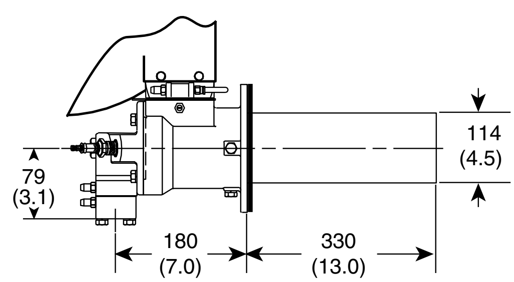
	Blower 6" w.c.													
	A		B		C		D		E		F		G	
Hz	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	484	19.0	532	20.9	N/A	N/A	N/A	N/A	272	10.7	309	12.2	291	11.5
60	424	16.7	473	18.6	482	19.0	447	17.6	243	9.5	279	11.0	291	11.5
	Blower 3" w.c.													
60	338	13.3	393	15.5	N/A	N/A	N/A	N/A	202	7.9	234	9.2	192	7.6



SiC Tube

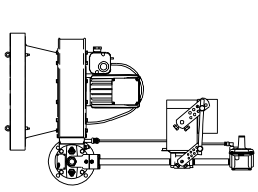
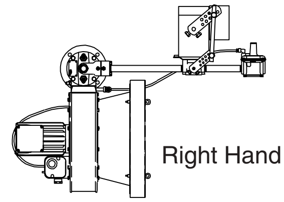
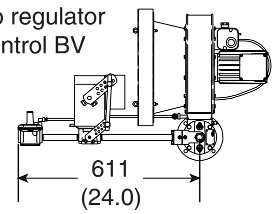
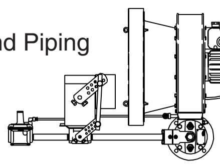
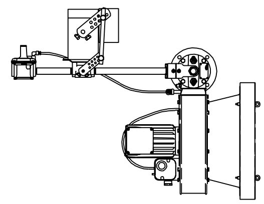
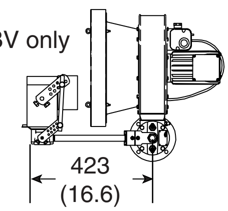
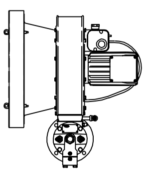
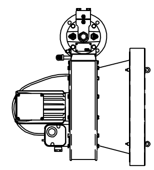
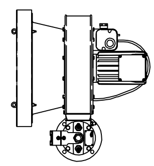


Mounting Pattern



310 Stainless Steel Alloy Tube

Piping

Orientation		Piping Options
Upright	**Inverted**	
Right Hand Piping 	 Right Hand Piping	With ratio regulator and control BV 
LeftHand Piping 	 Left Hand Piping	With control BV only 
No Piping 	 No Piping	Less ratio regulator and control BV 

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Data 114-6
12/02

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ThermAir Burners

Model TA200

Version 1.10

Main Specifications - TA200

PARAMETER	SPECIFICATIONS				
	Frequency	**Btu/hr**	**"w.c.**	**kW**	**mbar**
Maximum input *(To maintain 15% excess air with the standard air orifice and standard combustion air blower.)*	60 Hz packaged blower	2,071,000	-1.0	607	-2,5
		2,000,000	0.0	586	0,0
		1,871,000	1.0	548	2,5
	50 Hz packaged blower	2,235,000	-1.0	655	-2,5
		2,066,000	0.0	605	0,0
		2,028,000	1.0	594	2,5

Parameter		Specifications	
Minimum input		BTU/hr	kW
	Natural Gas, Propane or Butane	66,000	19,4
Main gas inlet pressure • *fuel pressure at gas inlet (Tap "B")*		"w.c.	mbar
	Natural Gas	9.4	23
	Propane	9.8	24
	Butane	9.8	24
High fire flame length • *measured from the outlet end of combustor*		inches	mm
	Natural Gas	54	1370
	Propane	54	1370
	Butane	53	1345
Maximum chamber temperature		˚F	˚C
	Alloy Tube	1500	815
	SiC Tube	1900	1038
Flame detection		UV scanner only	
Fuel		Natural Gas, Propane or Butane. *(For any other mixed gas, contact Eclipse Combustion for orifice sizing.)*	

- All information is based on laboratory testing in neutral (0.0"w.c.) chamber with standard combustor design. Different chamber conditions and/or combustor design will affect the data.
- Maximum inputs are given for the standard combustion air blower without an air filter.
- All inputs based upon gross calorific values and standard conditions: 1 atmosphere, 70°F (21°C).
- Blower motor service factors greater than 1.0 may be required when firing into negative chamber pressure applications. For specific application questions, contact your Eclipse Combustion representative.
- Eclipse reserves the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

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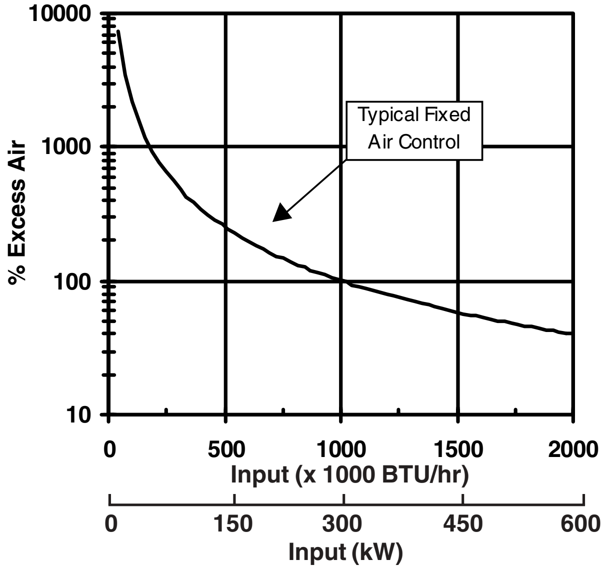
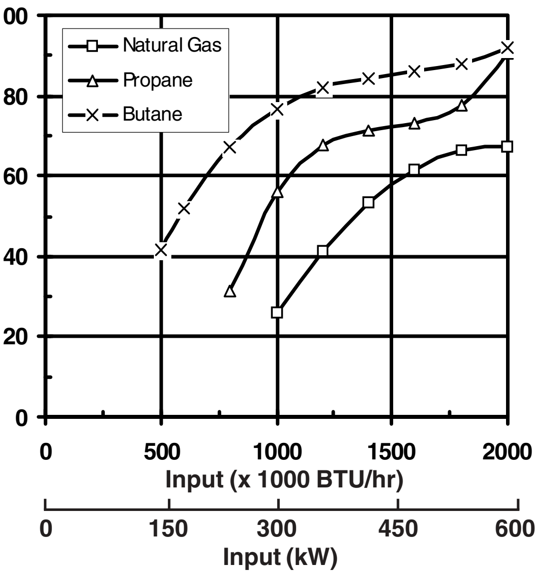
Performance Graphs
ThermAir TA200

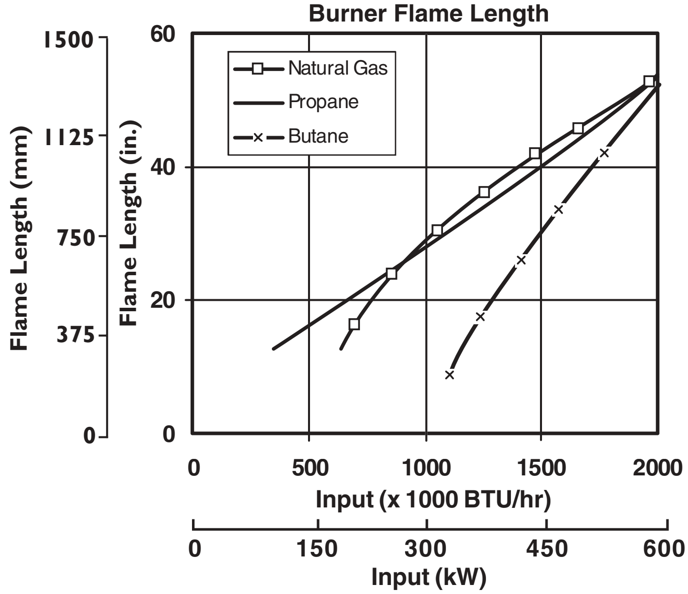
Control & Operation Zone



NOx Emission Data



Burner Flame Length



Notes on emission data

NOx emission data is given for:

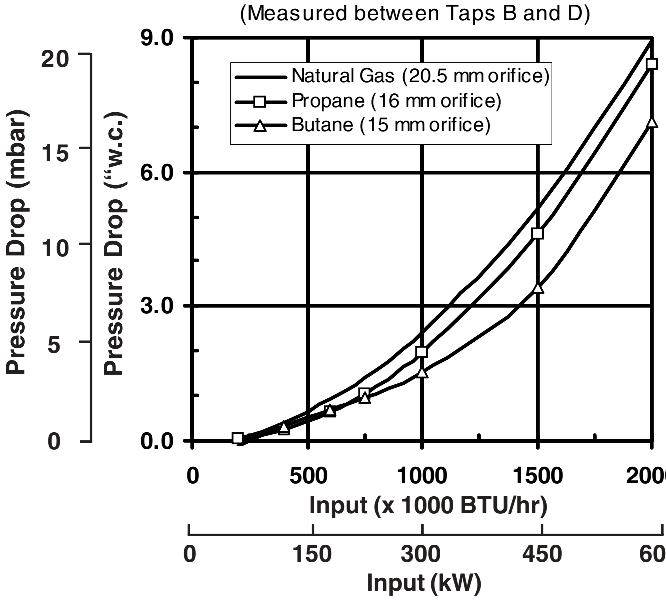
- Ambient combustion air ~70° F (20° C)
- Minimal process air velocity
- ppm volume dry at 3% O_2
- Neutral chamber pressure

Emissions are influenced by:

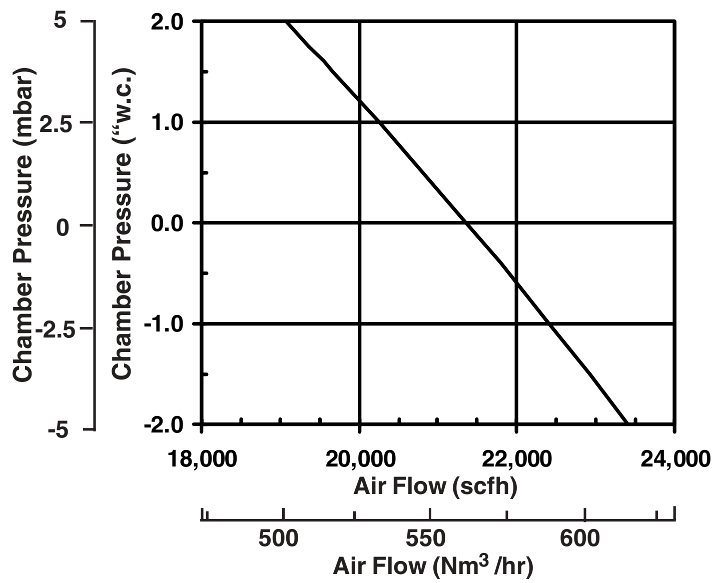
- Chamber conditions
- Fuel type
- Firing rate
- Combustion air temperature

CO emission is largely influenced by chamber conditions. Contact your local Eclipse Combustion representative for an estimate of CO emission on your application.

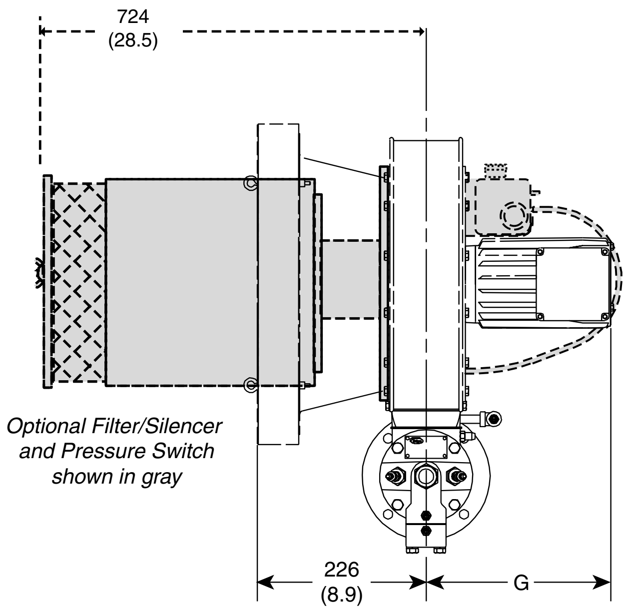
Fuel Orifice ∆ P vs. Input
(Measured between Taps B and D)

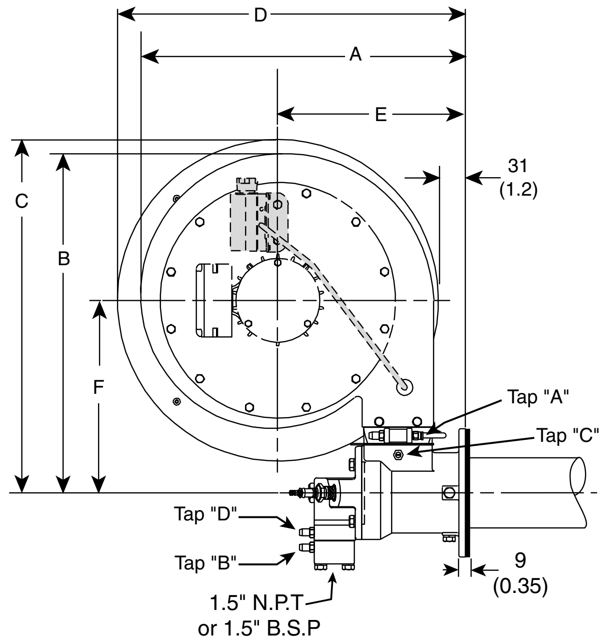


Air Flow vs. Chamber Pressure



mm (in)

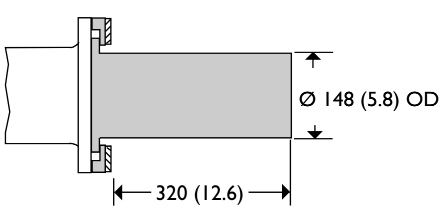




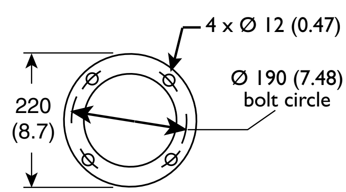
Port Connection	
Sparkplug	14mm
Flamerod or scanner	0.5" N.P.T.
Peepsight	0.75" N.P.T.

Weights	lb	kg
Burner, w/ blower	99	45
Burner, less blower	46	21
Filter/Silencer	41	19

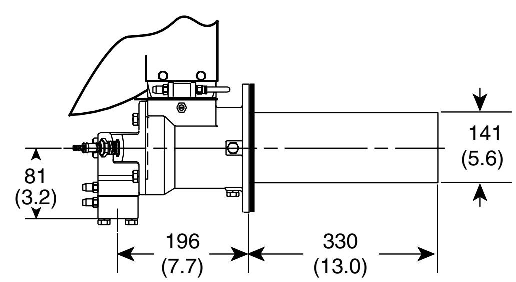
Blower 10" w.c.														
	A		B		C		D		E		F		G	
Hz	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	586	23.1	669	26.3	N/A	N/A	N/A	N/A	322	12.7	392	15.4	290	11.4
60	503	19.8	577	22.7	608	23.9	565	22.2	283	11.1	342	13.5	298	11.7



SiC Tube

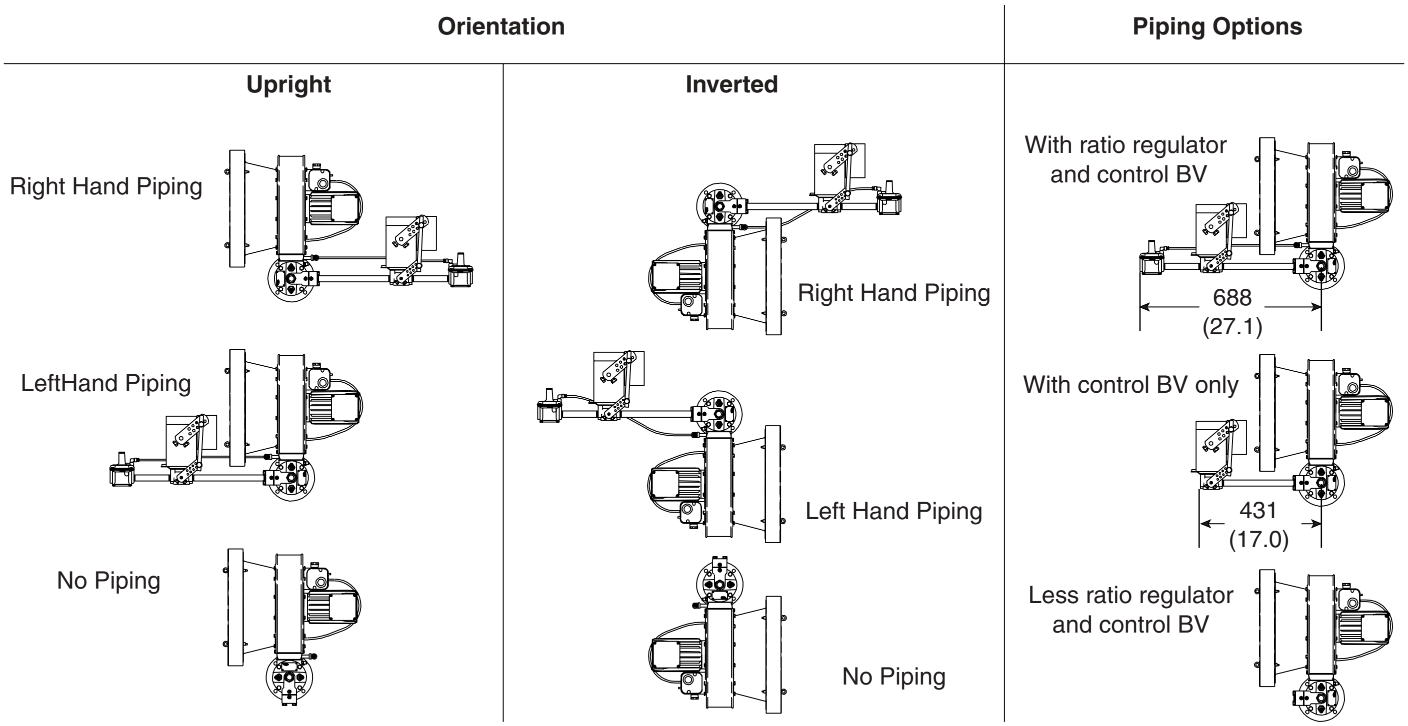


Mounting Pattern



310 Stainless Steel Alloy Tube

Piping



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Installation Guide 114
05/03

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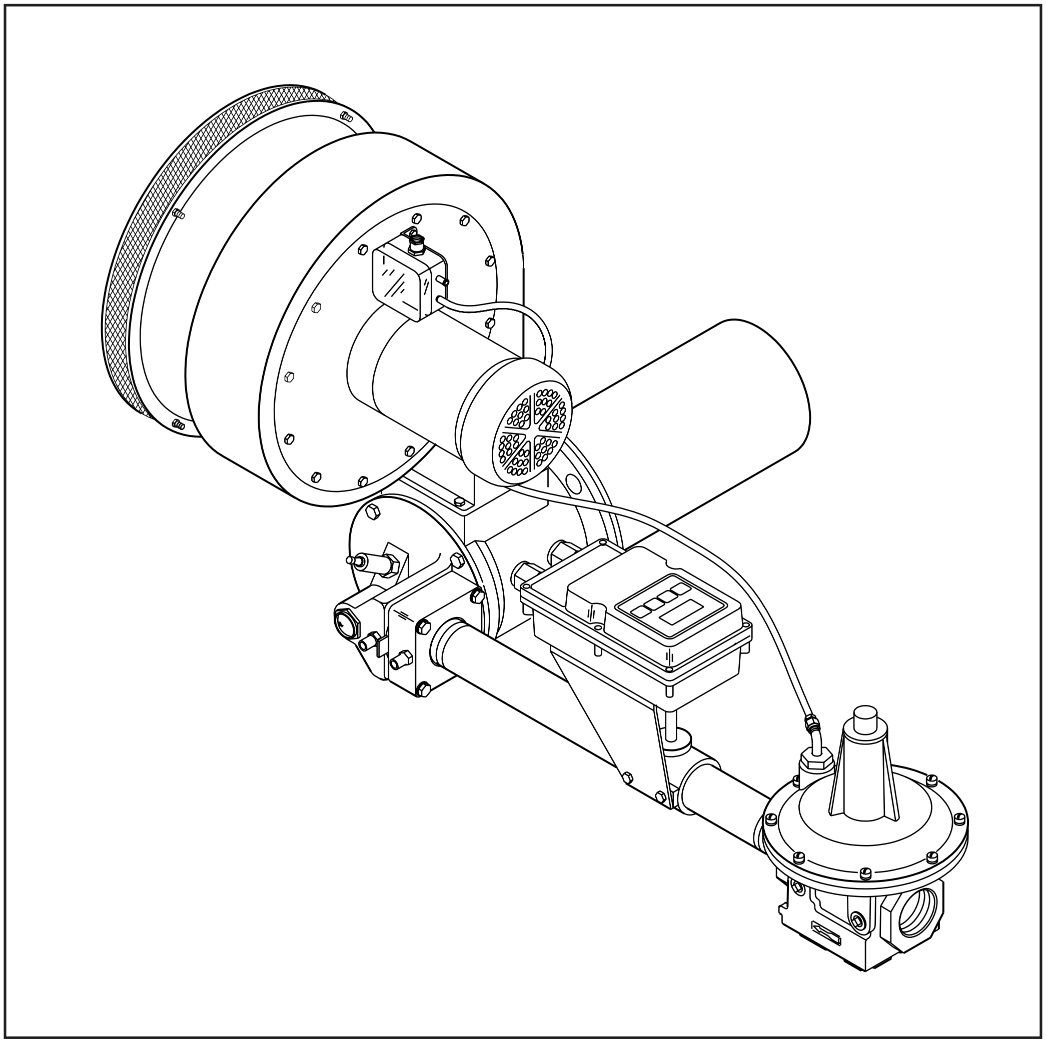
ThermAir Burners

TA Series

version 1.10



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DISCLAIMER NOTICE

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The material in this manual is believed adequate for the intended use of the product. If the product, or its individual modules or procedures, are used for purposes other than those specified herein, confirmation of their validity and suitability must be obtained. Eclipse Combustion, Inc. warrants that the material itself does not infringe any United States patents. No further warranty is expressed or implied.

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Documentation Manager.

LIABILITY AND WARRANTY

It must be understood that Eclipse Combustion's liability for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing of such replacement parts and Eclipse Combustion will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income of or damage to material arising in connection with the sale, installation, use of, inability to use or the repair or replacement of Eclipse Combustion's products.

Any operation expressly prohibited in this Guide, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

About this manual

AUDIENCE

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as "the burner system."

These aspects are:

- installation
- use
- maintenance.

The audience is expected to have had experience with this kind of equipment.

THERMAIR DOCUMENTS

Installation Guide No. 114

- This document

ThermAir Data Sheets, Series 114

- Available for individual TA models
- Required to complete design & selection

Design Guide No. 114

Used with Data Sheet to design burner system

ThermAir Price List No. 114

Used to order burners

RELATED DOCUMENTS

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 710, 732, 742, 760, 818, 832, 852, 854, 856, 610, 620, 630, 826, 820, 930, I-354.

Purpose

The purpose of this manual is to ensure the installation of a safe, effective, and trouble-free combustion system is carried out.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

Danger:

Indicates hazards or unsafe practices which WILL result in severe personal injury or even death. Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:

Indicates hazards or unsafe practices which could result in severe personal injury or damage.

Act with great care and follow the instructions.

Caution:

Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury, Act carefully.

Note:

Indicates an important part of the text. Read thoroughly.

How to Get Help

If you need help, contact your local Eclipse Combustion representative. You can also contact Eclipse Combustion at any of the addresses listed on the back of this document.

Table of contents

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5

Introduction

1

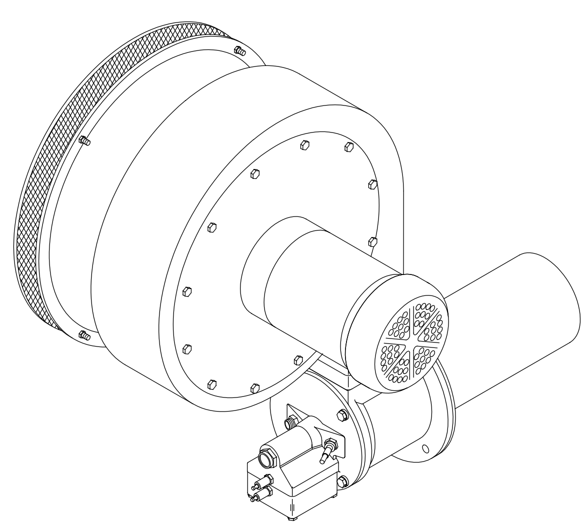
Product Description

The ThermAir burner (TA Series) is a nozzle-mix burner with a packaged combustion air blower that is designed to fire with fixed combustion air over a wide gas turndown range. An integral gas orifice is provided to ease burner setup. The burner is designed to facilitate:

- fixed air operation
- direct spark ignition
- simple gas control
- multiple fuel capability

The burner is suitable for direct and indirect air heating for a wide range of applications on industrial furnaces and ovens.

Figure 1.1 ThermAir Burner



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Safety

2

Introduction

This section is provided as a guide for the safe operation of the ThermAir burner system. All involved personnel should read this section carefully before operating this system.

Safety

Danger:

The ThermAir burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled, or maintained.

Do not bypass any safety feature; fire or explosion could result.

Never try to light a burner if it shows signs of damage or malfunction.

Warning:

The burner might have HOT surfaces. Always wear protective clothing when approaching the burner.

Note:

This manual provides information in the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written advice from Eclipse Combustion.

Read the entire manual before attempting to start this system. If you do not understand any part of the information contained in this manual, contact your local Eclipse representative or Eclipse Combustion before continuing.

Capabilities

Only qualified personnel, with good mechanical aptitude and experience on combustion equipment, should adjust, maintain, or troubleshoot any mechanical or electrical part of this system.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse Combustion only. All Eclipse Combustion approved, customer supplied valves or switches should carry UL, FM, CSA, CGA, and/or CE approval, where applicable.

Installation

3

INTRODUCTION

In this section you will find important notices about safe operation of the burner:

HANDLING AND STORAGE

Handling:

1. Make sure that the components are clean and free of damage.

2. Protect the components from weather, damage, dirt and moisture.
   - Transport in original shipping container
   - Do not drop

3. Protect the components from excessive temperatures and humidity.

4. Use appropriate support equipment, i.e. harnesses, straps, chains etc. when lifting burner components.

Storage:

1. Make sure that the area is clean.

2. Store the components in a cool, clean, dry room.

3. After you have made sure everything is present and in good condition, keep the components in the original package as long as possible.

APPROVALS OF COMPONENTS

Limit Controls and Safety Equipment

All limit controls and safety equipment must comply with the current following standards:

- NFPA Standard 86
- NFPA Standard 86C
- UL
- FM
- CGA
- EN 746-2
- all applicable local codes and/or standards.

Electrical wiring

All electrical wiring must comply with one of these standards:

- NFPA Standard 70
- ANSI-C11981
- EN 746-2
- the electrical wiring must be acceptable to the local authority having jurisdiction

Gas Piping

All gas piping must comply with one of these standards:

- NFPA Standard 70
- ANSI Z223
- EN 746-2
- the gas piping must be acceptable to the local authority having jurisdiction

Where to get standards

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062

The FM Standards are available from:
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062

Information on the EN standards, and where to get the standards is available from:

Comité Européen de Normalisation
Strassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819

Comité Européen de Normalisation Electronique
Strassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919

PRE-INSTALLATION CHECKLIST

Air Supply

Provide an opening in the burner room of at least one square inch per 4000 BTU/hr (6 cm^2 per 1 kW) to supply the burner intake with fresh, outdoor, combustion air.

If there are corrosive fumes or materials in the surrounding air, find an uncontaminated source to supply air to the burner.

Exhaust

Do not allow exhaust gases to accumulate in the work area. Provide a means for exhausting these gases from the building.

Access

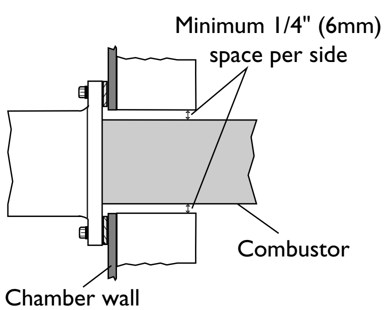
Install the burner so it may be easily accessed for inspection and maintenance.

Environment

Be sure the burner operating environment matches the original operating specifications. Check the following items:

- voltage, frequency, and stability of electrical power
- fuel type and fuel supply pressure
- adequate fresh, clean, combustion air
- humidity, altitude, and temperature of the supply air
- presence of damaging corrosive gases in the air
- prevent direct exposure to water.

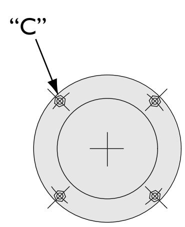
BURNER



Chamber Opening

Provide an opening in the chamber wall at least ½" (12mm) larger in diameter than the outside diameter of the combustor.

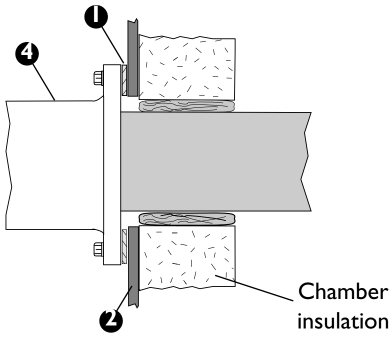
Provide an accessible pressure tap on the chamber wall to measure the pressure inside the firing chamber. The pressure tap should be located near the burner.



Mounting Pattern

Attach four mounting bolts to the chamber wall. Position these bolts to match the clearance holes (C) on the burner mounting flange. Refer to the appropriate ThermAir data sheet.

INSTALLATION
(CONTINUED)



Chamber Wall

Make sure the chamber wall ❷ is strong enough to support the weight of the burner ❹. If necessary, reinforce the mounting area.

Burner Mounting

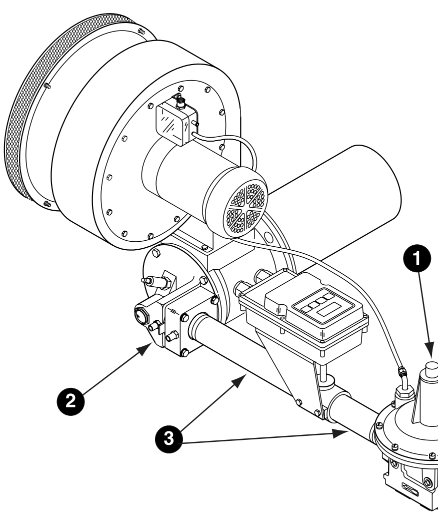
Mount burner to chamber wall using four (4) customer supplied nuts and lock washers.

1. Make sure that you install the burner mounting gasket, item ❶, between the burner mounting flange and the chamber wall.
2. Make sure that the gasket does not leak.

Insulate the Firing Tube

To insure that radiated heat doesn't reach the exterior of the chamber, insulate the combustion tube over the length contained within the chamber wall, filling any clearance completely. If the firing tube extends beyond the chamber wall thickness, **do not** insulate the exposed end of the tube.

GAS PIPING



Burner Piping

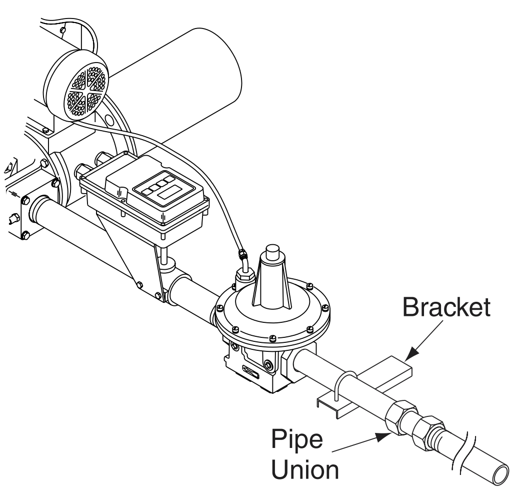
The burner is factory assembled and shipped as ordered.

> *Note:*
> *If it is necessary to redirect piping, be sure the:*
> - *ratio regulator spring column ❶ is pointing up.*
> - *arrow on the ratio regulator points in the direction of gas flow.*
> - *integral fuel orifice and o-rings ❷ are re-installed.*
> - *same straight runs of pipe ❸ remains between the ratio regulator and the burner .*

Supply Piping

Inlet pressure to the ratio regulator (if supplied) should be at least 15"w.c. (37.5 mbar). It should not exceed the maximum pressure rating of the ratio regulator.

- Locate the valve train close to the burner. The gas must reach the burner during the fixed trial for ignition.
- Sufficiently size shut off valves in the valve train.
- Make sure piping is large enough.
- Minimize piping elbows.



Pipe Connections

- Installation of a pipe union in the gas line is recommended to simplify burner removal.
- Use of flexible pipe is optional.

> *Note:*
> *Flexible pipe causes higher pressure drops than standard pipe. Consider this when sizing your gas lines.*

Piping Support

Use brackets or hangers to support the gas piping. If you have questions, consult your local gas company.

Control Motor

Install a control motor to modulate the gas control valve if not previously installed on the burner.

Installing the flame sensor

There are two different types of flame sensors:

U.V. scanner:

Each ThermAir burner is capable of U.V. flame monitoring. The burner will not come equipped with a U.V. scanner. A ½" NPT connection is provided on each ThermAir burner for the connection of a U.V. scanner.

For detailed information on how to install and connect an Eclipse U.V. scanner, refer to:

- straight U.V. scanner; Bulletin / Info Guide 854
- 90° U.V. scanner; Bulletin / Info Guide 852
- self-check U.V. scanner; Bulletin / Info Guide 856.

Flame rod:

If the flame rod option was selected when the burner was ordered, the burner will be delivered with the flame rod already installed on the burner.

Note:

Only specific burner sizes are capable of using a flame rod. These models are TA015, 025, 040, 075, and 100.

For detailed information on how to install and connect a flame rod, refer to:

- Bulletin / Info Guide 832.

Check List After Installation

To verify the system was properly installed, perform the following checks:

1. Be sure there are no leaks in the gas lines.
2. Be sure all the components contained in the flame monitoring and control system are properly installed. This includes verifying that:
   - all the switches are installed in the correct locations.
   - all wiring, pressure, and impulse lines are properly connected.
3. Be sure all components of the spark ignition system are installed and functioning properly.
4. Be sure the blower rotates in the proper direction. If the rotation is incorrect, have a qualified electrician rewire the blower to rotate in the proper direction.
5. Be sure all valves are installed in the proper location and correctly oriented relative to the flow direction.

Prepare for Adjustment

After installation of the burner system components is complete, the following steps should be followed in order to prepare for adjustment:

1. Set the air flow switch so that it drops out at 20% below the maximum pressure of the combustion air blower.
2. Set the low gas pressure switch at 20% below the gas pressure measured at the inlet to the main gas valve train.
3. Set the high gas pressure switch at 20% above the gas pressure measured at the inlet to the main gas valve train.
4. Close all manual valves feeding the burner.
5. Try to ignite the burner before the purge and other timers have finished their cycles. Make sure that the flame monitoring system indicates a flame failure.
6. Trip out the pressure switches and other limit interlocks. Make sure that the main gas valve train closes.

Danger:

If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding.

Adjustment, Start & Stop

4

INTRODUCTION

In this chapter you will find instructions on how to start and stop a burner. The chapter begins with general instructions that are useful for adjustment.

Danger:

The ThermAir burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled, or maintained.
Do not bypass any safety feature; fire or explosion could result.

Never try to light a burner if it shows signs of damage or malfunction.

Adjustment

There are two separate system adjustment procedures:

- **System 1**

Adjust a ThermAir burner with a ratio-regulator

- **System 2**

Adjust a ThermAir burner without a ratio-regulator

SYSTEM 1 BURNER ADJUSTMENT

With a Ratio-Regulator

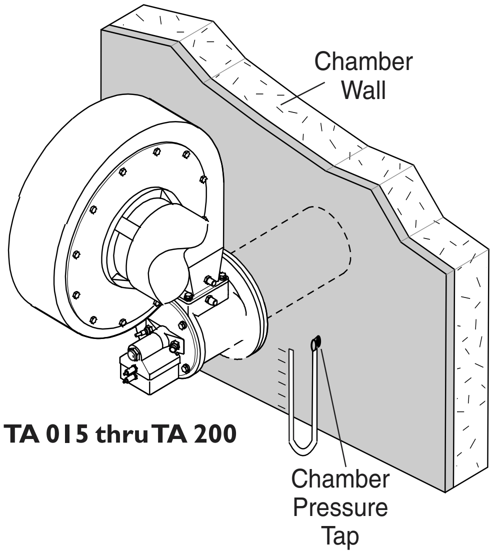
If you are adjusting a ThermAir burner equipped with a ratio-regulator for the first time, you must follow these steps:

1. Reset the system
2. Verify air flow
3. Ignite the burner
4. Set high fire gas
5. Set low fire gas
6. Verify gas settings
7. Stop Procedure

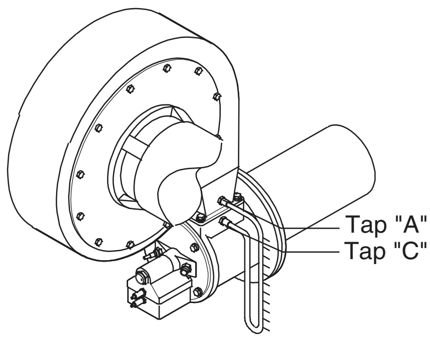
Step 1: Reset the system

1. Close these valves
   - the automatic gas valves
   - the manual gas cocks
2. Start the combustion air blower

Step 2: Verify air flow



TA 015 thru TA 200



TA 300 thru TA 500

TA 015, 025, 040, 075, 100, 200

1. Make sure that the pressure tap located on the chamber is open.
2. Connect the manometer to the chamber pressure tap.
3. Measure the chamber air pressure.
4. Determine actual air flow from the burner specific Data Sheet (ref.: Air flow vs. Chamber Pressure Chart) for the burner being setup.
5. Remove the manometer.
6. Close the pressure tap.

TA 300, 400, 500

1. Make sure that pressure taps A and C are open.
2. Connect the manometer to taps A and C.
3. Measure the air differential pressure.
4. Determine actual air flow from the burner specific Data Sheet (ref.: Air flow vs. Air Orifice ∆P Chart) for the burner being setup.
5. Remove the manometer.
6. Close the pressure taps

Note:

A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

Note:

Chamber pressure will directly influence air flow from the blower. Air flows should be rechecked once the process reaches its operating temperature and pressure. An oxygen analyzer may be used to confirm air flow rates once the system is operating.

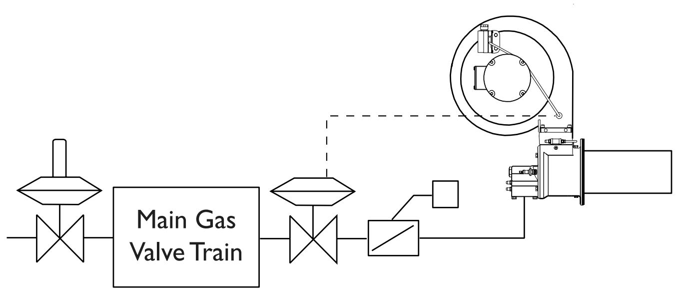
There are two separate ignition procedures which depend upon whether or not bypass start gas is installed on the burner. Each procedure is unique and both are outlined below.

Step 3a: Ignite the burner (Option 1: Burner not equipped with bypass start gas)

Warning:

This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used.

If low fire gas is too low to be used for ignition consider increasing low fire or providing bypass start gas. Refer to the section 3b on page 19.



1. Drive the gas control valve to low fire.

Note:

All ThermAir burners are limited to ignition at inputs below 40% of maximum unless the control circuit on page 15 of Design Guide 114 is followed.

2. Make sure the combustion air blower is running.
3. Verify that the adjusting screw on the ratio-regulator is six full (360°) turns down from the top.
4. Open all manual gas valves feeding the burner.
5. Initiate the ignition sequence through the flame monitoring control system.
6. Verify that the burner has ignited.

   If the burner does not ignite:

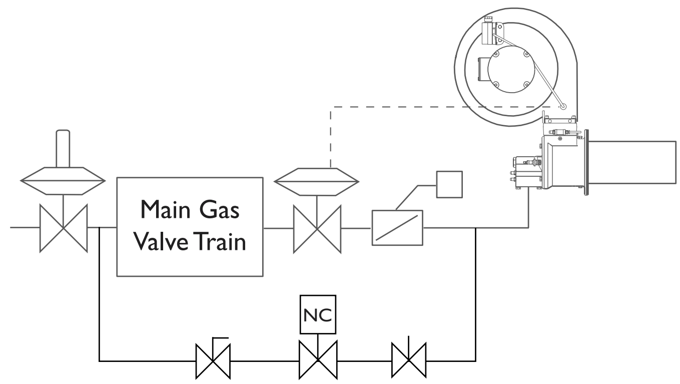
   a) Try to ignite again to purge the air out of the gas piping.

   b) If the burner does not ignite after one or two additional ignition attempts, see the Trouble shooting Guide contained in the Maintenance & Troubleshooting section of this guide.

Step 3b: Ignite the burner (Option 2: Burner equipped with bypass start gas)

Warning:

This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used.



1. Drive the gas control valve to low fire.
2. Make sure the combustion air blower is running.
3. Verify that the adjusting screw on the ratio-regulator is six full (360°) turns down from the top.
4. Open the flow adjusting valve in the bypass gas line.
5. Open the manual gas valve in the bypass gas line.
6. Initiate the ignition sequence through the flame monitoring control system.
7. Verify that the burner has ignited.

   If the burner does not ignite:

   a) Try to ignite again to purge the air out of the gas piping.

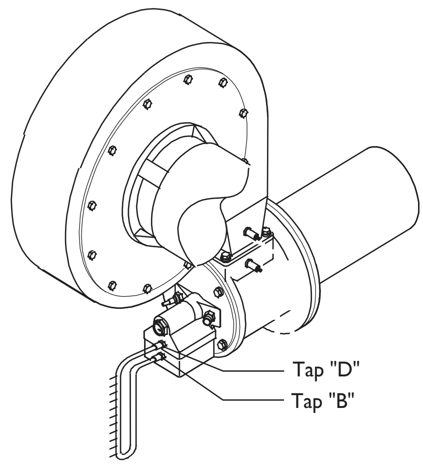
   b) If the burner does not ignite after one or two additional ignition attempts, see the Trouble shooting Guide contained in the Maintenance & Troubleshooting section of this guide.

If the burner has ignited:

a) Adjust the bypass flow adjusting valve such that the burner is able to maintain a stable flame and an adequate flame signal.

b) Open all remaining manual gas valves feeding the burner.

Step 4: Set high fire gas



1. If the burner has and is ignited, drive the main gas control valve to high fire (full open).

2. Verify air flow with the burner firing, repeat Step 2 "Verify air flow".

3. Make sure that pressure taps B and D are open.

4. Connect the manometer to taps B and D.

5. Measure the gas differential pressure.

6. Use the gas curve from the appropriate ThermAir Data Sheet for the gas being used to find the differential gas pressure needed at high fire.

Note:

Select the appropriate gas orifice differential pressure based upon the desired amount of excess air in the burner.

7. Readjust the control valve linkage to achieve the desired high fire gas flow.

Note:

The ThermAir gas orifice is sized to limit high fire gas flow to approximately 15% excess air with a packaged burner assembly purchased with a ratio-regulator and gas control valve.

8. Once the chamber conditions stabilize, (i.e. pressure and temperature), repeat items 2 through 7.

9. Check the gas pressure at the inlet to the ratio regulator. This should be at least 15"w.c. (37.5 mbar) It should not exceed the maximum pressure rating of the ratio regulator.

Warning:

Insufficient gas inlet pressure may cause the ratio regulator to remain fully open if there is a loss of air flow to the burner. This can cause excess fuel operation and the possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.

10. Remove the manometer.

11. Close the pressure taps.

Step 5: Set low fire gas

1. Drive the main gas control valve to low fire.

2. Adjust the control valve linkage to provide the desired low fire gas flow.

Note:

It is very difficult to measure the very low gas pressures experienced at low fire, and it may be necessary to rely on visual inspection of the flame. This is especially true when gas turndowns in excess of 10 to 1 are being used. The main intent is to provide a stable flame with good flame signal that will not cause the chamber temperature to overshoot.

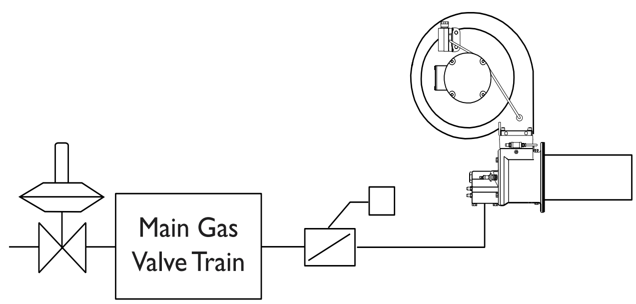
Step 6: Verify gas settings

Make sure that all settings are still the same after cycling the system several times between high and low fire.

SYSTEM 2 BURNER ADJUSTMENT

Without a Ratio-Regulator

You must provide a constant pressure to the burner to insure proper burner operation. If you are not using a burner equipped with a ratio-regulator, you must provide a service pressure regulator in order to maintain a constant inlet pressure to the burner.



If you are adjusting a ThermAir burner equipped without a ratio-regulator for the first time, you must follow these steps:

1. Reset the system
2. Verify air flow
3. Ignite the burner
4. Set high fire gas
5. Set low fire gas
6. Verify gas settings

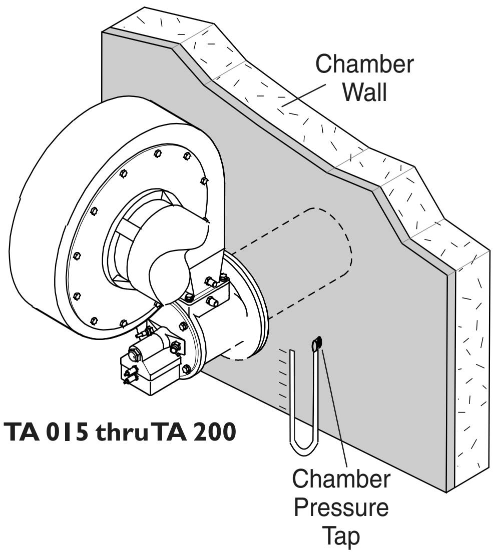
Step 1: Reset the system

1. Close these valves

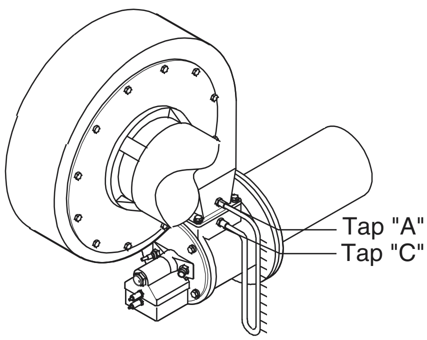
- the automatic gas valves
- the manual gas cocks

2. Start the combustion air blower

Step 2: Verify the system



TA 015 thru TA 200



TA 300 thru TA 500

TA 015, 025, 040, 075, 100, 200

1. Make sure that the pressure tap located on the chamber is open.
2. Connect the manometer to the chamber pressure tap.
3. Measure the chamber air pressure.
4. Determine actual air flow from the burner specific Data Sheet (ref.: Air flow vs. Chamber Pressure Chart) for the burner being setup.
5. Remove the manometer.
6. Close the pressure tap.

TA 300, 400, 500

1. Make sure that pressure taps A and C are open.
2. Connect the manometer to taps A and C.
3. Measure the air differential pressure.
4. Determine actual air flow from the burner specific Data Sheet (ref.: Air flow vs. Air Orifice ΔP Chart) for the burner being setup.
5. Remove the manometer.
6. Close the pressure taps

Note:

A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

Note:

Chamber pressure will directly influence air flow from the blower. Air flows should be rechecked once the process reaches its operating temperature and pressure. An oxygen analyzer may be used to confirm air flow rates once the system is operating.

Step 3a: Ignite the burner (Option 1: Burner not equipped with bypass start gas.) Ref. illustration page 21.

There are two separate ignition procedures which depend upon whether or not bypass start gas is installed on the burner. Each procedure is unique and both are outlined below.

Warning:

This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used.

If low fire gas is too low to be used for ignition consider increasing low fire or providing bypass start gas. Refer to section 3b on page 23.

1. Drive the gas control valve to low fire.

Note:

All ThermAir burners are limited to ignition at inputs below 40% of maximum unless the control circuit on page 15 of Design Guide 114 is followed

2. Make sure the combustion air blower is running.
3. Open all manual gas valves feeding the burner.
4. Initiate the ignition sequence through the flame monitoring control system.
5. Verify that the burner has ignited.

   If the burner does not ignite:

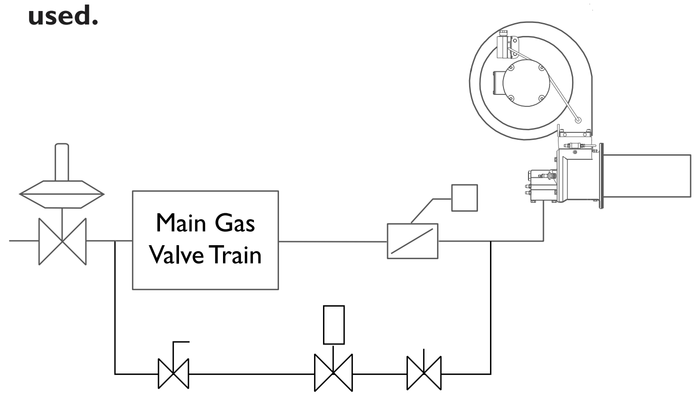
   a) Try to ignite again to purge the air out of the gas piping.

   b) If the burner does not ignite after one or two additional ignition attempts, see the Trouble shooting Guide contained in the Maintenance & Troubleshooting section of this guide.

Step 3b: Ignite the burner (Option 2: Burner equipped with bypass start gas.)

Warning:

This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used.



1. Drive the gas control valve to low fire.
2. Make sure the combustion air blower is running.
3. Verify that the adjusting screw on the ratio-regulator is six full (360°) turns down from the top.
4. Open the flow adjusting valve in the bypass gas line.
5. Open the manual gas valve in the bypass gas line.
6. Initiate the ignition sequence through the flame monitoring control system.
7. Verify that the burner has ignited.

   If the burner does not ignite:

   a) Try to ignite again to purge the air out of the gas piping.

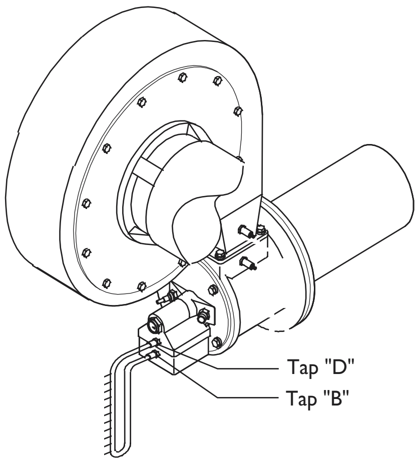
   b) If the burner does not ignite after one or two additional ignition attempts, see the Trouble shooting Guide contained in the Maintenance & Troubleshooting section of this guide.

   If the burner has ignited:

   a) Adjust the bypass flow adjusting valve such that the burner is able to maintain a stable flame and an adequate flame signal.

   b) Open all remaining manual gas valves feeding the burner.

Step 4: Set high fire gas



1. If the burner has and is ignited, set the main gas pressure regulator for 7" w.c. outlet pressure.
2. Drive the main gas control valve to high fire (full open).
3. Verify air flow with the burner firing, repeat Step 2 "Verify air flow".
4. Make sure that pressure taps B and D are open.
5. Connect the manometer to taps B and D.
6. Measure the gas differential pressure.
7. Use the gas curve from the appropriate ThermAir Data Sheet for the gas being used to find the differential gas pressure needed at high fire.

Note:
Select the appropriate gas orifice differential pressure based upon the desired amount of excess air in the burner.

8. Adjust the adjusting screw on the main gas pressure regulator to achieve the desired gas flow.
9. Once the chamber conditions stabilize, (i.e. pressure and temperature), repeat Steps 3 through 8.
10. Remove the manometer.
11. Close the pressure taps.

Step 5: Set low fire gas

1. Drive the main gas control valve to low fire.
2. Adjust the control valve linkage to provide the desired low fire gas flow.

Note:
It is very difficult to measure the very low gas pressures experienced at low fire, and it may be necessary to rely on visual inspection of the flame. This is especially true when gas turndowns in excess of 10 to 1 are being used. The main intent is to provide a stable flame with good flame signal that will not cause the chamber temperature to overshoot.

Step 6: Verify gas settings

Make sure that all settings are still the same after cycling the system several times between high and low fire.

Step 7: Stop Procedure

Caution:
Do not turn the combustion air blower off until the chamber temperature is below 250ºF (121ºC). This will prevent hot gases from back flowing into the burner and blower causing damage to the burner.

1. Stop the burner through the burner control system.
2. Run the combustion air blower until the chamber temperature drops below 250ºF (121ºC).
3. Shut off the combustion air blower.
4. Close all manual gas valves to the burner.

Maintenance & Troubleshooting

5

INTRODUCTION

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

Preventive maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance system is a list of periodic tasks.

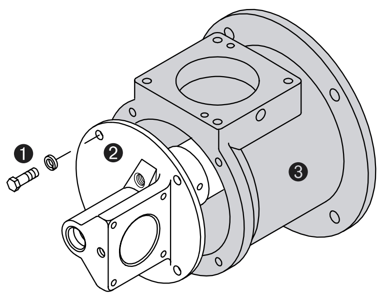
MAINTENANCE

Note:
These are guidelines only. The customer should make the final determination on maintenance intervals and tasks to be performed while considering the working environment.

Monthly Checklist

1. Inspect the flame sensing devices for good condition and cleanliness.
2. Check for proper air/gas pressures (Refer to the ThermAir Data Sheets, Series 114).
3. Test all the system alarms for proper response signals.
4. Check and clean igniter electrodes.
5. Check valve motors and control valves for free, smooth action and adjustment.
6. Check for the proper operation of ventilating equipment.
7. Test the interlock sequence on all safety equipment. Manually force each interlock to intentionally fail while at the same time noting if related equipment closes or stops as specified by the manufacturer. Test the flame safeguard by manually shutting off the gas to the burner.
8. Test the manual gas shut off cocks for proper operation.
9. Clean and/or replace the combustion air blower filter.
10. Inspect and clean the combustion air blower rotor.

Yearly Checklist



1. Leak test the safety shut-off valves for tightness of closure.
2. Test the pressure switch settings by checking the switch movements against pressure settings and comparing these with the actual impulse pressure.
3. Visually check igniter cable and connectors.
4. Remove, clean, and inspect all burners.
5. Be sure the following components are not damaged or distorted:
   - the burner nozzle.
   - the igniter.
   - the flame sensors.
   - the combustion tube.

The nozzle and combustion tube can be inspected without removing the burner from the chamber wall or entering the chamber. Perform the following:

- ***a.*** Shut the burner off and manually close the main gas shut off cocks.
- ***b.*** Allow the chamber temperature to cool down to 250°F (121°C).
- ***c.*** Disconnect the gas piping at a union or the gas inlet flange provided on the burner.
- ***d.*** Remove the four bolts ❶.
- ***e.*** Remove the rear cover ❷ from the burner housing ❸.
- ***f.*** To re-assemble, follow this sequence in the reverse order.

Troubleshooting Procedures

PROBLEM	POSSIBLE CAUSE	SOLUTION
Start-up sequence runs but burner does not light.	No ignition: • Attempting to ignite at inputs greater than 40%.	Reduce start point gas flow. Verify control circuit.
	No ignition: • Weak or non-existent spark.	Verify ignition transformer is a 6,000 - 8,000 volt transformer. (Not half-wave)
	No ignition: • There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	No ignition: • Open circuit between the ignition transformer and the igniter.	Repair or replace the wiring to the igniter.
	No ignition: • The igniter needs cleaning.	Clean the igniter.
	No ignition: • The igniter is not correctly grounded to the burner.	Clean the threads on the igniter and the burner. NOTE: Do not apply grease to the threads on the igniter.
	No ignition: • Igniter insulator is broken. Igniter is grounding out.	Inspect the igniter. Replace if broken.
	Not enough gas: • The gas flow into the burner is too low.	Check the start-up settings. Adjust low fire gas setting if necessary.
	Not enough gas: • If equipped with ratio regulator, loading line may not be attached	Reconnect loading line and verify loading pressure.
	Not enough gas: • The bypass valve is not open far enough.	Adjust bypass gas flow.
	Not enough gas: • Start gas solenoid valve does not open.	Check the solenoid valve coil for proper operation. Replace it if necessary.
	Not enough gas: • Gas valve does not open.	Check the wiring to the automatic gas shut-off valve. Check the output from the flame safeguard. Open manual gas cock.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Start-up sequence runs but burner does not light. *(continued)*	No flame signal: • Broken flamerod • Dirty UV scanner lens	Inspect and clean sensor Replace if necessary
	No flame signal: • Flamerod grounding out	Verify that the flamerod is installed correctly and is the correct length.
	Too much gas: • Wrong or missing burner fuel orifice.	Check ThermAir Data Sheets, Series 114 for fuel orifice and the given fuel.
The low fire flame is weak or unstable.	• Not enough gas flowing to the burner.	Adjust the gas control valve to increase the gas flow.
	• Not enough air.	Check for proper blower rotation. Check air filter for blockage.
The burner goes out when it cycles to high fire.	• Too much gas to the burner.	Verify gas orifice size for your fuel (ref. Data Sheets 114). Verify chamber pressure for proper air flow effect. Check the start-up settings. Measure the gas pressures and adjust them where necessary. Check for valve train pressure loss.
	• Loading line to the ratio regulator (if installed) is leaking.	Repair the leak in the loading line.
The burner is erratic and does not respond to adjustment.	Internal damage to the burner: • Some parts inside the burner are loose, dirty, or burned out.	Contact your Eclipse representative or Eclipse Combustion for further information.
The burner is unstable or produces soot or smoke.	• The air/gas ratio is out of adjustment.	Measure all the gas pressures and air pressures. Compare these pressures to the documented initial start-up settings and adjust them where necessary.
The burner cannot achieve full capacity.	• Air filter is blocked. (When equipped with Ratio Regulator)	Clean or replace the air filter.
	• Gas pressure going into the burner is too low.	Adjust the gas pressure.
	• Combustion chamber pressure is too high.	Derate burner for positive pressure installations.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate a start sequence.	• Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	• High gas pressure switch has activated. • Low gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	• Malfunction of the flame safeguard system (e.g., shorted-out flame sensor or electrical noise in the sensor line). • No power to the control unit.	Have a qualified electrician troubleshoot and correct the problem.
	• Main power is off.	Be sure the main power to the system is switched to the “on” position.

Appendix

Conversion Factors

Metric to English.

From	To	Multiply By
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hour (m^3/h)	cubic foot/hour (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 1.8) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("w.c.)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/m^3 (normal)	BTU/ft^3 (standard)	2.491×10^{-2}

Metric to Metric.

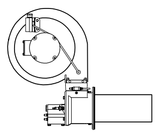
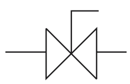
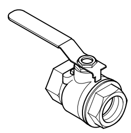
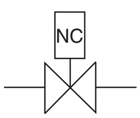
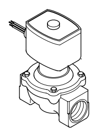
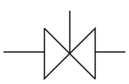
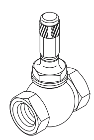
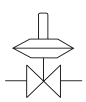
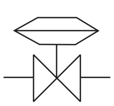
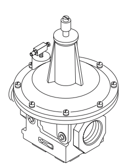
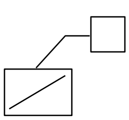
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric.

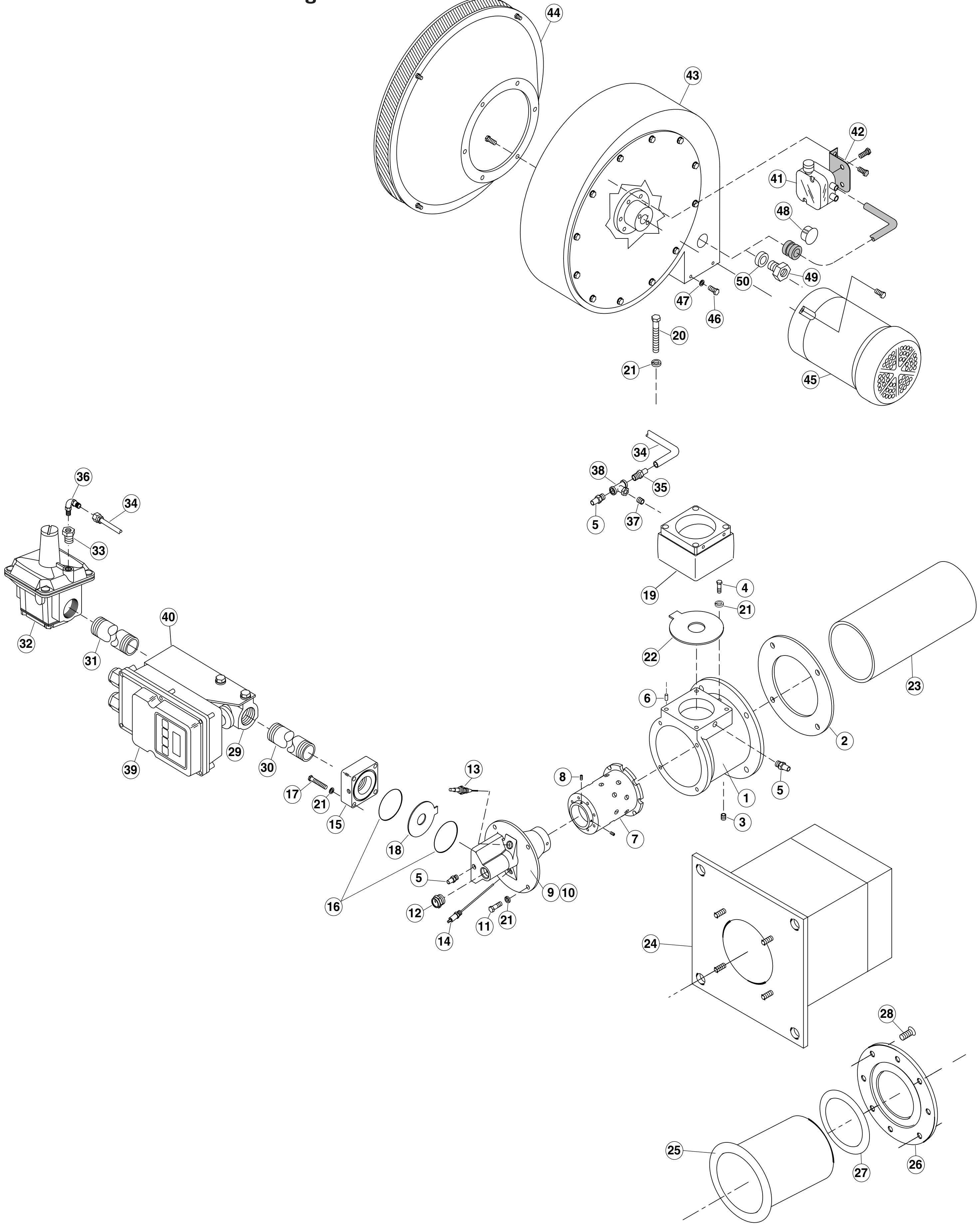
From	To	Multiply By
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F – 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column ("wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95
BTU/ft^3 (standard)	MJ/m^3 (normal)	40.14

Key to System Schematics

These are the symbols used in the schematics.

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		ThermAir		
Main gas shut-off valve train		Main Gas Shutoff Valve Train	Eclipse Combustion, Inc. strongly endorses NFPA as a minimum	756
		Gas Cock	Gas cocks are used to manually shut off the gas supply on both sides of the main gas shut-off valve train.	710
		Solenoid Valve (normally closed)	Solenoid valves are used to automatically shut off the gas supply on a bypass gas system or on small capacity burners.	760
		Adjustable Limiting Orifice	Adjustable limiting orifices are used for fine adjustment of gas flow.	730
		Pressure Regulator	A pressure regulator reduces gas pressure to a stable, usable pressure.	684
		Ratio Regulator	The ratio regulator adjusts the gas flow in ratio with the air flow. It contro;s the outlet pressure equal to the impulse line pressure. The impulse line is connected between the top of the ratio regulator and the blower housing.	742
		Automatic Gas Control Valve	An automatic gas control valve adjusts gas flow to the burner based on control system requirements.	720
--------		Impulse Line		

ThermAir Parts Drawing



ThermAir Parts List

Pos.	Qty.	Description	TA015	TA025	TA040	TA075	TA100	TA200	TA300	TA400	TA500
1	1	Body,alloy tube	7118-1	7118-1	7118-1	7046-1	3994	3994	7036-1	7036-1	7111-1
1	1	Body,SiC	7118-2	7118-2	7118-2	7046-3	3994-1	3994-1	N/A	N/A	N/A
2	1	Gasket,mounting	17054	17054	17054	20422	14932	14932	10027	10027	20151
3	2	Plug,0.125"NPT	15398	15398	15398	15398	15398	15398	15398	15398	15398
4	2	Screw,body	16022	16022	16022	16022	16022	16022	N/A	N/A	N/A
5	4	Tap,pressure	13445	13445	13445	13445	13445	13445	13445	13445	13445
6	4	Insert,thread,M12xM8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20304
7	1	Nozzle	7033-1	7033-2	7033-3	7133-2	3997-1	3997-1	7038-1	7038-1	7116-1
8	2	Screw,set,nozzle	19969	19969	19969	15885	15885	15885	15885	15885	15885
9	1	Cover,rear	7032-1	7032-1	7032-1	3998-1	3995	3995-1	7037-1	7037-1	7037-2
10	1	Adpt,plate,rear cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20150
11	4	Screw,rear cover	15886	15886	15886	15886	15886	15886	15886	15886	15886
12	1	Peepsight	10509	10509	10509	10509	10509	10509	13225	13225	13225
13	1	Spark Plug	23045	23045	23045	16927-1	16927-1	16927-1	10012	10012	10012
14	1	Flame Rod	17232-1	17232-1	17232-1	13312-6	13312-9	13312-9	N/A	N/A	N/A
14	1	Plug,protector,0.5"	11456-1	11456-1	11456-1	11456-1	11456-1	11456-1	11456-1	11456-1	11456-1
15	1	Block,inlet,gas,NPT	3974-4	3974-4	3974-2	7001-1	7156-2	3973-3	3973-3	3973-2	3973-2
15	1	Block,inlet,gas,Rc	3974-3	3974-3	3974-1	7001-3	7156-1	3973-1	3973-1	3973-10	3973-10
16	2	Seal,O-ring	14777	14777	14777	17037	14778	14778	14778	14778	14778
17	4	Screw,inlet,gas	15887	15887	15887	15893	15893	15893	15893	15893	15893
18	1	Plate,orifice,natural gas	14191-19	14191-1	14191-8	14934-15	14188-28	14188-26	14188-1	14188-20	14188-3
18	1	Plate,orifice,propane	14191-20	14191-19	14191-23	14934-3	14188-14	14188-9	14188-9	14188-1	14188-1
18	1	Plate,orifice,butane	14191-18	14191-3	14191-22	14934-14	14188-29	14188-27	14188-6	14188-19	14188-19
19	1	Block,inlet,blower	3977-3	3977-3	3977-3	7108-4	7045-2	7045-2	N/A	N/A	N/A
20	4	Screw,inlet,air	20246	20246	20246	20270	16015	16015	15892	15892	15892
21	12	Washer,M8	15222 (13)	15222 (13)	15222 (13)	15222 (13)	15222 (13)	15222 (13)	15222	15222	15222 (16)
22	1	Plate,orifice,air	14188-23	14188-24	14188-25	20362-4	14802-11	14802-9	10039-1	10039-4	20152-3
23	1	Combustor,alloy	14887-6	14887-6	14887-6	20400	20716-1	20716-1	100236	101279	101278
24	1	Block and holder	N/A	N/A	N/A	N/A	N/A	N/A	100013	10013	101161
25	1	Combustor,SiC	20474	20474	20474	20463	20718	20718	N/A	N/A	N/A
26	1	Retaining ring,SiC	19970	19970	19970	20464	10003	10003	N/A	N/A	N/A
27	1	Gasket,SiC	19971	19971	19971	20465	10005	10005	N/A	N/A	N/A
28	1	Screw,FH	10001	10001	10001	10001	10001	10001	10001	10001	10001
29	1	Valve,BV-A,NPT	501239	501239	501200	501201	501201	501203	501203	501204	501204
29	1	Valve,BV-A,Rc	202081	202081	101248	101249	101249	101250	101250	101251	101251
30	1	Nipple,NPT	20901	20901	20905	18779	18779	18808	14704	14791	14791
30	1	Nipple,Rc	20903	20903	20906	20891	20891	20875	20857	20823	20823
31	1	Nipple,NPT	18731	18731	18761	18774	18774	18806	18806	15307	15307
31	1	Nipple,Rc	20902	20902	20904	20884	20884	20858	20858	20814	20814
32	1	Ratio-Regulator,NPT	11080	11080	19997	15939	15939	20312	20312	10315	10315
32	1	Ratio-Regulator,Rc	20900	20900	19998	19999	19999	20311	20311	19990	19990
33	1	Bushing,Ratio-reg	N/A	N/A	N/A	N/A	N/A	18503	18503	20305	20305
34	3	Line,loading,plastic tubing	34505 (ft.)	34505 (ft.)	34505 (ft.)	34505 (ft.)	34505 (ft.)	34505 (ft.)	34505 (ft.)	34505 (ft.)	34505 (ft.)
34	36	Line,Loading,S.S. hose	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30	SC4(in)w/(2)30
35	1	Ftg,TB,Load line,plastic	14506 (2)	14506 (2)	14506 (2)	14506	14506	14506	14506	14506	14506
35	1	Ftg,load line,SS hose	2484 (2)	2484 (2)	2484 (2)	2484	2484	2484	2484	2484	2484
36	1	Ftg,load line,elb,plastic	N/A	N/A	N/A	14689	14689	14689	14689	14689	14689
36	1	Ftg,load line,elb,S.S hse	N/A	N/A	N/A	1494	1494	1494	1494	1494	1494
37	1	Nip,ftg,load line,0.125"	18684	18684	18684	18684	18684	18684	18682	18682	18682
38	1	Tee,ftg,0.125	19160	19160	19160	19160	19160	19160	N/A	N/A	N/A
38	1	Cross,ftg,0.125	N/A	N/A	N/A	N/A	N/A	N/A	20668	20668	20668
39	1	Act,M7284-A-1004	12200	12200	12200	12200	12200	12200	12200	12200	12200
39	1	Act,M7284-C-1000	15273-4	15273-4	15273-4	15273-4	15273-4	15273-4	15273-4	15273-4	15273-4
39	1	Act,EMP 423-5	22755	22755	22755	22755	22755	22755	22755	22755	22755
39	1	Act,EMP 424-5	22735	22735	22735	22735	22735	22735	22735	22735	22735
39	1	ACT004A3B1A1AX, RH	*	*	*	*	*	*	*	*	*
39	1	ACT004A4B1A1AX, LH	*	*	*	*	*	*	*	*	*
40	1	Mtg,kit,HW	100099	100099	100099	100099	100099	100099	100099	100099	100099
40	1	Mtg,kit,rotary,right hand	100127	100127	100127	100127	100127	100127	100127	100127	100127

ThermAir Parts List (Continued)

Pos.	Qty.	Description	TA015	TA025	TA040	TA075	TA100	TA200	TA300	TA400	TA500
40	1	Mtg,kit,rotary,left hand	100128	100128	100128	100128	100128	100128	100128	100128	100128
41	1	Air switch,AA-A2-4-5,2-20	20475	20475	20475	20475	20475	20475	20475	20475	20475
41	1	Air switch,AA-A2-6-5,2-20	20440	20440	20440	20440	20440	20440	20440	20440	20440
41	1	Air switch,AA-A2-6-3,.4-4	14641-1	14641-1	14641-1	14641-1	14641-1	N/A	N/A	N/A	N/A
41	1	Air switch,SMDF,2-6	14494	14494	14494	14494	14494	14494	14494	14494	14494
41	1	Air switch,JD2-P,.1-24"	16928-1	16928-1	16928-1	16928-1	16928-1	16928-1	16928-1	16928-1	16928-1
41	1	Air switch,JD2-P,.1-10"	16928	16928	16928	16928	16928	16928	16928	16928	16928
42	1	Mtg,kit,Dungs,plastic	101146	101146	101146	101146	101146	101146	101192	101192	101192
42	1	Mtg,kit,JD2-P,plastic	100074	100074	100074	100074	100074	100074	100074	100074	100074
42	1	Mtg,kit,SMDF,plastic	100075	100075	100075	100075	100075	100075	100075	100075	100075
42	1	Mtg,kit,Dungs,S.S.hose	101182	101182	101182	101182	101182	101182	101182	101182	101182
42	1	Mtg,kit,JD2-P,S.S.hose	101183	101183	101183	101183	101183	101183	101183	101183	101183
42	1	Mtg,kit,SMDF,S.S.hose	101184	101184	101184	101184	101184	101184	101184	101184	101184
43	1	BLOWER	**	**	**	**	**	**	**	**	**
44	1	Grille,inlet stdblower	100347-1	100347-1	100347-1	100347-2	100347-2	100347-2	100347-2	100347-2	100347-2
44	1	Grille,inlet,3in. blower	100346	100346	100346	100346	100346	N/A	N/A	N/A	N/A
44	1	Filter,round	200758	200758	200758	200757	200757	200757	200756	200756	200754
44	1	Filter,square,20x20	N/A	N/A	N/A	101010	101010	101010	202731	202731	202731
44	1	Filter,silencer	15405	15405	15405	20505	20505	20505	15407	15407	15407
45	1	Mtr,115-208-230/1,TEFC	N/A	N/A	N/A	12033	12033	N/A	N/A	N/A	N/A
45	1	Mtr,208-230/460/3,std	N/A	N/A	N/A	13101	13101	14938	20547	20548	16770
45	1	Mtr,208-230/460/3,3 in.	N/A	N/A	N/A	N/A	25115	N/A	N/A	N/A	N/A
45	1	Mtr,575/3,TEFC	N/A	N/A	N/A	21473	21473	21475	21476	21477	21478
45	1	Mtr,115/1,TEFC	21631	21631	21631	N/A	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,208-230/1,TEFC	21727	21727	21727	N/A	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,115/1,TENV	12995	12995	12995	N/A	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,230/460/3, AUTO	N/A	N/A	N/A	20528	N/A	20530	N/A	N/A	N/A
45	1	Mtr,460/3,AUTO	N/A	N/A	N/A	N/A	N/A	N/A	20371	20392	20360
45	1	Mtr,240/415/3,IEC 50Hz	20518	20518	20518	20520	20521	20522	20524	20524	20525
45	1	Mtr,230/1,IEC 50Hz	20554	20554	20554	20556	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,110/115/1,IEC 50Hz	21057	21057	21057	21059	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,115-208/1, 3in.TENV	N/A	N/A	N/A	21631	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,208-230/460/3,TENV	21472	21472	21472	N/A	N/A	N/A	N/A	N/A	N/A
45	1	Mtr,575/3,TENV	21495	21495	21495	N/A	N/A	N/A	N/A	N/A	N/A
46	4	Screw,blower,slip fit	15881	15881	15881	15881	15881	15881	N/A	N/A	N/A
47	4	Washer,M6	15625	15625	15625	15625	15625	15625	N/A	N/A	N/A
48	2	Plug,blower	20605	20605	20605	20605	20605	20605	20605 (1)	20605 (1)	20605 (1)
49	1	Ftg,press.,blower,0.125	N/A	N/A	N/A	N/A	N/A	N/A	20658	20658	20658
50	1	Nut,M14, ftg,press,blower	N/A	N/A	N/A	N/A	N/A	N/A	20812	20812	20812

* ACT004A3B1A1AX
** BLOWER-PACKAGED1.1

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Fisher Controls

MCK-1177
03/99

Low Pressure Second-Stage & Integral 2-Stage LP-Gas Regulators Type R400 & R500

Reguladores de Baja Presión Para Gas-LP de Segunda Etapa y Dos Etapas Integradas Tipo R400 y R500

WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher equipment must be installed, operated, and maintained in accordance with federal, state, and local codes and Fisher instructions. The installation in most states must also comply with NFPA No. 54 and 58 standards.

Only personnel trained in the proper procedures, codes, standards, and regulations of the LP-gas industry should install and service this equipment.

THINGS TO TELL THE GAS CUSTOMER:

1. Point out the regulator's vent to the customer (or vent assembly or vent tube), and **stress that this opening must remain unobstructed at all times.** Tell the customer to be sure to check the vent opening after a freezing rain, sleet storm, or snow to make sure ice has not formed in the vent.

2. Show the customer the shutoff valve on the container. The customer should close this valve immediately if gas is smelled, appliance pilot lights fail to stay on or appear higher than usual, or any other abnormal situation occurs.

3. Tell the customer to call your company to service the regulator if the regulator vents gas or a leak develops in the system. **Only a qualified gas serviceman should install or service the regulator.**

Introduction

Scope of Manual

This instruction manual covers installation and maintenance for the Types R422, R522 & R552 second stage low pressure regulators, and the Type R532 integral 2-stage unit containing a first stage regulator on the inlet. These low pressure regulators have an integral high capacity internal relief valve. Inlet and outlet pressure taps are standard, making pressure testing easier.

Description

These regulators are designed for low pressure (inches of water column) vapor service and are not to be used for liquid service. The outlet pressure setting is normally 11 inches wc. Integral 2-stage (reducing container pressure to 11 inches wc) are normally painted GRAY, while second-stage regulators (reducing first stage pressure to 11-inches wc) are painted PALM GREEN. The units differ in construction and capacity rating.

ADVERTENCIA

El no cumplir con estas instrucciones o no instalar y dar mantenimiento apropiado a este equipo puede resultar en una explosión y/o incendio, resultando en daños, heridas, o la muerte.

Los reguladores Fisher deben instalarse, operarse y recibir mantenimiento de acuerdo con las regulaciones, leyes y códigos federales, estatales y municipales, e instrucciones de Fisher. En la mayoría de los estados, la instalación debe cumplir, también, con los estándares NFPA 54 y 58.

Sólo personal entrenado en los procedimientos, códigos, estándares y regulaciones apropiadas para la industria de gas LP debe instalar y dar servicio a este equipo.

QUE DEBE INFORMARLE AL USUARIO:

1. Muestre al cliente la ventila del regulador (el ensamble de la ventila o la tubería de la ventila), y haga énfasis en que **esta abertura debe estar siempre libre de obstrucciones.** Indique al cliente que es necesario que cheque la ventila después de una nevada, granizada o tormenta de agua congelada, para asegurarse de que no se formó hielo en la ventila.
2. Muestre al cliente el contenedor de la válvula para apagar el regulador y adviértale que debe cerrarla de inmediato, en caso de oler a gas, que exista falla en el encendido de los pilotos o se vean de mayor tamaño que el normal, o si ocurre cualquier situación anormal.
3. Indique al cliente que es necesario solicitar a la compañía una visita de servicio si el regulador registra una fuga de gas o si existe una gotera en el sistema. **Sólo una persona calificada debe instalar o dar servicio al regulador.**

Introducción

Alcance de este Manual

Este manual de instrucciones cubre la instalación y mantenimiento del regulador de baja presión de segunda etapa Tipo R422, R522 y R552 y los reguladores de 2-etapas integradas tipo 532 que incluye un regulador de 1ra. etapa. Estos reguladores de baja presión disponen de una válvula interna de alivío de alta capacidad. La entrada y la salida disponen de tomas para medir la presión.

Descripción

Estos reguladores están diseñados para servicio de vapor en baja presión (pulg. de columna de agua), y no debe usarse para líquidos. El regulador es ajustado en fabrica a 11-pulgadas de c.a. (27.4 milibares). Los reguladores de 2-etapas integradas (reducen presión del contenedor a 11-pulg. de c.a. (27.4 milibares) son de color GRIS, mientras que los reguladores de segunda-etapa (que reducen de una presión de 1ra. etapa a 11-pulgadas de c.a. son VERDE PALMA. Los reguladores difieren en construcción y capacidades de flujo.

D450072T012

Specifications

Table 1 lists the specifications for the regulator. Contact the factory if the regulator is to be used on any service other than LP-gas, natural gas, or air. Second-Stage regulators are limited to 10 psig inlet pressure and must be used with a first-stage regulator.

Especifícaciones

La tabla 1 lista las especificaciones para este regulador. Contacte a la fábrica si al regulador va a darse un servicio distinto a gas LP, gas natural, o aire. Los reguladores de 2-etapas estan limitados a 10 psig (0.69 bares) de presión de entrada, por lo que deben utilizarse con reguladores de 1ra.-etapa.

Table 1 **Tabla 1**

TYPE NUMBER [MODELO]	TYPE OF SERVICE [SERVICIO]	MAX. INLET PRESSURE [MAX. PRESION DE ENTRADA]	SIZE, INCH, FNPT [TAMAÑO, PULGADAS, CONEXION NPT HEMBRA]		VAPOR CAPACITY, BTU/HR PROPANE*** [CAPACIDAD DE VAPOR EN BTU/HR PROPANO ***]
			INLET CONNECTION CONEXION DE ENTRADA	OUTLET CONECCTION CONEXION DE SALIDA	
R422	SECOND-STAGE [SEGUNDA ETAPA]	10 PSIG* [0.69 Bares]	3/4"	3/4"	2,025,000
R522	SECOND-STAGE [SEGUNDA ETAPA]	10 PSIG* [0.69 Bares]	1/4", 1/2", 3/4"	1/2"	875,000
				3/4"	1,375,000
R532	INTEGRAL TWO-STAGE [INTEGRAL DE DOS ETAPAS]	250 PSIG* [17.24 Bares]	1/4"	1/2"	685,000
				3/4"	1,100,000
R552	SECOND-STAGE [SEGUNDA ETAPA]	10 PSIG* [0.69 Bares]	3/4"	3/4"	1,100,000

* Body inlet pressure rating 250 psig
** Assumes first stage regulator failure
*** Based on 10 psig inlet pressure and 20% droop for second and integral two-stage.

* El cuerpo soporta una presión de 250 PSIG (17.2 Bares)
** Asume falla en el regulador de 1ra. etapa.
*** Basado en una presión de entrada de 10 psig (0.69 Bar) y 20% de caida y una unidad integrada de 2 etapas.

Installation

⚠ WARNING

The vent should be kept open to permit free flow of air into and out of the regulator. Protect the vent against the entrance of rain, snow, ice formation, paint, mud, insects, or any other foreign material that could plug the vent or vent line.

LP-gas may discharge to the atmosphere through the vent. An obstructed vent which limits air or gas flow can cause abnormally high pressure that could result in personal injury or property damage. Failure to use a vent line on Indoor Installations can cause a hazardous accumulation of gas which could result in personal injury or property damage.

Never use first stage (pounds to pounds) regulator on low pressure (inches of water column) service because personal injury or property damage could occur.

Make sure gas flow through the regulator is in the same direction as the arrow on the body "Inlet" and "Outlet" connections are clearly marked. The installation should be adequately protected from vehicular traffic and damage from other external sources.

Instalación

⚠ ADVERTENCIA

La ventila deberá mantenerse abierta, para permitir que el aire fluya libremente dentro y fuera del regulador. Proteja la ventila contra la entrada de lluvia, nieve, hielo, pintura, mugre, insectos o cualquier otro material ajeno que pueda obstruir la ventila o la línea de alivío.

Gas LP puede ser descargado a la atmósfera a través de la ventila. Una ventila obstruida limita el flujo de aire o gas, causando sobrepresiones que puede resultar en lesiones al personal o daño a la propiedad.

Nunca use los reguladores de 1ra. etapa (kilos a kilos) en servicio de baja presión (milimetros de columna de agua), ya que pueden presentarse lesiones al personal y/o daño a la propiedad.

Asegúrese de que el gas fluye a través del regulador en la misma dirección que las flechas del cuerpo del regulador – las conexiones de "entrada" y "salida" están claramente indicadas. La instalación debe protegerse adecuadamente del tráfico vehicular y daño por causas externas.

Install the regulator so that any gas discharge through the vent or vent assembly is over 3-feet horizontally from any building opening below the level of discharge. Install the regulator high enough above ground level - at least 18 inches - so that rain splatter cannot freeze in the vent. Whether a protective hood is used or not, do not install the regulator in a location where there can be excessive water accumulation or ice formation, such as directly beneath a down spout, gutter, or roof line of building.

A regulator installed outdoors without a protective hood must have its vent pointed vertically down, see figure 2, to allow condensate to drain. This minimizes the possibility of freezing and of water or other foreign material entering the vent and interfering with proper operation.

Before installing the regulator, check for damage which might have occurred in shipment. Also check for and remove any dirt or foreign material which may have accumulated in the regulator body or the pipeline. Apply pipe compound to the male threads of the pipe.

Some installations, such as in areas with heavy snowfall, may require a hood or enclosure to protect the regulator. **Horizontally mounted regulators, such as found in single cylinder installations, must be installed beneath a protective cover**. If possible, slope or turn the vent down sufficiently to allow any condensation to drain out of the spring case. Be careful that the slot in the hood or cover for the regulator's outlet piping does not extend too far and expose the vent to the elments.

By code, regulators installed indoors have limited inlet pressure, and they **require** a vent line to the outside of the building, see figure 3. A vent assembly, such as Fisher Y602 series, should be used on the end of the vent line. The same installation precautions apply to vent assemblies as the integral regulator vents covered previously. Use a vent line equal in size (diameter) or larger than the regulator vent. Vent piping must not restrict the flow passage of the regulator's internal relief valve. To install the vent line, remove the vent screen and apply a good grade of pipe dope to the male threads of the line.

Underground container systems require a vent tube to prevent water

Instale el regulador de tal manera que las descargas de gas a través de la ventila o del ensamble de la ventila queden a más de 3 pies (1 metro) de cualquier abertura que tenga el edificio abajo del nivel de la descarga. Instale el regulador a suficiente altura sobre el nivel del piso – por lo menos 18 pulgadas (45 cm) – para que la lluvia que salpique no llegue a congelarse en la ventila. Ya sea que use protector o no, no instale el regulador donde exista excesiva acumulación de agua, formación de hielo, como puede ser bajo una llave de agua, gotera o línea de desague.

Si se instala un regulador en el exterior sin "casco" protector, deberá colocarse la ventila en forma vertical hacia abajo, ver figura 2, para permitir que drene cualquier condensación. Así se minimiza la posibilidad de congelamiento y de que entre a la ventila agua o cualquier otro material ajeno, interfiriendo con la operación adecuada del equipo. Antes de instalar el regulador, verifique que no exista daño que pueda haber ocurrido durante el embarque. También cheque y quite cualquier sucio o materia ajena que pueda haberse acumulado en el cuerpo del regulador o en la tubería. Aplique compuesto para tubería en los extremos machos de la tubería.

En algunas instalaciones, como las que se hacen en áreas con nevadas pesadas pueden requerir de un "casco" o escudo para proteger el regulador. **Los reguladores montados en forma horizontal, como los que se encuentran en las instalaciones de un solo cilindro, deben instalarse bajo una cubierta protectora.** Si es posible, voltee la ventila hacia abajo lo suficiente para permitir que cualquier condensado drene hacia fuera del contenedor del resorte. Tenga cuidado en que el "casco" o la cubierta de la salida del regulador no se extienda demasiado lejos y la ventila quede expuesta a los elementos.

Por código, los reguladores instalados en interiores deben tener una presión de entrada limitada y **requieren** de una línea de ventilación hacia el exterior del edificio, vea figura 3. Un ensamble de ventila, como el Fisher serie Y602, debe usarse al final de la línea de ventilación. Las mismas precauciones de instalación aplican a los ensambles de las ventilas como a las ventilas integrales del regulador, ya descritas. Use una línea de venteo del mismo diámetro o mayor que la salida del alívio. La tuberia de venteo no debe limitar el flujo de gas de la válvula de alívio interno del regulador. Para instalar la ventila, remueva la malla de la ventilla, aplique compuesto de tuberia a la rosca de la tuberia.

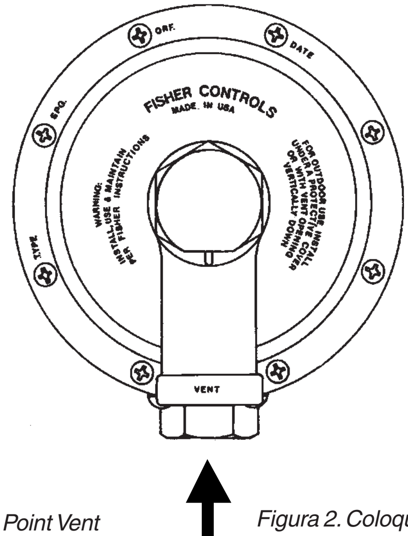

Figure 2. Point Vent Down on Outdoor Installations

Figura 2. Coloque la Ventila hacia abajo en Instalaciones Exteriores

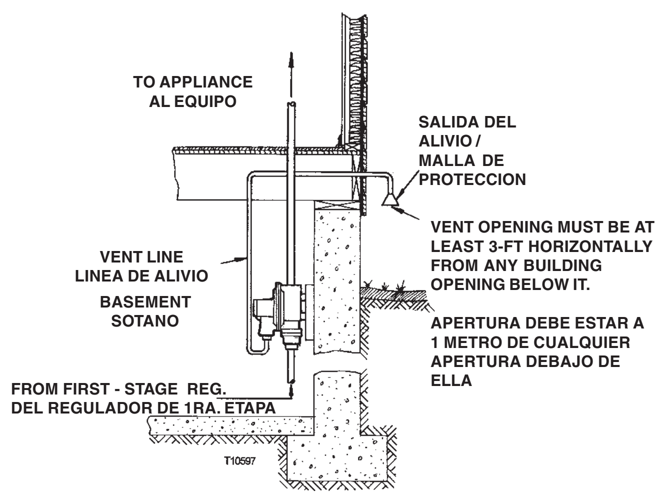

Figure 3. Typical Indoor Installation With Vent line and Vent Assembly

Figura 3. Instalación interior con linea de alivio y ensamble de alívio from entering the regulator spring case, see figure 4. Remove the vent screen and install a vent tube. The vent tube must be run from the regulator vent to above the maximum water table. The vent tube opening must terminate at the extreme top inside of the dome cover. Maintain drainage away from the dome at all times. For further information on underground installations, write for a copy of "Underground LP-Gas Systems: Suggested Installation, Inspection," available from The National Propane Gas Association, 1600 Eisenhower Lane, Suite 100, Lisle, IL 60532

Los sistemas subterráneos requieren de una linea de venteo para impedir que el agua entre al contenedor del resorte del regulador, ver figura 4. Quite la pantalla de la ventila e instale la linea con los mismos criterios ya mencionados. La linea de venteo debe correr desde la ventila hasta un lugar por encima del registro máximo de agua. La abertura de este tubo debe terminar en el extremo superior de la tapa. Asegúrese que la tapa del regulador está firme y libre de drenaje a todo tiempo. Para mayor información sobre instalaciones subterráneas, pida una copia de "Instalación e Inspección de Sistemas de Gas Subterráneos", disponible en The National Propane Gas Association, 1600 Eisenhower Lane, Suite 100, Lisle, Il 60532, USA.

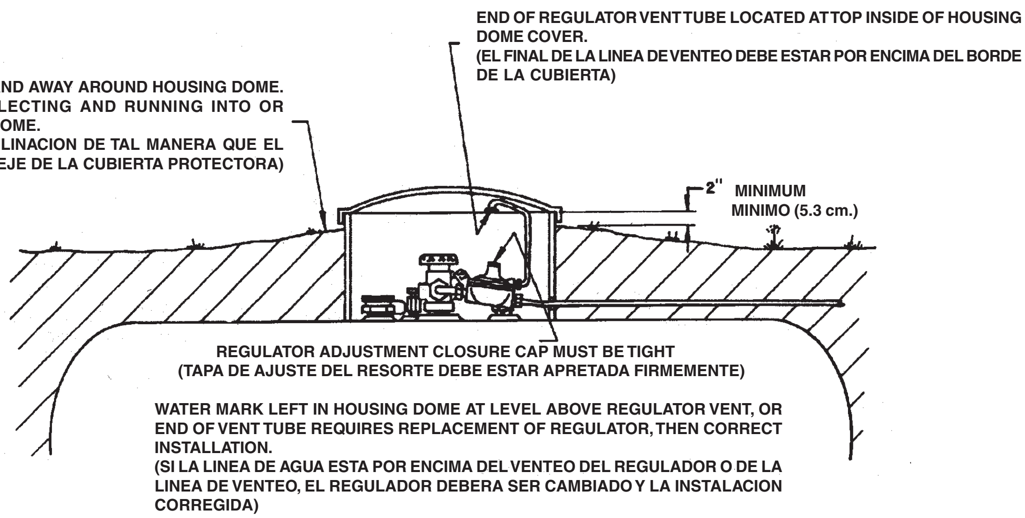

Figure 4. Regulators Installed on Underground Installations Require a Vent Tube

Figura 4. Reguladores instalados En Una Instalación Subterránea Requieren Linea de Venteo

Adjustment

Each regulator is indivually factory set to deliver 11 inches wc. If it becomes necessary to increase the outlet pressure, remove the closing cap and turn the adjustment screw clockwise. Turn the adjusting screw counterclockwise to decrease the outlet pressure. The outlet pressure plug may be removed using a 7/16" hexagon wrench. The plug can be removed with pressure on the outlet of the regulator. Install a water manometer or pressure gauge to determine the regulator's outlet setting during adjustment, (Actual pressure at the appliance may be less due to line loss.) After setting, reinstall the pipe plug and replace the closing cap. Check the plug for leakage.

Inlet pressure may be checked using the inlet pressure gauge tap and a pressure gauge. Remove the plug using a 7/16" wrench. The plug can be removed with pressure on the inlet of the regulator.

Overpressure Protection

WARNING

Personal injury or system damage may result if these regulators are installed without appropiate overpressure protection. Outlet pressures greater than 3 psig above the set point may cause damage to regulator parts, leaks in the regulator, or personal injury due to bursting of pressure-containing parts or explosion of accumulated gas.

If the regulator is exposed to an overpressure condition, it must be inspected for damage that may have occurred.

Ajuste

Cada regulador se ajusta en forma individual en la fábrica a 11 pulgadas de columna de agua (69.6 milibares). Si es necesario aumentar la presión de salida, quite la tapa y gire el tornillo de ajuste en el sentido de las manecillas del reloj; Si lo que se desea es disminuir la presión, ajuste el tornillo girándolo en sentido contrario a las manecillas del reloj. El tapón de presión de salida puede removerse usando una llave hexagonal de 7/16". El tapón puede removerse cuando existe presión en la salida del regulador. Instale un manómetro de agua o de presión para determinar el ajuste de la salida del regulador. (La presión real en el equipo puede ser menor debido a pérdida en la línea). Completado el ajuste, reinstale el tapón de prueba Asegúrese de que no hay fugas en el tapón.

La presión de entrada puede verificarse usando un manómetro. Remueva eltapón con una llave de 7/16"; puede quitarse con presión en la entrada del regulador.

Protección Contra SobrePresiones

PELIGRO

En caso de que estos reguladores se instalen sin una protección por sobrepresiones apropiadas, daños al sistema o a personas pudiera ocurrir . Una presión de salida mayor a 3 psig (0.2 bar) por encima del nivel de ajuste puede causar daño a partes internas del regulador, fugas en el regulador o daño al personal por explosión de partes presurizadas o del gas acumulado. Si el regulador es sometido a

Large volumes of gas may discharge through the regulator vent during internal relief valve operation which can result in fire or explosion from accumulated gas.

All of the regulators have an internal relief valve that opens when downstream pressure reaches approximately 1 psig on regulators set at 11 inches wc. When the internal relief valve opens, gas escapes to the atmosphere through the regulator's vent. The internal relief valve gives overpressure protection against excessive build-up resulting from seal leakage due to worn parts or chips or foreign material on the orifice.

Some type of external overpressure protection must be provided if inlet pressure will be high enough to damage downstream equipment. Common methods of external overpressure protection include relief valves, monitoring regulators, shutoff devices, and series regulation. The internal relief valve on second-stage and integral two-stage regulators with 1 inch vent (Type R400 series) and 3/4 inch vent (R500 series) limits downstream pressure to 2 psig as long as inlet pressure does not exceed the values in table 1 and the vent is unobstructed.

Maintenance

WARNING

To avoid personal injury or equipment damage, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure. Regulators that have been disassembled for repair must be tested for proper operation before being returned to service. Only parts manufactured by Fisher should be used for repairing Fisher regulators. Relight pilot lights according to normal startup procedures.

Due to normal wear or damage that may occur from external sources, these regulators must be inspected and maintained periodically. The frequency of inspection and replacemnet of the regulators depends upon the severity of service conditions or the requirements of local, state, and federal regulations. Even under ideal conditions, these regulators should be replaced after 15 years from date of manufacture or sooner should inspection reveal the need.

Visually inspect the regulator each time a gas delivery is made for:

1. Improper installation.
2. Plugged or frozen vent.
3. Wrong regulator or no regulator in the system.
4. Internal or external corrosion.
5. Age of the regulator.
6. Any other condition that could cause the uncontrolled escape of gas.

Failure to do the above could result in personal injury or property damage.

Make sure the regulator vent, vent assembly, or vent tube does not become plugged by mud, insects, ice, snow, paint, etc. The vent screen aids in keeping the vent from becoming plugged, and the screen should be clean and properly installed.

Replace any regulators that have had water in their spring case or show evidence of external or internal corrosion. Checking for internal

una sobrepresión, el mismo deberá inspeccionarse para verificar que no este dañado.

Volúmenes grandes de gas pueden ser descargados a través de la ventila del regulador si la válvula de alivio interna opera, pudiendo resultar en incendio o explosión del gas acumulado.

Todos los reguladores cuentan con una válvula de alivio interna que se abre cuando la presión de salida alcanza aproximadamente 1 psig (69 milibares) en reguladores ajustados a 11 pulgadas ca (27.4 milibares). Cuando se abre, escapa el gas a la atmósfera a través de la ventila del regulador. La válvula interna de alivio protege contra la sobrepresión que resulte al sellar una fuga debido a partes desgastadas, basura o material ajeno que esté en el orificio.

Debe darse protección externa contra la sobrepresión, si la presión interna puede ser tan alta que dañe el equipo corriente abajo. Los métodos comunes de protección externa contra la sobrepresión incluyen: válvulas de alivio, reguladores de monitoreo, aditamentos para apagar el equipo y regulación en serie. La válvula de alívio interno en los reguladores 2da. etapa e los integrados de 2-etapas con una ventila de 1 pulgada (Serie R400) y 3/4 de pulgada (Serie R500) limitan la presión aguas abajo del regulador a 2 psig (0.13 bares) siempre que la presión de entrada no supere los valores indicados en la tabla 1 y la ventila no este obstruida.

Mantenimiento

ADVERTENCIA

Para evitar lesiones al personal o daño al equipo, no intente dar mantenimiento o desensamblar el regulador sin primero aislarlo del sistema de presión y aliviar toda la presión interna. Los reguladores que se han desarmado para reparación deben probarse antes de regresarlos a servicio. Sólo deben usarse partes de Fisher al reparar los reguladores Fisher. Encienda nuevamente los pilotos de acuerdo con los procedimientos estándar de arranque.

En virtud de que puede ocurrir daño ocasionado por uso normal o por causas externas, es necesario inspeccionar y dar mantenimiento a este regulador en forma periódica. La frecuencia de la inspección y substitución de partes depende de la severidad de condiciones de operación y de los requerimientos de leyes y regulaciones locales, estatales y municipales. Aun en las condiciones ideales, es necesario reemplazar estos reguladores después de 15 años de la fecha de fabricación, o antes, si una inspección demuestra la necesidad de hacerlo así.

Cada vez que se hace una entrega de gas, se debe inspeccionar visualmente el regulador. La revisión debe incluir:

1. Instalación apropiada del regulador.
2. Chequeo que la ventila no este obstruida.
3. Que no se haya removido el regulador y que sea el adecuado.
4. Que no exista corrosión interna o externa.
5. Edad del Regulador.
6. Cualquier otra condición que pudiera causar el escape no-controlado de gas.

El no llevar a cabo lo anterior puede resultar en lesiones al personal o daño a la propiedad.

corrosion may require complete removal of the adjusting screw and shut down of the gas system. Closely examine regulators directly connected to the container valve by means of a solid POL adaptor (horizontal mounting) for signs of corrosion. Correct any improper installations.

Older regulators are more likely to catastrophically fail because of worn or corroded parts. Replace regulators over 15 years of age; other service or environmental conditions may dictate replacement of the regulator before it becomes 15 years old, refer to Fisher Bulletin LP-32.

These regulators have an internal inlet screen to help prevent foreign particles .003” across or larger from passing through the the regulator and into the downsteam appliances. Such foreign material can cause improper operation of both regulators and appliances.

In most installations, the inlet screen will provide adequate filtration capacity over the life of the regulator. However, in installations with extreme debris contamination, it is possible for the filter screen to become blocked and stop or restrict the flow of gas. If this should occur, remove the four inlet fitting cap screws along with the inlet fitting and its o-ring. Remove the filter screen and clean or replace it. After installation of the filter screen, reinstall the inlet fitting, its o-ring, and the four inlet fitting cap screws. Leak test the inlet fitting flange. **NOTE: The R522 inlet screen may be accessed by simply removing the inlet piping.**

Regulator Repair

Regulators that have been disassembled for repair must be tested for proper operation before being returned to service. Only parts manufactured by Fisher should be used to repair Fisher regulators. Be sure to give the complete type number of the regulator when corresponding with the factory.

Asegúrese de que la ventila del regulador, el ensamble de la ventila o el tubo de la ventila nos encuentran obstruidos por mugre, insectos, hielo, nieve, pintura, etc. La pantalla de la ventila es un auxiliar para conservar la ventila limpia y bien instalada.

Substituya cualquier regulador al que le haya caído agua en el contenedor del resorte o muestre evidencia de corrosión interna o externa. Para hacer una inspección de corrosión interna es necesaria la remoción total del tornillo de ajuste y apagar completamente el sistema de gas. Examine cuidadosamente los reguladores que están conectados directamente al contenedor de la válvula por medio de un adaptador sólido POL (montaje horizontal), para detectar algún signo de corrosión. Corrija cualquier instalación no adecuada.

Hay más probabilidades de que fallen los reguladores de más edad, debido al uso o a partes desgastadas. Substituya los reguladores de más de 15 años de edad; y a aquéllos que por el uso o las condiciones medio ambientales deban substituirse antes de cumplir 15 años. Consulte el Boletín Fisher LP-32 para más referencias.

Estos reguladores cuentan con una pantalla interna que ayuda a prevenir que partículas ajenas de más de .003 micras pasen al regulador y lleguen al sistema de flujo. Estos materiales ajenos pueden ocasionar operación inadecuada, tanto en el regulador como en los equipos alimentados por gas.

En la mayoría de las instalaciones, la pantalla interna puede brindar suficiente capacidad de filtración durante la vida activa del regulador. Sin embargo, en instalaciones con demasiados desechos contaminantes es posible que la pantalla del filtro quede obstruida y detenga o restrinja el flujo de gas.

Si esto llega a ocurrir, desconecte la linea de alimentación, retire el filtro y límpielo. Cambie el filtro si no se puede limpiar o si esta dañado. Con cuidado, presione el filtro en la entrada hasta que toque el fondo. Reinstale las tuberias y cheque si existe alguna fuga. **NOTA: El filtro de entrada del R522 puede ser removido removiendo la tuberia de entrada.**

Reparación de los reguladores

A los reguladores que se hayan desensamblado para reparación es necesario probarlos antes de reinstalarlo para operación. Unicamente utilize refacciones Fisher para reparar sus reguladores Fisher. Por favor incluya el numero completo del regulador en sus comunicaciones con la fabrica.

For further information, contact Fisher Controls International, LLC:

P.O.Box 8004,
McKinney, Texas 75069, USA
WEB SITE: www.fisherregulators.com/lp

Para mayor información, favor comuniquese con Fisher Controls International, LLC:

P.O.Box 8004
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Fisher Controls

Installation Manual

Type R522 and R522H Pressure Reducing Regulators

FISHER®

October 1992 Form 5331

Introduction

This installation manual covers the installation, startup, and adjustment procedures for Type R522 and R522H pressure reducing regulators. The Type R522 self-operated, spring-loaded regulator provides economical pressure-reducing control in a variety of service and industrial applications. The regulator can be used with a variety of gaseous fluids such as natural gas, manufactured gas, propane, or air.

The Type R522 regulators have high capacity and factory adjustable internal relief to help minimize overpressurization of the downstream system. Any excess outlet pressure above the start-to-discharge point of the relief valve spring, moves the diaphragm off the relief valve seat, allowing excess pressure to bleed out through the screened spring case vent.

Installation

WARNING

Personal injury, equipment damage, or leakage due to escaping accumulated gas or bursting of pressure-containing parts may result if this regulator is overpressured or is installed where service conditions could exceed the limits given in table 1. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by Title 49, Part 192, of the U.S. Code of Federal Regulations, by the National Fuel Gas Code Title 54 of the National Fire Codes of the National Fire Protection Association, or by other applicable codes) to prevent service conditions from exceeding those limits.

Additionally, physical damage to the regulator could result in personal injury or property damage due to escaping gas. To avoid such injury and damage, install the regulator in a safe location.

1. Only personnel qualified through training and experience should install, operate, and maintain a regulator. Before installing a Type R522 regulator, check for damage which might have occurred in shipment. Also check for dirt or foreign matter which may have accumulated in the regulator body or in the pipeline.

2. The Type R522 may be installed in any position (vertical or horizontal). Apply a good grade of pipe compound to the male threads (being sure not to apply pipe compound to flow path of the pipe) of the pipe and install the regulator so that the flow is in the direction of the arrow cast on the body. Use approved piping procedures when installing the regulator.

Table 1. Specifications

Body Sizes And End Connection Style

Inlet: ■ 1/4, ■ 1/2, and ■ 3/4-inch NPT screwed
Outlet: ■ 1/2 and ■ 3/4-inch NPT screwed

Maximum Allowable Inlet Pressure (1)

250 psig (17 bar)

Outlet Pressure Range (1)

4.5 inches w.c. to 15.5 psig (11.2 mbar to 1.1 bar)

Allowable Outlet Pressures(1)

Emergency (Casing): 20 psig (1.4 bar)
Maximum Operating to Avoid Internal Part Damage: 3 psi (0.21 bar differential) above outlet pressure setting

Orifice Sizes and Color Code

R522: ■ 1/8-inch (gray)
R522H: ■ 13/64-inch (tan)

Material Temperature Capabilities(1)

– 40°F to 160°F (– 40°C to 71°C)

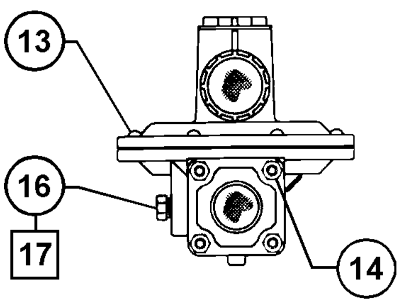
1. The pressure/temperature limits in this manual, and any applicable code or standard limitations, should not be exceeded.

Table 2. Outlet Pressure Ranges

Regulator Type number	Outlet Pressure Range	Control Spring Part Number	Control Spring Color Code
R522	4.5 to 6 inches w.c. (11.2 to 15 mbar) 5.5 to 8 inches w.c. (13.7 to 20 mbar) 7.5 to 9.5 inches w.c. (18.7 to 23.7 mbar) 9.5 to 13 inches w.c. (23.7 to 32.5 mbar) 13 to 20 inches w.c. (32.5 to 50 mbar) 20 to 28 inches w.c. (50 to 70 mbar)	T13588T0012 T13589T0012 T13590T0012 T13624T0012 T13592T0012 T13546T0012	Red Yellow Olive Drab Purple Gray Orange
R522H	1 to 2.5 psig (70 to 172 mbar) 2.5 to 5.5 psig (172 to 379 mbar) 5.5 to 10.5 psig (379 to 724 mbar) 10.5 to 15.5 psig (724 to 1069 mbar)	T13593T0012 T13599T0012 T13600T0012 T13601T0012	Blue Green Red Yellow

Key	Description
1	Body 1/2-inch size 3/4-inch size
2	Inlet Fitting 1/4-inch size 1/2-inch size 3/4-inch size
3	Spring Case Assembly
4	Vent Screen
5	Retaining Ring
6	Control Spring
7	Orifice Tube Assembly
8*	Orifice Tube O-Ring
9	Orifice Tube Screw
10	Diaphragm/Relief Valve Assembly
11	Closing 00061P08
12	Adjusting Screw
13	Spring Case Screw
14	Inlet Screw
15*	Inlet O-Ring
16	Pipe Plug
19	Screw
21	Screw
22	Inlet Screen

*Recommeded spare part.



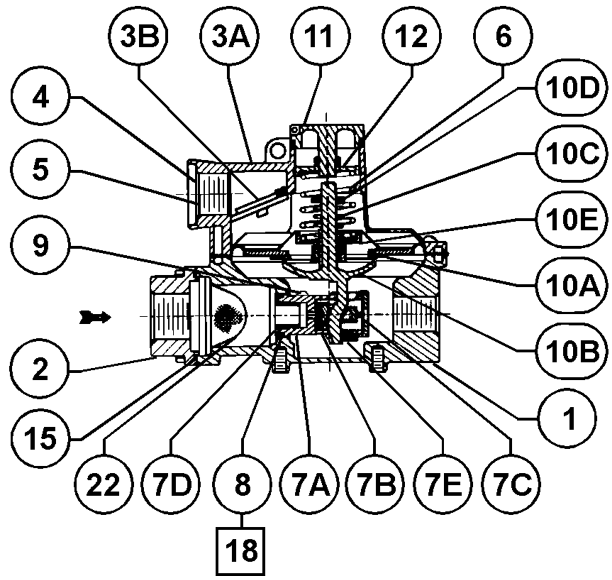


Figure 1. Type R522 Regulator Assembly

WARNING

A regulator may vent some gas to the atmosphere. In hazardous or flammable gas service, vented gas may accumulate, and cause personal injury, death, or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous location. The vent line or stack opening must be protected against condensation or clogging.

Under enclosed conditions, escaping gas may accumulate and be an explosion hazard. In these cases the vent should be piped away from the regulator to a safe location outdoors.

3. On outdoor installations, regulators installed with vents in positions other than vertically down require additional vent protection from the elements. Such protection may be with separate hood shields, or the Fisher Y602 Series vents.

4. Regulator operation within ratings does not preclude the possibility of damage from debris in the lines or from external sources. A regulator should be inspected for damage periodically and after any overpressure condition.

5. To adjust the regulator, monitor downstream pressure with a gauge during the adjustment procedure. To increase the outlet pressure, the adjustment screw (key 12, figure 1) must be turned clockwise. This requires removal of the closing cap (key 11, figure 1). To reduce the outlet pressure setting, turn the adjusting screw counter-clockwise. Do not adjust the spring to produce an outlet pressure setting above the limit stamped on the regulator.

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Fisher Controls

Instruction Manual

Type 1098-EGR & 1098H-EGR Pilot-Operated Regulators

FISHER

May 1987 Form 5084

Contents

TYPE 1098-EGR-6352 REGULATOR

TYPE 1098H-EGR-6354L REGULATOR

Figure 1. Typical Regulator Constructions

D100339 X012

Introduction

Scope of Manual

This manual describes and provides instructions and parts list for a Type 1098-EGR or 1098H-EGR regulator (figure 1) complete with standard P590 Series filter and either a 6350 Series regulator or a Type 61LD pilot. The Type 1806 relief valve also is covered when a Type 61LD pilot is used. However, instructions and parts lists for monitoring pilots and other equipment used with this regulator are found in separate manuals.

Product Description

Type 1098-EGR and 1098H-EGR regulators provide economical, accurate pressure control in a wide variety of applications such as gas distribution systems, heat-treating furnaces, and boiler plants. They are also used in plant air service and in liquid service where a slow stroking time (approximately 30 to 90 seconds) is desired on both opening and closing the main valve. The Type 1098-EGR regulator is used with a Type 6351, 6352, 6353 or the 61 series pilot. The Type 1098H-EGR regulator is used with a Type 6351, 6352, 6353, 6354H, 6354L, or 6354M pilot.

Specifications

Table 1 lists specifications for various Type 1098-EGR and 1098H-EGR constructions. Specifications for a given regulator as it originally comes from the factory are stamped on nameplates (figure 2) located on the actuator and main valve body, while the pilot control spring range appears on the pilot spring case and the pilot restriction code is stamped on the pilot body.

Table 1. Specifications

BODY SIZES AND END CONNECTION STYLES

Body Size, Inch	Material	End Connection Style	Rating(1)
1, 2	Cast iron	NPT screwed	Class 250B
	WCB steel	NPT screwed, butt-welding, or socketwelding	Class 600
2, 3, 4, 6, 8 x 6	Cast iron	Flat-face flanged	Class 125B
		Raised-face flanged	Class 250B
	WCB steel	Raised-face flanged	Class 150, 300, or 600
		Buttwelding	Class 600

MAXIMUM MAIN VALVE INLET PRESSURE(1)
400 psig (28 bar) or body rating limit, whichever is lower, except 20 psig (1.4 bar) for boiler fuel installations as shown in table 2

MAXIMUM PILOT SUPPLY PRESSURE(1, 2)
600 psig (41 bar)

PILOT RESTRICTION(3)

TYPE NUMBER	GAIN	RESTRICTION		
		Used	Color Code	Letter Code
6351	Standard	No	None	None
6352 through 6354M	Standard	Yes	Green	S
	Low for liquid service and/or broader proportional bands	No	None	L
	High for narrower proportional bands	Yes	Red	H

OUTLET (CONTROL) PRESSURE RANGES(4)
Type 6351 Pilot: J 3 to 20 psig (0.21 to 1.4 bar) with green spring **J** 5 to 35 psig (0.34 to 2.4 bar) with cadmium spring or **J** 35 to 100 psig (2.4 to 6.9 bar) with red spring
Type 6352 Pilot: J 2 inch wc to 2 psig (5 to 140 mbar) with yellow spring or **J** 2 to 10 psig (140 to 690 mbar) with black spring
Type 6353 Pilot: J 3 to 40 psig (0.21 to 2.8 bar) with yellow spring or **J** 35 to 125 psig (2.4 to 8.6 bar) with red spring
Type 6354L Pilot: 85 to 200 psig (5.9 to 14 bar) with blue spring and no diaphragm limiter
Type 6354M Pilot: 175 to 220 psig (12 to 15 bar) with blue spring and diaphragm limiter
Type 6354H Pilot: 200 to 300 psig (14 to 21 bar) with green spring and diaphragm limiter
Type 61LD Pilot: J 0.25 to 2 psig (0.017-0.138 bar) with red spring
J 1 to 5 psig (0.069-0.34 bar) with yellow spring **J** 2 to 10 psig (0.138-0.69 bar) with blue spring
J 5 to 15 psig (0.34-1.02 bar) with brown spring **J** 10 to 20 psig (0.69-1.4 bar) with green spring

MAXIMUM AND MINIMUM DIFFERENTIAL PRESSURES
See table 2

Table 1. Specifications (Continued)

ACTUATOR SIZES AND MAXIMUM ACTUATOR PRESSURES(1)

ACTUATOR SIZE		OUTLET (CONTROL) PRESSURE		EMERGENCY CASING PRESSURE	
		Psig	Bar	Psig	Bar
Type 1098	30	100	6.9	115	7.9
	40	75	5.2	82	5.7
	70	50	3.4	65	4.5
Type 1098H	30	300	21	400	28

MAIN VALVE FLOW CHARACTERISTIC J Linear (standard) or J quick-opening

MAIN VALVE FLOW DIRECTION In through seat ring and out through cage

MATERIAL TEMPERATURE CAPABILITIES(1) **Standard Elastomers:** -20 to 150_F (-29 to 66_C) **High-Temperature Elastomers:** 0 to 300_F (-18 to 149_C), except 0 to 180_F (-18 to 82_C) for water service

PORT DIAMETERS AND TRAVELS

BODY SIZE INCH	PORT DIAMETER		TRAVEL				
			Standard		Restricted Capacity		
	Inch	mm	Inch	mm	Percentage of Flow Capacity	Inch	mm
1	1-5/16	33.3	3/4	19	- - -	- - -	
2	2-3/8	60.3	1-1/8	29	30	3/8	10
					70	5/8	16
3	3-3/8	85.7	1-1/2	38	40	7/8	22
4	4-3/8	111.1	2	51	40	1	25
6 & 8 X 6	7-3/16	182.6					

APPROXIMATE WEIGHTS (WITH STANDARD SINGLE-PILOT CONSTRUCTION)

ACTUATOR SIZE		BODY SIZE, INCH				
		1	2	3	4	6
		Lb				
Type 1098	30	55	75	115	165	350
	40	65	85	125	175	360
	70	140	160	200	250	435
Type 1098H	30	80	100	140	190	375
		Kg				
Type 1098	30	25	34	52	75	159
	40	29	39	57	79	163
	70	64	73	91	113	197
Type 1098H	30	36	45	64	86	170

1. The pressure/temperature limits in this manual, and any applicable standard limitation should not be exceeded.
2. For stability or overpressure protection, a reducing regulator may be installed upstream of the pilot according to the installation section.
3. Restriction part numbers are given in the parts list.
4. Pilot control spring part numbers are given in the parts list.

Installation and Startup

WARNING

Personal injury, equipment damage, or leakage due to escaping accumulated gas or bursting of pressure-containing parts may result if this regulator is overpressured or is installed where service conditions could exceed the limits given in tables 1 and 2 and on the appropriate nameplate, or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by Title 49, Part 192, of the U.S. Code of Federal Regulations, by the National Fuel Gas Code Title 54 of the National Fire Codes of the National Fire Protection Association, or by other applicable codes) to prevent service conditions from exceeding those limits.

Additionally, physical damage to the regulator could results in personal injury and property damage due to escaping accumulated gas. To avoid such injury and damage, install the regulator in a safe location.

Standard Single-Pilot Regulator

Installations

A Type 1098-EGR or 1098H-EGR regulator bleeds no gas to atmosphere, making it suitable for installation in pits and other enclosed locations without elaborate venting systems. This regulator also can be installed in pits subject to flooding, by installing a special antiflood breather vent or by venting the pilot spring case above the expected flood level so that the pilot diaphragm can be referenced to atmospheric pressure.

Note

On the Design EGR main valve, normal pressure drop assists shutoff. Therefore, leakage may result during any reverse pressure drop condition.

1. Use qualified personnel when installing, operating, and maintaining regulators. Before installing, inspect the main valve, pilot, and tubing for any shipment damage or foreign material that may have collected during crating and shipment. Make certain the body interior is clean and the pipelines are free of foreign material. Apply pipe compound

Table 2. Maximum and Minimum Differential Pressures for Main Valve Spring Selection

CONSTRUCTION			Low-differential boiler fuel installation Type 1098-EGR requiring quick-opening cage and limited to 20 psig (1.4 bar) max inlet pressure	All Other Constructions		
MAXIMUM ALLOWABLE DIFFERENTIAL PRESSURE			**20 psig (1.4 bar)**	**60 psi (4.1 bar)**	**125 psi (8.6 bar)**	**400 psig (28 bar) or body rating limit, whichever is lower**
MINIMUM DIFFERENTIAL PRESSURE REQUIRED FOR FULL STROKE	**1 Inch Body**	**Size 40 Actuator**	**Not available**	**2.5 psi (0.17 bar)**	**4 psi (0.28 bar)**	**5 psi (0.34 bar)**
		Size 30 Actuator	**Not available**	**3.5 psi (0.24 bar)**	**5 psi (0.34 bar)**	**7 psi (0.48 bar)**
		Size 70 Actuator	**1.0 psi (0.069 bar)**	**1 psi (0.069 bar)**	**1.5 psi (0.10 bar)**	**2.5 psi (0.17 bar)**
	2 Inch Body	**Size 40 Actuator**	**Not available**	**3 psi (0.21 bar)**	**5 psi (0.34 bar)**	**10 psi (0.69 bar)**
		Size 30 Actuator	**Not available**	**4 psi (0.28 bar)**	**6 psi (0.42 bar)**	**11 psi (0.76 bar)**
		Size 70 Actuator	**1.0 psi (0.069 bar)**	**1.5 psi (0.10 bar)**	**2 psi (0.14 bar)**	**3 psi (0.21 bar)**
	3 Inch Body	**Size 40 Actuator**	**Not available**	**4 psi (0.28 bar)**	**6 psi (0.41 bar)**	**11 psi (0.76 bar)**
		Size 30 Actuator	**Not available**	**5 psi (0.34 bar)**	**8 psi (0.55 bar)**	**14 psi (0.97 bar)**
		Size 70 Actuator	**1.0 psi (0.069 bar)**	**2 psi (0.14 bar)**	**2.5 psi (0.17 bar)**	**4 psi (0.28 bar)**
	4 Inch Body	**Size 40 Actuator**	**Not available**	**5 psi (0.34 bar)**	**8 psi (0.55 bar)**	**13 psi (0.90 bar)**
		Size 30 Actuator	**Not available**	**10 psi (0.69 bar)**	**13 psi (0.90 bar)**	**22 psi (1.5 bar)**
		Size 70 Actuator	**1.3 psi (0.090 bar)**	**2.5 psi (0.17 bar)**	**3 psi (0.21 bar)**	**5 psi (0.34 bar)**
	6, 8 x 6 Inch Body	**Size 40 Actuator**	**Not available**	**9.5 psi (0.66 bar)**	**14 psi (0.97 bar)**	**19 psi (1.3 bar)**
		Size 30 Actuator	**Not available**	**13 psi (0.90 bar)**	**19 psi (1.3 bar)**	**28 psi (1.9 bar)(1)**
		Size 70 Actuator	**2.2 psi (0.15 bar)**	**4 psi (0.28 bar)**	**6 psi (0.42 bar)**	**8 psi (0.55 bar)**
MAIN VALVE SPRING COLOR CODE (2)			**Yellow, except green for 1 inch body**	**Green**	**Blue**	**Red**

1. Requires special 6350 Series pilot construction with Type 1806H relief valve.
2. Spring part numbers are given in the parts list.

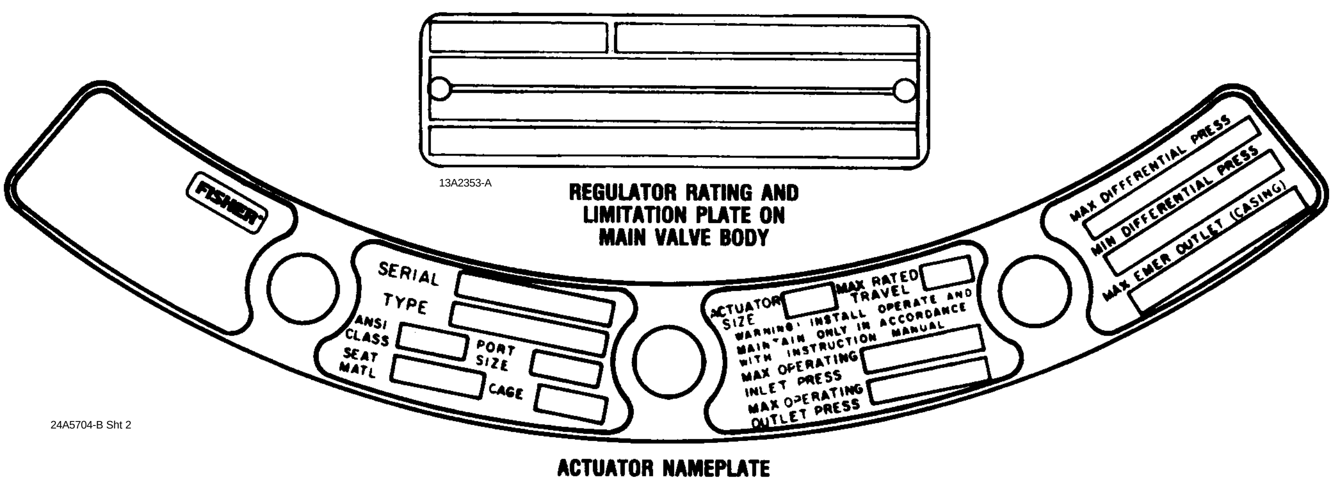


Figure 2. Regulator Nameplates

only to the male pipe threads with a screwed body, or use suitable line gaskets and good bolting practices with a flanged body.

With a weld end body, be sure to remove the trim package, including the gasket (key 4, figure 11), according to the Maintenance section before welding the body into the line. Do not install the trim package until any post-weld heat treatment is completed. If heat treating, prevent scale buildup on all machined guiding and sealing surfaces inside the body and at the bonnet flange/body joint.

Note

All Type 1098-EGR and 1098H-EGR regulators should be installed so that flow through the main valve matches the flow arrow attached to the valve body.

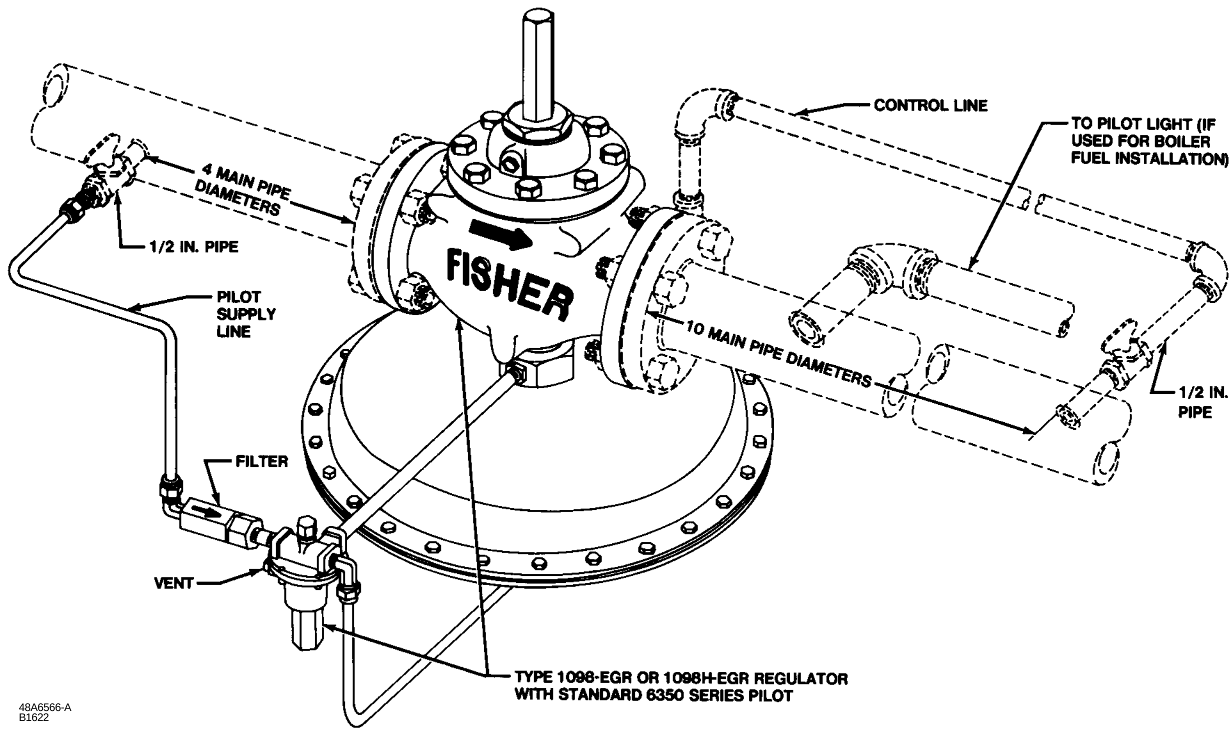


Figure 3. Standard Single-Pilot Installation

2. Install a three-valve bypass around the regulator if continuous operation is necessary during maintenance or inspection.

The standard pilot mounting position is shown in figure 1, the pilot may be field-changed to the opposite-side mounting position by swapping the pilot pipe nipple to the opposite bonnet tapping.

WARNING

A regulator may vent some gas to the atmosphere. In hazardous or flammable gas service, vented gas may accumulate, and cause personal injury, death, or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous location. The vent line or stack opening must be protected against condensation or clogging.

3. To keep the pilot spring case vent from being plugged or the spring case from collecting moisture, corrosive chemicals, or other foreign material, point the vent down or otherwise protect it. Vent orientation may be changed by removing the spring case and remounting it on the pilot body or on a standard Type 6352 through 6354M pilot, by twisting the vent (key 35, figure 13, or key 13, figure 14) in the spring case. To remotely vent a standard Type 6352 through 6354M pilot, remove the vent and install obstruction-free tubing or piping into the 1/4-inch NPT vent tapping. The Type 61LD pilot is vented by installing the vent piping in place of the pipe plug (key 22, figure 18). Then remove the closing cap assembly (key 5, figure 18) in order to remove the machine screw from inside the closing cap and tightly install it in the vent hole in the center of the closing cap. Provide protection on a remote vent by installing a screened vent cap into the remote end of the vent pipe.

4. Run a 3/8-inch outer diameter or larger pilot supply line from the upstream pipeline to the filter inlet as shown in figure 3, bushing the line down to fit the 1/4-inch NPT filter connection. Do not make the upstream pipeline connection in a turbulent area, such as near a nipple, swage, or elbow. If the maximum pilot inlet pressure could exceed the pilot rating, install a separate reducing regulator in the pilot supply line. Install a hand valve in the pilot supply line, and provide vent valves to properly isolate and relieve the pressure from the regulator.

5. Attach a 1/2-inch NPT downstream pressure control line downstream of the regulator in a straight run of pipe as shown in figure 3. Connect the other end of the control line to the bonnet connection. Do not make the tap near any elbow, swage, or nipple that might cause turbulence. Install a hand valve in the control line to shut off the control pressure when the bypass is in use.

6. If a quick acting solenoid is to be installed downstream of a regulator, the regulator and solenoid should be located as far apart as practical. This will maximize the gas piping volume between the regulator and solenoid and improve the regulator response to quick changing flow rates.

7. Consult the appropriate instruction manual for installation of an optional pneumatic or electric remote control drive unit. For optional remote pneumatic loading of a 6350 Series or 61LD pilot, make the loading piping connections to the 1/4-inch NPT vent connection.

Prestartup Considerations

Before beginning the startup procedures in this section, make sure the following conditions are in effect:

- Block valves isolate the regulator.
- Vent valves are closed.
- Hand valves are closed.

CAUTION

Introduce pilot supply pressure into the regulator before introducing any downstream pressure, or internal damage may occur due to reverse pressurization of the pilot and main valve components.

Always use pressure gauges to monitor downstream pressure during startup. Procedures used in putting this regulator into operation must be planned accordingly if the downstream system is pressurized by another regulator or by a manual bypass.

Note

For proper operation, pilot supply pressure must exceed control pressure by the minimum amount specified on the actuator nameplate as minimum differential pressure.

The only adjustment necessary on a Type 1098-EGR or 1098H-EGR regulator is the pressure setting of the pilot control spring. Turning the adjusting screw clockwise into the spring case increases the spring compression and pressure setting. Turning the adjusting screw counterclockwise decreases the spring compression and pressure setting.

Pilot Adjustment

To adjust standard 6350 Series pilots: loosen the locknut (key 11, figure 13, or key 10, figure 14), and turn the adjusting screw (key 10, figure 13, or key 9, figure 14). Then tighten the locknut to maintain the adjustment position. On a standard Type 6352 through 6354M pilot, a closing cap (key 28, figure 14) must be removed before adjustment and replaced afterward.

WARNING

To avoid possible personal injury from a pressure-loaded Type 61LD pilot, carefully vent the spring case before removing the closing cap. Otherwise, trapped loading pressure could forcefully eject the freed closing cap.

To adjust the Type 61LD pilot: remove the closing cap (key 5, figure 18) and turn the adjusting screw (key 6, figure 18). Any adjustments made should set the controlled pressure within the appropriate spring range shown in the Specifications table.

Startup

1. Slowly open the hand valve in the pilot supply line.

2. Slowly open the upstream block valve, and partially open the downstream block valve for minimum flow.

3. Slowly open the hand valve in the control line.

4. Adjust the pilot setting if necessary.

5. Completely open the downstream block valve.

6. Slowly close the bypass valve, if any.

Dual-Pilot Boiler Fuel Control Regulator

Installation

1. Perform the Standard Single-Pilot Regulator Installation section through step 3, making sure that the regulator is installed in a horizontal pipeline with the actuator below the main valve as shown in figure 4.

2. Run a 1/2-inch outer diameter or larger pilot supply line from the upstream pipeline to the 1/2-inch NPT supply connection in the pipe tee as shown in figure 4. Do not make the connection in a turbulent area, such as near a nipple, swage, or elbow. If the maximum pilot inlet pressure could exceed the pilot rating, install a separate reducing regulator in the pilot line. Install a hand valve in the pilot supply line, and provide vent valves so that pressure can be properly isolated and relieved from the regulator.

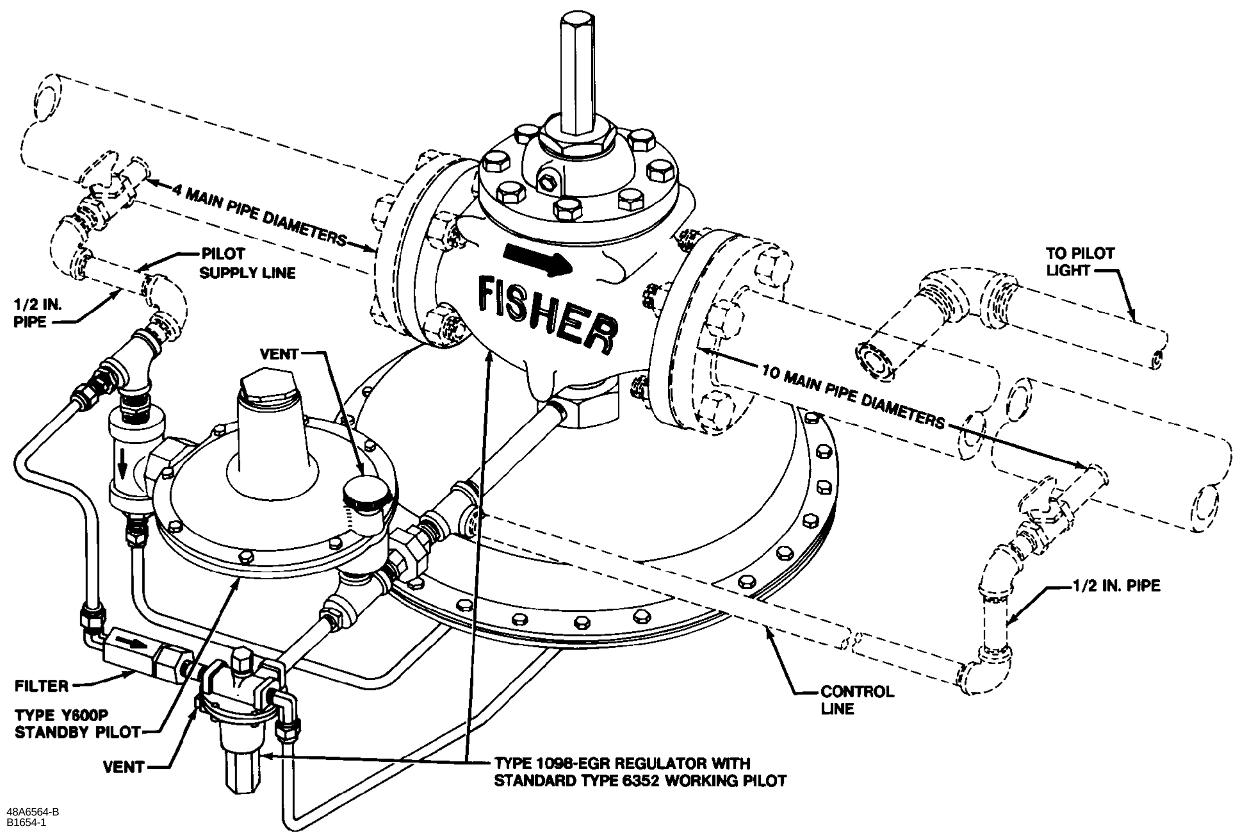


Figure 4. Typical Dual-Pilot Boiler Fuel Installation

3. Attach a 1/2-inch NPT downstream pressure control line ten pipe diameters downstream of the regulator in a straight run of pipe. Connect the other end of the control line to the 1/4-inch NPT connection in the control line pipe tee as shown in figure 4. Do not make the tap near any elbow, swage, or nipple which might cause turbulence. Install a hand valve in the control line to shut off the control pressure when the bypass is in use. Also use the hand valve to dampen out pulsations which may cause instability or cycling of the regulator.

4. Consult the appropriate instruction manual for installation of an optional pneumatic or electric remote control drive unit. For optional remote pneumatic loading of a 6350 Series or Type 61LD pilot, make the loading piping connections to the 1/4-inch NPT vent connection.

Prestart Considerations

Before beginning the startup procedures in this section, make sure the following conditions are in effect:

- Block valves isolate the regulator.
- Vent valves are closed.
- Hand valves are closed.

CAUTION

Introduce pilot supply pressure into the regulator before introducing any downstream pressure, or internal damage may occur due to reverse pressurization of the pilot and main valve components.

Always use pressure gauges to monitor downstream pressure during startup. Procedures used in putting this regulator into operation must be planned accordingly if the downstream system is pressurized by another regulator or by a manual bypass.

Note

For proper operation, pilot supply pressure must exceed control pressure by the minimum amount specified on the actuator nameplate as minimum differential pressure.

The only adjustment necessary on a Type 1098-EGR or 1098H-EGR regulator is the pressure setting of the pilot control spring. Turning the adjusting screw clockwise into the spring case increases the spring compression and pressure setting. Turning the adjusting screw counterclockwise decreases the spring compression and pressure setting.

Pilot Adjustment

To adjust standard 6350 Series pilots: loosen the locknut (key 11, figure 13, or key 10, figure 14), and turn the adjusting screw (key 10, figure 13, or key 9, figure 14). Then tighten the locknut to maintain the adjustment position. On a standard Type 6352 through 6354M pilot, a closing cap (key 28, figure 14) must be removed before adjustment and replaced afterward.

WARNING

To avoid possible personal injury from a pressure-loaded Type 61LD pilot, carefully vent the spring case before removing the closing cap. Otherwise, trapped loading pressure could forcefully eject the freed closing cap.

To adjust the Type 61LD pilot: remove the closing cap (key 5, figure 18) and turn the adjusting screw (key 6, figure 18). Any adjustments made should set the controlled pressure within the appropriate spring range shown in the Specifications table.

Startup

1. Slowly open the hand valve in the pilot supply line.

2. Slowly open the upstream block valve, and partially open the downstream block valve for minimum flow.

3. Slowly open the hand valve in the control line and make sure that the standby pilot is set far enough below the working pilot so that the standby pilot remains closed during normal operation. For example, with final desired settings of 11 inches wc (27 mbar) for the working pilot and 10 inches wc (25 mbar) for the standby pilot, begin by reducing the working pilot setting far enough below 10 inches wc (25 mbar) for the working pilot to shut off. Then set the standby pilot for an outlet pressure of 10 inches wc (25 mbar). Finally, set the working pilot for an outlet pressure of 11 inches wc (27 mbar).

Table 3 shows how close the standby pilot can be set to the working pilot setting.

4. Completely open the downstream block valve.

5. Slowly close the bypass valve, if any.

Working Monitor

Installation

1. For both the working monitor regulator and the working regulator, perform the Standard Single-Pilot Regulator Installation section through step 6.

2. Connect another downstream pressure control line and hand valve (figure 5) to the monitoring pilot according to the monitoring pilot instruction manual. Attach a 1/2-inch NPT intermediate pressure control line and hand valve from the intermediate pressure pipeline to the working monitor regulator. Pipe supply pressure between the monitoring pilot and the working monitor regulator according to the monitoring pilot manual.

For two typical monitoring pilots, table 4 gives the spread between normal distribution pressure and the minimum pressure at which the working monitor regulator can be set to take over if the working regulator fails open.

Prestartup Considerations

Before beginning the startup procedures in this section, make sure the following conditions are in effect:

- Block valves isolate the regulator.
- Vent valves are closed.
- Hand valves are closed.

CAUTION

Introduce pilot supply pressure into the regulator before introducing any downstream pressure, or internal damage may occur due to reverse pressurization of the pilot and main valve components.

Always use pressure gauges to monitor downstream pressure during startup. Procedures used in putting this regulator into operation must be planned accordingly if the downstream system is pressurized by another regulator or by a manual bypass.

Note

For proper operation, pilot supply pressure must exceed control pressure by the minimum amount specified on the actuator nameplate as minimum differential pressure.

Table 3. Standby Pilots for Boiler Fuel Control Applications

STANDBY PILOT INFORMATION			MINIMUM PRESSURE AT WHICH STANDBY PILOT CAN BE SET
Construction	**Spring Range**	**Spring Part Number**	
Type Y600P with 3/8 inch (9.5 mm) port diameter and 150 psig (10 bar) maximum allowable pilot inlet	3 to 8 inch wc (8 to 20 mbar)(1) 5 to 15 inch wc (12 to 38 mbar)(1) 11 to 28 inch wc (27 to 68 mbar)(1)	1B6358 27052(1) 1B6539 27022(1) 1B5370 27052(1)	1 inch wc (2.5 mbar) under working pilot set point
	1 to 2-1/2 psig (0.069 to 0.17 bar)(2) 2-1/4 to 4-1/2 psig (0.16 to 0.31 bar)(2) 4-1/2 to 7 psig (0.31 to 0.48 bar)(2)	1B5371 27022(2) 1B5372 27022(2) 1B5373 27052(2)	0.2 psig (14 mbar) under working pilot set point
Type 621-107 with 3/8 inch (9.5 mm) port diameter and 150 psig (10 bar) maximum allowable pilot inlet for cast iron body or 750 psig (52 bar) maximum allowable pilot inlet for malleable iron or steel body	5 to 10 psig (0.34 to 0.69 bar)	1D8923 27022	0.3 psig (21 mbar) under working pilot set point

1. With standard diaphragm plate.
2. With heavy diaphragm plate.

Table 4. Working Monitor Performance

MONITORING PILOT INFORMATION			MINIMUM PRESSURE AT WHICH WORKING MONITOR REGULATOR CAN BE SET
Construction	**Spring Range**	**Spring Part Number**	
Type Y600M with 1/8 inch (3.2 mm) port diameter and 150 psig (10 bar) maximum allowable pilot inlet	5 to 15 inch wc (12 to 38 mbar) 11 to 28 inch wc (27 to 68 mbar)	1B6539 27022 1B5370 27052	3 inch wc (7 mbar) over normal distribution pressure
	1 to 2-1/2 psig (0.069 to 0.17 bar) 2-1/4 to 4-1/2 psig (0.16 to 0.31 bar) 4-1/2 to 7 psig (0.31 to 0.48 bar)	1B5371 27022 1B5372 27022 1B5373 27052	0.5 psig (0.034 bar) over normal distribution pressure
Type 621-109 with 1/8 inch (3.2 mm) port diameter and 150 psig (10 bar) maximum allowable pilot inlet for cast iron body or 750 psig (52 bar) maximum allowable pilot inlet for malleable iron or steel body	5 to 15 psig (0.34 to 1.0 bar) 10 to 25 psig (1.0 to 1.7 bar) 20 to 35 psig (1.4 to 2.4 bar) 25 to 60 psig (1.7 to 4.1 bar)	1D8923 27022 1D7515 27022 1D6659 27022 1D7555 27142	30 psig (0.21 bar) over normal distribution pressure
	40 to 80 psig (2.8 to 5.5 bar) 80 to 150 psig (5.5 to 10 bar) 130 to 200 psig (9.0 to 14 bar)	1E5436 27142 1P9013 27142(1) 1P9013 27142(2)	5.0 psig (0.34 bar) over normal distribution pressure

1. With large diaphragm plate.
2. With small diaphragm plate.

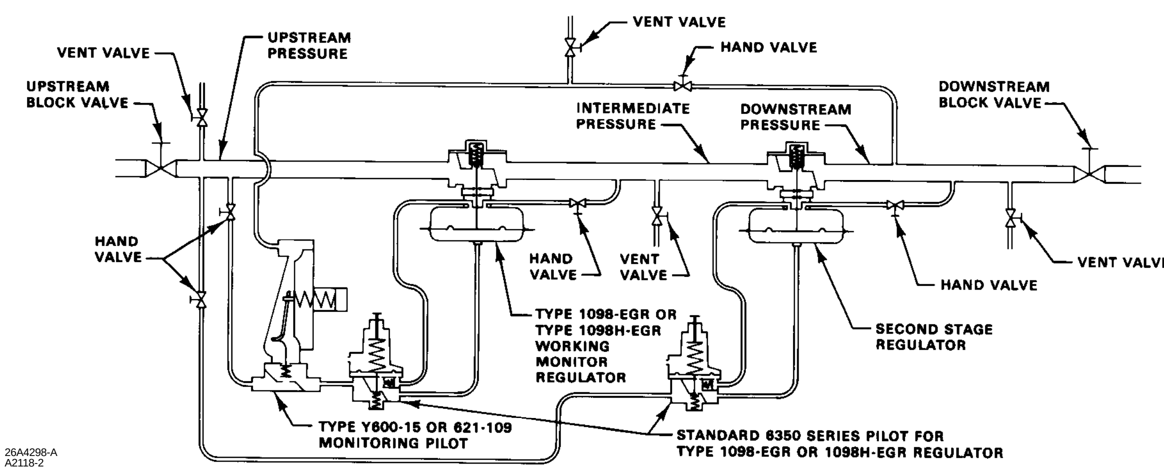


Figure 5. Typical Working Monitor Installation

The only adjustment necessary on a Type 1098-EGR or 1098H-EGR regulator is the pressure setting of the pilot control spring. Turning the adjusting screw clockwise into the spring case increases the spring compression and pressure setting. Turning the adjusting screw counterclockwise decreases the spring compression and pressure setting.

Pilot Adjustment

To adjust all standard 6350 Series pilots: loosen the locknut (key 11, figure 13, or key 10, figure 14), and turn the adjusting screw (key 10, figure 13, or key 9, figure 14). Then tighten the locknut to maintain the adjustment position. On a standard Type 6352 through 6354M pilot, a closing cap (key 28, figure 14) must be removed before adjustment and replaced afterward.

WARNING

To avoid possible personal injury from a pressure-loaded Type 61LD pilot, carefully vent the spring case before removing the closing cap. Otherwise, trapped loading pressure could forcefully eject the freed closing cap.

To adjust the Type 61LD pilot: remove the closing cap (key 5, figure 18) and turn the adjusting screw (key 6, figure 18). Any adjustments made should set the controlled pressure within the appropriate spring range shown in the Specifications table.

Startup

On a working monitor installation (figure 5), be sure that the second-stage working regulator is set to operate at a pressure lower than the Type 1098-EGR or 1098H-EGR working monitor regulator. To do this, increase the setting of the monitoring pilot until the working pilot is in control of the intermediate pressure and the second-stage working regulator is in control of the downstream pressure. If this is not done, the monitoring pilot tries to take control of the downstream pressure.

1. Slowly open the upstream block valve and the hand valves in both pilot supply lines. This energizes both pilots so that their setpoints can be adjusted. Partially open the downstream block valve for minimum flow.

2. To enable intermediate pressure adjustment with the working monitor regulator, slowly open the hand valve in the intermediate pressure control line.

3. To enable downstream pressure adjustment with the second-stage working regulator, slowly open the hand valve in the control line to this regulator.

4. Adjust the setting of the monitoring pilot to establish the desired emergency downstream pressure, which is to be maintained in the event of open failure of the second-stage working regulator. The emergency downstream pressure should exceed the desired downstream pressure by at least the amount listed in table 4. The steps followed to set the monitoring pilot may vary with each piping situation; however, the basic method remains the same. The following substeps a and b may be used as examples for setting the monitoring pilot:

a. Increase the outlet pressure setting of the second-stage working regulator until the monitoring pilot takes control of the downstream pressure. Adjust the monitoring pilot setting until the desired emergency downstream pressure is achieved. Then readjust the second-stage working regulator to establish the desired downstream pressure.

b. Install special piping (not shown in figure 5) so that the monitoring pilot senses the intermediate pressure. The intermediate pressure then appears to the monitoring pilot as if it were increased downstream pressure, and the monitoring pilot controls and reduces the intermediate pressure. Adjust the monitoring pilot setting until the desired emergency downstream pressure is achieved at the intermediate pressure stage. Then slowly close the special piping, and open up the monitoring downstream control line for normal service.

5. Slowly open the downstream block valve.

6. Slowly close the bypass valve, if any.

Wide-Open Monitor

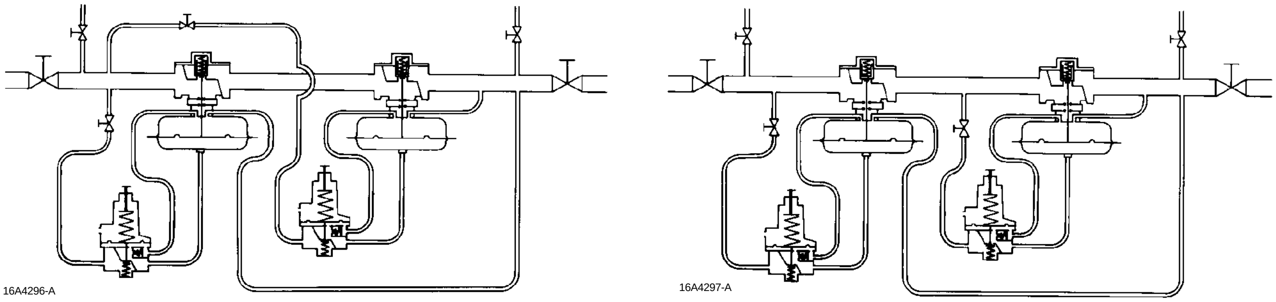
Installation

1. For both the wide-open monitoring regulator and the working regulator, perform the Standard Single-Pilot Regulator Installation section through step 6.

2. Connect the control line of a wide-open monitoring regulator (figure 6) to downstream piping near the working regulator control line connection. During normal operation the wide-open monitoring regulator stands wide open with the pressure reduction being taken across the working regulator. Only in case of working regulator failure does the wide-open monitoring regulator take control at its slightly higher setting.

Prestartup Considerations

Before beginning the startup procedures in this section, make sure the following conditions are in effect:



FLEXIBLE WIDE-OPEN MONITOR ARRANGEMENT THAT PERMITS WIDE-OPEN MONITOR TO BE EITHER UPSTREAM OR DOWNSTREAM

MINIMUM PIPING WIDE-OPEN MONITOR ARRANGEMENT THAT REQUIRES WIDE-OPEN MONITOR ALWAYS TO BE UPSTREAM

Figure 6. Typical Wide-Open Monitor Installations

D Block valves isolate the regulator.

D Vent valves are closed.

D Hand valves are closed.

CAUTION

Introduce pilot supply pressure into the regulator before introducing any downstream pressure, or internal damage may occur due to reverse pressurization of the pilot and main valve components.

Always use pressure gauges to monitor downstream pressure during startup. Procedures used in putting this regulator into operation must be planned accordingly if the downstream system is pressurized by another regulator or by a manual bypass.

Note

For proper operation, pilot supply pressure must exceed control pressure by the minimum amount specified on the actuator nameplate as minimum differential pressure.

The only adjustment necessary on a Type 1098-EGR or 1098H-EGR regulator is the pressure setting of the pilot control spring. Turning the adjusting screw clockwise into the spring case increases the spring compression and pressure setting. Turning the adjusting screw counterclockwise decreases the spring compression and pressure setting.

Pilot Adjustment

To adjust all standard 6350 Series pilots: loosen the locknut (key 11, figure 13, or key 10, figure 14), and turn the adjusting screw (key 10, figure 13, or key 9, figure 14). Then tighten the locknut to maintain the adjustment position. On a standard Type 6352 through 6354M pilot, a closing cap (key 28, figure 14) must be removed before adjustment and replaced afterward.

WARNING

To avoid possible personal injury from a pressure-loaded Type 61LD pilot, carefully vent the spring case before removing the closing cap. Otherwise, trapped loading pressure could forcefully eject the freed closing cap.

To adjust the Type 61LD pilot: remove the closing cap (key 5, figure 18) and turn the adjusting screw (key 6, figure 18). Any adjustments made should set the controlled pressure within the appropriate spring range shown in the Specifications table.

Startup

Repeat this procedure in turn for each regulator in the installation.

1. Slowly open the hand valve in the pilot supply line.

2. Slowly open the upstream block valve, and partially open the downstream block valve for minimum flow.

3. Slowly open the hand valve in the control line and adjust the pilot setting if necessary. Set the monitoring regulator at a slightly higher control pressure than the working regulator.

4. Completely open the downstream block valve.

5. Slowly close the bypass valve, if any.

Shutdown

Installation arrangements vary, but in any installation it is important that the valves be opened or closed slowly and that the outlet pressure be vented before venting inlet pressure to prevent damage caused by reverse pressurization of the pilot or main valve. The following steps apply to the typical installation as indicated.

Single-Pilot, Dual-Pilot Regulator or Wide-Open Monitor

As well as applying to a single-pilot regulator (figure 3), the steps in this procedure also are valid for a dual-pilot regulator (figure 4) or a wide-open monitoring installation (figure 6) and just need to be repeated for each regulator in such an installation.

1. Slowly close the downstream block valve. If the control line is downstream of the block valve, also close the hand valve in the control line.

2. Slowly close the upstream block valve and the hand valve in the pilot supply line.

3. Slowly open the vent valve in the downstream pipeline. If the control line is downstream of the block valve, also open the vent valve in the control line. Permit all pressure to bleed out.

4. Slowly open the vent valve in the upstream pipeline. Permit all pressure to bleed out of both the piping and the pilot.

Working Monitor

1. Slowly close the downstream block valve and the hand valve in the downstream pressure control line.

2. Slowly close the upstream block valve and the hand valves in both pilot supply lines.

3. Slowly open all vent valves and permit all pressures to bleed out of the piping and regulators.

Principle of Operation

The pilot-operated Type 1098-EGR and Type 1098H-EGR regulators both use inlet pressure as the operating medium, which is reduced through pilot operation to load the actuator diaphragm. Outlet or downstream pressure opposes loading pressure in the actuator and also opposes the pilot control spring. The operation of each regulator is the same, and the Type 1098-EGR regulator operation schematic is shown in figure 7.

In operation, assume that outlet pressure is below the pilot control setting. Control spring force on the pilot diaphragm thus opens the pilot valve plug (Type 6351 pilot) or relay orifice (Type 61LD pilot), providing additional loading pressure to the actuator diaphragm. This diaphragm loading pressure opens the main valve plug, supplying the required gas to the downstream system.

When downstream demand has been satisfied, outlet pressure tends to increase, acting on the pilot and actuator diaphragms. This pressure exceeds the pilot control spring setting, moving the pilot diaphragm away and letting the valve plug spring (Type 6351 or Type 61LD pilots) or bellows (Type 6352 through 6354M pilot) close the pilot valve plug (unbalanced in the Type 6351 or Type 61LD pilots but balanced in the Type 6352 through 6354M pilot). Excess loading pressure on the actuator diaphragm escapes downstream through the bleed hole (Type 6351 pilot), bleed orifice (Type 61LD pilot), or restriction (Type 6352 through 6354M pilot).

Reduced actuator loading pressure permits the main valve to close. The combination of main valve spring force and valve plug unbalance provides positive shutoff of the valve plug against the port and upper seals.

To protect the Type 1098 or 1098H actuator diaphragm from excessive differential pressure, all 6300 series and 61LD pilots have a relief valve that allows loading pressure to bleed downstream at approximately 25 psi (1.7 bar) differential across the actuator diaphragm.

A dual-pilot regulator (figure 7) also operates similarly to a single-pilot regulator. In addition, the large ports of the standby pilot open to quickly supply additional loading pressure to the Type 1098 diaphragm. This extra loading pressure strokes the main valve quickly in order to satisfy rapid load changes in the boiler system.

A working monitor system (figure 5) reduces pressure and throttles while the working monitor regulator is in operation. If the working regulator fails open, the working monitor regulator takes over the entire pressure reduction function. The working monitor concept allows observation of the performance of the first-stage regulator at all times.

As long as the second-stage working regulator maintains normal downstream pressure, the monitoring pilot stays wide open. This permits inlet pressure to go straight through to the working monitor pilot for reduction to actuator loading pressure.

Downstream pressure is piped back to the monitoring pilot. As long as the downstream pressure is less than the monitoring pilot setting, the working pilot controls the actuator to maintain intermediate pressure. If the second-stage working regulator fails open, the downstream pressure increases to the setting of the monitoring pilot (slightly higher than the original downstream pressure). The monitoring pilot takes control and the working monitor pilot throttles down the loading pressure to

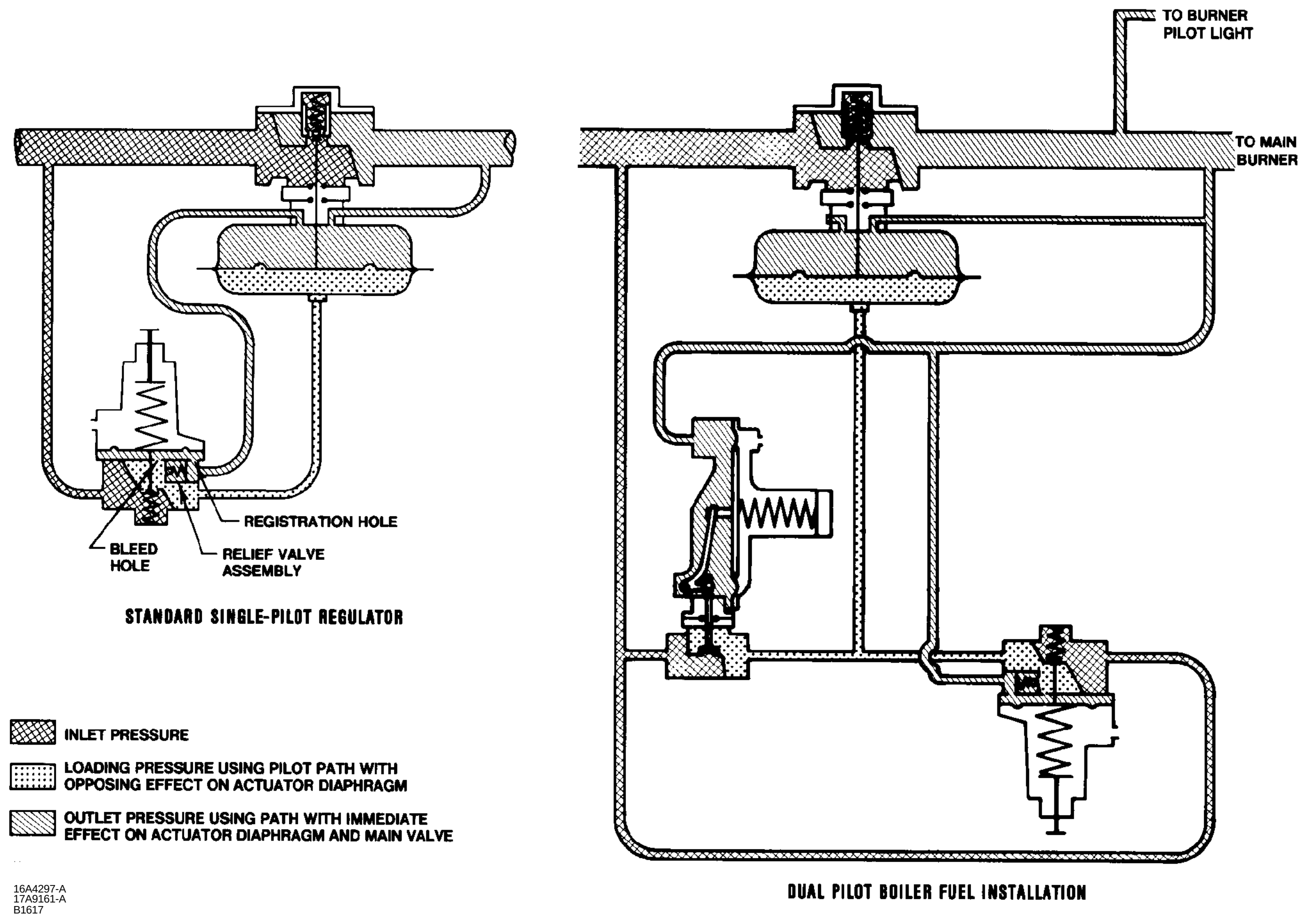


Figure 7. Principle of Operation Schematics

the working monitor regulator actuator. This actuator will move the valve plug and control the downstream pressure at the emergency level. Thus, downstream equipment is protected against a major overpressure condition without disrupting service or venting gas to the atmosphere.

Maintenance

Regulator parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement of parts depends upon the severity of service conditions or the requirements of local, state, and federal regulations. Due to the care Fisher takes in meeting all manufacturing requirements (heat treating, dimensional tolerances, etc.), use only replacement parts manufactured or furnished by Fisher. The stem O-rings on the Type 1098 or 1098H actuator can be lubricated annually, using the grease fitting (key 28, figure 20). Stem O-rings can be checked for damage during normal operation by line pressure leakage or unexpected grease extrusion from the actuator vent (key 27, figure 20). All O-rings, gaskets, and seals should be lubricated with a good grade of general-purpose grease and installed gently rather than forced into position. Be certain that the nameplates are updated to accurately indicate any field changes in equipment, materials, service conditions, or pressure settings.

WARNING

To avoid personal injury resulting from sudden release of pressure, isolate the regulator from all pressure and cautiously release trapped pressure from the regulator before attempting disassembly.

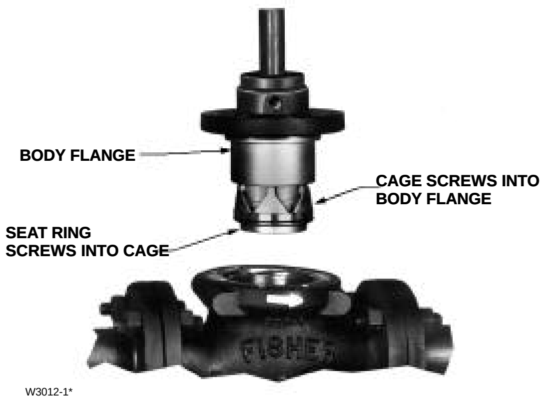


Figure 8. Trim Package Removal

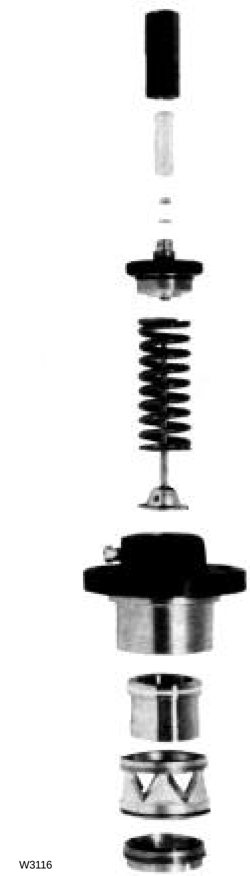


Figure 9. Exploded View of Full-Capacity Trim Package Assembly

Design EGR Main Valve

Replacing Quick-Change Trim Package

Perform this procedure if the entire trim package (figure 8) is replaced. Key numbers for both the complete main valve and its trim package are referenced in figure 11. Some replacement trim package assembly numbers are listed in a table in the parts list.

Note

All disassembly, trim change, and reassembly steps in this section may be performed with the regulator in the main line and without disconnecting pilot supply or control lines.

1. Remove the cap screws (key 3) with a cast iron body, or remove the stud bolt nuts (key 29, not shown) with a steel body. Pry the body flange (key 2) loose from the valve body (key 1), and lift out the trim package.

2. Perform any required inspection, cleaning, or maintenance on the exposed surfaces of the valve body or trim package. Replace the gasket (key 4) or cage O-ring (key 17) as necessary.

3. On a pre-built replacement trim package, check indicator zeroing by unscrewing the indicator protector (key 19) and seeing if the flange of the indicator nut (key 22) lines up evenly with the bottom marking on the indicator scale (key 18). If not, remove the indicator scale and separate the indicator nut and hex nut (key 8). Hold the indicator scale against the indicator fitting (key 5) with the scale base resting against the shoulder of the fitting, and turn the indicator nut until its flange is aligned with the bottom scale marking. Then lock both nuts against each other, and install the indicator scale and protector.

4. Coat the cage seating surfaces of the valve body web and the body flange seating surfaces of the valve body neck with a good grade of general-purpose grease. Install the trim package, and secure it evenly with the cap screws or stud bolt nuts. No particular trim package orientation in the body is required.

Replacing Trim Parts

Perform this procedure if inspecting, cleaning, or replacing individual parts in a trim package. Key numbers are referenced in figure 11. An exploded view of a standard full-capacity trim package only is shown in figure 9.

Note

Access to the spring (key 9), flange O-ring (key 21), travel indicator parts, or optional travel stop (key 32) in step 1 can be gained without removing the body flange (key 2).

1. Remove the indicator fitting (key 5) and attached parts. Proceed to step 5 if only maintenance on the fitting or attached parts is performed.

2. Remove the cap screws (key 3) with a cast iron body, or remove the stud bolt nuts (key 29, not shown) with a steel body, and pry the body flange loose from the valve body (key 1).

3. Use the valve body as a holding fixture if desired. Flip the body flange over, and anchor it on the valve body as shown in figure 10, removing the pipe plug (key 31) first if necessary.

4. To gain access to the port seal (key 12), upper seal (key 15), or valve plug parts, unscrew the seat ring (key 13) from the cage (key 11) and the cage from the body flange. For leverage, a wrench handle or similar tool may be inserted into the seat ring slots (figure 10) and a strap wrench may be wrapped around a standard or a Whisper Trim**R** cage, or a soft bar may be inserted through the windows of a standard cage. To remove the piston ring (key 14) and/or plug O-ring (key 20), remove the valve plug (key 16) from the body flange, insert a screwdriver into the precut foldover area of the piston ring, and unfold the piston ring. Proceed to step 6 if no further maintenance is necessary.

5. To replace the body flange or gain access to the spring, indicator stem (key 10), stem O-ring (key 7), spring seat (key 28), E-ring (key 23), or optional travel stop, remove the indicator protector (key 19) and indicator scale (key 18). Since some compression is left in the spring, carefully remove the flanged nut (key 22) and hex nut (key 8). A screwdriver may be inserted through the press-fit bushing (key 6) to remove the stem O-ring without removing the bushing. If necessary, unscrew the travel stop (if used), and unclip the E-ring from the indicator stem.

6. Replace and lubricate parts such as the gasket (key 4) and cage O-ring (key 17) as necessary, making sure that if the port and upper seals were removed they are installed in their retaining slots with the grooved sides facing out. Also lubricate any other surfaces as necessary for ease of installation. No further main valve maintenance is necessary if just the indicator fitting and attached parts were removed.

7. Install the plug O-ring (key 20) and piston ring (key 14) onto the valve plug. Insert the valve plug into the body flange, install the cage plus upper seal and O-ring into the body flange, and then install the seat ring plus port seal into the cage. Use the valve body as a holding fixture during this step as shown in figure 10, and insert a wrench handle or similar tool into the seat ring slots for leverage when tightening the seat ring and cage.

8. Remove the upside-down body flange if it was anchored on the body. Coat the cage seating surfaces of the valve body web and the body flange seating surfaces of the valve body neck with a good grade of general-purpose grease. Install the body flange on the body, and secure it evenly with the cap screws or stud bolt nuts. Except on the 1-inch body, which does not use it, the pipe plug (key 31) must be installed in the side tapping of the flange for proper operation.

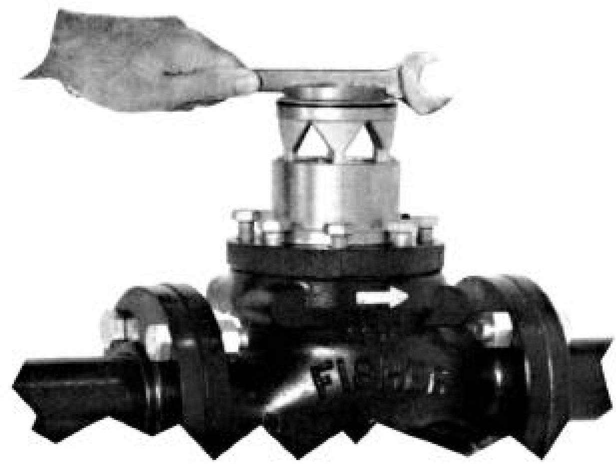

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Figure 10. Seat Ring/Cage Removal or Installation Using Body as Holding Fixture

9. Make sure that the flange and stem O-rings and the bushings are installed in the indicator fitting. Orient the spring seat as shown in figure 11, and attach it with the E-ring to the slotted end of the indicator stem. Install a travel stop (if it is used) on the spring seat, and then install the spring.

10. Being careful not to cut the stem O-ring with the stem threads, install the indicator fitting down over the indicator stem until resting on the spring. Install the hex nut and then the flanged indicator nut on the indicator stem, pushing on the fitting if necessary to provide sufficient stem thread exposure. To maintain clearance for indicator part installation, draw up the spring seat by turning the hex nut down on the stem until the threads bottom.

11. Install the indicator fitting with attached parts into the body flange. Back the hex nut off until the spring completely closes the valve plug against the port and upper seals, as indicated by stem threads showing between this nut and the fitting. Hold the indicator scale against the fitting with the scale base resting against the shoulder of the fitting, and turn the indicator nut until its flange is aligned with the bottom scale marking. Then lock both nuts against each other, and install the indicator scale and protector.

P590 Series Filter

Perform this procedure to clean or replace filter parts in a standard Type P593-1 or P594-1 filter assembly. Remove the following as shown in figure 12: filter body (key 1), machine screw (key 4), gasket (key 7), two flat washers (key 5), and filter element (key 2).

Upon reassembly, one of the flat washers must go between the filter element and filter head (key 3) and the other must go between the filter element and gasket. Use a good grade of pipe thread sealant on the filter head pipe threads as shown by L.S. in figure 12.

Type 6351 Pilot

Perform this procedure if changing the control spring for one of a different range, or if inspecting, cleaning, or replacing any other pilot parts. Pilot key numbers are referenced in figure 13 and mounting key numbers in figure 15, 16, or 17.

Note

The body assembly (key 1) may remain on the pipe nipple (key 23, figure 15, or key 39, figure 16) unless the entire pilot is replaced. The optional spring case (key 2) for a Type 661 electric remote control drive unit may remain installed during maintenance.

1. To gain access to the diaphragm assembly (key 7), control spring (key 9), or spring seat (key 8), loosen the locknut (key 11, not used with Type 661 mounting), and turn the adjustment screw (key 10) out until compression is removed from the spring. Remove the machine screws (key 12), and separate the body assembly from the spring case.

2. Inspect the removed parts, and replace as necessary. Make sure the registration and bleed holes in the pilot body are free from debris. After assembly, make sure of the proper control spring setting according to the Startup section, and re-mark the spring case if necessary.

3. To replace the valve plug (key 4), remove the body plug (key 3) and body plug gasket (key 23). Be careful to keep the valve plug spring (key 6) and valve plug spring seat (key 5) from falling out and possibly getting lost while removing the valve plug. Inspect the removed parts, and replace as necessary. Make sure the valve plug seating surfaces are free from debris.

Type 6352 Through 6354M Pilots

Perform this procedure if changing the control spring for one of a different range, or if inspecting, cleaning, or replacing any other pilot parts. Pilot part key numbers are referenced in figure 14. Mounting key numbers are referenced in figure 15 for single-pilot constructions and in figure 16 or 17 for dual-pilot constructions.

Note

The body (key 1) may remain on the pipe nipple (key 23, figure 15 or key 39, figure 16) unless the entire pilot is replaced.

1. To gain access to the diaphragm assembly (key 5), diaphragm limiter (key 23) if used, control spring (key 6), restriction (key 22), stem guide (key 8), or spring seat (key 7), remove the closing cap (key 11), loosen the locknut (key 10), and turn the adjusting screw (key 9) counterclockwise until compression is removed from the spring. Remove the machine screws (key 14), and separate the body from the spring case (key 2).

2. Inspect the removed parts, and replace as necessary. Make sure the restriction and the registration hole in the body are free from debris. After assembly, make sure of the proper control spring setting according to the Startup section, and re-mark the spring case if necessary.

3. To replace the valve plug (key 4) or bellows O-ring (key 17), remove the body plug (key 3) and body plug gasket (key 12). Be careful to keep the bellows assembly (key 16) from falling out and possibly getting lost while removing the valve plug. Inspect the removed parts, and replace as necessary. Make sure the valve plug seating surfaces are free from debris.

Type 61LD Pilot and Type 1806 Relief Valve

Perform this procedure if changing the control spring for one of a different range, or if inspecting, cleaning, or replacing relief valve or any other pilot parts. Pilot part key numbers are referenced in figure 18 and mounting part and relief valve key numbers in figure 19.

1. Remove the pilot from the pipe nipple (key 14) unless just the control spring is to be changed.

2. To gain access to the control spring or other internal parts, remove the closing cap assembly (key 5) and relieve control spring (key 7) compression by turning the adjusting screw (key 6) counterclockwise. Change the control spring and install the adjusting screw and closing cap assembly if no other maintenance will be performed. Make sure of the proper control spring setting according to the Installation and Startup section, and restamp the nameplate if necessary.

3. For any other internal maintenance, relieve control spring compression according to step 2. Then remove the cap screw (key 20) and separate the pilot into three sections; spring case (key 1), body (key 2), and diaphragm case (key 3).

4. To inspect the two diaphragm (keys 14 and 15) thoroughly, remove the diaphragm nut (key 11), hex nut (key 19), and the upper and lower diaphragm plates (key 16 and 17). The projecting prong in the body may be used as the restraining member to keep the yoke from turning while removing the nuts. Also inspect the O-ring (key 12), and replace any parts as necessary.

5. Take the yoke (key 4) and attached parts out of the body to examine the disk holder assembly (key 9). Remove the relay orifice (key 8) to check for clogging and replace if necessary.

6. To replace the disk holder assembly, first unscrew the bleed orifice (key 10). Remove it and the associated parts. Then unscrew the disk holder assembly from the bleed valve (key 26) to gain access to the relay spring (key 13). Clean or replace any parts as necessary before reassembling.

7. Upon reassembly, pay particular attention to the following assembly suggestions.

a. Before replacing the diaphragm case or spring case, be sure the yoke assembly is positioned so that it will not bind or rub on the prong in the relay body.

b. Avoid wrinkling the diaphragms when replacing the diaphragm case and spring case.

c. Replace the diaphragm case, carefully working the upper diaphragm (key 14) into the recess in the diaphragm case. If the diaphragm case rocks with respect to the pilot body, the diaphragm is probably wrinkled.

d. Replace the spring case, using care to smooth the lower diaphragm (key 15) evenly into the recess in the pilot body.

e. Install the eight cap screws, tightening them down evenly in a crisscross pattern to avoid crushing the diaphragm. Recommended final torque on these cap screws in 10 to 12 foot pounds (14 to 16 N•m).

8. After assembly, make sure of the proper control spring setting according to the Installation and Startup section, and restamp the nameplate (key 27) if necessary.

9. To gain access to the Type 1806 relief valve (key 17), disconnect the relief tubing at the connector fitting (key 21) and unscrew the relief valve. Make sure the spring closes the ball, or replace the relief valve if necessary. Install the relief valve back in the pipe tee (key 16) and reconnect the relief tubing (key 18) and connector fitting.

Type 1098 and 1098H Actuator and Pilot Mounting Parts

Perform this procedure if changing the actuator or inspecting, cleaning, or replacing actuator and/or pilot mounting parts. Actuator part key numbers are referenced in figure 20, and mounting part key numbers in figure 15, 16, or 17 unless otherwise indicated.

1. The actuator and pilot(s) may be removed and replaced as a unit by disconnecting the control line and pilot supply line.

2. Access to all internal parts except the stem O-rings (key 6) may be gained without removing the bonnet (key 3) or upper diaphragm case (key 2) from the main valve or the pilot(s) from the bonnet pipe nipple (key 23, figure 15, or keys 37 and 39, figure 16). Disconnect the loading tubing (key 24, figure 15, 16, or 17) from the actuator elbow fitting (key 25, figure 15, or key 41, figure 16), and with a Type 61LD pilot also disconnect the relief tubing (key 18, figure 19) from the fitting tee.

3. Remove the cap screws (key 10), nuts (key 11), lower diaphragm case (key 1), diaphragm (key 7), and diaphragm plate (key 8). To separate the stem (key 12) from the diaphragm plate (key 8), remove the stem cap screw (key 9).

4. **To remove the Type 1098 case O-ring (key 5),** unscrew the four case cap screws (key 4), remove the upper diaphragm case (key 2), and remove the case O-ring.

To remove the Type 1098 and Type 1098H stem O-rings (key 6), remove the pilot(s) and pipe nipple(s) if necessary. Unscrew either the Type 1098 bonnet (key 3) or the Type 1098H upper diaphragm case (key 2), and remove the O-rings.

5. Lubricate both stem O-rings (key 6) with grease, and install them in either the Type 1098 bonnet (key 3) or in the Type 1098H upper diaphragm case (key 2).

For the Type 1098H actuator, thread the upper diaphragm casing into the main valve body.

For the Type 1098 actuator, lubricate the case O-ring (key 5), and install it in the bonnet (key 3). Line up the holes in the upper diaphragm casing and the bonnet; insert and tighten the four case cap screws to secure the parts together. Thread the bonnet into the main valve body.

6. Secure the diaphragm plate to the stem with the stem cap screw (key 9). Lay the entire diaphragm, diaphragm plate, and stem assembly into the lower diaphragm case so the diaphragm convolution laps up over the diaphragm plate according to figure 20. Then install the stem slowly up

into the bonnet to prevent stem or O-ring damage, and secure the lower diaphragm case to the upper diaphragm case with the cap screws and nuts. Tighten the cap screws and nuts evenly in a crisscross pattern to avoid crushing the diaphragm.

7. Grease the stem O-rings through the grease fitting (key 28) until excess grease starts coming out the vent (key 27).

8. Install the pipe nipple(s) and pilot(s) if they were removed during maintenance. Connect the actuator loading tubing if it was disconnected.

Parts Ordering

Each Type 1098-EGR or 1098H-EGR regulator is assigned a serial number or F.S. number which can be found on the nameplates (figure 2). Refer to this number when contacting your Fisher sales office or sales representative for assistance, or when ordering replacement parts.

When ordering a replacement part, be sure to include the complete 11-character part number from the following parts list. Some commonly used trim packages can be ordered according to the 11-character assembly number given in the parts kits listed in the parts list.

Parts List

Note

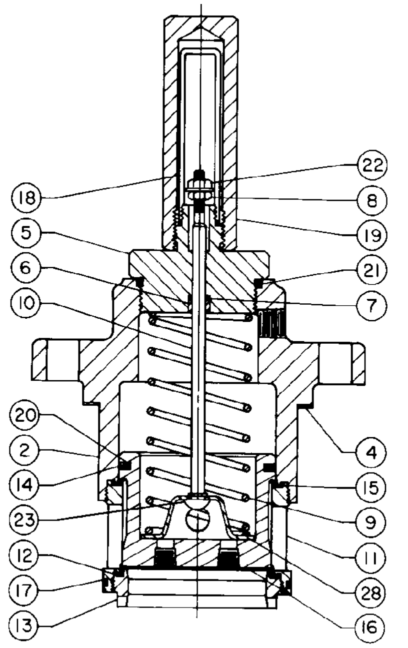
Except where indicated, sizes shown are valve body sizes.

Design EGR Main Valve (figure 11)

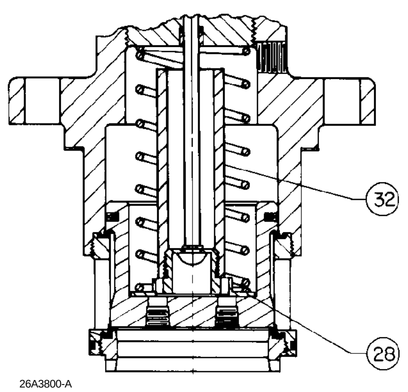
Key	Description	Part Number
	Parts kit (included are: gasket, key 4; stem O-ring, key 7; port seal, key 12; piston ring, key 14; upper seal, key 15; cage O-ring, key 17; plug O-ring, key 20; and indicator fitting O-ring, key 21)	
	2-inch	R63EG X00022
	3-inch	R63EG X00032
	4-inch	R63EG X00042
	6-inch	R63EG X00062
	Parts kit, Quick Change Trim Assembly (included are: body flange, key 2; linear cage, key 11; spring, key 9; valve plug, key 16; seat ring, key 13; travel indicator, key 10; and standard elastomers)	
	60 Psi (4.1 bar) spring color green	
	Cast Iron Body Flange	
	1-inch	25A3170 X012
	2-inch	25A3170 X102
	3-inch	25A3170 X152
	4-inch	25A3170 X222
	6-inch	25A3170 X272
	Steel Body Flange	
	1-inch	25A3170 X422
	2-inch	25A3170 X452
	3-inch	25A3170 X372
	4-inch	25A3170 X482
	6-inch	25A3170 X512
	125 Psi (8.6 bar) spring color blue	
	Cast Iron Body Flange	
	1-inch	25A3170 X032
	2-inch	25A3170 X082
	3-inch	25A3170 X142
	4-inch	25A3170 X192
	6-inch	25A3170 X282
	Steel Body Flange	
	1-inch	25A3170 X432
	2-inch	25A3170 X382
	3-inch	25A3170 X462
	4-inch	25A3170 X492
	6-inch	25A3170 X342
	400 Psi (28 bar) spring color red	
	Cast Iron Body Flange	
	1-inch	25A3170 X052
	2-inch	25A3170 X112
	3-inch	25A3170 X172
	4-inch	25A3170 X242
	6-inch	25A3170 X312
	Steel Body Flange	
	1-inch	25A3170 X442
	2-inch	25A3170 X332
	3-inch	25A3170 X472
	4-inch	25A3170 X502
	6-inch	25A3170 X522

Key	Description	Part Number
1	Valve Body	
	Cast Iron	
	NPT screwed	
	1 inch	34A6351 X012
	2 inch	34A6763 X012
	Class 125B FF	
	1 inch	34A6353 X012
	2 inch	34A5694 X012
	3 inch	34A5695 X012
	4 inch	34A5703 X012
	6 & 8 x 6 inch	34A6999 X012
	Class 250B RF	
	1 inch	34A6354 X012
	2 inch	34A5672 X012
	3 inch	34A5657 X012
	4 inch	34A5642 X012
	6 & 8 x 6 inch	34A7000 X012
	WCB steel, heat-treated	
	NPT screwed	
	1 inch	34A6352 X012
	2 inch	34A6764 X012
	2 inch (NACE)(1)	34A6764 X022
	Class 150 RF	
	1 inch	34A6355 X012
	1 inch (NACE)	34A6355 X042
	2 inch	34A6765 X012
	2 inch (NACE)	34A6765 X022
	3 inch	34A6773 X012
	3 inch (NACE)	34A6773 X032
	4 inch	34A6776 X012
	4 inch (NACE)	34A6776 X032
	6 inch	34A6998 X012
	6 inch (NACE)	34A6998 X032
	8 x 6 inch	38A4214 X012
	8 x 6 inch (NACE)	38A4214 X022
	Class 300 RF	
	1 inch	34A6754 X012
	2 inch	34A6766 X012
	2 inch (NACE)	34A6766 X032
	3 inch	34A6774 X012
	3 inch (NACE)	34A6774 X022
	4 inch	34A6777 X012
	4 inch (NACE)	34A6777 X032
	6 inch	34A6993 X012
	6 inch (NACE)	34A6993 X022
	8 x 6 inch	38A5825 X012
	8 x 6 inch (NACE)	38A5825 X032
	Class 600 RF	
	1 inch	34A6755 X012
	2 inch	34A6767 X012
	2 inch (NACE)	34A6767 X032
	3 inch	34A6775 X012
	3 inch (NACE)	34A6775 X022
	4 inch	34A6778 X012
	4 inch (NACE)	34A6778 X022

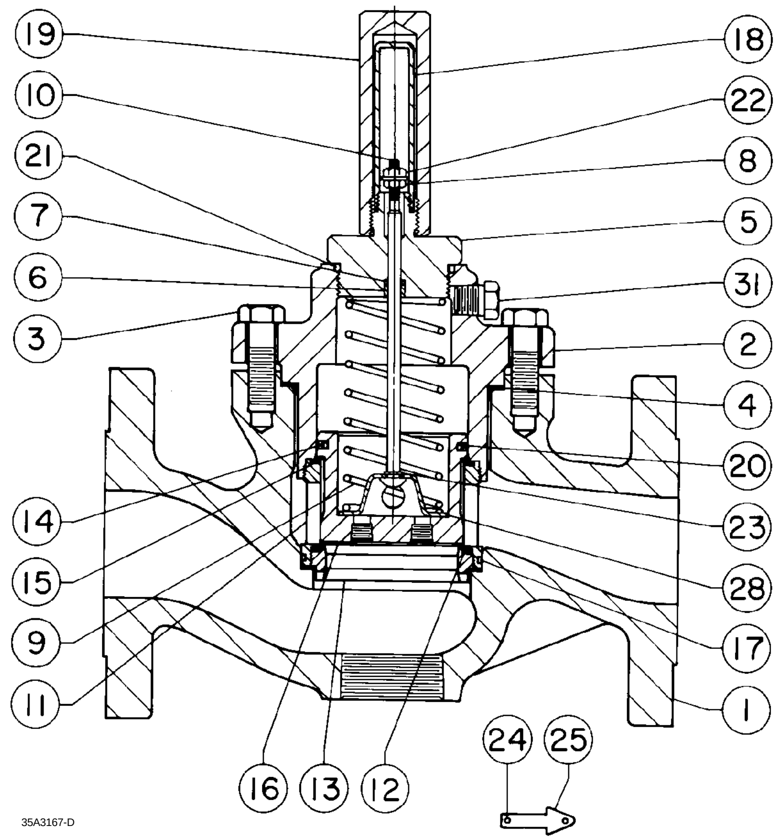
1. National Association of Corrosion Engineers (NACE) standard MR-01-75.



QUICK-CHANGE TRIM PACKAGE ASSEMBLY



DETAIL OF OPTIONAL RESTRICTED-CAPACITY CONSTRUCTION



COMPLETE CAST IRON FULL-CAPACITY MAIN VALVE ASSEMBLY

Figure 11. Design EGR Main Valve

Key	Description	Part Number
1	Valve Body (Continued)	
	Class 600 RF	
	6 inch	34A6997 X012
	6 inch (NACE)	34A6997 X022
	8 x 6 inch	39A7068 X012
	8 x 6 inch (NACE)	39A7068 X022
	Socket weld	
	1 inch	36A3941 X012
	2 inch	36A3945 X012
	Schedule 40 butt weld	
	1 inch	36A3942 X012
	2 inch	36A3944 X012
	3 inch	36A3947 X012
	4 inch	36A3949 X012
	6 & 8 x 6 inch	36A3952 X012
	Schedule 80 butt weld	
	1 inch	36A3943 X012
	2 inch	36A3946 X012
	3 inch	36A3948 X012
	4 inch	36A3950 X012
	6 & 8 x 6 inch	36A3951 X012
2	Body Flange	
	Cast iron, ENC(2)	
	1 inch	24A6761 X012
	2 inch	25A3168 X012
	3 inch	24A9034 X012
	4 inch	25A2309 X012
	6 & 8 x 6 inch	34A8172 X012
	WCB steel, ENC, heat-treated	
	1 inch	24A6779 X012
	1 inch (NACE)	24A6779 X032
	2 inch	25A2254 X012
	2 inch (NACE)	25A2254 X022
	3 inch	25A2300 X012
	3 inch (NACE)	25A2300 X022
	4 inch	24A9032 X012
	4 inch (NACE)	24A9032 X022
	6 & 8 x 6 inch	34A7152 X012
	6 & 8 x 6 inch (NACE)	34A7152 X022

*Recommended spare part.
2. Part included in trim package assembly can be ordered according to the parts kit trim package.

Key	Description	Part Number
3	Cap Screw, zn pl steel (use w/cast iron body)	
	1 inch (4 req'd)	1R2811 24052
	2 inch (8 req'd)	1A4533 24052
	3 inch (8 req'd)	1A4541 24052
	4 inch (8 req'd)	1A4857 24052
	6 & 8 x 6 inch (12 req'd)	1U5131 24052
3	Stud Bolt, steel (use w/steel body) (not shown)	
	1 inch (4 req'd)	1R2848 31012
	2 inch (8 req'd)	1K2429 31012
	3 inch (8 req'd)	1A3781 31012
	4 inch (8 req'd)	1R3690 31012
	6 & 8 x 6 inch (12 req'd)	1A3656 31012
4*(2)	Gasket, composition	
	1 inch	14A6785 X012
	2 inch	14A5685 X012
	3 inch	14A5665 X012
	4 inch	14A5650 X012
	6 & 8 x 6 inch	14A6984 X012
5(2)	Indicator Fitting, pl steel	
	1 inch	14A6758 X012
	1 inch (NACE)	14A6758 X022
	2, 3, & 4 inch	14A9689 X012
	2, 3, & 4 inch (NACE)	14A9689 X042
	6 & 8 x 6 inch	24A8183 X012
	6 & 8 x 6 inch (NACE)	24A8183 X022
6(2)	Bushing	
	416 stainless steel	14A5677 X012
	410 stainless steel (NACE)	14A5677 X022
7*	Stem O-Ring	
	Nitrile(2)	1D6875 06992
	Fluoroelastomer	1N4304 06382
8(2)	Hex Nut, pl steel	1A6622 28992
9(2)	Spring, steel	
	20 psi (1.4 bar) maximum drop yellow	
	2 inch	14A6768 X012
	3 inch	14A6771 X012
	4 inch	14A6770 X012
	6 & 8 x 6 inch	15A2253 X012
	60 psi (4.1 bar) maximum drop green	
	1 inch	14A9687 X012
	2 inch	14A6626 X012
	2 inch (NACE)	16A5501 X012
	3 inch	14A6629 X012
	3 inch (NACE)	16A5503 X012
	4 inch	14A6632 X012
	4 inch (NACE)	16A5506 X012
	6 & 8 x 6 inch	14A9686 X012
	6 & 8 x 6 inch (NACE)	16A5510 X012
	125 psi (8.6 bar) maximum drop blue	
	1 inch	14A9680 X012
	1 inch (NACE)	10B1882 X012
	2 inch	14A6627 X012
	2 inch (NACE)	16A5995 X012
	3 inch	14A6630 X012
	3 inch (NACE)	16A5996 X012
	4 inch	14A6633 X012
	4 inch (NACE)	16A5997 X012
	6 & 8 x 6 inch	14A9685 X012
	6 & 8 x 6 inch (NACE)	16A5999 X012
	400 psi (28 bar) maximum drop red	
	1 inch	14A9679 X012
	2 inch	14A6628 X012
	2 inch (NACE)	16A5499 X012
	3 inch	14A6631 X012
	3 inch (NACE)	16A5500 X012
	4 inch	14A6634 X012
	4 inch (NACE)	16A5998 X012
	6 & 8 x 6 inch	15A2615 X012
	6 & 8 x 6 inch (NACE)	16A6000 X012
10(2)	Indicator Stem	
	Stainless steel	
	1 inch	14A6756 X012
	2 inch	14A6994 X012
	3 inch	14A6995 X012
	4 inch	14A8179 X012
	6 & 8 x 6 inch	14A6986 X012
10(2)	Indicator Stem (Continued)	
	316 stainless steel (NACE)	
	1 inch (NACE)	14A6756 X022
	2 inch (NACE)	14A6994 X022
	3 inch (NACE)	14A6995 X022
	4 inch (NACE)	14A8179 X022
	6 & 8 x 6 inch (NACE)	14A6986 X022
11	Cage	
	Linear	
	Cast iron, ENC(2)	
	1 inch	24A6783 X012
	2 inch	24A5669 X012
	3 inch	24A5654 X012
	4 inch	24A5639 X012
	6 & 8 x 6 inch	24A6990 X012
	WCB steel, ENC, heat-treated	
	1 inch	24A6783 X022
	1 inch (NACE)	24A6783 X032
	2 inch	24A5669 X022
	2 inch (NACE)	24A5669 X032
	3 inch	24A5654 X022
	3 inch (NACE)	24A5654 X042
	4 inch	24A5639 X022
	4 inch (NACE)	24A5639 X032
	6 inch	24A6990 X022
	6 & 8 x 6 inch (NACE)	24A6990 X032
	Whisper Trim	
	416 stainless steel	
	1 inch	24A2043 X012
	2 inch	24A5707 X012
	3 inch	24A5708 X012
	4 inch	24A5709 X012
	6 & 8 x 6 inch	24A8174 X012
	316 stainless steel (NACE)	
	2 inch (NACE)	24A5707 X022
	3 inch (NACE)	24A5708 X032
	4 inch (NACE)	24A5709 X022
	6 & 8 x 6 inch (NACE)	24A8174 X022
	Quick Opening, cast iron, ENC	
	1 inch	37A7211 X012
	2 inch	37A7212 X012
	3 inch	37A7213 X012
	4 inch	37A7214 X012
	6 & 8 x 6 inch	37A7215 X012
12*	Port Seal	
	Nitrile(2) standard	
	1 inch	14A6788 X012
	2 inch	24A5673 X012
	3 inch	24A5658 X012
	4 inch	24A5643 X012
	6 & 8 x 6 inch	14A8175 X012
	Fluoroelastomer	
	1 inch	14A8186 X012
	2 inch	25A7412 X012
	3 inch	25A7375 X012
	4 inch	25A7469 X012
	6 & 8 x 6 inch	14A6996 X012
13*(2)	Seat Ring	
	416 stainless steel	
	1 inch, 1-5/16 inch (33 mm) port	24A6781 X012
	2 inch, 2-3/8 inch (60 mm) port	24A5670 X012
	3 inch, 3-3/8 inch (86 mm) port	24A5655 X012
	4 inch, 4-3/8 inch (111 mm) port	24A5640 X012
	6 inch, 7-3/16 inch (183 mm) port	24A6989 X012
	8 x 6 inch 7-3/16 inch (183 mm) port	38A4216 X012
	316 stainless steel (NACE)	
	1 inch, 1-5/16 inch (33 mm) port (NACE)	24A6781 X022
	2 inch, 2-3/8 inch (60 mm) port (NACE)	24A5670 X022
	3 inch, 3-3/8 inch (86 mm) port (NACE)	24A5655 X022
	4 inch, 4-3/8 inch (111 mm) port (NACE)	24A5640 X022
	6 inch, 7-3/16 inch (183 mm) port (NACE)	24A6989 X022
	8 x 6 inch 7-3/16 inch (183 mm) port (NACE)	38A4216 X022
14*(2)	Piston Ring	
	1 inch, TFE (clear)	14A6786 X012
	2 inch, TFE (clear)	14A5675 X012
	3 inch, TFE (clear)	14A5660 X012
	4 inch, TFE (clear)	14A5645 X012
	6 & 8 x 6 inch, glass-filled TFE (yellow)	14A6985 X022

*Recommended spare part
2. Part included in trim package assembly which can be ordered according to the parts kit trim package.

Key	Description	Part Number
15*	Upper Seal	
	Nitrile(2) (standard)	
	1 inch	14A6789 X012
	2 inch	24A5674 X012
	3 inch	24A5659 X012
	4 inch	24A5644 X012
	6 & 8 x 6 inch	14A8176 X012
	Fluoroelastomer	
	1 inch	14A8187 X012
	2 inch	25A7413 X012
	3 inch	25A7376 X012
	4 inch	25A7468 X012
	6 & 8 x 6 inch	14A8185 X012
16*(2)	Valve Plug, heat-treated	
	416 stainless steel	
	1 inch	14A6780 X012
	2 inch	24A6772 X012
	3 inch	24A9421 X012
	4 inch	24A8182 X012
	6 & 8 x 6 inch	24A6992 X012
	316 stainless steel (NACE)	
	1 inch (NACE)	14A6780 X022
	2 inch (NACE)	24A6772 X032
	3 inch (NACE)	24A9421 X022
	4 inch (NACE)	24A8182 X022
	6 & 8 x 6 inch (NACE)	24A6992 X022
17*	Cage O-Ring	
	Nitrile(2) (standard)	
	1 inch	10A7777 X012
	2 inch	10A7779 X012
	3 inch	14A5688 X012
	4 inch	10A3481 X012
	6 & 8 x 6 inch	18A2556 X022
	Fluoroelastomer	
	1 inch	10A7778 X012
	2 inch	10A7779 X022
	3 inch	10A3441 X012
	4 inch	10A3483 X012
	6 & 8 x 6 inch	18A2556 X032
18	Indicator Scale, plastic	
	1 inch(2)	14A6759 X012
	2 inch(2)	14A5678 X012
	3 inch(2)	14A5662 X012
	4 inch	
	w/2 inch (51 mm) travel(2)	14A5647 X012
	w/1-1/2 inch (38 mm) travel	14A5662 X012
	6 & 8 x 6 inch(2)	14A5647 X012
19	Indicator Protector	
	Zn pl steel	
	1 & 2 inch(2)	14A8180 X012
	3, 6 & 8 x 6 inch(2)	14A6769 X012
	4 inch(2) w/2 inch (51 mm) travel	14A6769 X012
	Pl steel	
	4 inch w/1-1/2 inch (38 mm) travel	14A5664 X012
20*	Plug O-Ring	
	Nitrile(2) (standard)	
	1 inch	14A6981 X012
	2 inch	14A5686 X012
	3 inch	1V3269 06562
	4 inch	14A5688 X012
	6 & 8 x 6 inch	1K8793 06992
	Fluoroelastomer	
	1 inch	14A8188 X012
	2 inch	14A5686 X022
	3 inch	1V3269 X0042
	4 inch	10A3441 X012
	6 & 8 x 6 inch	1V5476 06382
21*	Indicator Fitting O-Ring	
	Nitrile(2)	
	1 inch	10A8931 X012
	2, 3, & 4 inch	10A3800 X012
	6 & 8 x 6 inch	1F2629 06992
	Fluoroelastomer	
	1 inch	10A0811 X012
	2, 3, & 4 inch	1R7276 06382
	6 & 8 x 6 inch	1P4877 06382

Key	Description	Part Number
22(2)	Flange Nut, pl steel	14A5693 X012
23(2)	E-Ring	
	stainless steel	14A8181 X012
	1577 steel, heat treated (NACE)	14A8181 X022
24	Drive Screw, stainless steel (4 req'd)	1A3682 28982
25	Flow Arrow, stainless steel	1V1059 38982
26	Body Rating Plate, stainless steel (not shown)	13A2353 X012
28	Spring Seat	
	Full capacity trim(2)	
	zinc plated steel	
	1 inch	14A6982 X012
	2, 3, & 4 inch	15A2206 X012
	6 & 8 x 6 inch	14A8177 X012
	Heat-treated wrought steel (NACE)	
	1 inch (NACE)	14A6982 X022
	2 inch, 3 inch, 4 inch (NACE)	15A2206 X022
	6 & 8 x 6 inch (NACE)	14A8177 X022
	Restricted capacity trim, heat-treated,	
	416 stainless steel	
	2, 3, & 4 inch	14A9678 X012
	6 inch	14A9688 X012
	2, 3, & 4 inch (NACE)	14A9678 X012
	6 & 8 x 6 inch (NACE)	14A9688 X012
29	Hex Nut Steel (use w/steel body) (not shown)	
	1 inch (4 req'd)	1C3306 24072
	2 inch (8 req'd)	1A3772 24072
	3 inch (8 req'd)	1A3760 24072
	4 inch (8 req'd)	1A3520 24072
	6 & 8 x 6 inch (12 req'd)	1A4409 24072
31(2)	Pipe Plug	
	zinc plated steel	1A7675 24662
	steel (NACE)	
	2, 3, or 4 inch (NACE)	1A7675 24012
	6 or 8 x 6 inch (NACE)	1B5731 X0012
32	Travel Stop, galvanized zn pl steel (not used w/full capacity trim)	
	2 inch	
	30% capacity	14A9677 X012
	70% capacity	14A9676 X012
	3 inch,	
	40% capacity	14A9671 X012
	4 inch,	
	40% capacity	14A9670 X012
	6 inch,	
	40% capacity	14A9682 X012
33	NACE Tag (not shown) (NACE)	
	18-8 stainless steel (NACE)	19A6034 X012
34	Tag Wire (not shown) (NACE)	
	304 stainless steel (NACE)	1U7581 X0022

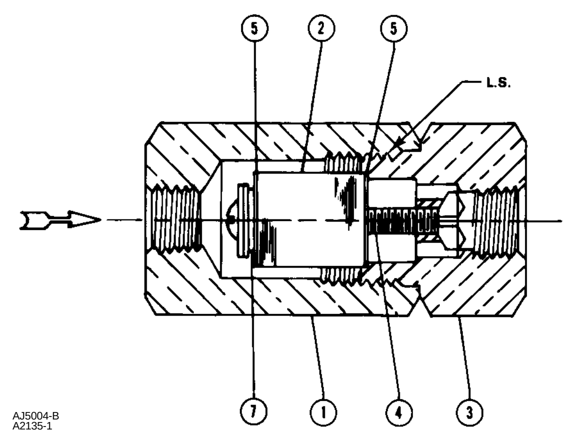
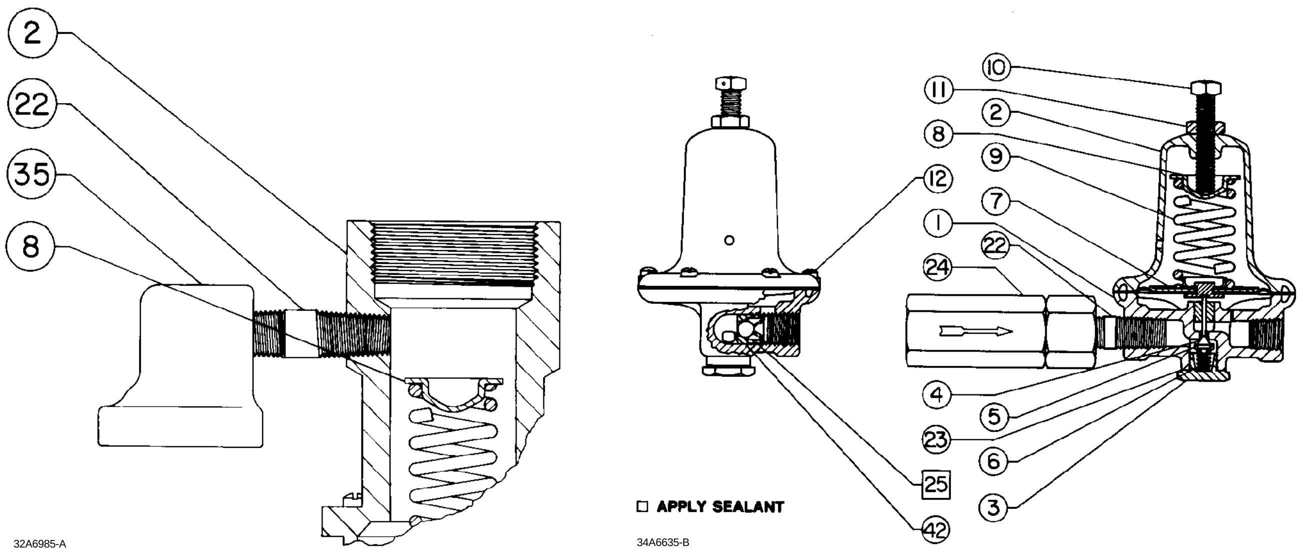


Figure 12. Standard P590 Series Filter Assembly

*Recommended spare part
2. Part included in trim package assembly which can be ordered according to the parts kit trim package.



DETAIL OF SPRING CASE AND VENT FOR TYPE 661 MOUNTING

COMPLETE PILOT SHOWING STANDARD SPRING CASE CONSTRUCTION

Figure 13. Type 6351 Pilot Assembly

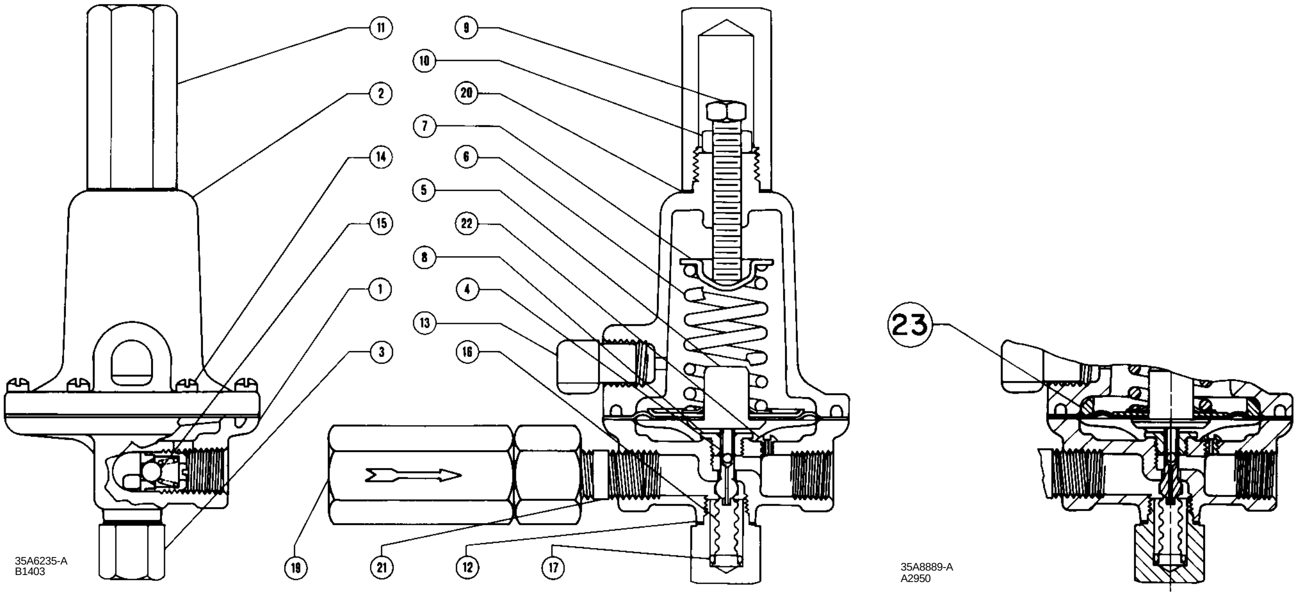
Standard P590 Series Filter (figure 12)

Key	Description	Part Number
1	Filter Body	
	Type P594-1, brass	1E3124 14012
	Type P593-1,	
	aluminum	1E3124 09012
	aluminum (NACE)	1E3124 09012
2*	Filter Element,	
	cellulose	1E3126 06992
	cellulose (NACE)	1E3126 06992
3	Filter Head	
	Type P594-1, brass	1E3125 14012
	Type P593-1,	
	aluminum	1E3125 09012
	aluminum (NACE)	1E3125 09012
4	Machine Screw	
	Type P594-1, brass	1J5002 18992
	Type P593-1,	
	aluminum	1J5002 09012
	aluminum (NACE)	1J5002 09012
5	Washer (2 req'd)	
	Type P594-1, brass	1J5000 18992
	Type P593-1,	
	aluminum	1J5000 10062
	aluminum (NACE)	1J5000 10062
7*	Gasket, composition	1F8268 04022
11	NACE Tag (Type P593-1 only) (NACE)	
	18-8 stainless steel (not shown)	19A6034 X012
12	Tag Wire (Type P593-1 only) (NACE)	
	303 stainless steel (NACE)	1U7581 X0022

Type 6351 Pilot (figure 13)

Key	Description	Part Number
	Parts kit (included are: valve plug, key 4; valve spring, key 6; diaphragm assembly, key 7; body plug gasket, key 23 and for the P590 Series Filter, filter element, key 2; and gasket, key 7)	R6351 X00012
1	Body Assembly	
	Aluminum w/brass bushing	1B7971 X0092
	Aluminum w/315 stainles steel bushing (NACE)	1B7971 X0232
	Brass w/brass bushing	1B7971 X0112
	316 stainless steel w/303 stainless steel bushing	1B7971 X0122
2	Spring Case, aluminum	
	w/untapped vent (standard)	2B7974 08012
	w/1/4 inch NPT tapped vent (for use w/Type 661 mtg)	13A0166 X012
3	Body Plug	
	Aluminum	1B7975 09032
	Brass	1B7975 14012
	316 Stainless steel	1B7975 35072
	Stainless steel (NACE)	1B7975 09032
4*	Valve Plug	
	Nitrile w/brass stem	1D5604 000A2
	Nitrile w/stainless steel stem	1D5604 000B2
	Fluoroelastomer w/brass stem	1N3798 71662
	Fluoroelastomer w/stainless steel stem	1N3798 000C2
4	Inner Valve, 304 stainless steel/nitrile (NACE)	1D5604 000B2
5	Valve Plug Spring Seat	
	Aluminum (use w/brass stem)	1E5322 11032
	316 stainless steel (use w/stainless steel stem)	1L2511 35072
	316 stainless steel (NACE)	1L2511 35072
6	Valve Plug Spring,	
	stainless steel	1B7979 37022
	heat-treated alloy 600 (UNS N07750)	19A2860 X012
7*	Diaphragm Assembly (includes zn pl steel diaphragm plate)	
	Nitrile w/aluminum pusher post	1B7980 000B2
	Fluoroelastomer w/aluminum pusher post	1B7980 000C2
	Nitrile w/stainless steel post	1B7980 X00A2
	Nitrile diaphragm w/stainless steel pusher post & diaphragm plate (NACE)	1B7980 X0112
8	Upper Spring Seat, zn pl steel	1B7985 25062
9	Control Spring, Cd pl steel	
	3 to 20 psig (0.21 to 1.4 bar) range, green	1B9860 27212
	5 to 35 psig (0.34 to 2.4 bar) range,cadmium	1B7883 27022
	35 to 100 psig (2.4 to 6.9 bar) range, red	1K7485 27202
10	Adjusting Screw, pl steel (not used w/Type 661 mtg)	10A2099 X012
11	Locknut, zn pl steel (not used w/Type 661 mtg)	1A9463 24122
12	Machine Screw, pl steel (6 req'd)	1B7839 28982
22	Body Inlet Pipe Nipple,	
	galvanized zn pl steel (use w/P590 Series filter)	1C4882 26232
	steel (NACE)	1C4882 X0032
22	Spring Case Vent Pipe Nipple,	
	galvanized zn pl steel (use w/Type 661 mtg)	1C6789 26232
23*	Body Plug Gasket, composition	1C4957 04022
24	P590 Series Filter (parts listed under separate heading)	
	Type P594-1, brass & cellulose (standard)	AJ5004 000A2
	Type P593-1, aluminum & cellulose	AJ5004 T0012
25	Sealant Loctite N. 516 (one pint can, not supplied)	1M1137 X0012
35	Type Y602-13 Vent Assembly, zinc w/stainless steel screen (use w/Type 661 mtg)	17A6572 X042
42	Relief Valve Assembly Aluminum/stainless steel	
	25 psi (1.7 bar differential)	16A5929 X022
42	Aluminum/302 stainless steel (NACE)	
	25 psi (1.7 bar differential)	16A5929 X042

*Recommended spare part



COMPLETE TYPE 6352, 6353, OR 6354L PILOT

DETAIL OF TYPE 6354H OR 6354M PILOT

Figure 14. Type 6352 Through 6354M Pilot Assemblies

Type 6352 Through 6354M Pilot (figure 14)

Key	Description	Part Number
	Parts kit (included are: valve plug, key 4; diaphragm assembly, key 5; body plug gasket, key 12; bellows O-ring, key 17; closing cap gasket, key 20; and for the P590 Series Filter, filter element, key 2; and gasket, key 7)	
	Type 6352	R6352 X00012
	Type 6353	R6353 X00012
	Type 6354	R6354 X00012
1	Body	
	Aluminum	35A6228 X012
	Brass	35A6224 X012
	Steel	35A6226 X012
	316 stainless steel	39A5971 X012
	Aluminum (NACE)	35A6228 X012
	316 stainless steel (NACE)	39A5971 X012
2	Spring Case	
	Aluminum	
	Use w/closing cap	25A6220 X012
	Use w/o closing cap	15A1581 X012
	Use w/Type 661 mtg	26A6790 X012
	Brass	25A6790 X012
	Steel	25A6223 X012
	316 Stainless steel	28A9277 X012
	Aluminum (NACE)	25A6220 X012
	316 stainless steel (NACE)	28A9277 X012
3	Body Plug	
	Aluminum	15A6221 X012
	Brass	15A6221 X022
	Steel	15A6221 X032
	316 stainless steel	15A6221 X042
	Aluminum (NACE)	15A6221 X012
	316 stainless steel (NACE)	15A6221 X042
4*	Valve Plug & Stem Assembly,	
	nitrile disk w/stainless steel stem	15A6207 X012
	316 stainless steel stem (NACE)	15A6207 X052
5*	Diaphragm Assembly	
	Type 6352 w/natural rubber diaphragm	15A6216 X012
	Fluoroelastomer diaphragm (NACE)	15A6216 X132
	Type 6353 w/nitrile diaphragm	15A6216 X022
	Type 6354L, 6354M, or 6354H w/neoprene diaphragm	15A6216 X032

Key	Description	Part Number
6	Control Spring	
	Zn pl steel	
	Type 6352	
	2 inch wc to 2 psig (5 to 140 mbar), yellow	14A9672 X012
	Type 6352	
	2 to 10 psig (0.14 to 0.69 bar), black	14A9673 X012
	2 inch wc to 2 psig (5 to 140 mbar), yellow (NACE)	14A9672 X012
	2 inch wc to 2 psig (5 to 140 mbar), black (NACE)	14A9673 X012
	Type 6353	
	3 to 40 psig (0.21 to 2.8 bar), yellow	1E3925 27022
	35 to 125 psig (2.4 to 6.9 bar), red	1K7485 27202
	Type 6354L	
	85 to 200 psig (5.9 to 14 bar), blue	1L3461 27142
	Type 6354M	
	175 to 220 psig (12 to 15 bar), blue	1L3461 27142
	17-4PH stainless steel	
	Type 6354H	
	200 to 300 psig (14 to 21 bar), green	15A9258 X012
7	Spring Seat	
	Zn pl steel (for Types 6352 & 6353)	1B7985 25062
	Pl steel (for Type 6354L, 6354M, or 6354H)	1K1558 28982
8	Stem Guide	
	416 stainless steel, heat-treated	15A6222 X012
	410 stainless steel (NACE)	15A6222 X022
9	Adjusting Screw	
	Zn pl steel (for Types 6352 & 6353)	1H3050 28982
	Pl steel (for aluminum spring case w/closing cap & Type 6354L, 6354M, or 6354H)	1B7986 28982
10	Locknut, zn pl steel	1A9463 24122
11	Closing Cap	
	Aluminum	1H2369 X0012
	Brass	1H2369 14012
	Steel	1H2369 X0022
	316 stainless steel	1H2369 X0032
12*	Body Plug Gasket	
	Composition	1C4957 04022
	Composition (NACE)	1C4957 04022
13	Type Y602-12 Vent Assembly, plastic w/stainless steel screen	27A5516 X012
14	Machine Screw (6 req'd)	
	Steel	1H4217 28992
	Pl steel	
	For aluminum spring case w/o closing cap	1H2676 28982
	For Type 661 mtg	1E9752 28982

*Recommended spare part

Key	Description	Part Number
15	Relief Valve Assembly	
	Aluminum/stainless steel	
	25 psi (1.7 bar) differential	16A5929 X052
	Aluminum/302 stainless	
	steel for 25 psi (1.7 bar) differential (NACE)	16A5929 X042
16	Bellows Assembly, stainless steel/ nickel	15A6202 X012
17*	Bellows O-Ring, nitrile	1D6825 06992
19	P590 Series filter (parts listed under separate heading)	
	Type P594-1, brass & cellulose (standard)	AJ5004 000A2
	Type 593-1, aluminum & cellulose	AJ5004 T0012
20*	Closing Cap Gasket, composition	15A6218 X012
21	Pipe Nipple	
	Galvanized zn pl steel	1C4882 26232
	Noncorrosive, NACE steel (NACE)	1C4882 X0032
	Corrosive, 316 stainless steel (NACE)	1C4882 X0042
22	Restriction, pl steel (not used for low-gain construction)	
	Standard gain (indicated by S stamped on pilot body), No. 51 drill size or 0.067 inch (1.7 mm) diameter, green	17A2030 X012
	High gain for narrower proportional bands (indicated by H stamped on pilot body), No. 57 drill size or 0.043 inch (1.09 mm) diameter, red	17A2029 X012
22	Restriction, NACE construction 316 stainless steel (not used for low-gain construction) Standard gain (indicated by S stamped on pilot body), No. 51 drill size or 0.067 inch (1.7 mm) diameter, green color code	17A2030 X022
	High gain for narrower proportional bands (indicated by H stamped on pilot body), No. 57 drill size or 0.043 inch (1.09 mm) diameter, red color code	17A2029 X022
23	Diaphragm Limiter, aluminum (for Types 6354H or 6354M)	15A9259 X012
26	NACE Tag (Type 6352 only), NACE 18-8 stainless steel not shown)	19A6034 X012
27	Tag Wire (Type 6352 only), NACE 303 stainless steel (not shown)	1U7581 X0022

Type 61LD Pilot (figure 18)

Key	Description	Part Number
	Parts kit (included are: relay orifice, key 8; disk holder assembly, key 9; bleed orifice, key 10; O-ring, key 12 relay spring, key 13; upper relay diaphragm, key 14; lower relay diaphragm, key 15; bleed valve, key 26; and closing cap gasket, key 28)	R61LD X00012
1	Spring Case, cast iron	1B9839 19012
2	Body, cast iron	2J5819 19012
3	Diaphragm Case, Cast iron	2C5186 19012
4	Yoke	
	Zinc	1D6625 44012
	Cast iron	1B9840 19012
5	Closing Cap Assembly (includes keys 5a, 5b, 5c and 5d)	AD5586 000A2
5A	Screen, stainless steel (not used with Type 661 mtg)	1B6335 38392
5B	Snap Ring, stainless steel (not used with Type 661 mtg)	1B6336 38992
5C	Machine Screw, steel (not used with Type 661 mtg)	1D5589 28992
5D	Closing Cap, zinc (not used with Type 661 mtg)	2D3715 44012
6	Adjusting Screw, zinc (not used with Type 661 mtg)	1B5379 44012
7	Control Spring, steel pl	
	1/4-2 psig (0.017-0.138 bar) range, red spring	1B8863 27022
	1-5 psig (0.069-0.34 bar) range, yellow spring	1J8578 27022
	2-10 psig (0.138-0.69 bar) range, blue spring	1B8864 27022
	5-15 psig (0.34-1.02 bar) range, brown spring	1J8579 27142
	10-20 psig (0.69-1.4 bar) range, green spring	1B8865 27022
8	Relay Orifice, stainless steel	1C5201 35032
9	Disk Holder Assembly	
	Brass/nitrile (standard)	1B8868 000A2
	Stainless steel/nitrile (corrosive)	1B8868 000B2
10	Bleed Orifice, stainless steel	1B8873 35032
11	Diaphragm Nut	
	Brass	1B9895 14012
	Stainless Steel	1B9895 35072
12*	O-ring, nitrile	1B8855 06992
13	Relay Spring, 302 stainless steel	1E6436 37022
14*	Upper Diaphragm, Nitrile	1B8852 02052
15*	Lower Diaphragm, Nitrile	1B8860 02052
16	Upper Diaphragm Plate, Steel	1B9893 25072
17	Lower Diaphragm Plate, Steel	1B9894 25072
18	Spring Seat, steel, cd pl	1B8862 25072
19	Hex Nut, steel, cd pl	1A3403 24122
20	Cap Screw, steel, (8 req'd)	1B9896 24052
22	Pipe Plug, steel (not used with Type 661 mtg)	1A6495 28992
23	Vent Screen, alloy 400 (used only with Type 661 mtg)	0L0783 43062
24	Pipe Nipple, steel zinc pl	1C4882 26232
25	P590 Series filter (parts listed under separate heading)	
	Type P594-1, brass & cellulose (standard)	AJ5004 000A2
	Type 593-1, aluminum & cellulose	AJ5004 T0012
26	Bleed Valve, 416 stainless steel	1H9516 35132
27	Nameplate, aluminum	14A1711 X012
28*	Gasket, neoprene	1P7533 06992
30	Pipe Plug, cast iron (2 req'd)	1A3619 19012
35	Spring Seat, steel (used only with Type 661 mtg)	1J4284 24092
50	Drive Screw, steel, pl (2 req'd)	1E9530 28982

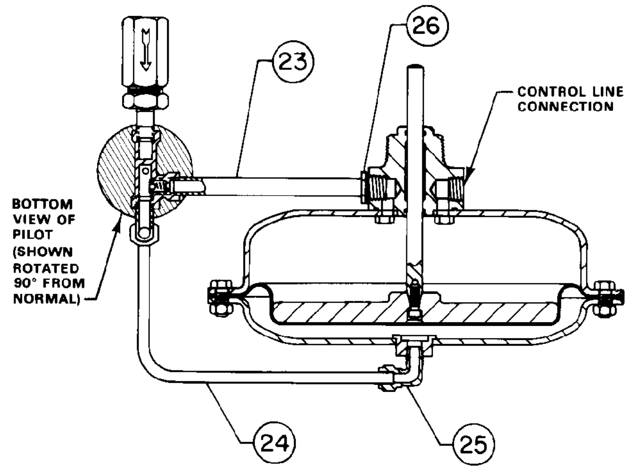


Figure 15. Single-Pilot Mounting Parts

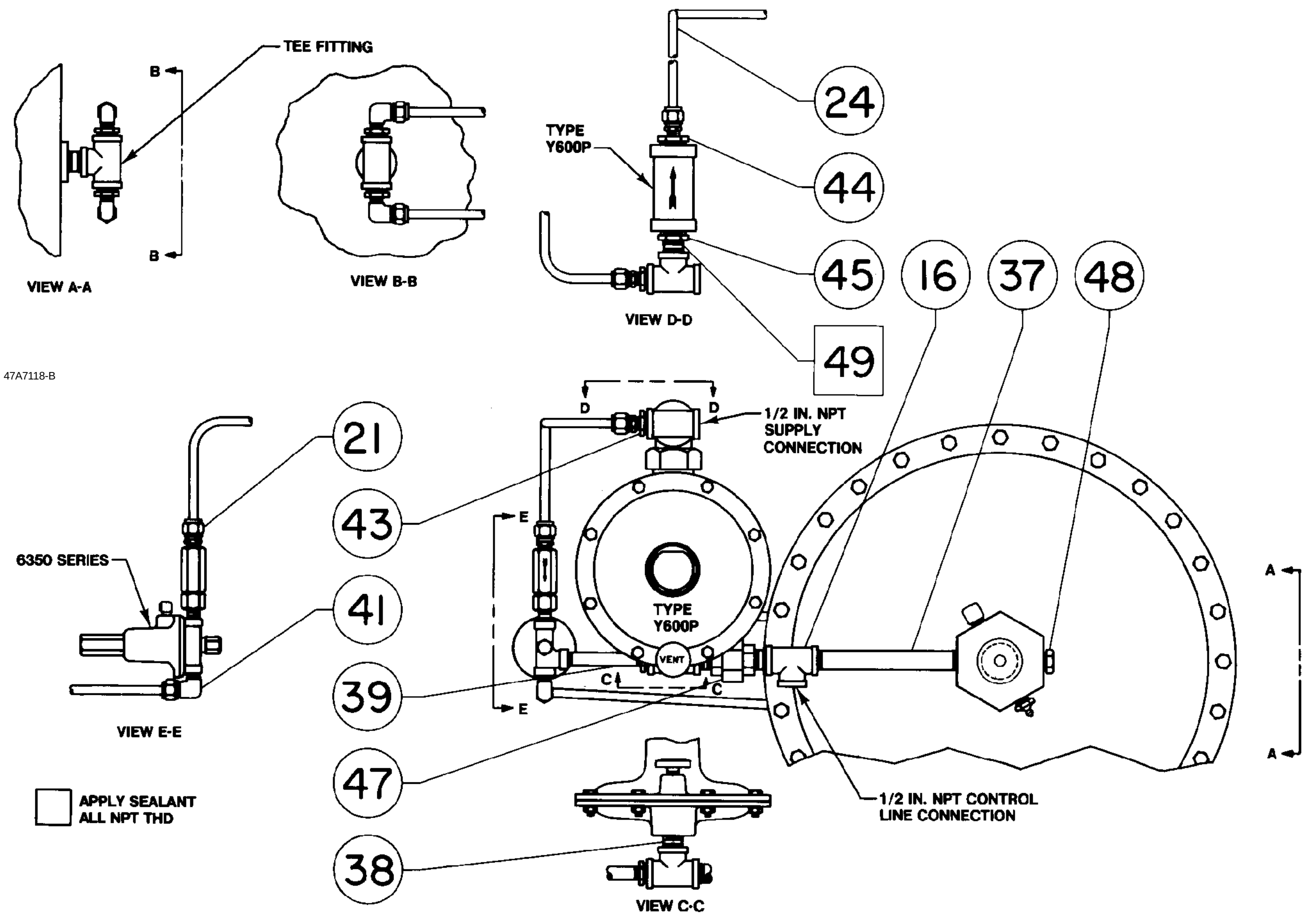
Standard Single-Pilot Mounting Parts (figures 15 & 19)

Note

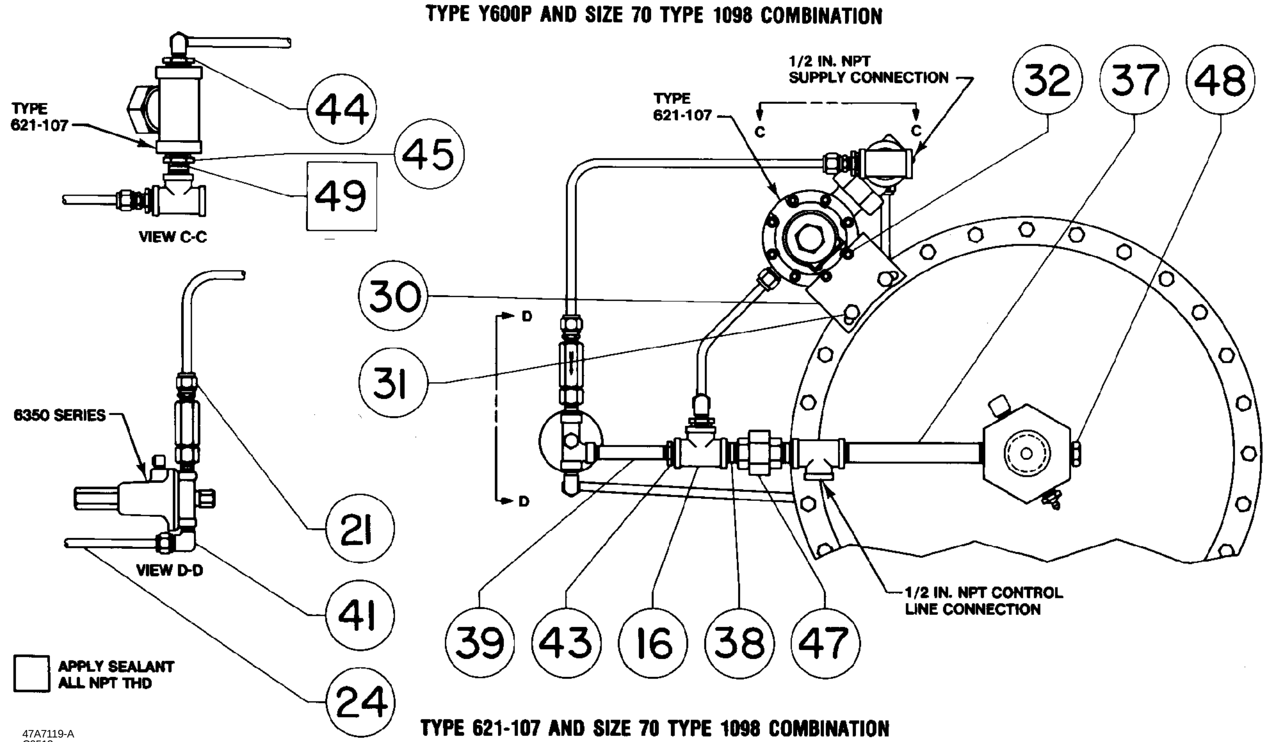
Key numbers 14 through 22 are only for mounting a Type 61LD pilot.

Key	Description	Part Number
14	Pipe Nipple, galvanized zn pl steel	1F7315 26012
15	Pipe Nipple, galvanized zn pl steel	1F7302 26012
16	Pipe Tee, Malleable iron	1A4736 21992
17	Type 1806 Relief Valve, SST ball and spring	
	Brass body and spring seat	AF5001 X00A2
	Aluminum body and spring seat	AF5001 X0012
	Stainless steel body and spring seat	AF5001 X0022
18	Relief Tubing	
	Copper	14A9457 X012
	Aluminum	14A9457 X032
	Steel	14A9457 X022
	Stainless steel	14A9457 X042

*Recommended spare part



TYPE Y600P AND SIZE 70 TYPE 1098 COMBINATION



TYPE 621-107 AND SIZE 70 TYPE 1098 COMBINATION

Figure 16. Dual-Pilot Mounting Parts for Boiler Fuel Installations

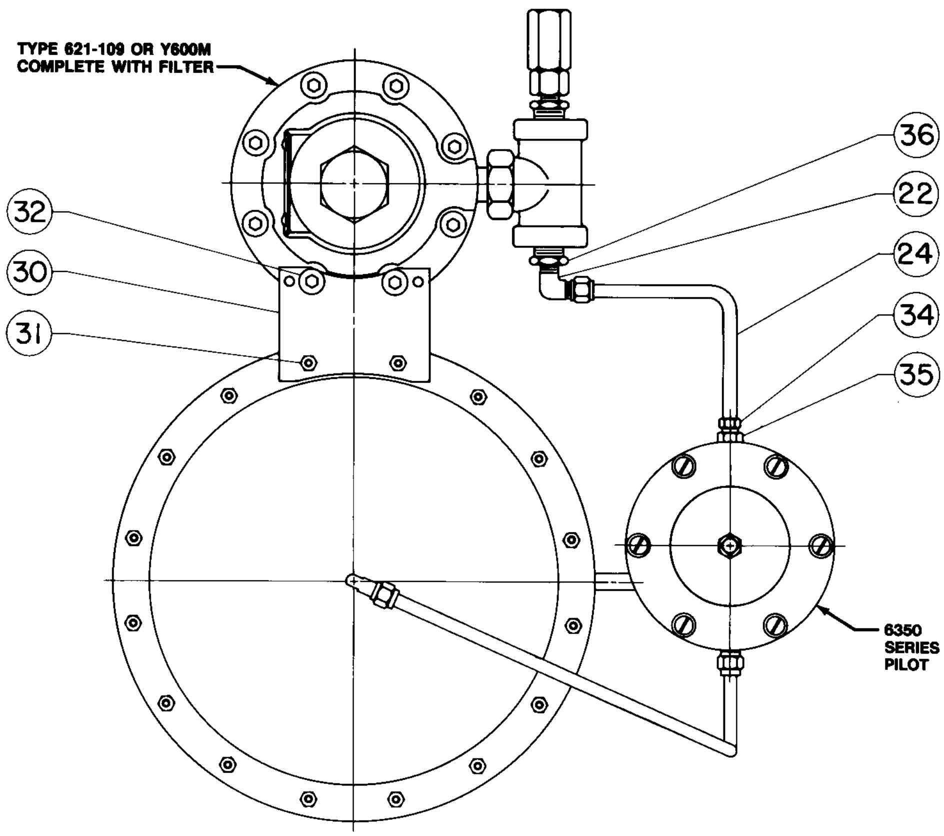


Figure 17. Dual-Mounting Parts for Working Monitor Regulator

Key	Description	Part Number
19	Tee Fitting	
	Brass	14A9056 X012
	Steel	14A9056 X032
	Stainless steel	14A9056 X042
20	Loading Tubing	
	Copper	24A9459 X012
	Aluminum	24A9459 X032
	Steel	24A9459 X022
	Stainless steel	24A9459 X042
21	Connector Fitting	
	Brass	1H8682 18992
	Aluminum	1J9886 11992
	Steel	1J1395 28992
	Stainless steel	1L9272 38992
22	Elbow Fitting	
	Brass	1L2497 18992
	Aluminum	1K5654 11992
	Steel	1J1396 28992
	Stainless steel	1N6856 38992
23	Pipe Nipple, galvanized zn pl steel	
	Size 30 or 40 actuator	1C2100 26232
	Size 70 actuator	19A7858 X012
	Pipe Nipple, NACE construction	
	Size 30 or 40 actuator	
	Aluminum	1C2100 X0022
	316 stainless steel	1C2100 X0012
	Size 70 actuator	
	Aluminum	19A7858 X022
	316 stainless steel	19A7858 X032
24	Loading Tubing	
	Steel (standard)	
	Size 30 or 40 actuator	14A9458 X022
	Size 70 actuator	050021 2401W
	Stainless steel	
	Size 30 or 40 actuator	14A9458 X042
	Size 70 actuator	050198 3807W
24	Loading Tube (Continued)	
	Copper	
	Size 30 or 40 actuator	14A9458 X012
	Size 70 actuator	050021 1701W
	Aluminum	
	Size 30 or 40 actuator	14A9458 X032
	Size 70 actuator	050021 1107W
	NACE construction	
	Size 30 or 40 actuator	
	Aluminum	14A9458 X032
	304 stainless steel	14A9458 X042
	Size 70 actuator (specify main valve type number and body size)	
	Aluminum	050021 1107W
	304 stainless steel	050198 3807W
25	Elbow Fitting (2 req'd)	
	Pl steel (standard)	15A6002 X472
	Stainless steel	15A6002 X612
	Brass	15A6002 X162
	Aluminum	15A6002 X402
	Aluminum (NACE)	15A6002 X402
	316 stainless steel (NACE)	15A6002 XC72
26	Pipe Bushing	
	Malleable iron	1B2928 21992
	Steel (NACE)	1B2928 X0032

Boiler Fuel Installation Dual-Pilot Mounting Parts (figure 16)

Key	Description	Part Number
16	Pipe Tee, galvanized malleable iron (4 req'd)	1A4736 21992
21	Tubing Connector, pl steel (3 req'd)	15A6002 X462
24	Tubing, steel	050021 2401W
30	Mounting Bracket, steel (for Type 621-107)	1H3504 X0012
31	Cap Screw, zn pl steel (2 req'd) (for Type 621-107)	1A5828 24052
32	Cap Screw, zn pl steel (2 req'd) (for Type 621-107)	1K7646 24052

Key	Description	Part Number
37	Pipe Nipple, galvanized zn pl steel	1F7315 26012
38	Pipe Nipple, galvanized zn pl steel (5 req'd for Type Y600P; 4 req'd for Type 621-107)	1K2015 26022
39	Pipe Nipple, galvanized zn pl steel	1C5599 26232
41	Tubing Elbow pl steel (3 req'd for Type Y600P; 5 req'd for Type 621-107)	15A6002 X472
43	Pipe Bushing, pl steel (4 req'd)	1C3790 26232
44	Pipe Bushing, steel	1A3424 28992
45	Pipe Bushing, galvanized zn pl steel	1K2895 28992
47	Female Union, malleable iron	1B5405 21992
48	Pipe Plug, steel	1A3692 24492
49	Led-Plate[3] No. 250 Sealant, 5 lb (2.3 kg) can (not furnished w/regulator)	1M5240 06992

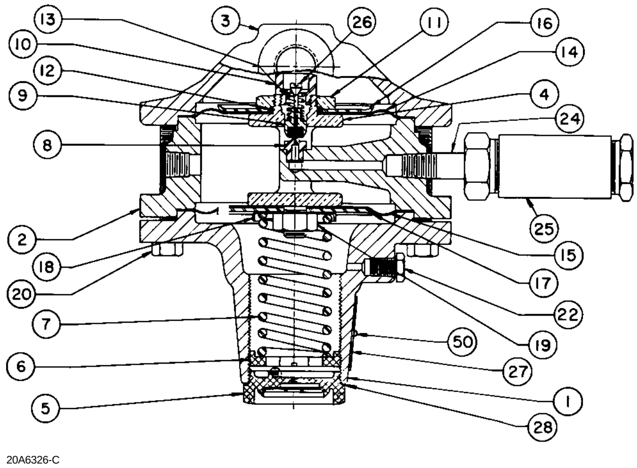
Working Monitor Dual-Pilot Mounting Parts (figure 17)

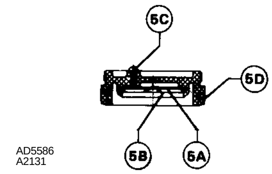
Key	Description	Part Number
22	Tubing Elbow, pl steel	15A6002 X472
24	Tubing, steel	050021 2401W
30	Mounting Bracket, steel	1H3504 X0012
31	Cap Screw, zn pl steel (2 req'd)	1A5828 24052
32	Cap Screw, zn pl steel (2 req'd)	1K7646 24052
34	Flared Nut, zn pl steel	1D6921 24272
35	Tubing Connector, brass	1D6922 14012
36	Pipe Bushing, steel (2 req'd)	1A3424 28992

Type 1098 and 1098H Actuators (figure 20)

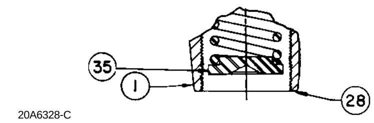
Key	Description	Part Number
	Parts kit (included are: casing O-ring, key 5; stem O-ring, key 6; and diaphragm, key 7)	
	Size 30	R1098 X00302
	Size 40 (standard)	R1098 X00402
	Size 70	R1098 X00702
1	Lower Diaphragm Case	
	Type 1098	
	Size 30, zn pl steel	2E8007 28992
	Size 40, steel	24A7155 X012
	Size 70, zn pl steel	2N1266 28992
	Type 1098H	
	Size 30, WCB steel	36A8537 X012
	NACE Construction	
	Type 1098	
	Size 30, heat-treated zinc plated steel (NACE)	2E8007 X0022
	Size 40, NACE steel	24A7155 X032
	Size 70, NACE steel	2N1266 X0022
	Type 1098H (size 30 only), heat-treated WCB steel (NACE)	36A8537 X022
2	Upper Diaphragm Case	
	Type 1098	
	Size 30	
	Steel	25A7340 X012
	Wrought steel (NACE)	25A7340 X022
	Size 40	
	zinc plated steel	24A5680 X012
	Wrought steel (NACE)	24A5680 X022
	Size 70	
	zinc plated steel	25A2607 X012
	Wrought steel (NACE)	25A2607 X022
	Type 1098H	
	Size 30	
	WCB steel	36A8535 X012
	Heat-treated WCB steel (NACE)	36A8535 X022
3	Bonnet (for Type 1098 only)	
	Steel	24A5681 X012
	Wrought steel (NACE)	24A5681 X022
4	Cap Screw (for Type 1098 only)	
	Zinc plated steel	1D5287 24952
	B7M zinc plated steel (NACE)	1D5298 X0012
5*	Casing O-Ring	
	Nitrile (not req'd for Type 1098H)	1F9141 06992
	Fluoroelastomer	1F9141 X0012
6*	Stem O-Ring (2 req'd)	
	Nitrile	1C7822 06992
	Fluoroelastomer	1K7561 06382
7*	Diaphragm, nitrile	
	Size 30	2E7919 02202
	Size 40	2E6700 02202
	Size 70	2N1269 02202
8	Diaphragm Plate	
	Cast iron	
	Size 30	15A7339 X012
	Size 40	14A5682 X012
	Size 70	15A2606 X012
	Heat-treated WCB steel (NACE)	
	Type 1098	
	Size 30	19A7317 X012
	Size 40	19A7318 X012
	Size 70	19A7319 X012
	Type 1098H (size 30 only)	19A7317 X012
9	Stem Cap Screw	
	Plated steel	
	Size 30 or 40	1L5454 28982
	Size 70	11B1768 X012
	Grade 8 black steel (NACE)	
	Type 1098 (NACE)	
	Size 30 or 40 (NACE)	1L5454 X0012
	Size 70 (NACE)	11B1768 X022
	Type 1098H (size 30 only) (NACE)	1L5454 X0012
10	Cap Screw, zn pl steel	
	Type 1098	
	Size 30 (12 req'd)	1E7603 24052
	Size 40 (16 req'd)	1E7603 24052
	Size 70 (28 req'd)	1A5828 24052
	Type 1098H	
	Size 30 (12 req'd)	1A9155 24052
11	Hex Nut, zn pl steel	
	Type 1098	
	Size 30 (12 req'd)	1A3465 24122
	Size 40 (16 req'd)	1A3465 24122
	Size 70 (28 req'd)	1A3465 24122
	Type 1098H	
	Size 30 (12 req'd)	1A3403 24122
12	Stem	
	17-4PH stainless steel	
	1 inch	14A6757 X012
	2 inch	14A5683 X012
	3 inch	14A5663 X012
	4 inch	14A5648 X012
	6 inch	14A6987 X012
	8 x 6 inch	18A4217 X012
	316 stainless steel (NACE)	
	1 inch main valve body (NACE)	14A6757 X022
	2 inch main valve body (NACE)	14A5683 X022
	3 inch main valve body (NACE)	14A5663 X022
	4 inch main valve body (NACE)	14A5648 X022
	6 inch main valve body (NACE)	14A6987 X022
	8 x 6 inch main valve body (NACE)	18A4217 X022
13	Nameplate, stainless steel (not shown)	
	Size 30	25A8373 X012
	Size 40	24A5704 X012
	Size 70	25A8374 X012
26	NACE Tag, 18-8 stainless steel (not shown)	19A6034 X012
27	Type Y602-12 Vent Assembly	27A5516 X012
27	Tag Wire, 303 stainless steel (not shown) (NACE)	1U7581 X0022
28	Grease Fitting, steel	1L8478 28992

*Recommended spare part
3. Trademark of Armite Laboratories.





DETAIL OF CLOSING CAP ASSEMBLY



DETAIL OF SPRING CASE FOR TYPE 661 MOUNTING

Figure 18. Type 61LD Pilot Assembly

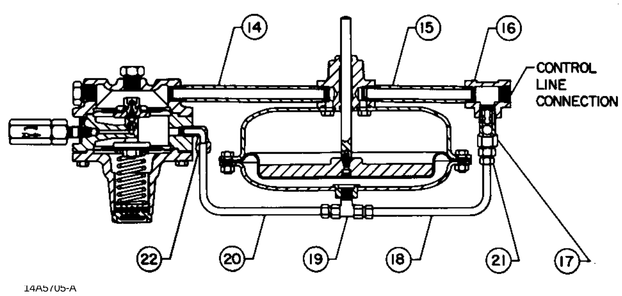
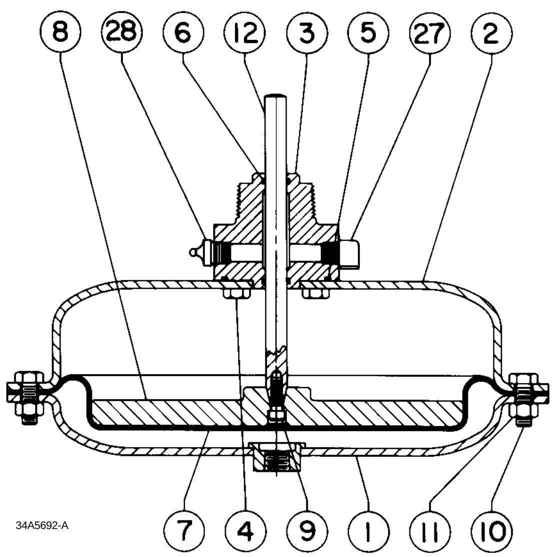
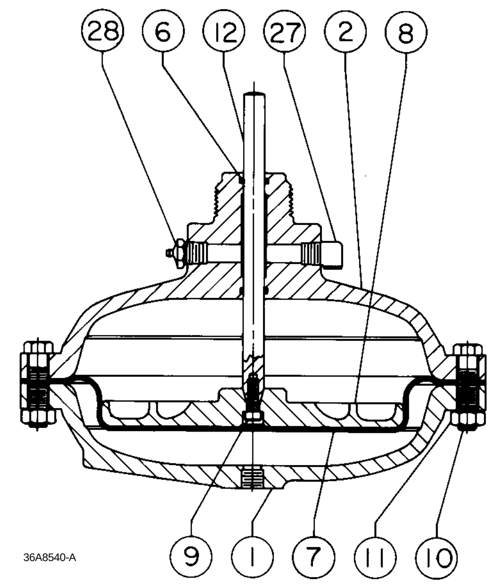


Figure 19. Type 61LD Pilot and Type1806 Relief Valve Mounting



TYPE 1098



TYPE 1098H

Figure 20. Type 1098 and 1098H Actuator Assemblies

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May 1997

Errata Sheet
for

Type 1098-EGR & 1098H-EGR Pilot-Operated Regulators,
Form 5084, May 1987

This errata sheet covers updated information on the Type 1098-EGR Pilot Operated Regulators. Each bullet on this errata sheet refers to the Type 1098 and 1098H Actuator and Pilot Mounting Parts section on page 17 and figure 20 on page 28 of the Type 1098-EGR & 1098H-EGR Pilot-Operated Regulators instruction manual Form 5084.

The Type 1098 bonnet has been redesigned to incorporate a wiper ring, bearings and larger casing O-ring. This redesign effects all body sizes and actuator sizes (size 30, 40, 70 and 30H) for the Type 1098.

When doing maintenance on the Type 1098 original bonnet design and the bonnet redesign, the repair kits R1098X00302, R1098X00402 and R1098X00702 will include all the necessary parts to repair both designs. When repairing the original design, key numbers 56 (bearings) and 57 (wiper ring) will not be needed (refer to figure 20).

- Replace the steps in the section Type 1098 and 1098H Actuator and Pilot Mounting Parts on page 17 with the following steps.

2. Access to all internal parts except the stem O-rings, bearings and wiper (keys 6, 56, 57) may be gained without removing the bonnet (key 3) or upper diaphragm case (key 2) from the main valve or the pilot(s) from the bonnet pipe nipple (key 23, figure 15, or keys 37 and 39, figure 16). Disconnect the loading tubing (key 24, figure 15, 16, or 17) from the actuator elbow fitting (key 25, figure 15, or key 41, figure 16), and with a Type 61LD pilot also disconnect the relief tubing (key 18, figure 19) from the fitting tee.

Second paragraph of step 4.

To remove the Type 1098 and Type 1098H stem O-rings (key 6), remove the pilot(s) and pipe nipple(s) if necessary. Unscrew either the Type 1098 bonnet (key 3) or the Type 1098H upper diaphragm case (key 2), and remove the wiper ring, bearings and O-rings.

5. Lubricate both stem O-rings (key 6), and wiper ring (key 57) and install them with the stem bearings (key 56) in either the Type 1098 bonnet (key 3) or in the Type 1098H upper diaphragm case (key 2).

- Add the diagram on the following page to figure 20 on page 28 of the instruction manual.

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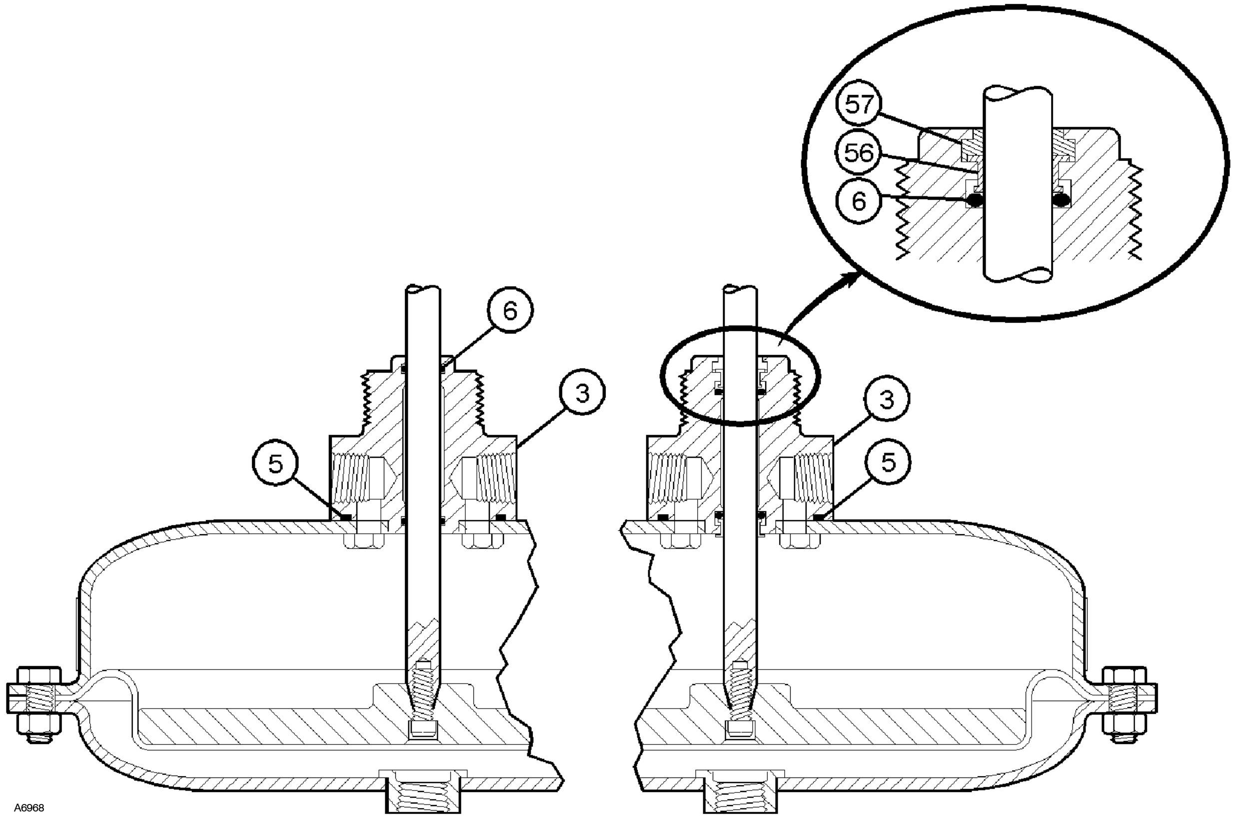

Key	Description	Part Number
3	Bonnet, Steel	24A5681X012
5	Casing O-ring, Nitrile	1F914106992
6	Stem O-ring (2 req d)	
	Nitrile	1C782206992
	Fluoroelastomer	1K756106382

Key	Description	Part Number
3	Bonnet, Steel	33B0301X012
5	Casing O-ring, Nitrile	1F358106992
6	Stem O-ring (2 req d)	
	Nitrile	1C782206992
	Fluoroelastomer	1K756106382
56	Bearing, Nylon (2 req d)	17A7112X012
57	Wiper Ring	15A6002XN12

Figure 20. Type 1098 and 1098H Actuator Assemblies

August 1999

Errata Sheet
for

Types 1098-EGR & 1098H-EGR Pilot-Operated Regulators
Form 5084, May 1987

The body plug on the Type 6351 pilot has been redesigned. The body plug gasket and body plug previously used on the Type 6351 pilot have been replaced with a new body plug assembly. The body plug assembly includes the body plug and the body plug O-ring. Replace or add the following information on the Types 1098-EGR & 1098H-EGR Instruction Manual, form 5084.

- **Replace step 3 of the Type 6351 Pilot section on page 16 with the following:**

3. To replace the valve plug (key 4), remove body plug (key 3 or 3A) to let the plug spring (key 6) and plug/stem assembly (key 4) drop freely from the body (key 1). Inspect the removed parts, replace if neccessary. Make sure the plug seating surfaces are free from debris. Inspect body plug O-ring (key 3B), replace if necessary. Type 6351 pilots manufactured before May 1999 need to have the body plug gasket (key 23) and the body plug (key 3) replaced with a new body plug assembly (key 3), which includes the body plug (key 3A) and the body plug O-ring (key 3B). Install the body plug O-ring (key 3B) over the body plug (key 3A). Stack the plug spring (key 6) and the plug/stem assembly on the body plug assembly (key 3), and install the body plug assembly with stacked parts into the body (key 1).

- **Replace the following Parts List information beginning on page 21 with the information below:**

Type 6351 Pilot (figure 13)

Key	Description	Part Number
	Parts Kit (includes keys 3, 4, 6, 7, and P590 Series filter, key 2)	R6351X00012
3	Body Plug Assembly (includes body plug and O-ring)	
	Aluminum body plug	
	with nitrile O-ring	18B6542X022
	with fluoroelastomer O-ring	18B6542X042
	Stainless steel body plug	
	with nitrile O-ring	18B6542X052
	with fluoroelastomer O-ring	18B6542X062

- **Delete the following Parts List information on page 22:**

Key	Description	Part Number
23*	Body Plug Gasket, composite	1C495704022

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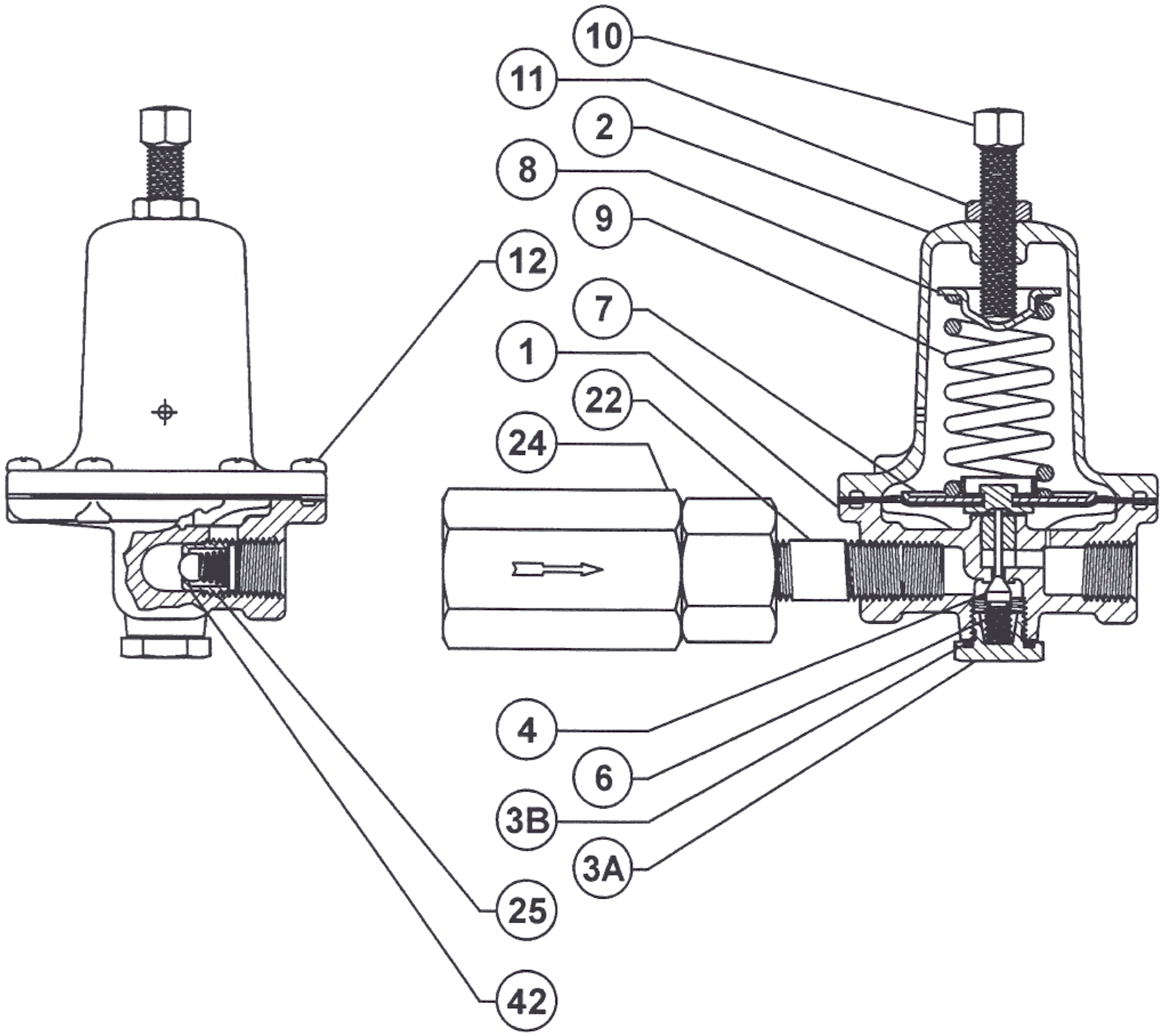
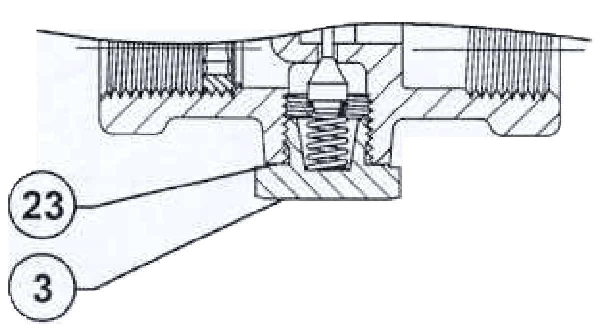
- **Replace the Type 6351 Interior Assembly in figure 13 on page 22 with the figure below:**



NEW TYPE 67 OR 67R ASSEMBLY DRAWING
SHOWING NEW BODY PLUG AND BODY PLUG GASKET



OLD TYPE 67 OR 67R ASSEMBLY DRAWING
SHOWING OLD BODY PLUG AND BODY PLUG GASKET

July 2002

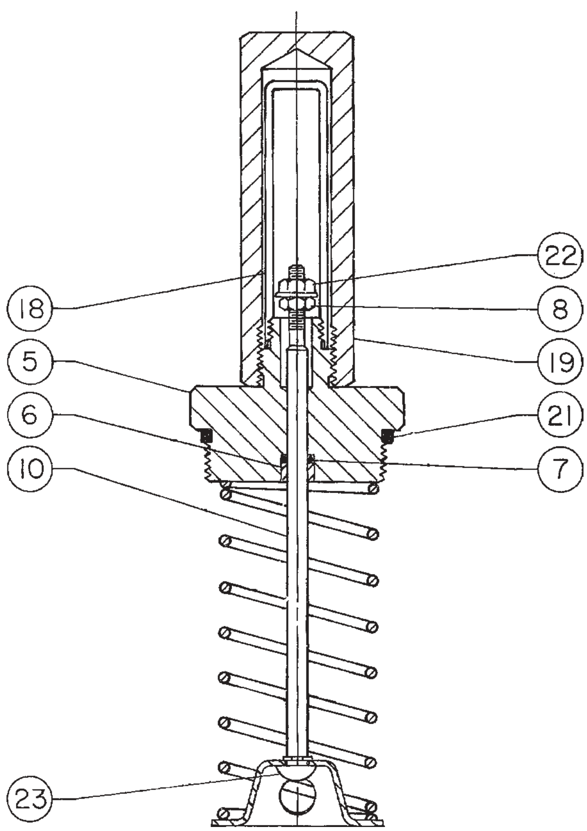
Errata Sheet
for

Type 1098-EGR and 1098H-EGR Pilot-Operated Regulators
Form 5084, May 1987

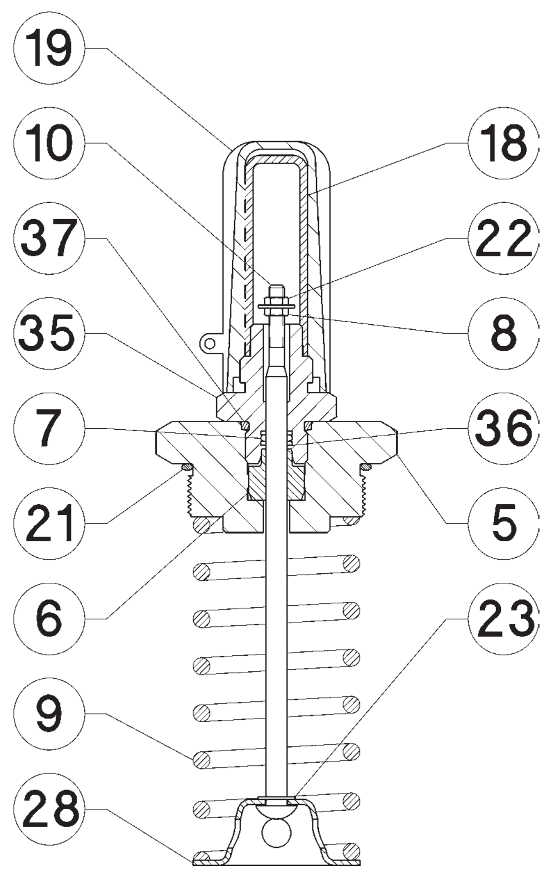
This errata sheet covers the redesign of the Type 1098-EGR and 1098H-EGR travel indicator assemblies. This redesign has been incorporated into all body sizes, regardless of actuator size. The Type 1098-EGR and 1098H-EGR travel indicator assemblies now incorporate a redesigned O-ring retainer (key 6), TFE back-up rings (key 36), and an additional indicator fitting (key 35).

When performing maintenance on the original Type 1098-EGR or 1098H-EGR body flange, travel indicator replacement is recommended. The redesigned travel indicator assembly is incorporated into all Quick-Change Trim kits (e.g. 25A3170X012) and on the Travel Indicator Kits (see table by size). The elastomer repair kits contain the components for the redesigned travel indicator assembly.

See the drawings below for old versus new design.



TYPE 1098 ORIGINAL DESIGN (PRIOR TO SPRING 2002)



TYPE 1098 REDESIGN (10C1212 KIT)

Type 1098-EGR and 1098H-EGR Travel Indicator Assemblies

Types 1098-EGR and 1098H-EGR

• Insert the following steps after “Replacing Quick-Change Trim Package” section on page 14.

Replacing Travel Indicator Assembly

1. Remove the travel indicator assembly by removing lower indicator fitting (key 5) from body flange (key 2).

2. Coat the threads of the lower indicator fitting (key 5) with a good grade of general-purpose grease.

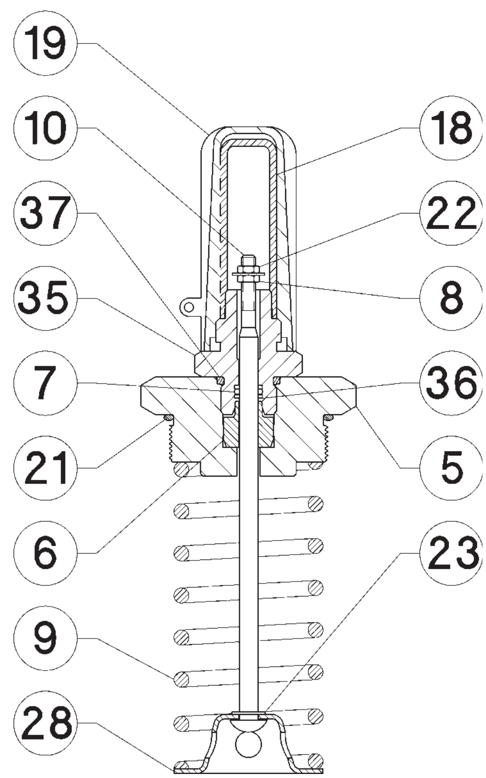
3. Install travel indicator assembly (10C1212), torque to 40 inch-pounds.

4. Check indicator zeroing by unscrewing the indicator protector (key 19) and seeing if the flange of the indicator nut (key 22) lines up evenly with the bottom marking on the indicator scale (key 18). If not, remove the indicator scale and separate the indicator nut and hex nut (key 8). Hold the indicator scale against the indicator fitting (key 5) with the scale base resting against the shoulder of the fitting, and turn the indicator nut until its flange is aligned with the bottom scale marking. Then lock both nuts against each other, and install the indicator scale and protector.

• Insert the following parts kit list after “Quick Change Trim Assembly” on page 18

Key	Description	Part Number
	Parts kit, QuickChange Travel Indicator Kit (included are: indicator stem, key 10;O-ring retainer, key 6; indicator fitting, key 35; lower indicator fitting, key 5; mach hex nut, key 8; nitrile O-ring, key 7; back-up scarf ring, key 36, 2 required; nitrile o-ring, key 21; indicator cover, key 18; flange nut, key 22; E-ring, key 23; nitrile O-ring, key 37; adjusting screw cap, key 19; spring seat, key 28; spring, key 9)	
	Note: Indicator zeroing of key 8, 12 and 18 may be needed. See Step 4 above.	
	60 Psi (4,1 bar) spring color green	
	1-inch	10C1212X042
	2-inch	10C1212X012
	3-inch	10C1212X022
	4-inch	10C1212X032
	6-inch	10C1212X052
	125 Psi (8.6 bar) spring color blue	
	1-inch	10C1212X092
	2-inch	10C1212X062
	3-inch	10C1212X072
	4-inch	10C1212X082
	6-inch	10C1212X102
	400 Psi (28 bar) spring color red	
	1-inch	10C1212X142
	2-inch	10C1212X112
	3-inch	10C1212X122
	4-inch	10C1212X132
	6-inch	10C1212X152

• Insert “1098 Redesign” into figure 11, page 19.



Travel Indicator Assembly

For information, contact Fisher Controls:
Marshalltown, Iowa 50158 USA
28320 Gallardon, France
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Singapore 128461

Printed in U.S.A.

627 Series Pressure Reducing Regulators

Introduction

Scope of Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering for the 627 Series regulators. These regulators usually are shipped separate for line installation, although sometimes they are shipped installed on other equipment. Refer to the instruction manual for the other equipment for installation and operating instructions.

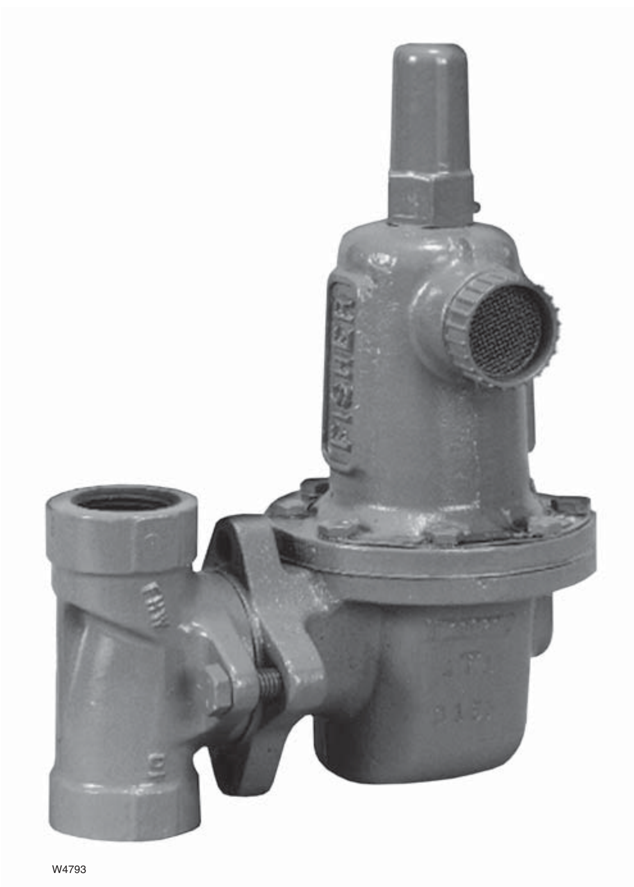

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Figure 1. Typical 627 Series Self-Operated Pressure Reducing Regulator

Description

The 627 Series self-operated pressure reducing regulators (figure 1) are for high and low pressure systems. These regulators can be used with natural gas, air, or a variety of other gases. Performance characteristics vary according to construction (see the AVAILABLE CONFIGURATIONS specification in table 1).

Specifications

Table 1 gives some general specifications for the 627 Series regulators. The nameplates (figure 2) gives detailed information for a particular regulator as it comes from the factory.

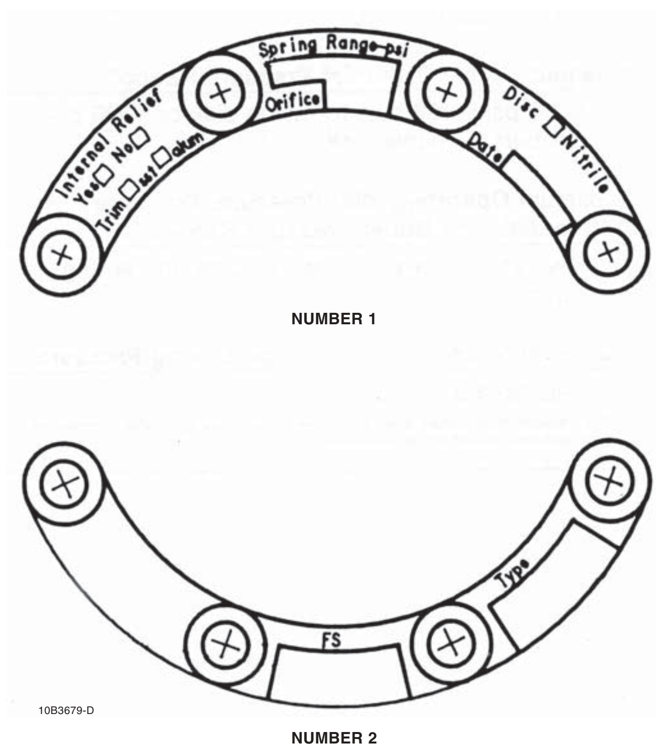


Figure 2. Nameplates

Table 1. Specifications

Available Constructions

Type 627: Self-operated pressure reducing regulator equipped with a pitot tube for greater regulated capacities (figure 7)

Type 627R: Type 627 with internal relief and with an open throat (figure 8)

Type 627M: Type 627 with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4-inch NPT downstream control line connection (figure 9)

Type 627MR: Type 627M with internal relief (figure 10)

Type 627H: Type 627 with a diaphragm limiter to deliver a higher outlet pressure (figure 11)

Type 627HM: Type 627H with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through two 1/4-inch NPT downstream control line connections (figure 12)

Body Sizes

3/4, 1, or 2-inch

End Connection Styles

3/4, 1, or 2-inch body sizes: NPT

1 or 2-inch body sizes: ANSI Class 300 or 600 RF flanged

Maximum Inlet Pressure(1) (Body Rating)

2000 psig (138 bar) for NPT steel, 1480 psig (102 bar) for RF flanged steel, or 1000 psig (69 bar) for ductile iron

Maximum Valve Disk Inlet Pressure Rating(1)

2000 psig (138 bar) for nylon disk or 1000 psig (69 bar) for nitrile disk

Maximum Operating Inlet Pressure, Pressure Differential, and Outlet Pressure Ranges(1)

See table 2 for pressures by port and spring range

Maximum Spring and Diaphragm Casing Pressure(1)

See table 3

Maximum Body Outlet Pressure(1) (Type 627M, 627MR, and 627HM Only)

2000 psig (138 bar) for screwed steel, 1480 psig (102 bar) for RF flanged steel, or 1000 psig (69 bar) for ductile iron. (Type 627 and 627R are limited by maximum diaphragm casing pressure)

Port Diameters

See table 2

Internal Relief Performance

Type 627R: See table 4

Type 627MR: Limited by field-installed control line piping

Temperature Capabilities(1)

-20 to 180°F (-29 to 82°C)

Pressure Registration

Type 627, 627H or 627R: Internal

Type 627M, 627HM or 627MR: External through 1/4-inch NPT control line connection in the diaphragm casing

De-Icer System

See figure 3 and Type 627M Regulator De-Icer System Application section

Relief Indicator

For 627R and 627MR (see figures 8 and 9)

Spring Case Vent Connection

3/4-inch NPT female with removable screened vent assembly

Control Line Connection (Type 627M, 627HM or 627MR Only)

1/4-inch NPT female

Approximate Weight

Ductile Iron or Steel Casings: 10 pounds (4,5 kg)

Aluminum Casings: 6.3 pounds (2.8 kg)

1. The pressure/temperature limits in this instruction manual or any applicable standard limitation should not be exceeded.

Table 2. Maximum Inlet Pressures, Differential Pressures, and Outlet Pressure Ranges

TYPE NUMBER	OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	ORIFICE SIZE, INCHES (mm)	MAXIMUM INLET PRESSURE, PSIG (bar)	MAXIMUM DIFFERENTIAL PRESSURE, PSID (bar)
627 and 627M[3]	5[2] to 20 psig (0,34 to 1,4 bar) 10B3076X012 Yellow	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	1000 (69)[1]	1000 (69)[1]
		3/16 (4,8)	750 (51,7)	750 (51,7)
		1/4 (6,4)	500 (34,5)	500 (34,5)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	250 (17,2)	250 (17,2)
	15 to 40 psig (1,0 to 2,8 bar) 10B3077X012 Green	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	1500 (103)[1]	1500 (103)[1]
		3/16 (4,8)	1000 (69)[1]	1000 (69)[1]
		1/4 (6,4)	750 (51,7)	750 (51,7)
		3/8 (9,5)	500 (34,5)	500 (34,5)
		1/2 (12,7)	300 (20,7)	300 (20,7)
	35 to 80 psig (2,4 to 5,5 bar) 10B3078X012 Blue	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	2000 (138)[1]	2000 (138)[1]
		3/16 (4,8)	1750 (121)[1]	1750 (121)[1]
		1/4 (6,4)	1500 (103)[1]	1500 (103)[1]
		3/8 (9,5)	1000 (69)[1]	1000 (69)[1]
		1/2 (12,7)	750 (51,7)	750 (51,7)
	70 to 150 psig (4,8 to 10,3 bar) 10B3079X012 Red	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	2000 (138)[1]	2000 (138)[1]
		3/16 (4,8)	2000 (138)[1]	2000 (138)[1]
		1/4 (6,4)	1750 (121)[1]	1750 (121)[1]
		3/8 (9,5)	1250 (86,2)[1]	1250 (86,2)[1]
		1/2 (12,7)	750 (51,7)	750 (51,7)
627R and 627MR	5[2] to 20 psig (0,34 to 1,4 bar) 10B3076X012 Yellow	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	1000 (69)[1]	1000 (69)[1]
		3/16 (4,8)	750 (51,7)	750 (51,7)
		1/4 (6,4)	500 (34,5)	500 (34,5)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	200 (13,8)	200 (13,8)
	15 to 40 psig (1,0 to 2,8 bar) 10B3077X012 Green	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	1500 (103)[1]	1500 (103)[1]
		3/16 (4,8)	1000 (69)[1]	1000 (69)[1]
		1/4 (6,4)	750 (51,7)	750 (51,7)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	200 (13,8)	200 (13,8)
	35 to 80 psig (2,4 to 5,5 bar) 10B3078X012 Blue	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	1750 (121)[1]	1750 (121)[1]
		3/16 (4,8)	1000 (69)[1]	1000 (69)[1]
		1/4 (6,4)	750 (51,7)	750 (51,7)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	200 (13,8)	200 (13,8)
	70 to 150 psig (4,8 to 10,3 bar) 10B3079X012 Red	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	1000 (69)[1]	1000 (69)[1]
		3/16 (4,8)	500 (34,5)	500 (34,5)
		1/4 (6,4)	300 (20,7)	300 (20,7)
		3/8 (9,5)	200 (13,8)	200 (13,8)
		1/2 (12,7)	200 (13,8)	200 (13,8)
627H and 627MH[3]	140 to 250 psig (9,7 to 17,2 bar) 10B3078X012 Blue	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	2000 (138)[1]	2000 (138)[1]
		3/16 (4,8)	1750 (121)[1]	1750 (121)[1]
		1/4 (6,4)	1500 (103)[1]	1000 (69)[1]
		3/8 (9,5)	1000 (69)[1]	500 (34,5)
		1/2 (12,7)	750 (51,7)	250 (17,2)
	240 to 500 psig (16,5 to 34,5 bar) 10B3079X012 Red	3/32 (2,4)	2000 (138)[1]	2000 (138)[1]
		1/8 (3,2)	2000 (138)[1]	2000 (138)[1]
		3/16 (4,8)	1750 (121)[1]	1750 (121)[1]
		1/4 (6,4)	1500 (103)[1]	1000 (69)[1]
		3/8 (9,5)	1000 (69)[1]	500 (34,5)
		1/2 (12,7)	750 (51,7)	250 (17,2)

1. For inlet pressure in excess of 1000 psig (69 bar), refer to the maximum body and disk pressure ratings in the specification table.
2. For pressure settings under 10 psig (0,69 bar), inlet pressure should be limited to approximately 100 psig (6,9 bar) so the setpoint adjustment can be obtained.
3. The unbalance forces change from the wide-open monitor mode to an active regulator mode such that the Type 627M or 627MH should have a 3/8-inch (9,5 mm) or larger orifice when used as a wide-open monitor.

Table 3. Maximum Spring and Diaphragm Casing Pressure(1)

MAXIMUM PRESSURE DESCRIPTION	SPRING AND DIAPHRAGM CASING STYLE	TYPE 627, PSIG (bar)	TYPE 627R, PSIG (bar)	TYPE 627M, PSIG (bar)	TYPE 627MR, PSIG (bar)	TYPE 627H AND 627HM, PSIG (bar)
Maximum pressure to spring and diaphragm casings to prevent leak to atmosphere other than relief action (internal parts damage may occur)	Die cast aluminum	250 (17,2)	250 (17,2)	Not Available	Not Available	Not Available
	Die cast aluminum	250 (17,2)	250 (17,2)	250 (17,2)	Not Available	Not Available
	Steel	250 (17,2)	250 (17,2)	250 (17,2)	250 (17,2)	800 (55,2)
Maximum pressure to spring and diaphragm casings to prevent burst of casings during abnormal operation (leak to atmosphere and internal parts damage may occur)	Die cast aluminum	375 (25,9)	375 (25,9)	Not Available	Not Available	Not Available
	Ductile iron	465 (32)	465 (32)	465 (32)	465 (32)	Not Available
	Steel	1500 (103)	1500 (103)	1500 (103)	1500 (103)	1500 (103)
Maximum diaphragm casing overpressure (above setpoint) to prevent damage to internal parts	All styles	60 (4,1)	120 (8,3)	60 (4,1)	120 (8,3)	120 (8,3)

1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your Fisher Sales Representative.

WARNING

Personal injury, property damage, equipment damage, or leakage due to escaping gas or bursting of pressure-containing parts may result if this regulator is overpressured or is installed where service conditions could exceed the limits given in tables 1, 2, 3, and 4, or where conditions exceed any ratings of the adjacent piping or piping connections.

To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation, or standard) to prevent service conditions from exceeding those limits. The Type 627R or 627MR regulator with internal relief will provide downstream overpressure protection within the limits given in tables 1, 2, 3 and 4. If these limits are exceeded additional downstream overpressure protection must be provided by the user.

Additionally, physical damage to the regulator could cause personal injury or property damage due to escaping gas. To avoid such injury or damage, install the regulator in a safe location.

Installation

Regulator operation within ratings does not preclude the possibility of damage from debris in the lines or from external sources. A regulator should be inspected for damage periodically and after any overpressure condition. Key numbers referenced in this section are shown in figures 7 through 12. Ensure that the operating temperature capabilities listed in table 1 are not exceeded.

Like most regulators, 627 Series regulators have outlet pressure ratings that are lower than their inlet pressure ratings. A pressure relieving or pressure limiting device must be provided by the user for the Type 627, 627H, 627M, and 627HM regulators if the inlet pressure can exceed the outlet pressure rating, since these regulators do not have internal relief.

Type 627R regulators provide internal relief which limits the total outlet pressure buildup over setpoint. Use table 4 to determine the total outlet pressure. This internal relief may be adequate for the application, if not, provide additional pressure relief or a pressure limiting device downstream.

Note

If the regulator is shipped mounted on another unit, install that unit according to the appropriate instruction manual.

Perform steps 1 through 6 for all types of regulators:

1. Only personnel qualified through training and experience should install, operate, or maintain this regulator.

2. For a regulator that is shipped separately, make sure that there is no damage to, or foreign material in, the regulator.

3. Ensure that all tubing and piping have been blown free of foreign debris.

4. The regulator may be installed in any position as long as the flow through the body is in the direction indicated by the arrow cast on the body.

5. If continuous operation is required during inspection or maintenance, install a three-valve bypass around the regulator.

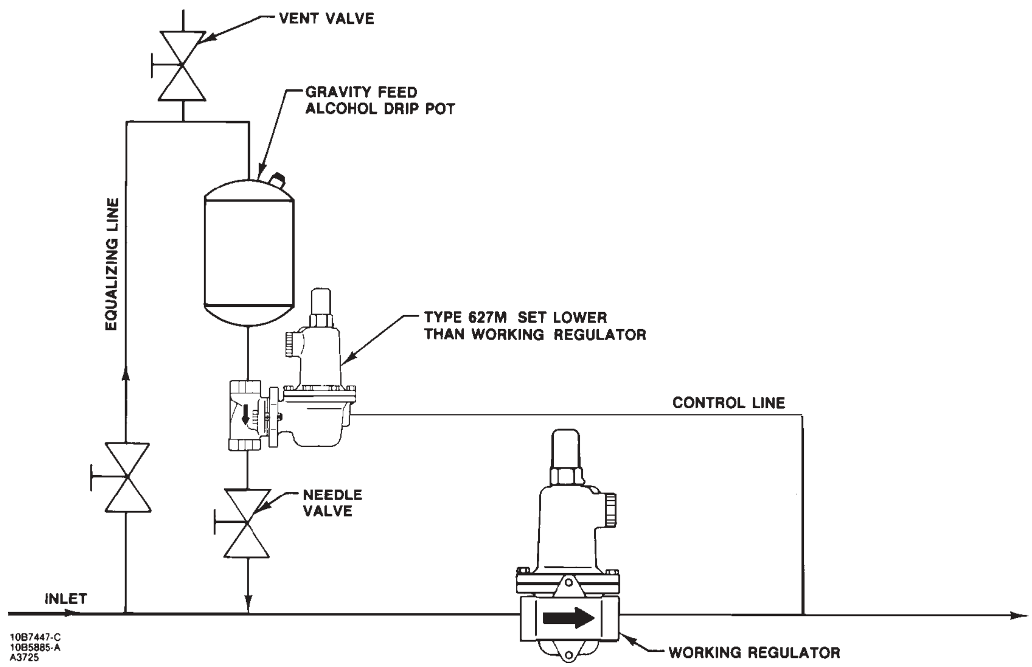


Figure 3. Schematic of De-Icer System

WARNING

A regulator may vent some gas to the atmosphere. In hazardous or flammable gas service, vented gasmay accumulate and cause personal injury, death, or property damage due to fire or explosion. Vent a regulator in hazardousgas service toa remote, safe location away from air intakes or any hazardous area. The vent line or stack opening must be protected against condensation or clogging.

6. Position the body (key 1) and/or diaphragmspring case (key 29) so it will not collectmoisture or debris into the screened vent. If the regulator requires repositioning, refer to the body area maintenance procedures and/or the diaphragm case area maintenance procedures in the Maintenance section to reposition the screened vent for the application.

Perform steps 7 through 9 for Types 627M, 627HM, and 627MR regulators only:

7. A Type 627M, 627HM, or 627MR regulator requires a downstream control line. Install the control line before putting the regulator into operation.

8. Ensure that the downstream control line piping is at least 3/8-inch or larger outside diameter tubing and connected to a straight section of outlet piping 10 diameters downstream of the regulator.

9. A hand valve should be installed in the control line. This hand valve can be used to throttle down and dampen outlet pulsations in control pressure which may cause unstability or cycling of the regulator.

Remote Vent Line Installation

All 627 series regulators have a vent assembly installed in the 3/4-inch NPT spring case vent opening. The vent assembly can be removed to install a remote vent line if necessary. Remote vent lines must have the largest practical diameter. The vent line should be as short as possible with a minimum number of bends or elbows.

Protect the remote vent opening against entrance of rain, snow, or any other foreign material that may plug the vent or vent line and prevent proper operation of the regulator. Periodically check the vent opening to be sure it is not plugged with foreign debris.

Type 627M or 627HM Regulator De-Icer System Application

For the Type 627M or 627HM regulator de-icer system, refer to the application shown in figure 3. With a large pressure drop across the working regulator, ice can

Table 4. Type 627R Internal Relief Performance(1)

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	OUTLET PRESSURE SETTING, PSIG (bar)	MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE, PSIG (bar)	MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED, PSIG (bar)(2) — Orifice Size, Inches (mm): 3/32 (2,4)	1/8 (3,2)	3/16 (4,8)	1/4 (6,4)	3/8 (9,5)	1/2 (12,7)
5(3) to 20 psig (0,34 to 1,4 bar) 10B3076X012 Yellow	10 (0,69)	60 (4,1)	1250 (86,2)	740 (51,1)	320 (22,1)	190 (13,1)	95 (6,56)	75 (5,18)
		100 (6,9)	2000 (138)	1500 (103)	620 (42,7)	390 (26,9)	180 (12,4)	130 (8,97)
		125 (8,6)	2000 (138)	1900 (131)	830 (57,2)	480 (33,1)	220 (15,2)	160 (11,0)
		175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	960 (66,2)	450 (31,0)	320 (22,1)
	15 (1,0)	60 (4,1)	1000 (69,0)	620 (42,7)	260 (17,9)	170 (11,7)	90 (6,2)	70 (4,8)
		100 (6,9)	2000 (138)	1400 (96,5)	610 (42,1)	370 (25,5)	170 (11,7)	130 (8,97)
		125 (8,6)	2000 (138)	1900 (131)	810 (55,8)	480 (33,1)	220 (15,2)	160 (11,0)
		175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	960 (66,2)	450 (31,0)	320 (22,1)
	20 (1,4)	60 (4,1)	850 (58,6)	490 (33,8)	210 (14,5)	130 (9,0)	80 (5,52)	65 (4,49)
		100 (6,9)	2000 (138)	1300 (89,6)	600 (41,4)	360 (24,8)	170 (11,7)	120 (8,28)
		125 (8,6)	2000 (138)	1800 (124)	800 (55,2)	480 (33,1)	220 (15,2)	160 (11,0)
		175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	960 (66,2)	450 (31,0)	320 (22,1)
15 to 40 psig (1,0 to 2,8 bar) 10B3077X012 Green	15 (1,0)	60 (4,1)	1000 (69,0)	380 (26,2)	210 (14,5)	130 (8,97)	80 (5,5)	65 (4,49)
		100 (6,9)	2000 (138)	1300 (89,6)	590 (40,7)	350 (24,1)	170 (11,7)	120 (8,28)
		125 (8,6)	2000 (138)	1800 (124)	800 (55,2)	470 (32,4)	220 (15,2)	160 (11,0)
		175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	640 (44,1)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	780 (53,8)	370 (25,5)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (66,2)	960 (66,2)	450 (31,0)	320 (22,1)
	20 (1,4)	60 (4,1)	630 (43,4)	200 (13,8)	150 (10,3)	100 (6,9)	70 (4,83)	65 (4,49)
		100 (6,9)	2000 (138)	1200 (82,7)	550 (37,9)	330 (22,8)	160 (11,0)	120 (8,28)
		125 (8,6)	2000 (138)	1700 (117)	760 (52,4)	450 (31,1)	210 (14,5)	160 (11,0)
		175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	630 (43,4)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (66,2)	960 (66,2)	460 (31,7)	320 (22,1)
	30 (2,1)	100 (6,9)	2000 (138)	950 (65,5)	450 (31,1)	260 (17,9)	140 (9,66)	110 (7,59)
		125 (8,6)	2000 (138)	1500 (103)	670 (46,2)	400 (27,6)	190 (13,1)	150 (10,3)
		175 (12,1)	2000 (138)	2000 (138)	1000 (69,0)	610 (42,1)	300 (20,7)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1200 (82,7)	760 (52,4)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	970 (66,9)	460 (31,7)	320 (22,1)
	40 (2,8)	100 (6,9)	1500 (103)	700 (48,3)	330 (22,8)	200 (13,8)	120 (8,28)	108 (7,45)
		125 (8,6)	2000 (138)	1300 (89,6)	560 (38,6)	340 (23,4)	180 (12,4)	140 (9,66)
		175 (12,1)	2000 (138)	1800 (124)	1000 (69,0)	550 (37,9)	290 (20,0)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1200 (82,7)	730 (50,3)	350 (24,1)	250 (17,2)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	970 (66,9)	460 (31,7)	320 (22,1)

form with in this regulator. The formation of ice decreases the size of the port opening, so the regulator is unable to supply enough flow to satisfy the downstream demand. When the downstream pressure falls below the outlet pressure setting of the Type 627M or 627HM regulator, the disk assembly of the Type 627Mor 627HMregulator moves off its seat ring, permitting alcohol to flow into the main gas line. The alcohol carried to the main regulator by the flow stream prevents additional ice from forming on the seat ring. When normal flow resumes, and as pressure in the downstream system is restored, the Type 627M or 627HM regulator shuts off.

Startup and Adjustment

Startup

WARNING

To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during startup, release downstream pressure to prevent an overpressure condition on the diaphragm of the regulator.

Table 4. Type 627R Internal Relief Performance(1) (continued)

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	OUTLET PRESSURE SETTING, PSIG (bar)	MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE, PSIG (bar)	MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED, PSIG (bar)(2)					
			Orifice Size, Inches (mm)					
			3/32 (2,4)	1/8 (3,2)	3/16 (4,8)	1/4 (6,4)	3/8 (9,5)	1/2 (12,7)
35 to 80 psig (2,4 to 5,5 bar) 10B3078X012 Blue	40 (2,8)	125 (8,6)	2000 (138)	1100 (75,8)	500 (34,5)	300 (20,7)	170 (11,7)	140 (9,66)
		150 (10,3)	2000 (138)	1600 (110)	750 (51,7)	440 (30,3)	230 (15,9)	180 (12,4)
		175 (12,1)	2000 (138)	2000 (138)	980 (67,6)	580 (40,0)	290 (20,0)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1200 (82,7)	720 (49,6)	340 (23,4)	250 (17,2)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	940 (64,8)	450 (31,0)	320 (22,1)
	50 (3,4)	125 (8,6)	1400 (96,5)	820 (56,5)	400 (27,6)	230 (15,9)	150 (10,3)	140 (9,66)
		150 (10,3)	2000 (138)	1400 (96,5)	650 (44,8)	370 (25,5)	210 (14,5)	170 (11,7)
		175 (12,1)	2000 (138)	1900 (131)	700 (48,3)	530 (36,5)	270 (18,6)	210 (14,5)
		200 (13,8)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	330 (22,8)	240 (16,5)
		250 (17,2)	2000 (138)	2000 (138)	1500 (103)	920 (63,4)	430 (29,6)	320 (22,1)
	60 (4,1)	125 (8,6)	900 (62,1)	450 (31,1)	270 (18,6)	190 (13,1)	140 (9,66)	130 (8,97)
		150 (10,3)	1700 (117)	1100 (75,8)	540 (37,2)	300 (20,7)	190 (13,1)	160 (11,0)
		175 (12,1)	2000 (138)	1700 (117)	780 (53,8)	470 (32,4)	250 (17,2)	200 (13,8)
		200 (13,8)	2000 (138)	2000 (138)	1000 (69,0)	610 (42,1)	310 (21,4)	230 (15,9)
		250 (17,2)	2000 (138)	2000 (138)	1400 (96,5)	880 (60,7)	420 (29,0)	310 (21,4)
	70 (4,8)	150 (10,3)	1200 (82,7)	850 (58,6)	430 (29,6)	250 (17,2)	170 (11,7)	160 (11,0)
		175 (12,1)	2000 (138)	1400 (96,5)	670 (46,2)	400 (27,6)	230 (15,9)	190 (13,1)
		200 (13,8)	2000 (138)	2000 (138)	920 (63,4)	550 (37,9)	280 (19,3)	230 (15,9)
		250 (17,2)	2000 (138)	2000 (138)	1300 (89,6)	830 (57,2)	400 (27,6)	310 (21,4)
	80 (5,5)	150 (10,3)	800 (55,2)	500 (34,5)	300 (20,7)	200 (13,8)	160 (11,0)	150 (10,3)
		175 (12,1)	1500 (103)	1200 (82,7)	550 (37,9)	330 (22,8)	210 (14,5)	190 (13,1)
		200 (13,8)	2000 (138)	1700 (117)	800 (55,2)	480 (33,1)	270 (18,6)	220 (15,2)
		250 (17,2)	2000 (138)	2000 (138)	1200 (82,7)	770 (53,1)	390 (26,9)	300 (20,7)
70 to 150 psig (4,8 to 10,3 bar) 10B3079X012 Red	70 (4,8)	175 (12,1)	1900 (131)	600 (41,4)	400 (27,6)	260 (17,9)	200 (13,8)	175 (12,1)
		200 (13,8)	2000 (138)	1200 (82,7)	630 (43,4)	380 (26,2)	250 (17,2)	210 (14,5)
		250 (17,2)	2000 (138)	2000 (138)	1100 (75,8)	680 (46,9)	360 (24,8)	290 (20,0)
	80 (5,5)	175 (12,1)	1400 (96,5)	250 (17,2)	240 (16,5)	200 (13,8)	190 (13,1)	175 (12,1)
		200 (13,8)	2000 (138)	960 (66,2)	520 (35,9)	330 (22,8)	240 (16,5)	210 (14,5)
		250 (17,2)	2000 (138)	2000 (138)	1000 (69,0)	620 (42,7)	350 (24,1)	280 (19,3)
	100 (6,9)	200 (13,8)	1500 (103)	250 (17,2)	240 (16,5)	230 (15,9)	210 (14,5)	210 (14,5)
		250 (17,2)	2000 (138)	1600 (110)	770 (53,1)	520 (35,9)	320 (22,1)	270 (18,6)
	125 (8,6)	250 (17,2)	2000 (138)	1000 (69,0)	500 (34,5)	390 (26,9)	290 (20,0)	260 (17,9)
	150 (10,3)	250 (17,2)	1200 (82,7)	260 (17,9)	260 (17,9)	260 (17,9)	260 (17,9)	260 (17,9)

1. The internal relief performance values are obtained by removing the disk assembly.
2. For inlet pressures in excess of 1000 psig (69 bar), refer to the maximum body and disk pressure ratings in the specifications table.
3. For pressure settings under 10 psig (0,69 bar), inlet pressure should be limited to approximately 100 psig (6,9 bar) so the setpoint adjustment can be obtained.

- Shaded areas indicate maximum inlet pressures allowed during system malfunction only. Table 6 gives the maximum inlet pressure for normal regulator operation.

In order to avoid an overpressure condition and possible equipment damage, pressure gauges should always be used to monitor pressures during startup.

1. Slowly open the upstream shutoff valve.
2. Slowly open the downstream shutoff valve.
3. Check all connections for leaks.
4. Make final control spring adjustments according to the adjustment procedures.

Adjustment

The range of allowable pressure settings is marked on the nameplate (figure 2). If a pressure setting beyond this range is necessary, substitute the appropriate regulator control spring. Change the nameplate to indicate the new pressure range.

Before increasing the setting, refer to tables 2, 3, or 4. Review the pressure limits for the control spring range being used and be certain that the new pressure setting will not result in an overpressure condition.

Table 5. Maximum Torque Values

KEY NUMBER[1]	DESCRIPTION	MAXIMUM TORQUE, FOOT-POUNDS (N•m)
2	Seat ring	25 (34)
3	Cap screw (w/ aluminum diaphragm casing)	16 (22)
	Cap screw (w/ ductile iron or steel diaphragm casing)	25 (34)
18	Lever cap screw	7 (9)
22	Diaphragm connector nut	17 (23)
26	Guide retainer (for Type 627R and 627MR only)	3 (4)
37	Spring case cap screw (w/ aluminum or ductile iron diaphragm casing)	7 (9)
	Spring case cap screw (w/ steel diaphragm casing)	35 (47)
46	Diaphragm cap screw (w/Type 627 or 627M)	7 (9)
	Diaphragm cap screw (w/Type 627H or 627MH)	14 (19)

1. Refer to figures 7 through 10 for key number locations.

Note

Always use a pressure gauge to monitor pressure when making adjustments.

Refer to figures 7 through 12 for key number locations.

1. Remove the adjusting screw cap (key 36).
2. Loosen the locknut (key 34).
3. Increase the outlet pressure setting by turning the adjusting screw (key 35) clockwise. Decrease the outlet pressure setting by turning the adjusting screw counter-clockwise.
4. When the desired pressure is obtained, hold the adjusting screw (key 35) in place and tighten the locknut (key 34).

Shutdown

WARNING

To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during shutdown, release downstream pressure to prevent an overpressure condition on the diaphragm of the regulator.

1. Close the nearest upstream shutoff valve.
2. Close the nearest downstream shutoff valve.
3. Open the vent valve between the regulator and the downstream shutoff valve nearest to it.
4. For a Type 627, 627H, or 627R regulator, the regulator will open to release pressure between the upstream shutoff valve and the regulator.
5. A Type 627M, 627HM, or 627MR regulator requires venting the control line and downstream pressure from the regulator before maintenance. The pressure between these shutoff valves is released through the open regulator because the disk assembly remains open in response to the decrease in control line pressure.

Maintenance

Unless otherwise specified, the following maintenance procedures apply to all types of regulators. For a summary of maximum torque values required for all types of regulators, refer to table 5.

Due to normal wear, damage from external sources, or debris in the air or gas line, regulator parts such as the disk assembly, seat ring, and diaphragm must be inspected periodically and replaced as necessary to ensure correct performance. The frequency of inspection and replacement depends upon the severity of conditions and the requirements of state and federal laws. Normal wear of the seat ring and disk assembly is accelerated with high pressure drops and with large amounts of impurities in the flow stream. Instructions are given below for replacing the disk assembly, seat ring, diaphragm, and O-rings. These procedures may also be used for disassembly required for inspection and replacement of other parts.

Problem Indication for Type 627R and 627MR Regulators

WARNING

Isolate the regulator from all pressure to avoid personal injury and equipment damage due to explosion or sudden release of process pressure. Cautiously release pressure from the regulator before attempting disassembly.

The vent assembly is equipped with a relief indicator (key 49, figure 4). The cap for the relief indicator snaps over the vent assembly opening. If the relief valve opens wide, exhaust gas pops the cap off the screen vent assembly opening indicating a problem with the regulator. If the cap pops off, refer to the shutdown and to the body area maintenance procedures to inspect the disk assembly and seat ring.

If the disk assembly and seat ring are not damaged, refer to the diaphragm and spring case area maintenance procedures in this section.

The disk assembly and seat ring can be inspected, removed, and replaced without removing the regulator body from the line connections. Refer to the body area maintenance procedures.

Body Area Maintenance Procedures

These procedures are for gaining access to the disk assembly, seat ring, diaphragm casing O-ring and stem assembly. All pressure must be released from the diaphragm casing before the performing these steps.

While using the following procedures, refer to figures 7 through 12 for key number locations.

Replacing the Disk Assembly or Seat Ring

1. To inspect and replace the disk assembly (key 9) or seat ring (key 2), remove the cap screws (key 3, figure 5), and separate the diaphragm casing (key 5) from the body (key 1).

2. Inspect and, if necessary, remove the seat ring (key 2). If removed, coat the threads of the replacement seat ring with lubricant (key 38) and torque to 25 foot-pounds (34 N•m).

3. Inspect the disk assembly and, if necessary, remove the hair pin clip (key 13) that holds the disk assembly (key 9) in place. If replacing the disk assembly is the only maintenance required, skip to step 16.

Figure 4. Relief Indicator

Replacing the Stem Assembly

If it is necessary to perform maintenance on the stem assembly, continue with steps 4 through 8 and 15 through 19 for Type 627, 627H, and 627R regulators, or steps 9 through 19 for Type 627M, 627HM, and 627MR regulators.

Perform steps 4 through 8 for Type 627, 627H, and 627R Regulators only:

4. ForType 627, 627H, and627R regulators (figure 5), use steps 5 through 8 to remove and replace the stem assembly.

5. Remove the boost body (key 6), stabilizer (key 7), and stem guide (key 8) from the diaphragm casing (key 5). Unhook and remove the stem (key 10) from the diaphragm casing (key 5).

6. Remove and inspect the diaphragm casing O-ring (key 4, figure 7, 8, or 11) and replace it if necessary.

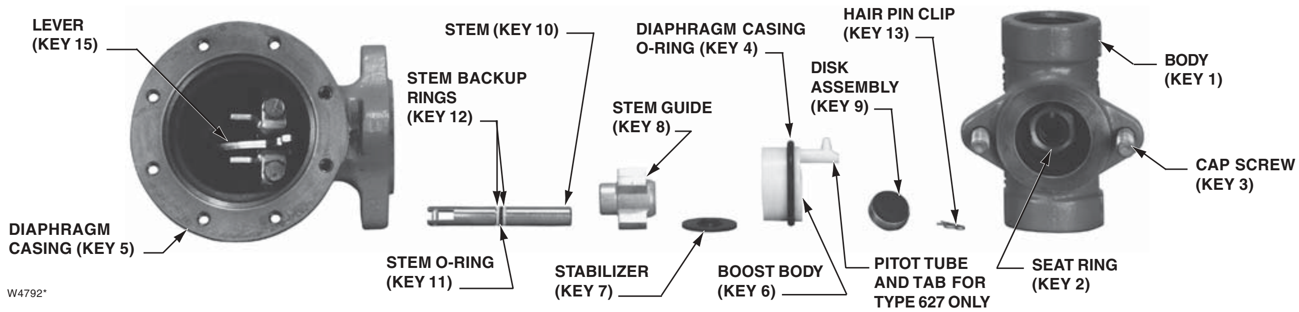
7. Apply lubricant (key 42) to a replacement diaphragm casing O-ring (key 4, figure 7, 8, or 11) and install it onto the boost body (key 6). Skip to step 14.

8. For the Type 627 or 627H regulators, be sure to insert the pitot tube (tab) into the outlet side of the body (see figure 7 or 11). Skip to step 14.

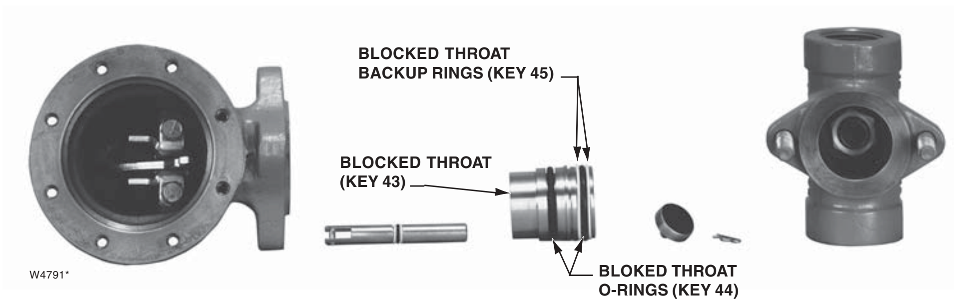
Perform steps 9 through 19 for Type 627M, 627HM, and 627MR Regulators only:

9. For Type 627M, 627HM, and 627MR regulators (figure 5), use steps 10 through 14 to remove and replace the stem assembly.

10. To remove the blocked throat (key 43), insert a screw driver blade into the groove provided in the throat and pry it out of the diaphragm casing (key 5). Inspect and replace parts as necessary.



Type 627 and 627R



Type 627M amd 627MR

Figure 5. Stem Assemblies

11. Inspect and, if necessary, replace the blocked throat O-rings (key 44, figure 5) and backup rings (key 45, figure 5).

12. Apply lubricant (key 42) to replacement blocked throat O-rings (key 44) and backup rings (key 45).

13. Apply lubricant (key 42) to the replacement stem O-ring (key 11) and stem backup rings (key 12) and install them on the stem (key 10).

14. For assembly, insert the stem (key 10) into the diaphragm casing (key 5) and hook it on the lever (key 15).

15. Insert parts into the diaphragm casing (key 5) that were removed in steps 5 and 6 or step 10 (see figure 5).

16. Install the the disk assembly (key 9), line up the hole in the disk assembly and stem (key 10) and insert the hair pin clip (key 13).

17. Position the diaphragm casing plus attached parts in relation to the body (key 1) so that they are correct for the application.

18. Secure the diaphragm casing to the body with the cap screws (key 3, figure 5). For an aluminum diaphragm casing (key 5), torque the cap screws (key 3) to 16 foot-pounds (22 N•m). For ductile iron or steel diaphragm casings, torque the cap screws (key 3) to 25 foot-pounds (34 N•m).

19. It may be necessary to reposition the diaphragm spring case to prevent rain, ice, and foreign debris from entering the spring case. Refer to the diaphragm and spring case area maintenance procedures, steps 1, 2, and 21 through 25.

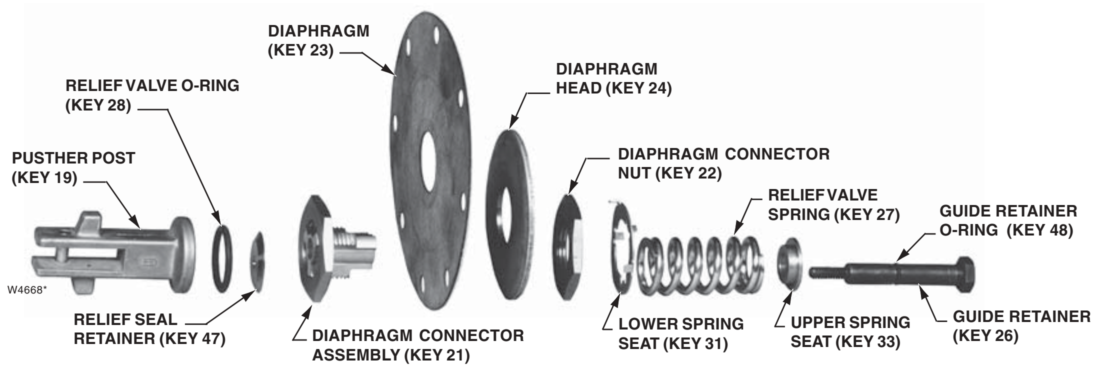
Diaphragm and Spring Case Area Maintenance Procedures

These procedures are for gaining access to the control spring, diaphragm assembly, and lever assembly. All spring pressure must be released from the diaphragm casing before these steps can be performed.

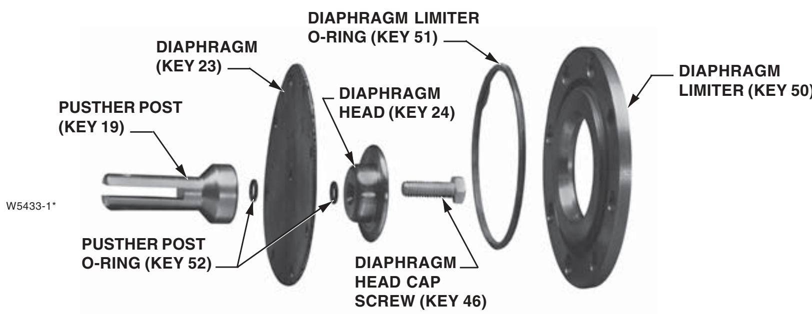
While using the following procedures, refer to figures 7 through 12 for key number locations.

1. Remove the adjusting screw cap (key 36), loosen the lock nut, and turn the adjusting screw (key 35) counterclockwise until all compression is removed from the control spring (key 32).

2. Remove the spring case cap screws (key 37), the nameplates, and lift off the spring case (key 29). If changing the control spring (key 32) or repositioning the spring case (key 29) is the only maintenance required, install the replacement control spring or rotate the spring case so it is correct for the application. Skip to step 21. For diaphragm area maintenance, continue with step 3.



Type 627, 627R, 627M, or 627MR



Type 627H amd 627HM

Figure 6. Diaphragm Assemblies

3. Remove the diaphragm limiter and O-ring (keys 50 and 51, on the Type 627H or 627HM only). Remove the diaphragm assembly by tilting it so that the pusher post (key 19) slips off the lever (key 15).

4. If it is necessary to replace the lever assembly, remove the lever cap screws (key 18).

5. Install the replacement lever (key 15) into the lever retainer (key 16) by inserting the lever pin (key 17). Secure the lever assembly into the diaphragm casing with the cap screws (key 18) and torque the cap screws to 7 foot-pounds (9 N•m).

If it is necessary to perform maintenance on the diaphragm assembly, continue with steps 6 through 11 and step 20 for Type 627, 627H, 627M, and 627HM regulators, or steps 12 through 19 for Type 627R and 627MR regulators.

Perform steps 6 through 11 for Type 627, 627H, 627M, and 627HM Regulators only:

6. For Type 627, 627H, 627M, and 627HM regulators (figures 5 & 6), use steps 7 through 11 to disassemble and reassemble the diaphragm assembly.

7. Remove the diaphragm head cap screw (key 46), lower spring seat (key 31,Type 627 or 627Monly), and diaphragm head (key 24). On the Type 627H or 627HM, remove the diaphragm cap screw O-rings (key 52). Separate the diaphragm (key 23) from the pusher post (key 19).

8. Install the diaphragm (key 23), in reverse order in step 7, on the pusher post (key 19), insert and finger tighten the diaphragm head cap screw (key 46).

9. Hook the pusher post on the lever (key 15), then turn the diaphragm (key 23) to match the holes in the diaphragm with the holes in the spring casing.

10. Unhook the pusher post from the lever and torque the diaphragm head cap screw (key 46) to 7 foot-pounds (9 N•m) for the Type 627 or 627M. On the Type 627H or 627HM torque the diaphragm head cap screw to 14 foot-pounds (18 N•m).

11. Hook the pusher post on the lever (key 15) and check the hole alignment. If necessary, loosen the cap screw (key 46) and reposition the diaphragm (key 23) on the pusher post (key 19). Retorque the screw (see step 10). Skip to step 20.

Perform steps 12 through 19 for Type 627R and 627MR Regulators only:

12. For Type 627R and 627MR regulators (figure 6), use steps 13 through 19 to disassemble and reassemble the diaphragm assembly:

13. Remove the guide retainer (key 26) and separate the diaphragm parts. Refer to figure 6 for the sequence of parts.

14. To remove the diaphragm (key 23), remove the diaphragm connector nut (key 22) and lift off the diaphragm head (key 24) and diaphragm (key 23) from the connector assembly (key 21). Do not attempt to disassemble the connector assembly (key 21).

15. Position the replacement diaphragm (key 23) on the connector assembly (key 21), install the diaphragm head (key 24) and connector nut (key 22), then torque to 17 foot-pounds (32 N•m).

16. If necessary, replace the guide retainer O-ring (key 48) and, set the guide retainer (key 26) aside, ready for assembly.

17. On the pusher post (key 19) install the relief seal O-ring (key 28) and lubricate (key 42). Also, install the relief seal retainer (key 47), diaphragm connector assembly (key 21, with attached parts) relief spring (key 27), upper relief spring seat (key 33), and guide retainer (key 26). Torque the guide retainer (key 26) to 3 foot-pounds (4 N•m).

18. Hook the pusher post (with attached parts) on the lever (key 15) to check the alignment of the holes in the diaphragm with the holes in the spring casing. If the holes do not line up, unhook the pusher post from the lever, hold the pusher post, and rotate the diaphragm to the correct position.

19. Install the lower spring seat (key 31) over the relief spring so it rests flat on the connector nut (key 22).

20. Insert the diaphragm assembly into the diaphragm casing (key 5) and hook the pusher post on the lever (key 15).

21. Install the control spring (key 32) and upper spring seat (key 33), and apply lubricant (key 38) to the upper spring seat (key 33).

22. Install the spring case (key 29) so that the screened vent assembly (key 30) is in the correct position for the application. Place the nameplates (key 39) over the screw holes, insert the spring case cap screws (key 37), and finger tighten.

23. Screw in the adjustment screw to put slack into the diaphragm (key 23).

24. Using a crisscross pattern, finish tightening the spring case cap screws (key 37) to 7 foot-pounds (9 N•m) of torque.

25. If necessary, refer to the installation and/or the startup and adjustment procedures.

26. Install the adjusting screw cap (key 34) after regulator adjustment.

Parts Ordering

When corresponding with your Fisher sales office or sales representative about this regulator, always reference the type number which is found on the nameplate (key 39, figures 7 through 12).

When ordering replacement parts, reference the key number of each needed part as found in the following parts list.

Parts List

Key	Description	Part Number
	Type 627 Parts Kit with aluminum/nitrile trim (includes keys 4, 9, 11, 12, and 23)	R627X000A12
	Type 627 Parts Kit with stainless steel/nitrile trim (includes keys 4, 9, 11, 12, and 23)	R627X000S12
	Type 627R Parts Kit with aluminum/nitrile trim (includes keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00A12
	Type 627R Parts Kit with stainless steel/nitrile trim (includes keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00S12
1	Body	
	Ductile iron	
	1000 psig (69 bar) max inlet pressure	
	3/4-inch NPT size	30B3046X012
	1-inch NPT size	30B3048X012
	2-inch NPT size	30B3096X012
	Steel	
	2000 psig (138 bar) max inlet pressure	
	3/4-inch NPT size	30B3050X012
	1-inch NPT size	30B3051X012
	2-inch NPT size	30B7452X012
	Steel, ANSI Class 600 RF flanged	
	1480 psig (102 bar) max inlet pressure	
	1-inch size	40B6754X012
	2-inch size	40B6756X012
2*	Seat ring	
	Aluminum	
	3/32-inch (2.4 mm) port diameter	0R044109022
	1/8-inch (3.2 mm) port diameter	1A936709012
	3/16-inch (4.8 mm) port diameter	00991209012
	1/4-inch (6.4 mm) port diameter	0B042009012
	3/8-inch (9.5 mm) port diameter	0B042209012
	1/2-inch (12.7 mm) port diameter	1A928809012
	303 Stainless steel	
	3/32-inch (2.4 mm) port diameter	0R044135032
	1/8-inch (3.2 mm) port diameter	1A936735032
	3/16-inch (4.8 mm) port diameter	00991235032
	1/4-inch (6.4 mm) port diameter	0B042035032
	3/8-inch (9.5 mm) port diameter	0B042235032
	1/2-inch (12.7 mm) port diameter	1A928835032

*Recommended spare part.

Key	Description	Part Number
2*	Seat ring (continued)	
	316 Stainless steel, NACE(1) construction only	
	3/32-inch (2.4 mm) port diameter	0R0441X0012
	1/8-inch (3.2 mm) port diameter	1A9367X0022
	3/16-inch (4.8 mm) port diameter	009912X0012
	1/4-inch (6.4 mm) port diameter	0B0420X0012
	3/8-inch (9.5 mm) port diameter	0B0422X0012
	1/2-inch (12.7 mm) port diameter	1A9288X0012
3	Cap Screw (not shown), (2 req'd)	
	Type 627 and 627R w/aluminum diaphragm case, pl steel	18A1087X012
	All Types w/ductile iron diaphragm case, pl steel	1C403824052
	or steel diaphragm case, pl steel	1C403024052
4*	Diaphragm Case O-Ring (Type 627, 627H, or 627R only), nitrile	17A2325X022
5	Diaphragm Case	
	For Type 627 or 627R	
	Aluminum w/o 1/8-inch gauge tap	40B3084X012
	Aluminum with 1/8-inch gauge tap for Type 627 only	11B5380X012
	Ductile iron w/o 1/8-inch gauge tap	30B3053X012
	Ductile iron with 1/8-inch gauge tap for Type 627 only	31B0641X012
	Steel	30B3104X012
	For Type 627M or 627MR	
	Ductile iron	39A5987X012
	Steel	30B8734X012
	For Type 627H, steel	30B3104X012
	For Type 627HM, steel	30B8734X012
6	Boost Body (not for Type 627M, 627HM, or 627MR), Delrin(2)	
	For Type 627 or 627H	30B3056X012
	For Type 627R	30B3057X012
7	Stabilizer (for Type 627, 627H, and 627R only), nitrile	10B3060X012
8	Stem Guide (for Type 627, 627H, and 627R only), powdered metal	20B3061X012
9*	Disk Assembly (for all port diameters)	
	Aluminum holder and nitrile disk	1C4248X0212
	303 Stainless steel holder and nitrile disk	1C4248X0202
	Aluminum holder and nylon disk	1C4248X00A2
	303 Stainless steel holder and nylon disk	1C4248X0062
	NACE construction only	
	Aluminum holder and nitrile disk	1C4248X0212
	316 Stainless steel holder and nitrile disk	1C4248X0252
	Aluminum holder and nylon disk	1C4248X00A2
	316 Stainless steel holder and nylon disk	1C4248X0262
10	Stem	
	303 stainless steel	10B3059X012
	316 stainless steel (NACE)	10B3059X022
11*	Stem O-Ring, nitrile	1D687506992
12	Stem Backup Ring, TFE (2 required)	1K786806992
13	Hair Pin Clip, stainless steel	10B3058X012
14	Drive Pin, plated steel	1A953228982
15	Lever, plated steel	20B3063X012
16	Lever Retainer, plated steel	30B3097X012
17	Lever Pin	
	Stainless steel	10B3083X012
	316 stainless steel (NACE)	10B3083X022
18	Lever Cap Screw (2 required)	
	Plated steel	10B7454X012
	316 stainless steel (NACE)	10B7454X022
19	Pusher Post, aluminum	
	For Type 627 or 627M	10B3098 X012
	For Type 627R or 627MR	10B3098 X022
	For Type 627H or 627HM, 416 stainless steel	10B3098 X032
21	Diaphragm Connector (for Type 627R or 627MR only), stainless steel	10B6758X012
22	Diaphragm Connector Nut (for Type 627R or 627MR only), stainless steel	10B7449X012
23*	Diaphragm, nitrile	
	For Type 627 or 627M w/aluminum or ductile iron diaphragm case	10B3069X012
23*	Diaphragm, nitrile (continued)	
	For Type 627 or 627M w/steel diaphragm case	10B8735X012
	For Type 627R or 627MR w/aluminum or ductile iron diaphragm case	10B3068X012
	For Type 627R or 627MR w/steel diaphragm case	10B8736X012
	For Type 627H or 627HM w/steel diaphragm case (diaphragm is neoprene with nylon fabric)	12B0178X012
24	Diaphragm Head, plated steel	
	For Type 627 or 627M, plated steel	1D666428982
	For Type 627R or 627MR, plated steel	10B3071X012
	For Type 627H or 627HM, 416 stainless steel	12B0175X012
25	Relief Spring Seat (for Type 627R or 627MR only), steel	10B7446X012
26	Guide Retainer (for Type 627R or 627MR only), stainless steel	10B7450X012
27	Relief Spring (for Type 627R or 627MR only), plated steel	10B6757X012
28*	Relief Seal O-Ring (for Type 627R or 627MR only), nitrile	1J108506992
29	Spring Case	
	For Type 627 or 627R	
	Aluminum	40B3086X012
	Ductile iron	30B3055X012
	Steel	30B3102X012
	For Type 627M or 627MR	
	Ductile iron	30B3055X012
	Steel	30B3102X012
	For Type 627H or 627HM	
	Steel	30B3102X012
30	Screened Vent Assembly, plastic	10B3093X012
31	Lower Spring Seat, plated steel	
	For Type 627 or 627M	1D666625072
	For Type 627R or 627MR	20B3073X012
32	Control Spring, pl steel	
	5 to 20 psig (0.34 to 1.4 bar), yellow	10B3076X012
	15 to 40 psig (1.0 to 2.8 bar), green	10B3077X012
	35 to 80 psig (2.4 to 5.5 bar), blue	10B3078X012
	70 to 150 psig (4.8 to 10.3 bar), red	10B3079X012
	140 to 250 psig range (9.6 to 17.2 bar), blue, used in a Type 627H or 627HM	10B3078X012
	240 to 500 psig range (16.5 to 34.5 bar), red, used in a Type 627H or 627HM	10B3079X012
33	Upper Spring Seat, plated steel	1D667125072
34	Locknut, plated steel	1D667728982
35	Adjusting Screw, pl steel	
	For Type 627 or 627M	10B3081X012
	For Type 627H or 627HM	10B3081X012
	For Type 627R or 627MR	10B3080X012
36	Adjusting Screw Cap, plastic	20B3082X012
37	Spring Case Cap Screw, pl steel (8 required)	
	For aluminum or ductile iron diaphragm case	1A391724052
	For steel diaphragm case	10B8737X012
	For Type 627H/HM, steel diaphragm case	1A346424052
39	Nameplate	- - - - - - - - - - -
43	Blocked Throat (for Type 627M, 627HM or 627MR only), stainless steel	10B3085X012
44	Blocked Throat O-Ring (for Type 627M, 627HM, or 627MR only), nitrile (2 required)	1E264306992
45	Blocked Throat Backup Ring (for Type 627M, 627HM, or 627MR only), TFE (2 required)	10B3106X012
46	Diaphragm Head Cap Screw, steel	
	For Type 627 or 627M	1K920724052
	For Type 627H or 627HM	1C379124052
47	Relief Seal Retainer (for Type 627R or 627MR only), stainless steel	10B7445X012
48*	Guide Retainer O-Ring (for Type 627R or 627MR only), nitrile	1D682506992
49	Relief Indicator (for Type 627R or 627MR only), rubber (not shown)	30B3100X012
50	Diaphragm Limiter	22B0176X012
51*	Diaphragm Limiter O-Ring	1K877606992
52*	Pusher Post O-Ring (2 required)	1C853806992

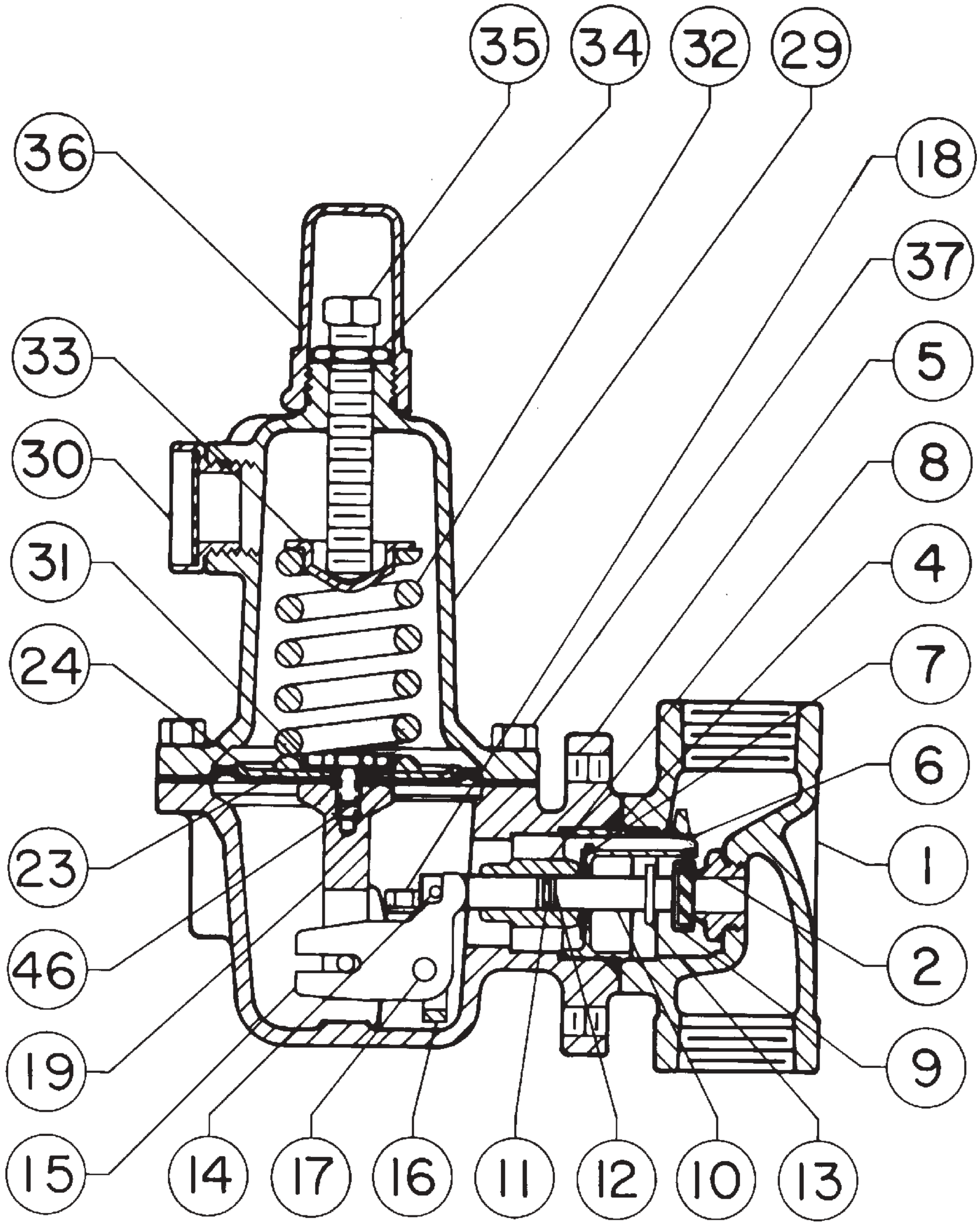


Figure 7. Type 627 Regulator Components

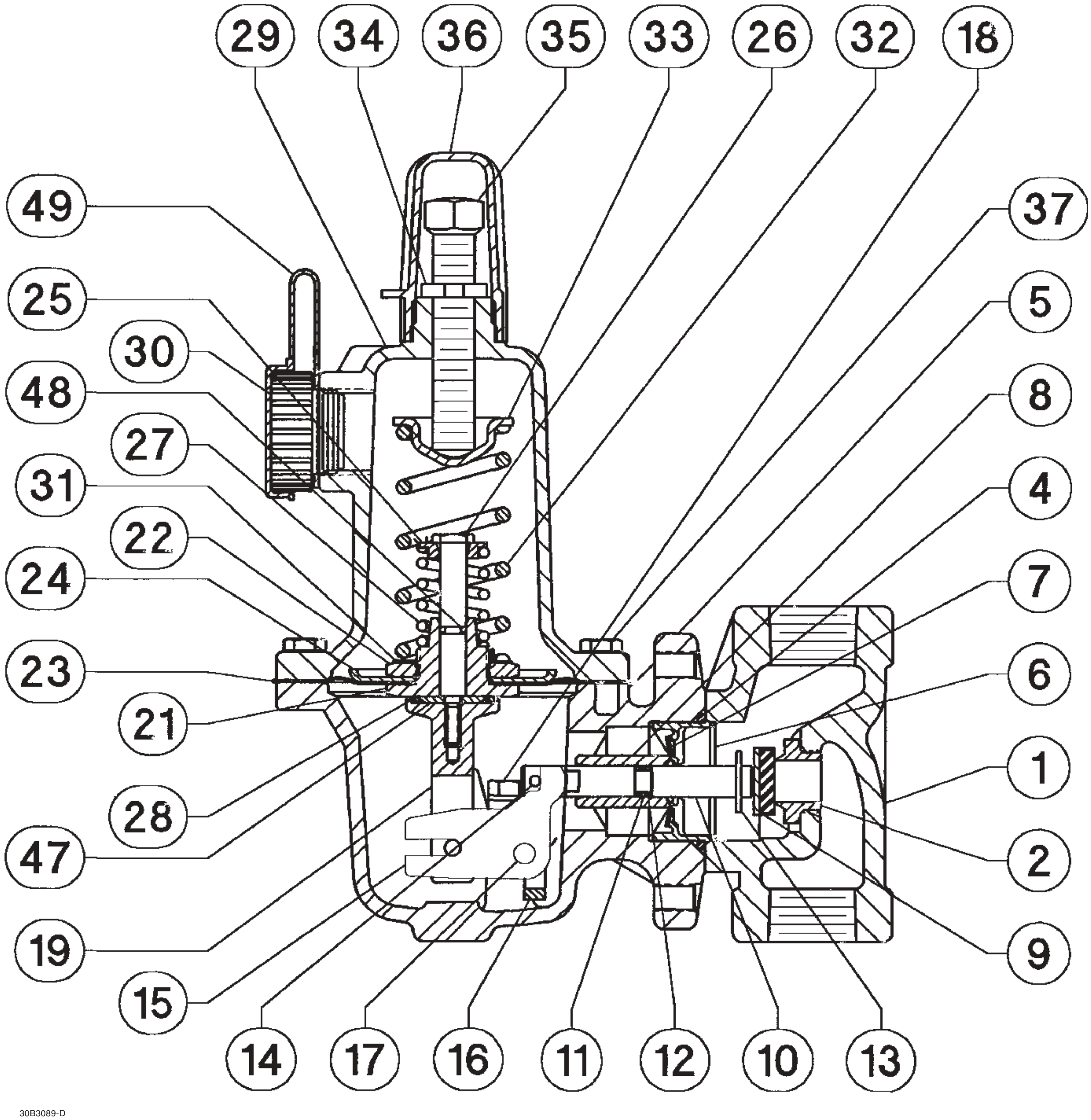


Figure 8. Type 627R Regulator Components

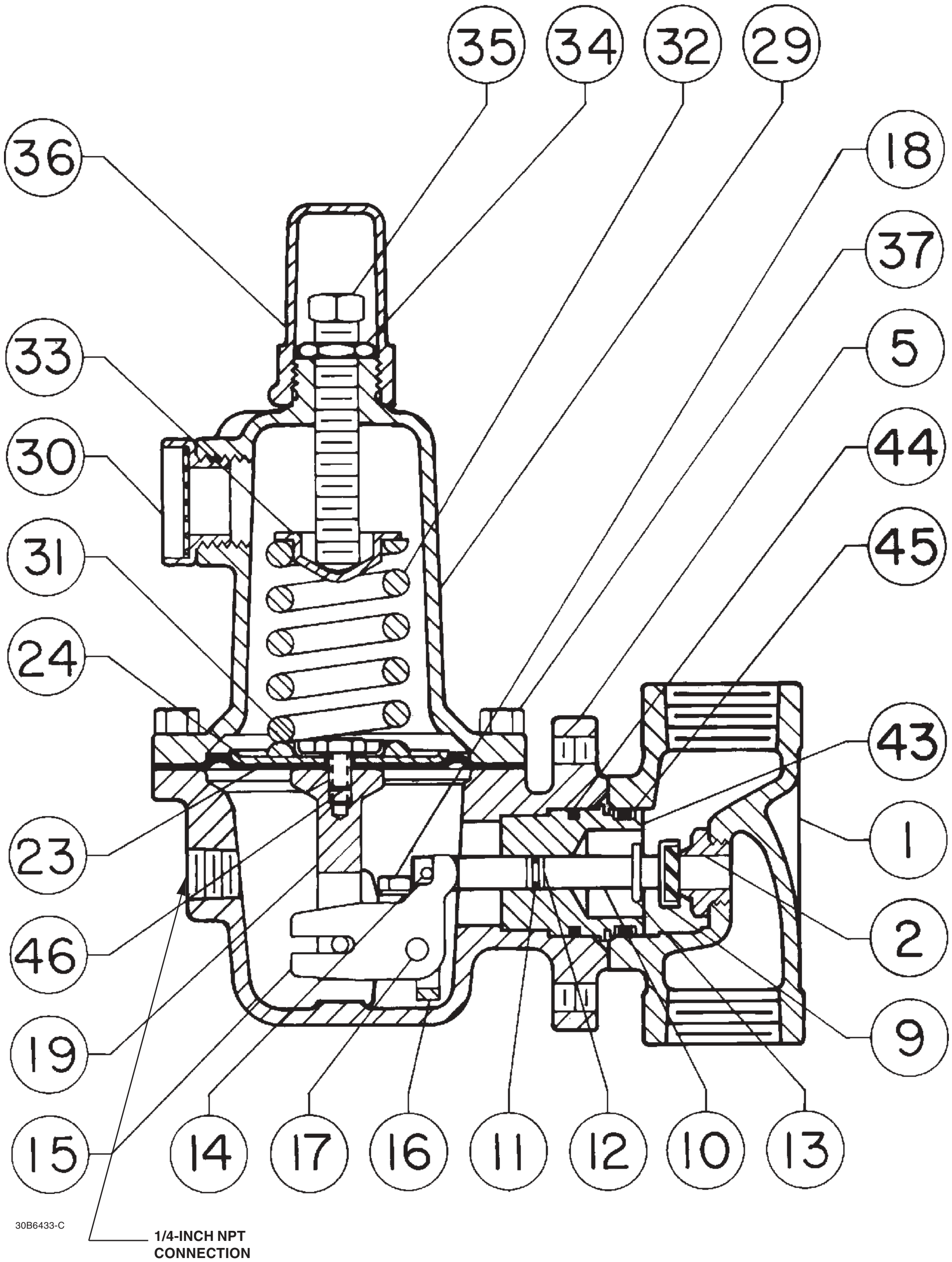


Figure 9. Type 627M Regulator Components

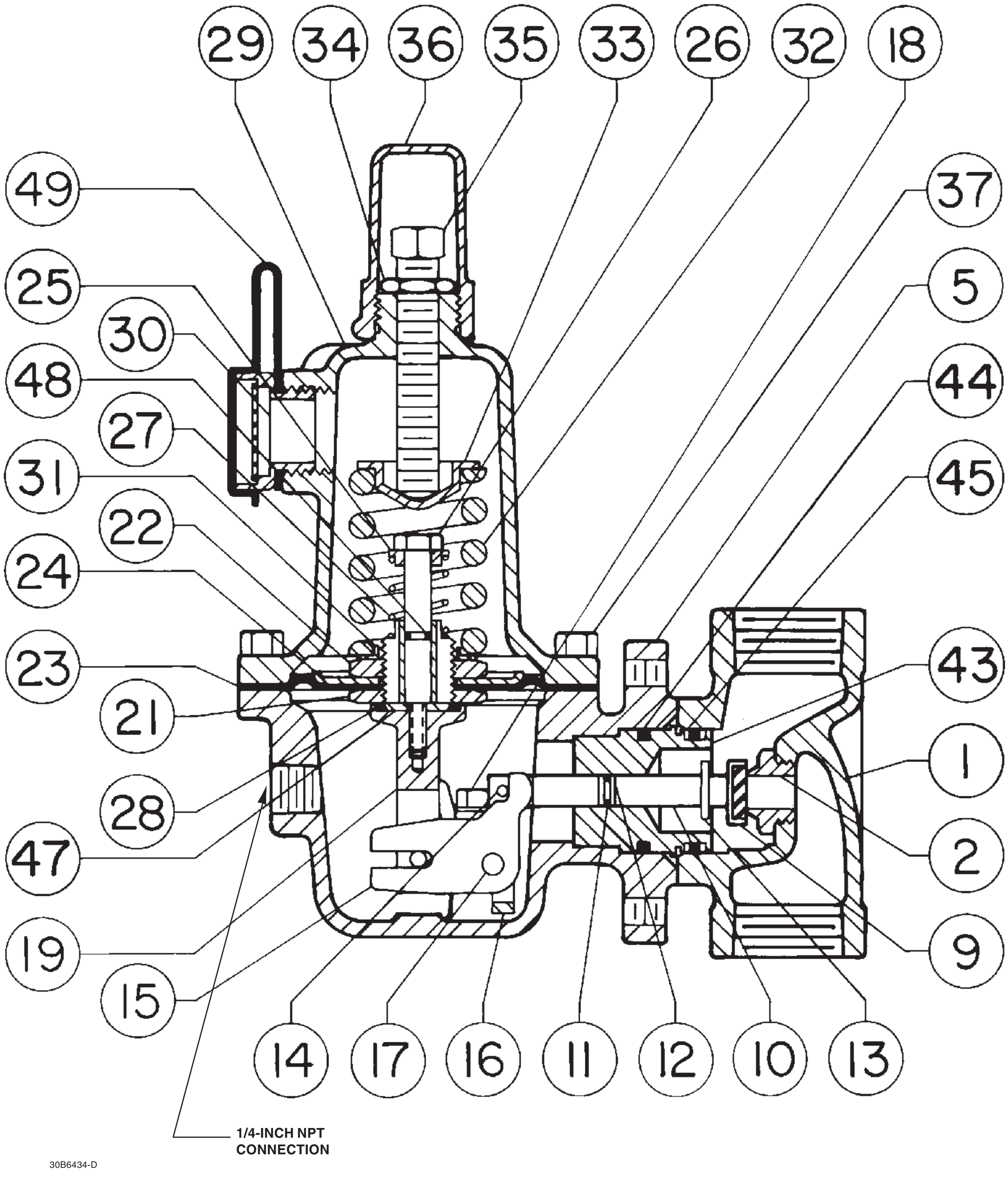


Figure 10. Type 627MR Regulator Components

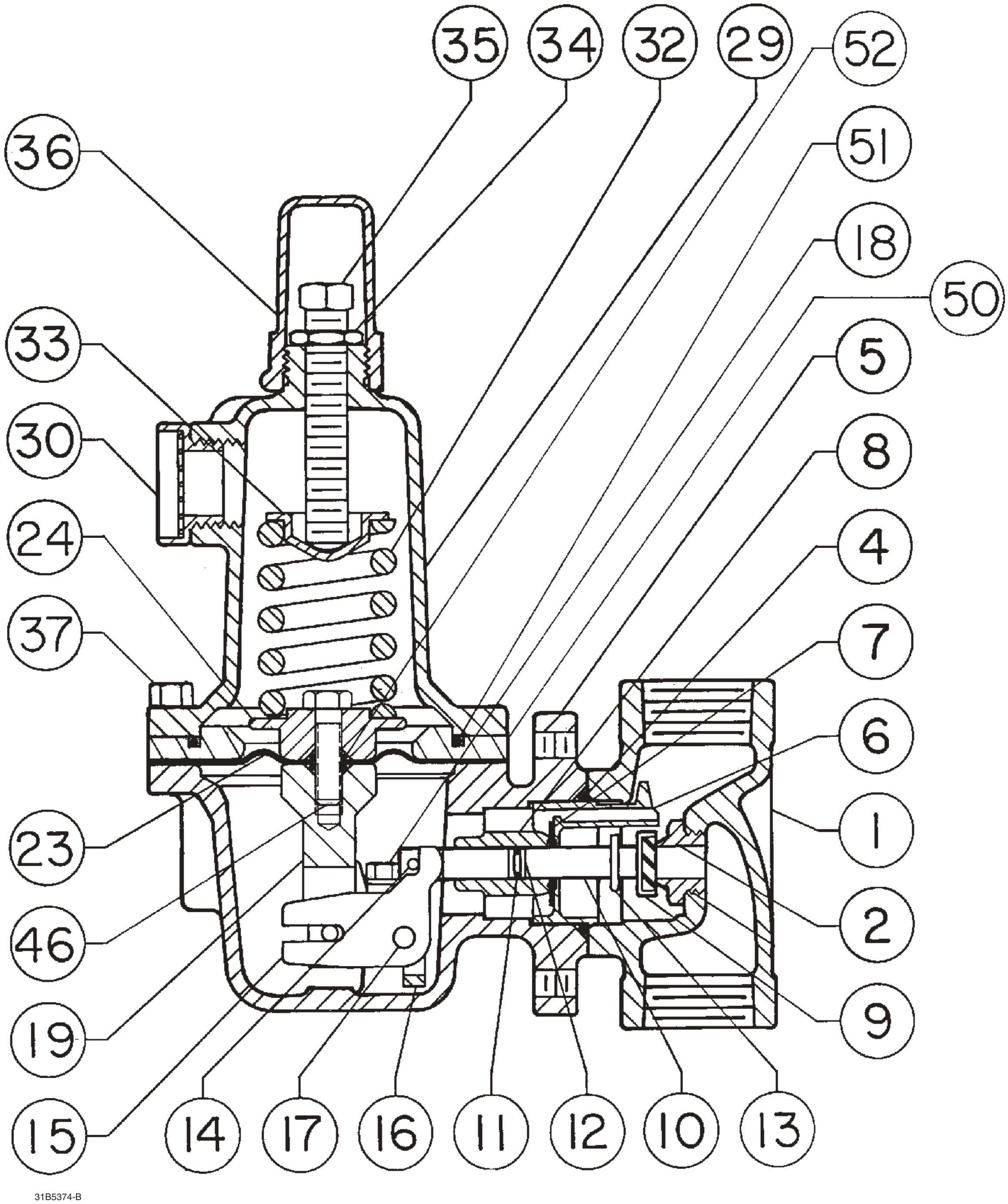


Figure 11. Type 627H Regulator Components

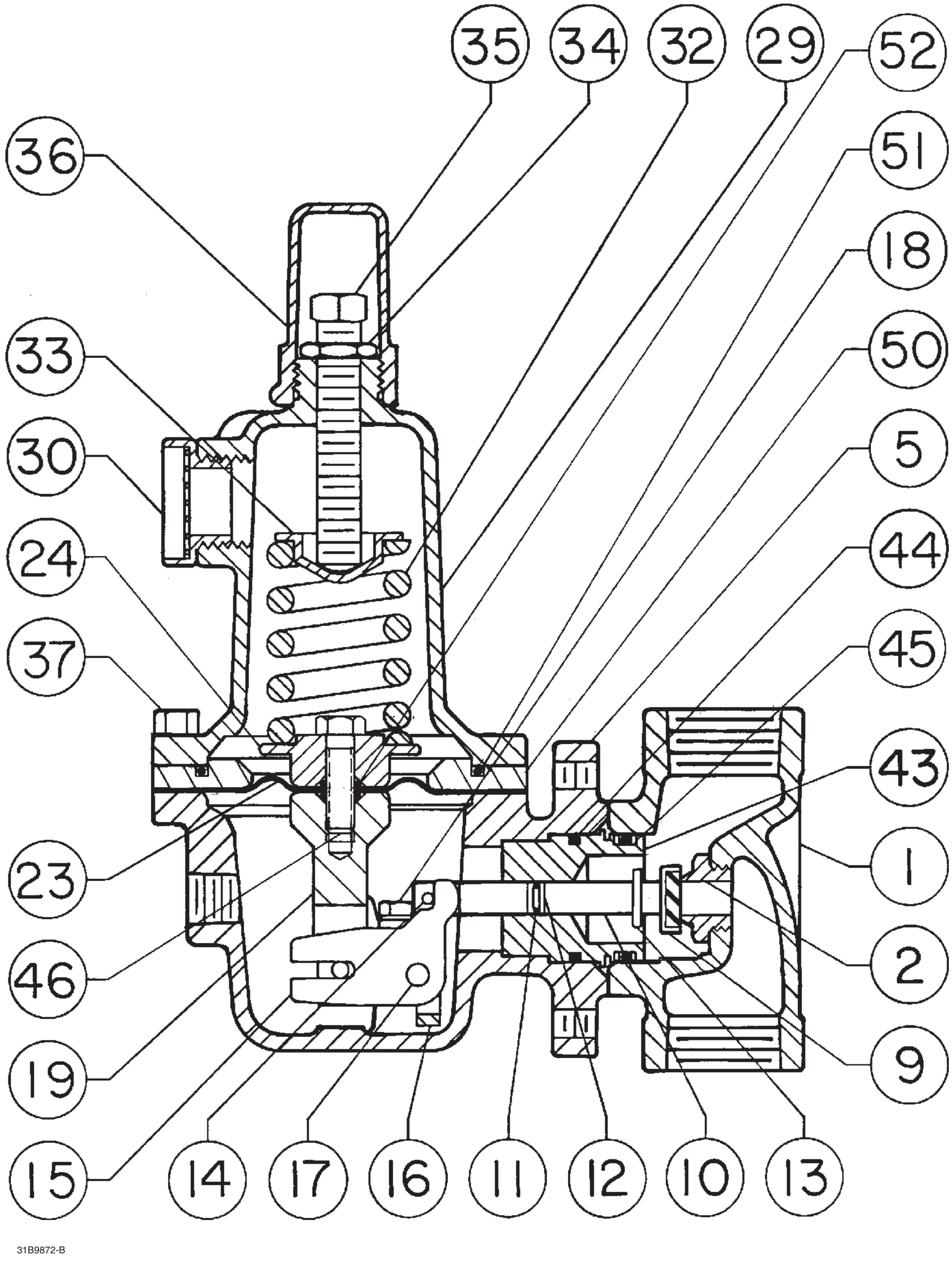


Figure 12. Type 627HM Regulator Components

January 2001

Errata Sheet
for

627 Series
Form 5252, July 1989

This errata sheet includes information covering the Type 627LB extended body regulator. This new body style is available on all 627 Series configurations and will be an addition to key 1 in the Parts List. The pressure ratings on the Type 627LB bodies will be identical to the existing specifications stated in the current 627 Series Instruction Manual. Each bullet on this errata sheet refers to a section of the 627 Series Instruction Manual (form 5252) where this infornation needs to be added.

• Add the following to the Available Constructions section of Table 1. Specifications on page 2.

Type 627LB: A 627 Series construction with an extended NPT screwed body. Note: The pressure ratings and capacities for a Type 627LB depend on the 627 Series construction. See the above listed constructions for ratings and specifications.

• Add the following to the Parts List on page 12.

Key	Description	Part Number
1	Body	
	Type 627LB - Ductile iron	
	1000 psig (69 bar) max inlet pressure	
	3/4-inch NPT screwed body	39B2450X012
	1-inch NPT screwed body	39B2451X012
	2-inch NPT screwed body	39B0414X012
	Type 627LB - Steel	
	2000 psig (138 bar) max inlet pressure	
	3/4-inch NPT screwed body	39B0411X012
	1-inch NPT screwed body	39B0412X012
	2-inch NPT screwed body	39B0415X012

• Add the following figure to the end of page 18.

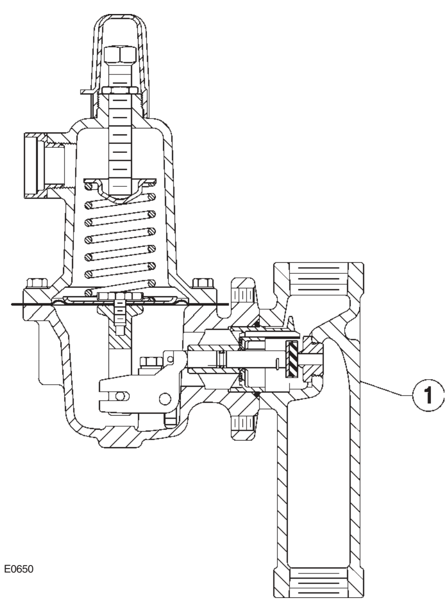


Figure 13. Type 627LB Regulator Body

For information, contact Fisher Controls:
Marshalltown, Iowa 50158 USA
28320 Gallardon, France
Sao Paulo 05424 Brazil
Singapore 128461

Printed in U.S.A.

FISHER® Regulators

October 1995

P590 Series Filters

Scope of Manual

This manual provides instructions for installation, maintenance and parts information for P590 Series filters.

Product Description

P590 Series filters are designed to remove dirt, scale or other solid substances from gases just upstream from pilot supply lines for air or gas pressure regulators.

P590 Series filters come with either aluminum or brass bodies and cellulose or aluminum/brass filter elements. Type P593-1 is also available with a NACE option.

The brass body filters (P595 and P594-1) are capable of handling up to 1400 psig (96,60 bar) working pressure, while the aluminum-bodied (P593-1) can withstand 600 psig (41,10 bar) maximum working pressure.

Installation

WARNING

Personal injury, equipment damage, or leakage due to escaping gas or bursting of pressure-containing parts may result if the filter is installed where its capabilities can be exceeded or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid this, install a filter where:

- **Service conditions are within unit capabilities.**
- **Service conditions are within applicable codes, regulations, or standards.**

Using good piping practices, make sure that all tubing and piping are clean and unobstructed. Apply a good grade of pipe compound to the male pipeline threads. Install the filter in the line with the flow in the direction of the arrow shown in figure 1.

Maintenance

Filter parts are subject to normal wear and must be inspected periodically and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions and upon applicable codes and government regulations.

Due to the care Fisher takes in meeting all manufacturing requirements (heat treating, dimensional tolerances, etc.), use only replacement parts manufactured or furnished by Fisher.

WARNING

To avoid personal injury resulting from sudden release of pressure, isolate the regulator/filter from all pressure and cautiously release trapped pressure from the regulator/filter before attempting disassembly.

Perform this procedure to clean or replace filter parts in a P590 Series filter assembly. Key numbers are referenced in figure 1.

Remove the following parts: filter body (key 1), machine screw (key 4), spring washer (key 6), gasket (key 7), two flat washers (key 5), and filter element (key 2).

Upon reassembly, one of the flat washers (key 5) must go between the filter element and the filter head (key 3) and the other must go between the filter element and gasket. Use a good grade of pipe thread sealant on the filter head pipe threads as shown by P.T.S. in figure 1.

D101555X012

Parts Ordering

When corresponding with your Fisher sales office or Fisher representative about this filter, always reference the FS number.

When ordering replacement parts, specify the complete 11-character part number from the following parts list.

Parts List

Note

In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the National Association of Corrosion Engineers (NACE) standard MR0175.

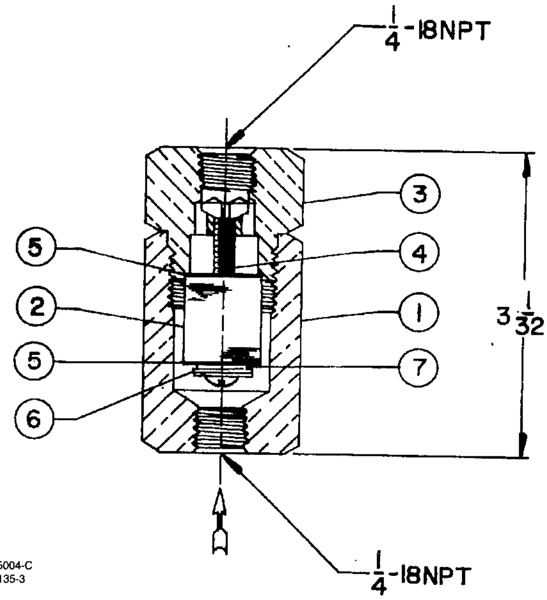


Figure 1. Typical P590 Series Filter Assembly

Key	Description	Part Number
1	Filter Body	
	Type P595, P594-1, brass	1E312414012
	Type P593-1,	
	aluminum	1E312409012
	aluminum (NACE)	1E312409012
2*	Filter Element,	
	aluminum/brass	1C533499012
	cellulose	1E312606992
	cellulose (NACE)	1E312606992
3	Filter Head	
	Type P595, P594-1, brass	1E312514012
	Type P593-1,	
	aluminum	1E312509012
	aluminum (NACE)	1E312509012
4	Machine Screw	
	Type P595, P594-1, brass	1J500218992
	Type P593-1,	
	aluminum	1J500209012
	aluminum (NACE)	1J500209012
5	Washer (2 required)	
	Type P595, P594-1, brass	1J500018992
	Type P593-1,	
	aluminum	1J500010062
	aluminum (NACE)	1J500010062
6	Spring Washer, steel	1H885128982
7*	Gasket, composition	
	Type P594-1, P593-1	1F826804022
11	NACE Tag (Type P593-1 NACE only)	
	18-8 stainless steel (not shown)	19A6034X012
12	Tag Wire (Type P593-1 NACE only)	
	303 stainless steel (NACE)	1U7581X0022

* Recommended spare parts.

For information, contact Fisher:
Marshalltown, Iowa 50158 USA
McKinney, Texas 75070 USA
28320 Gallardon, France
40013 Castel Maggiore (BO), Italy
Sao Paulo 05424 Brazil
Singapore 128461

www.FISHERregulators.com

FISHER

Honeywell

L4081A,B and L6081A,C Multiple Aquastat® Controllers

The L4081, L6081 Aquastat® Controllers provide boiler water regulation in gas- or oil-fired hydronic heating systems.

- An immersion type liquid-filled sensing element actuates two snap switches.
- One switch operates as a high limit control.
- The other switch operates as a low limit and/or circulator control, depending on model.
- Controller may be mounted in any position and needs no leveling.
- Separate, easy-to-read calibrated dial and setpoint adjustment for each switch.
- Differential adjustment on low limit or circulator switch.
- All adjustments accessible inside front cover .
- Push-in terminals for quick connecting.
- Single sensing element for easy installation.
- Two spst snap switches (one spst and one spdt in L6081A,C) act independently at respective temperature settings.

CONTENTS

J. H. • Rev. 3-95 •

60-2105-5

Specifications

IMPORTANT: *The specifications given in this publication do not include normal manufacturing tolerances. Therefore, this unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions, and some minor differences in performance can be expected if those conditions are changed.*

TRADELINE® MODELS
TRADELINE® models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE® model specifications are the same as those of standard models except as noted below.
TRADELINE® MODEL AVAILABLE: L6081A Multiple Aquastat Controller.

ADDITIONAL FEATURES: TRADELINE® pack with cross reference label and special instruction sheet, well adapter, tube of heat-conductive compound, and setting stops.

STANDARD MODELS
Refer to Table 1 for model specifications.

RANGES:
High Limit: 130°F (54.5°C) to 240°F (115.5°C). Stops burner if boiler temperature exceeds setpoint.
Low Limit: 110°F (43.5°C) to 220°F (104.5°C). Controls burner during thermostat off periods to maintain boiler water temperature.
Circulator: 110°F (43.5°C) to 220°F (104.5°C). Permits circulator operation only if boiler water temperature exceeds low limit setting.

TABLE 1—MODEL SPECIFICATIONS.

Model Number	Insertion Type[a]	High Temperature Side		Low Temperature Side	
		Switching	Action on Temperature Rise to Setpoint	Switching	Action on Temperature Rise to Setpoint
L4081A	Well	Spst Hi Limit	Breaks	Spst Low Limit	Breaks
L4081B	Well	Spst Hi Limit	Breaks	Spst Circulator	Makes
L6081A	Well	Spst Hi Limit	Breaks	Spdt Low Limit/Circulator	Breaks R-B Makes R-W
L6081C[b]	Well	Spst Hi Limit	Breaks	Spdt Low Limit/Circulator	Breaks R-B Makes R-W

[a] Some models are shipped less well; if well is needed, refer to form 68-0040 for ordering information.
[b] Device is less case and cover.

Ordering Information

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

1. Order number.
2. Accessories, if desired.
3. Order additional system components and system accessories separately.

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

1. Your local Home and Building Control Sales Office (please check the white pages of your phone directory).
2. Home and Building Control Customer Logistics
   Honeywell Inc., 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386 (612) 951-1000

   In Canada—Honeywell Limited/Honeywell Limitée, 740 Ellesmere Road, Scarborough, Ontario M1P2V9. International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

SCALE MARKINGS:
For Fahrenheit Models:
High Limit:160, 180, 200, 220°F.
Low Limit or Circulator: 120, 140, 160, 180, 200°F.
For Celsius Models:
High Limit: 55, 65, 75, 85, 95, 105°C.
Low Limit or Circulator: 45, 55, 65, 75, 85, 95°C.
DIFFERENTIALS:
High Limit: 10°F (5.5°C) nominal.
Low Limit or Circulator:
L6081A,C: 10-25°F (5.5-14°C) adjustable.
L4081A,B: 10°F (5.5°C) nominal or 10-25°F (5.5-14°C) adjustable.
MAXIMUM PRESSURE RATING:
Well Mounted: 200 psi (1380 kPa).
Direct Immersion: 100 psi (690 kPa).
MAXIMUM AMBIENT TEMPERATURE:
At Switches: 150°F (65.5°C).
At Sensing Element: 265°F (129.5°C).
JUMPER: The 128975 Push-in Field Addable Jumper (included) can be inserted in slot between R-R terminals to simplify wiring. (Insert with formed legs up in slot labeled jumper. Be sure to insert fully to positive stop.)
MOUNTING DIMENSIONS: See Fig. 1 and 2.
APPROVALS:
Underwriters Laboratories Inc. Listed (L4081A,B and L6081A): File No. MP466, Guide No. MBPR. Component Recognized (L6081C): File No. MP466, Guide No. MBPR2.
Canadian Standards Association Component Recognized (L4081A,B and L6081A): File No. LR1620, Guide No. 400-E-0.

Fig. 1—L4081A,B and L6081A mounting.

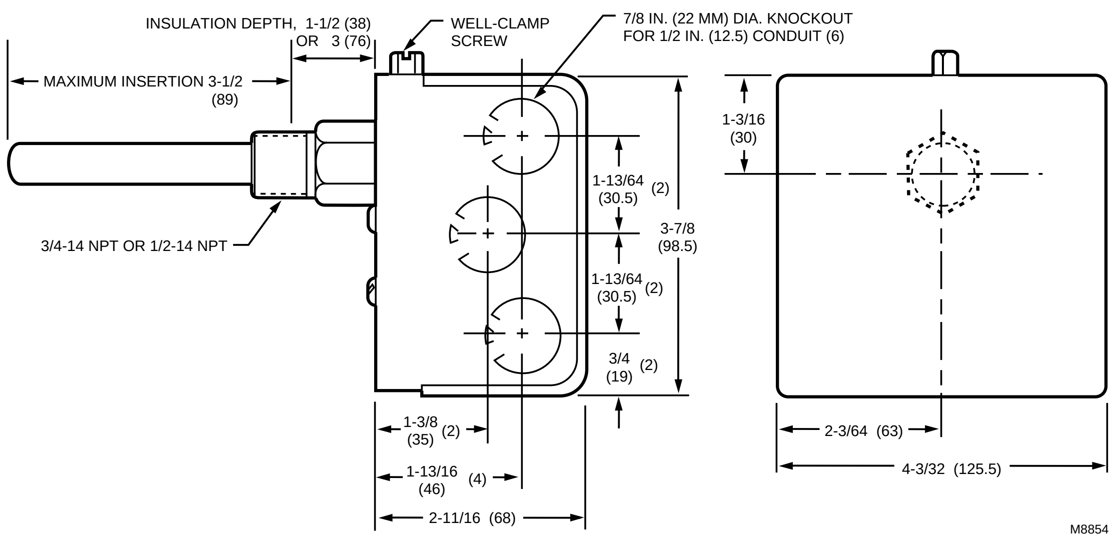
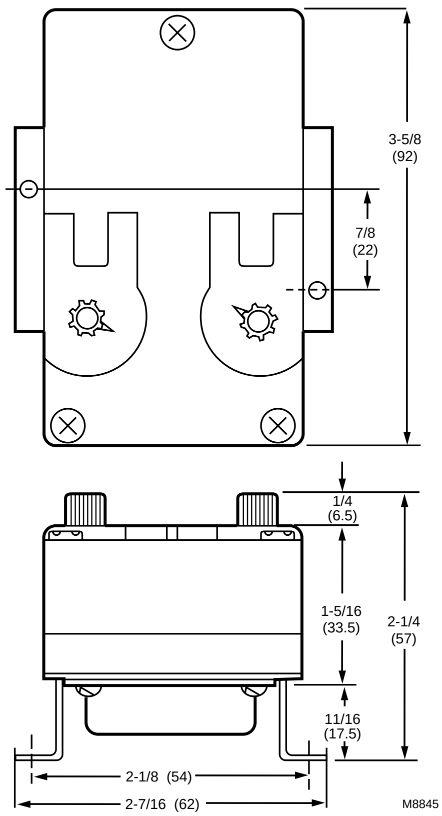


Fig. 2—L6081C mounting dimensions in in. (mm).



ELECTRICAL RATING (A): See Table 2.

TABLE 2—ELECTRICAL RATINGS.

	120 Vac	240 Vac
Full Load	8.0	5.1
Locked Rotor	48.0	30.6
Millivoltage	0.25A at 1/4 to 12 Vdc	

Plus ignition transformer load of 360 VA. Maximum connected load 2000 VA.

WELL SPUD LENGTH: 1-1/2 in. (38 mm). Longer spud for 3 in. (76 mm) of insulation available.
SPUD THREAD SIZE:
3/4-14 NPT standard.
1/2-14 NPT available.
OPTIONAL SPECIFICATIONS:
Plastic coating on immersion well to minimize electrolytic deterioration (on some with well models).
Celsius scale on L4081A.
ACCESSORY: 126580 Setting Stop. Used to prevent turning setting knob beyond a predetermined point.

Installation

WHEN INSTALLING THIS PRODUCT...

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

! *CAUTION*

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

These devices can be installed in any position. Proper location, sizing, and threaded boiler tapping are required.

NOTE: Maximum pressure rating for these models is 200 psi (1380 kPa).

Maximum permissible ambient temperature at sensing bulb is 265°F (129.5°C); at switches, 150°F (65.5°C). The L6081C is without enclosure or well assembly.

MOUNTING

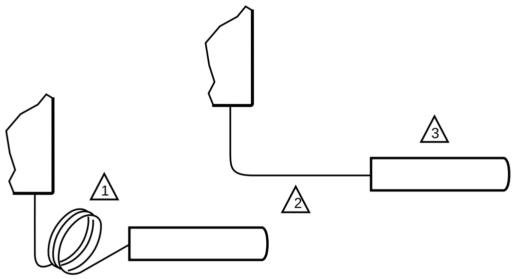
Follow instructions provided by system manufacturer if available. Otherwise, proceed as follows:

1. Drain the boiler if system is filled with water.
2. Place front of controller down on a horizontal surface and gently raise the sensing bulb until it is at a right angle with the back of the case and centered with the large hole in the case. This requires bending the capillary tube, but be sure to make no sharp bends and no bends near the bulb.

NOTE: Some models have an adjustable tubing length to 3 in. (76 mm). In these models, extra tubing inside the case can be pulled out, if needed. See Fig. 3
.

3. Adjust the position of the bulb so that bulb projects 4-7/8 in. (124 mm) from back of case for immersion well designed for 1-1/2 in. (38 mm) insulation; or 6-3/8 in. (162 mm), if designed for 3 in. (76 mm) insulation. If this requires bending the tube inside the case, insert end of

Fig. 3—Adjusting the capillary length.



CAUTION:
EXCESSIVE HANDLING OR SHARP BENDS CAN DAMAGE THE CAPILLARY.

1. SENSING ELEMENT IS FACTORY FORMED FOR 1.5 INCH INSULATION WELL ASSEMBLIES.
2. FOR 3 INCH INSULATION WELL ASSEMBLIES, PULL OUT SUFFICENT CAPILLARY TO ASSURE THAT THE CAPSULE BOTTOMS IN THE WELL.
3. STRAIGHTEN CAPILLARY SUFFICENTLY SO IT DOES NOT INTERFERE WITH INSERTING THE CAPSULE INTO THE WELL.

M8882

index finger through the hole and carefully mold the tube into the correct shape as you gently pull (or push) the bulb to the correct position. The bulb must project the right distance so that after the case is installed, the spring force of the capillary tube holds the bulb against inner end of the well for good thermal contact. The tube must be straight for at least 3/8 in. (9.5 mm) inside the case so the end of the well spud does not strike the coiled tube and pull the bulb away from contact with the inner end of the well.

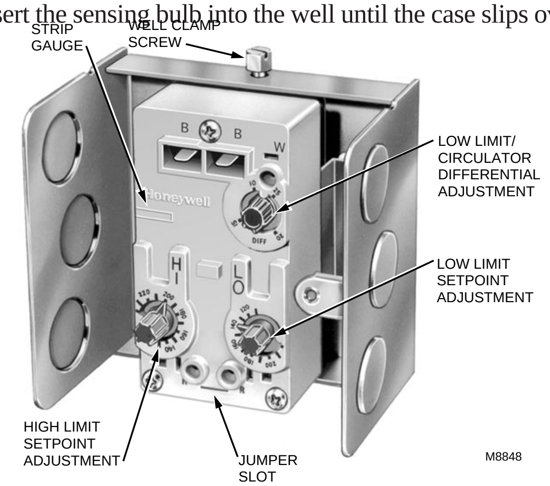
4. Remove the plug from a properly located boiler tapping.

5. Apply pipe dope sparingly to the threads of the well; then screw the well tightly into the boiler tapping.

6. Fill the system with water, then carefully examine around the threads for leakage. Tighten the well if necessary to stop any leakage.

7. Loosen the wall clamp screw three or four turns; move the screw in and out and note how it moves the well clamp. See Fig. 4. Loosen the screw enough so that when the screw is pushed inward, the T-shaped clamp guide is at the far end of the slot in the case.

Fig. 4—L6081A with cover removed to show adjustments.



8. Mount the case on the well spud in any position that facilitates wiring. With the case in final position, carefully insert the sensing bulb into the well until the case slips over the end of the well spud and fits squarely against the shoulder of the spud.

NOTE: Open the clamp to receive the spud by pushing in the well clamp screw.

9. While holding the case in the correct position, firmly tighten the well clamp screw.

Wiring

⚠ *CAUTION*

- Disconnect power supply to prevent electrical shock or equipment damage.
- Use care to avoid strain on control case when using cable or conduit.

⚠ *WARNING*

CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.
This Product is for use only in a system with a pressure relief valve.

All wiring must comply with applicable codes and ordinances. See cover insert for electrical load ratings. Refer to Fig. 5 through 9 for typical wiring diagrams.

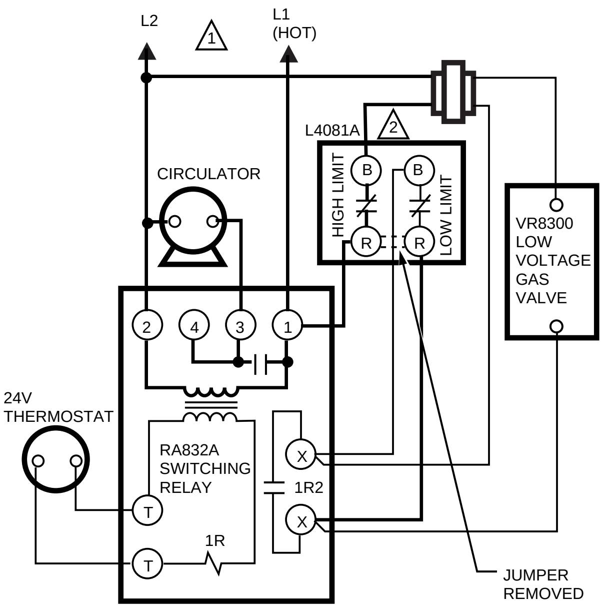
Use the following procedure when connecting wires to the B tab terminals (Fig. 4):

1. Connect no. 14, 16, or 18 solid, or no. 14 or 16 unistranded wire to the tab terminals.
2. Strip insulation from the end of each wire.
3. Use the included wire nut from the bag assembly to connect the tab terminal connector to the wire.
4. Connect the wire to the tab terminal.

JUMPER

When using the controller field addable jumper (Fig. 4), connect terminals R-R. *When the jumper is added, make sure that the two prongs of the jumper face the center of the controller.*

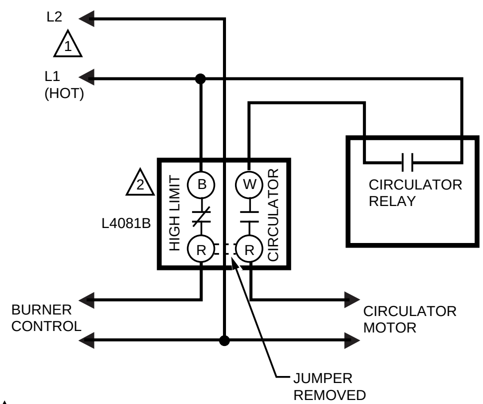
Fig. 5—L4081A used with gas burner (line voltage limit).



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. B TERMINALS ARE TAB TERMINALS.

M8846

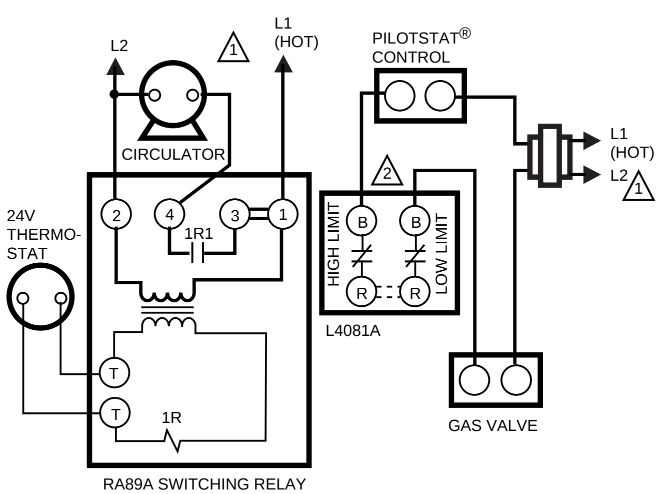
Fig. 6—L4081B used to prevent circulator operation with boiler water temperature below low limit setting.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. B IS A TAB TERMINAL.

M8787

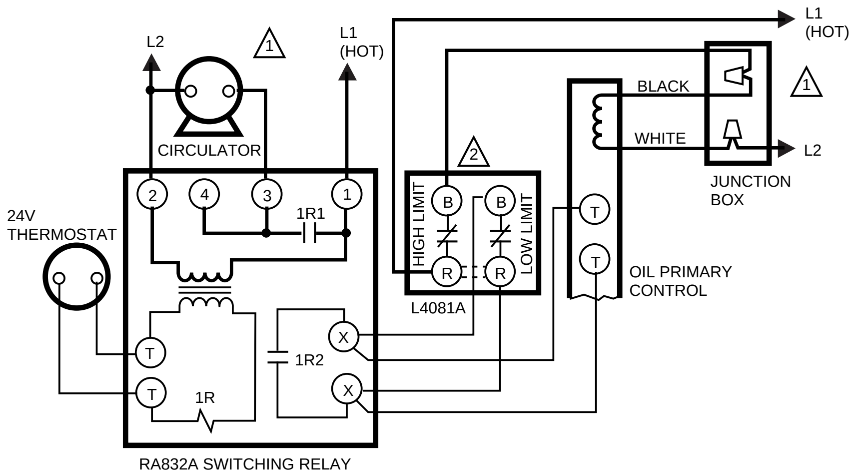
Fig. 7—L4081A used with burner cycled from the water temperature.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. B TERMINALS ARE TAB TERMINALS.

M8788

Fig. 8—L4081A used with oil burner.

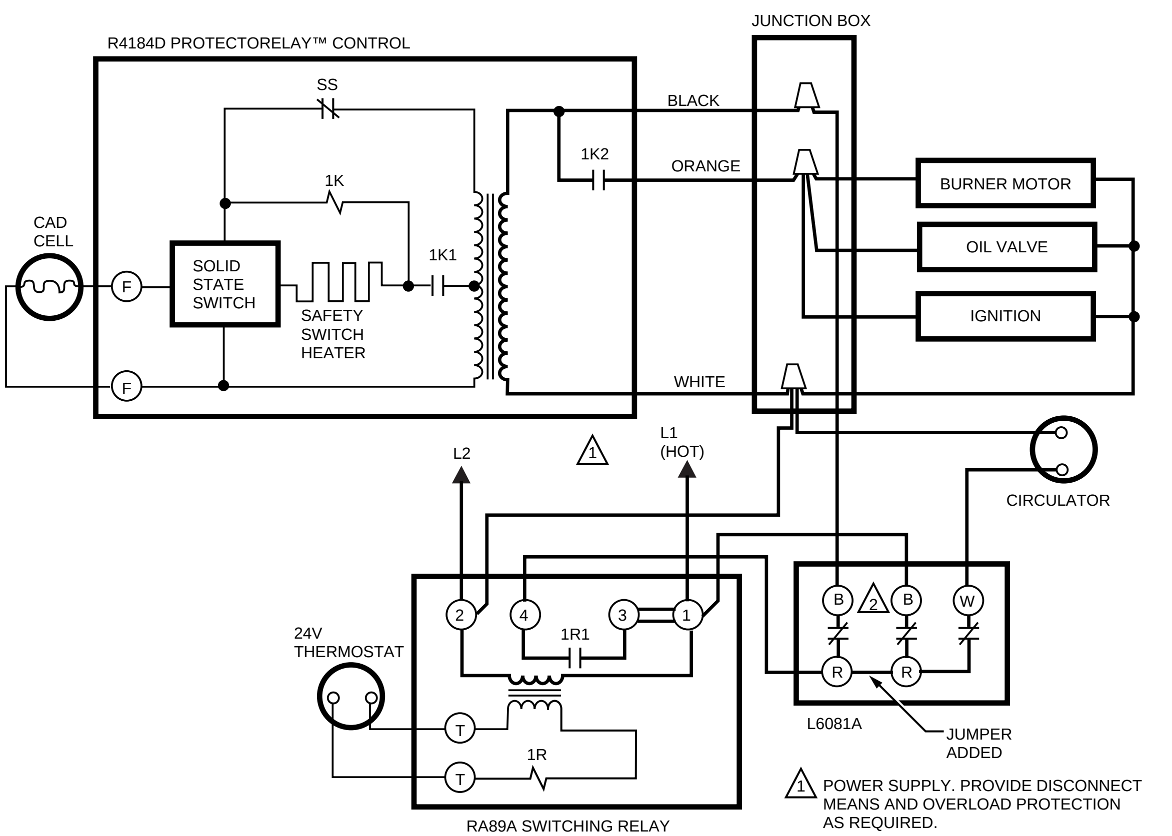


1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 B TERMINALS ARE TAB TERMINALS.

M8786

Fig. 9—L6081A used with oil burner.



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 B TERMINALS ARE TAB TERMINALS.

M8855

Operation

HIGH LIMIT

The high limit opens and turns off the burner when the water temperature reaches the set point. The high limit automatically resets after the water temperature drops past the set point and through the 10°F (5.5°C) differential.

LOW LIMIT AND CIRCULATOR

On a temperature rise, with the adjustable differential at the minimum setting of 10°F (5.5°C) (also applies to fixed 10°F (5.5°C) differential models), the burner circuit (R-B) breaks and the circulator circuit (R-W) makes at the control setpoint. On a temperature drop of 10°F (5.5°C) below the setpoint, the R-B circuit makes and the R-W circuit breaks.

At any differential setting greater than 10°F (5.5°C), the R-B make temperature and R-W break temperature remains the same control setting minus 10°F (5.5°C). The R-B break and R-W make temperature are the setpoint temperature plus the difference between the differential setting and 10°F (5.5°C).

EXAMPLES:

L4081A: Setpoint of 140°F (60°C); differential set at 25°F (14°C). On a temperature rise, the switch breaks at 155°F (68.5°C). On a temperature fall, the switch makes at 130°F (54.5°C).

L4081 B: Setpoint of 140°F (60°C); differential set at 25°F (14°C). On a temperature rise, the switch makes at 155°F (68.5°C). On a temperature fall, the switch breaks at 130°F (54.5°C).

L6081A,B: Setpoint of 140°F (60°C); differential set at 25°F (14°C). On a temperature rise, R-B breaks and R-W makes at 155°F (68.5°C). On a temperature fall, R-B makes and R-W breaks at 130°F (54.5°C).

Settings

Because heating systems differ, follow the boiler manufacturer recommendations when selecting temperature settings.

Study the applicable chart in Fig. 10, which shows the switching response to temperature changes.

With cover off, set the high limit adjustment at the temperature desired but *not* higher than recommended by the boiler manufacturer (Fig. 4).

Set the low limit and/or circulator adjustment to obtain temperature desired but *not less than* 20°F (11°C) below the high limit setting.

The differential adjustment applies to only the low-limit and/or circulator switch(es). Minimum differential adjustment provided is 10°F (5.5°C) nominal; maximum is 25°F (14°C) nominal. Set as desired.

SETTING STOP

Install the 126580 Setting Stop on the adjusting knob to prevent turning the knob beyond a predetermined point. Fig. 11 shows stops installed on knob of high limit switch to prevent setting higher than 180°F (82°C).

To install the setting stop, proceed as follows:

1. Turn knob to the setting that is to be established as the limit.
2. Place setting stop over knob in position to arm of setting stop (after stop is pressed into place) strikes projection A and prevents turning the knob beyond the desired limit setting.
3. Press setting stop tightly onto knob so its inner teeth securely engage knob.
4. Turn knob back and forth several times to make sure stop functions properly.
5. When all settings are made, replace the cover.

Fig. 10—Charts showing switching response to temperature changes.

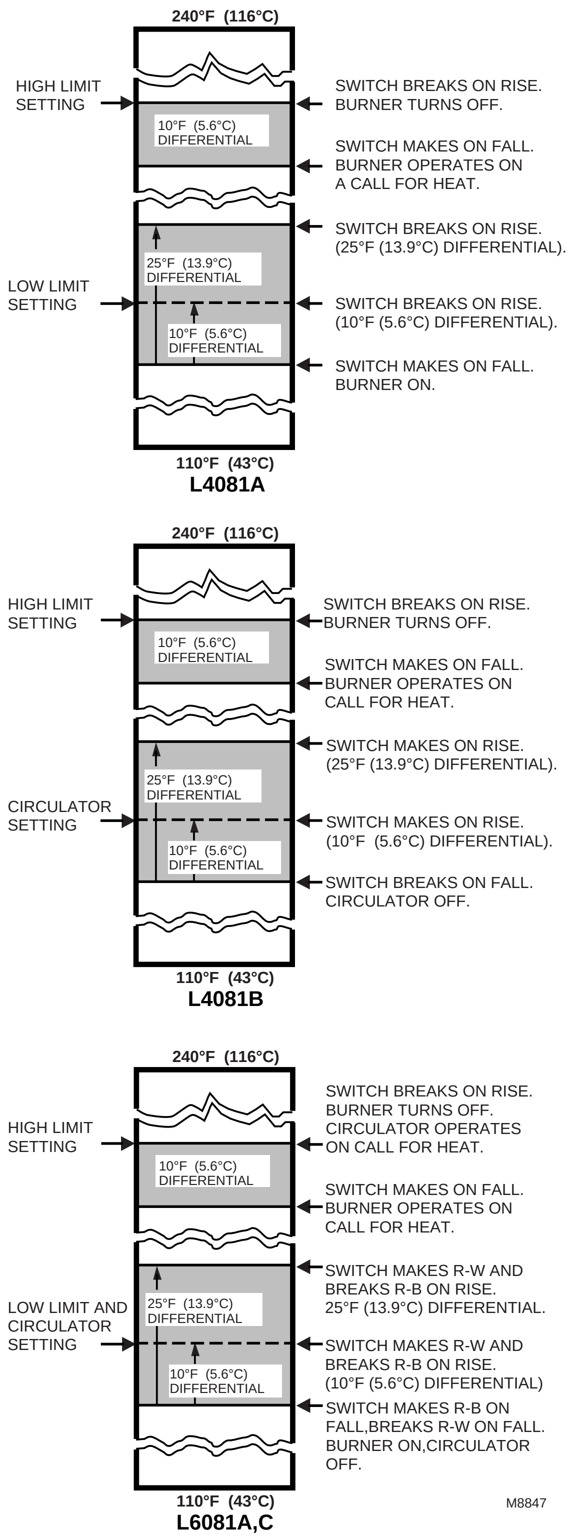
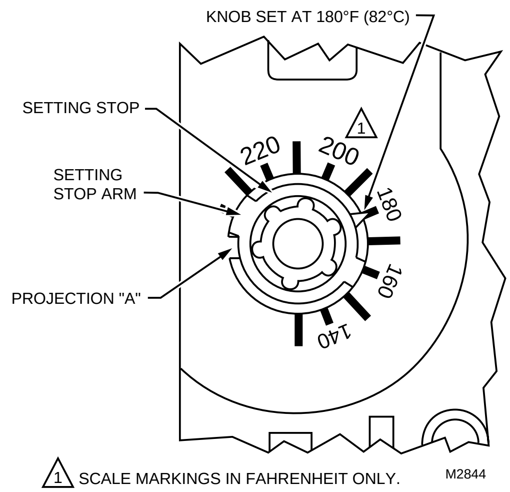


Fig. 11—Setting stop shown in position to limit high limit setting to 180°F (82°C).



Checkout

After completing installation and controller settings, operate the system. Carefully observe the operation of all components through at least one complete cycle. Be sure to include a check of the high limit switch operation. Make any correction needed; then repeat the checkout. Repeat until system operates properly.

Material Safety Data Sheet (MSDS) for heat-conductive compound, which is included with the TRADELINE® Aquastat Relay models.

MATERIAL SAFETY DATA SHEET (MSDS)

ISSUED: Dec 2 1986 REVISED: Jan 15 1992 DS 9021

SECTION I	EMERGENCY TELEPHONE NO.
TRADE NAME (if None, Put Chemical) Heat Conductive Compound	(612) 542-7684

CHEMICAL NAME AND SYNONYMS: NA

MANUFACTURER'S NAME AND INFO TELEPHONE NO.: Honeywell, Inc. (612) 542-7500

ADDRESS (Number, Street City, State, Zip Code): 1985 Douglas Drive North, Minneapolis MN 55422

SECTION II - HAZARDOUS INGREDIENTS		%	TLV	PEL	UNITS
Petroleum hydrocarbon	0000A-06-7	60-70	NE	NE	
Barium, acetate tallow fatty acids complexes (*)	68201-19-4	5-10	NE	NE	
Aluminum, as Al, Pyro Powders	A7429-90-5	25-30	5	5	mg/m3
Stearic Acid	00057-11-4	1-5	NE	NE	

Part No. 120650 (0.5 oz. tube); Part No. 107408 (4 oz. can); Part No. 197007 (5 gal. container); M.S. 1699. Specific chemical identity and C.A.S. number witheld as trade secret pursuant to 29 CFR 1910.1200 (i). HMIS RATING: H=0, F=1, R=0, PPE=Sec. VII

(*) SARA 313 Reportable; (C) Ceiling Value; (S) Skin Notation; CAS numbers prefaced by the letters A-G refer to different forms of a compound for TLV and PEL purposes; Numbers beginning with 0000A are PACE ID numbers, not valid CAS numbers.

SECTION III - PHYSICAL DATA

BOILING POINT (°F)	UN	SPECIFIC GRAVITY (Water=1)	UN
VAPOR PRESSURE (MM Hg.)	NA	PERCENT VOLATILE BY VOLUME	NA
VAPOR DENSITY (AIR=1)	NA	pH	NA
SOLUBILITY IN WATER	Neglble	EVAPORATION RATE	NA

APPEARANCE AND ODOR: Aluminum color, semi-solid material; pleasant odor.

SECTION IV-FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): 450 F (COC) | FLAMMABLE LIMITS % by Vol. LEL UN | UEL UN

EXTINGUISHING MEDIA: CO2, dry chemical or foam.

SPECIAL FIREFIGHTING PROCEDURES: None. As in all fire situations, firefighters should wear SCBA.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None.

ADDITIONAL INFORMATION: NA

NA - Not Applicable NE - Not Established UN - Unavailable PACE MBH039

Prepared by PACE, Incorporated, Minneapolis, MN

Material Safety Data Sheet (MSDS) for heat-conductive compound, which is included with the TRADELINE® Aquastat Relay models.

SECTION V - HEALTH HAZARD INFORMATION

ACUTE EFFECTS/SYMPTOMS

DS 9021

No data has been found regarding acute exposures to this material.

CHRONIC EFFECTS/SYMPTOMS

Prolonged and/or repeated contact may cause skin, eye, and mucous membrane irritation. These potential effects are greatly minimized if good personal hygiene practices are used. No irritation has been noted in all the years of production and packaging.

CARCINOGENICITY	NTP yes [ ] no [X]	IARC yes [ ] no [X]	OSHA yes [ ] no [X]	OTHER NA

FIRST AID

EYES	Immediately flush eyes with water for 15 minutes. Obtain medical attention if irritation persists.
SKIN	Remove excess with cloth or paper. Wash with soap and water. Obtain medical attention if irritation develops or continues.
INHALATION	Inhalation is unlikely to be a route of exposure. However if this does occur, remove victim to fresh air and treat symptomatically.
INGESTION	Contact local poison control center or physician IMMEDIATELY.

SECTION VI - REACTIVITY DATA

STABILITY	Stable.
INCOMPATIBILITY	Strong oxidizing agents and halogens.
DECOMPOSITION	Carbon dioxide, carbon monoxide, oxides of barium.
POLYMERIZATION	Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

PROCEDURES

Use absorbant material to clean up spills. Place in appropriate containers for proper disposal.

WASTE DISPOSAL METHOD

Dispose of in accordance with Local, State and Federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY	None.
EYEWEAR	Not normally required. However, use chemical safety goggles or faceshield if potential for eye contact exists, especially if material is heated.
CLOTHING/ GLOVES	Not normally required. However, protective clothing and gloves are recommended because material is difficult to remove from skin and clothing.
VENTILATION	No special ventilation is required when working with this product.

SECTION IX - ADDITIONAL INFORMATION

This product is not hazardous according to DOT criteria. Keep containers closed until ready for use. Do not store near open flame or heat.

APPROVAL: David E. Downs, CIH, CSP — Manager, Industrial Hygiene — DATE 2/13/92

MBH039

Honeywell

Home and Building Control
Honeywell Inc.
1985 Douglas Drive North
Golden Valley, MN 55422

Home and Building Control
Honeywell Limited—Honeywell Limitée
740 Ellesmere Road
Scarborough, Ontario
M1P 2V9

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QUALITY IS KEY

Printed in U.S.A.

DL205 User Manual

Automationdirect.com

WARNING

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To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

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Environmental Specifications

The following table lists the environmental specifications that generally apply to the DL205 system (CPU, Bases, I/O Modules). The ranges that vary for the Handheld Programmer are noted at the bottom of this chart. I/O module operation may fluctuate depending on the ambient temperature and your application. Please refer to the appropriate I/O module specifications for the temperature derating curves applying to specific modules.

Specification	Rating
Storage temperature	–4° F to 158° F (–20° C to 70° C)
Ambient operating temperature*	32° F to 131° F (0° C to 55° C)
Ambient humidity**	30% – 95% relative humidity (non–condensing)
Vibration resistance	MIL STD 810C, Method 514.2
Shock resistance	MIL STD 810C, Method 516.2
Noise immunity	NEMA (ICS3–304)
Atmosphere	No corrosive gases

* Operating temperature for the Handheld Programmer and the DV–1000 is 32° to 122° F (0° to 50° C) Storage temperature for the Handheld Programmer and the DV–1000 is –4° to 158° F (–20° to70° C).
**Equipment will operate below 30% humidity. However, static electricity problems occur much more frequently at lower humidity levels. Make sure you take adequate precautions when you touch the equipment. Consider using ground straps, anti-static floor coverings, etc. if you use the equipment in low humidity environments.

Power

The power source must be capable of supplying voltage and current complying with the base power supply specifications.

Specification	AC Powered Bases	24 VDC Powered Bases	125 VDC Powered Bases
Part Numbers	D2–03B–1, D2–04B–1, D2–06B–1, D2–09B–1	D2–03BDC1–1, D2–04BDC1–1, D2–06BDC1–1, D2–09BDC1–1	D2–06BDC2–1, D2–09BDC2–1
Input Voltage Range	100–240 VAC +10% –15%	10.2 – 28.8VDC (24VDC) with less than 10% ripple	104–240 VDC +10% –15%
Maximum Inrush Current	30 A	10A	20A
Maximum Power	80 VA	25W	30W
Voltage Withstand (dielectric)	1 minute @ 1500 VAC between primary, secondary, field ground, and run relay		
Insulation Resistance	> 10 MΩ at 500 VDC		
Auxiliary 24 VDC Output	20–28 VDC, less than 1V p-p 300mA max.	None	20–28 VDC, less than 1V p-p 300mA max.
Fusing (internal to base power supply)	non–replaceable 2A @ 250V slow blow fuse; external fusing recommended	non–replaceable 3.15A @ 250V slow blow fuse; external fusing recommended	non–replaceable 2A @ 250V slow blow fuse; external fusing recommended

Agency Approvals

Some applications require agency approvals. Typical agency approvals which your application may require are:

- UL (Underwriters’ Laboratories, Inc.)
- CSA (Canadian Standards Association)
- FM (Factory Mutual Research Corporation)
- CUL (Canadian Underwriters’ Laboratories, Inc.)

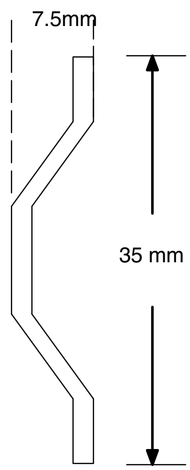
Using Mounting Rails

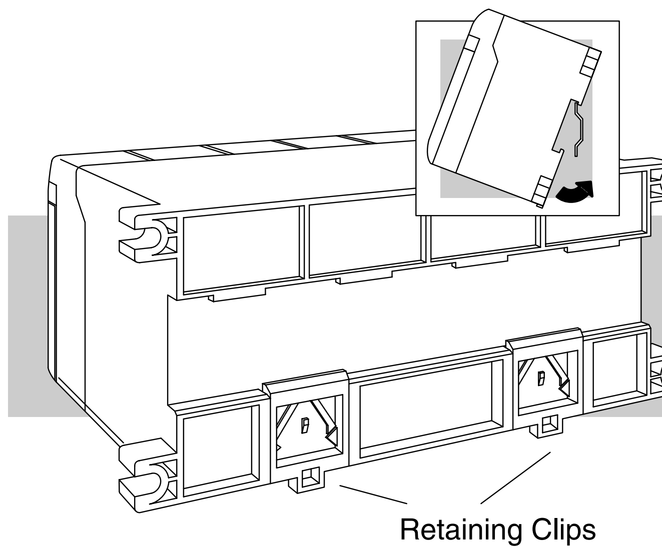
The DL205 bases can also be secured to the cabinet by using mounting rails. You should use rails that conform to DIN EN standard 50 022. Refer to our catalog for a complete line of DIN rail, DINnectors and DIN rail mounted apparatus. These rails are approximately 35mm high, with a depth of 7.5mm. If you mount the base on a rail, you should also consider using end brackets on each end of the rail. The end brackets help keep the base from sliding horizontally along the rail. This helps minimize the possibility of accidentally pulling the wiring loose.

If you examine the bottom of the base, you'll notice small retaining clips. To secure the base to a DIN rail, place the base onto the rail and gently push up on the retaining clips. The clips lock the base onto the rail.

To remove the base, pull down on the retaining clips, lift up on the base slightly, and pull it away from the rail.

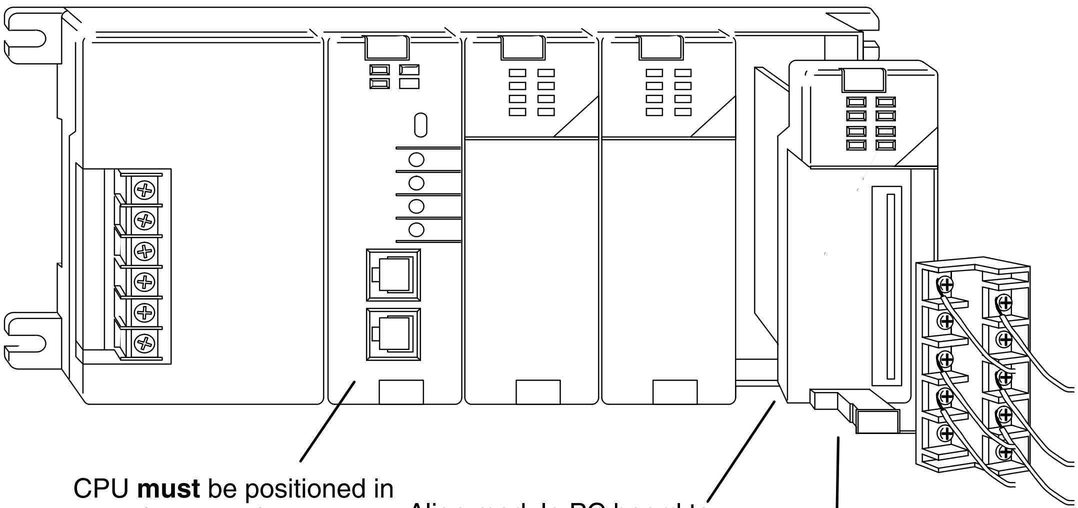
DIN Rail Dimensions

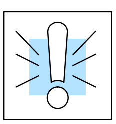




Installing Components in the Base

To insert components into the base: first slide the module retaining clips to the out position and align the PC board(s) of the module with the grooves on the top and bottom of the base. Push the module straight into the base until it is firmly seated in the backplane connector. Once the module is inserted into the base, push in the retaining clips to firmly secure the module to the base.





WARNING: Minimize the risk of electrical shock, personal injury, or equipment damage, always disconnect the system power before installing or removing any system component.

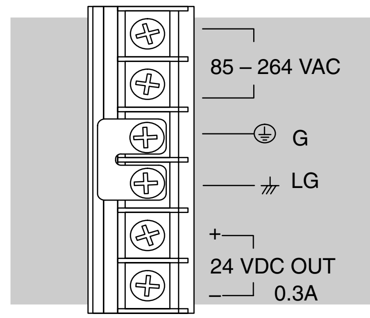
Base Wiring Guidelines

Base Wiring

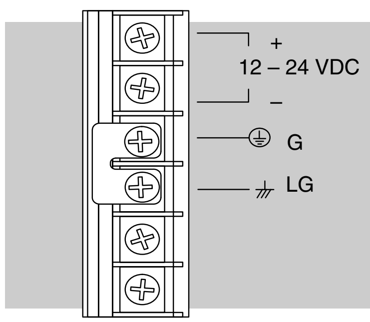
The diagrams show the terminal connections located on the power supply of the DL205 bases. The base terminals can accept up to 16 AWG. You may be able to use larger wiring depending on the type of wire used, but 16 AWG is the recommended size. Do not overtighten the connector screws; recommended torque value is 7.81 pound-inches (0.882 N•m).

NOTE: You can connect either a 115 VAC or 220 VAC supply to the AC terminals. Special wiring or jumpers are not required as with some of the other ***Direct***LOGIC™ products.

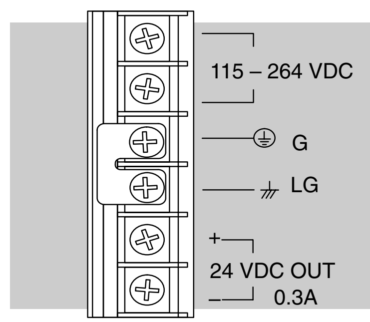
110/220 VAC Base Terminal Strip

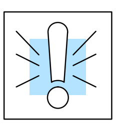


12/24 VDC Base Terminal Strip



125 VDC Base Terminal Strip



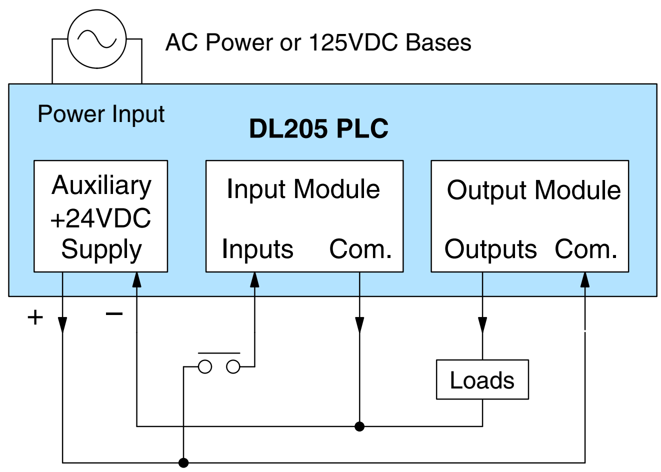


WARNING: Once the power wiring is connected, install the plastic protective cover. When the cover is removed there is a risk of electrical shock if you accidentally touch the wiring or wiring terminals.

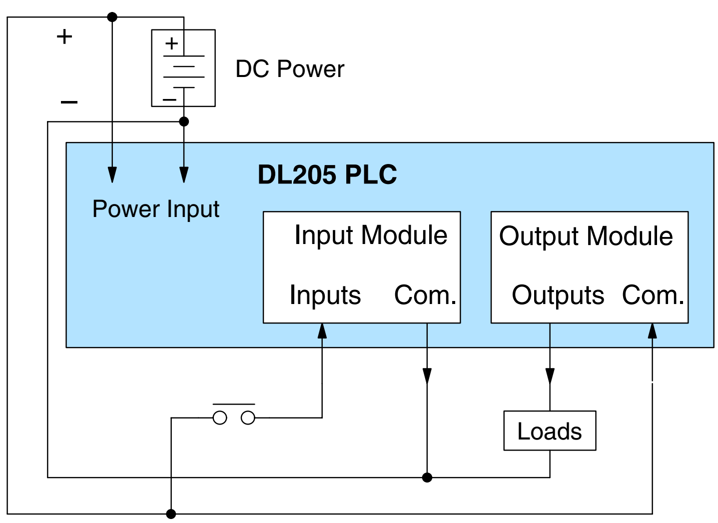
In some cases, using the built-in auxiliary +24VDC supply can result in a cost savings for your control system. It can power combined loads up to 300mA. Be careful not to exceed the current rating of the supply. If you are the system designer for your application, you may be able to select and design in field devices which can use the +24VDC auxiliary supply.

Powering I/O Circuits with the Auxiliary Supply

All AC powered and 125VDC DL205 bases feature the internal auxiliary supply. If input devices AND output loads need +24VDC power, the auxiliary supply may be able to power both circuits as shown in the following diagram.



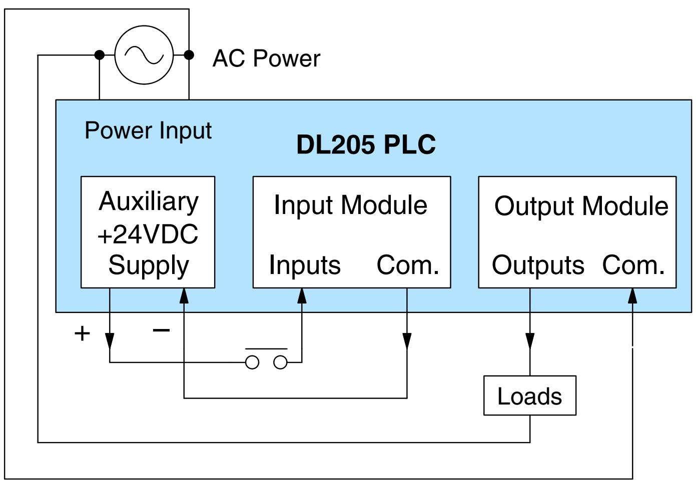
12/24VDC powered DL205 bases are designed for application environments in which low-voltage DC power is more readily available than AC. These include a wide range of battery–powered applications, such as remotely-located control, in vehicles, portable machines, etc. For this application type, all input devices and output loads typically use the same DC power source. Typical wiring for DC-powered applications is shown in the following diagram.

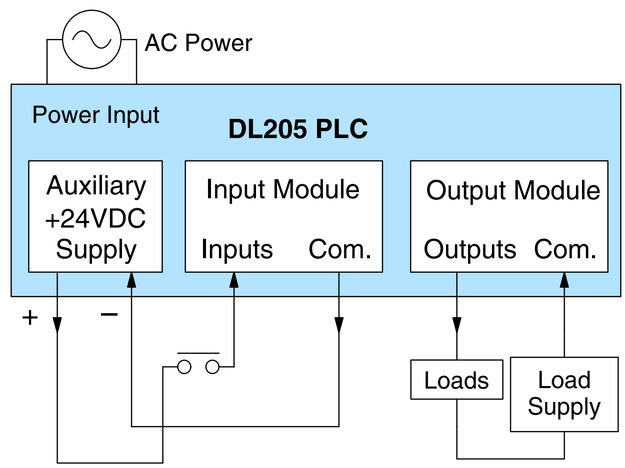


Powering I/O Circuits Using Separate Supplies

In most applications it will be necessary to power the input devices from one power source, and to power output loads from another source. Loads often require high-energy AC power, while input sensors use low-energy DC. If a machine operator is likely to come in close contact with input wiring, then safety reasons also require isolation from high-energy output circuits. It is most convenient if the loads can use the same power source as the PLC, and the input sensors can use the auxiliary supply, as shown to the left in the figure below.

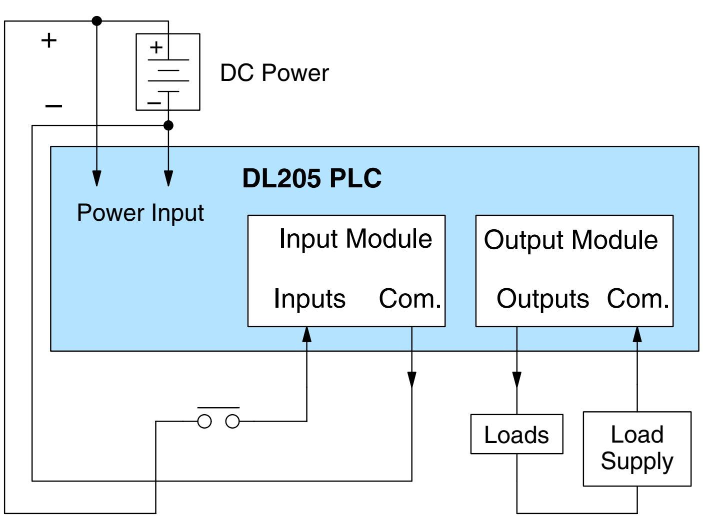
If the loads cannot be powered from the PLC supply, then a separate supply must be used as shown to the right in the figure below.

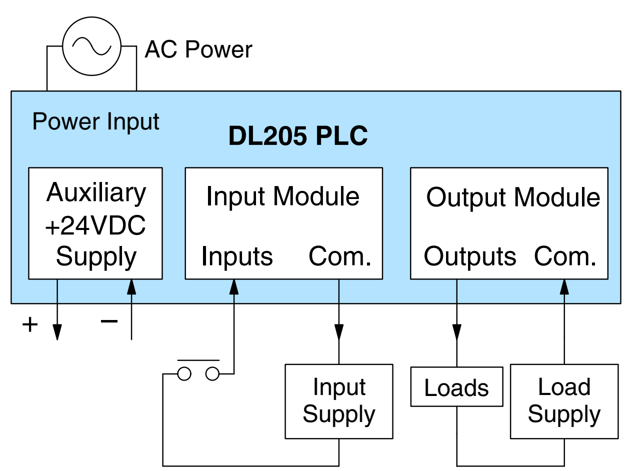




Some applications will use the PLC external power source to also power the input circuit. This typically occurs on DC-powered PLCs, as shown in the drawing below to the left. The inputs share the PLC power source supply, while the outputs have their own separate supply.

A worst-case scenario, from a cost and complexity view-point, is an application which requires separate power sources for the PLC, input devices, and output loads. The example wiring diagram below on the right shows how this can work, but also the auxiliary supply output is an unused resource. You will want to avoid this situation if possible.





Sinking / Sourcing Concepts

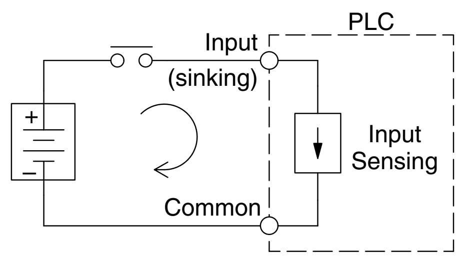
Before going further in the study of wiring strategies, you must have a solid understanding of "*sinking*" and "*sourcing*" concepts. Use of these terms occurs frequently in input or output circuit discussions. It is the goal of this section to make these concepts easy to understand, further ensuring your success in installation. First the following short definitions are provided, followed by practical applications.

Sinking = provides a path to supply **ground (–)**

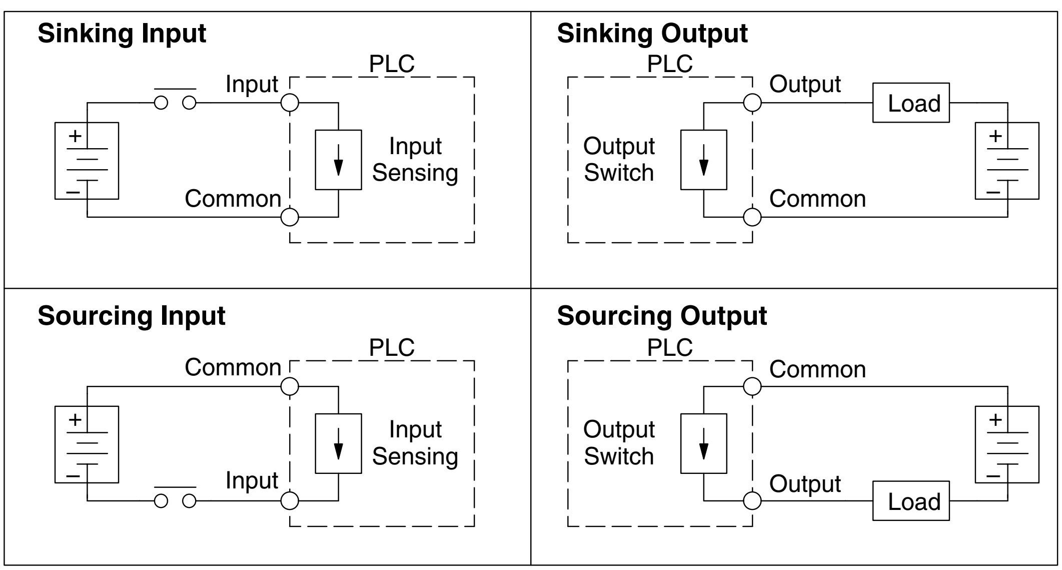
Sourcing = provides a path to supply **source (+)**

First you will notice these are only associated with DC circuits and not AC, because of the reference to (+) and (–) polarities. Therefore, *sinking and sourcing terminology only applies to DC input and output circuits.* Input and output points that are sinking or sourcing *only* can conduct current in only one direction. This means it is possible to connect the external supply and field device to the I/O point with current trying to flow in the wrong direction, and the circuit will not operate. However, you can successfully connect the supply and field device every time by understanding "sourcing" and "sinking".

For example, the figure to the right depicts a "sinking" input. To properly connect the external supply, you will have to connect it so the input *provides a path to ground (–)*. Start at the PLC input terminal, follow through the input sensing circuit, exit at the common terminal, and connect the supply (–) to the common terminal. By adding the switch, between the supply (+) and the input, the circuit has been completed . Current flows in the direction of the arrow when the switch is closed.

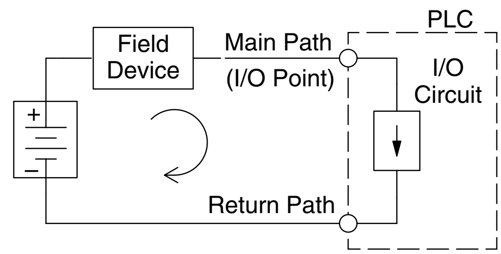


By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types as shown below. The I/O module specifications at the end of this chapter list the input or output type.

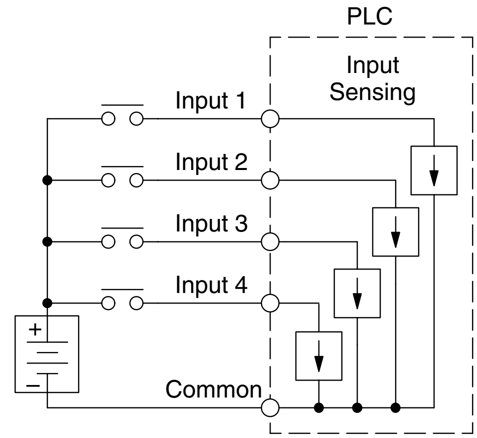


I/O "Common" Terminal Concepts

In order for a PLC I/O circuit to operate, current must enter at one terminal and exit at another. Therefore, at least two terminals are associated with every I/O point. In the figure to the right, the Input or Output terminal is the *main path* for the current. One additional terminal must provide the *return path* to the power supply.



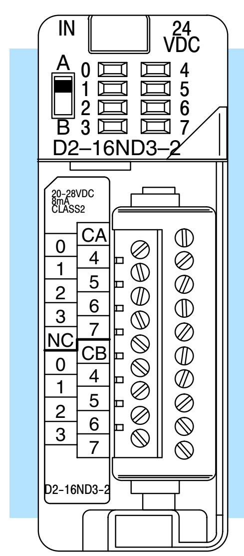
If there was unlimited space and budget for I/O terminals, every I/O point could have two dedicated terminals as the figure above shows. However, providing this level of flexibility is not practical or even necessary for most applications. So, most Input or Output points on PLCs are in groups which share the return path (called *commons*). The figure to the right shows a group (or *bank*) of 4 input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.

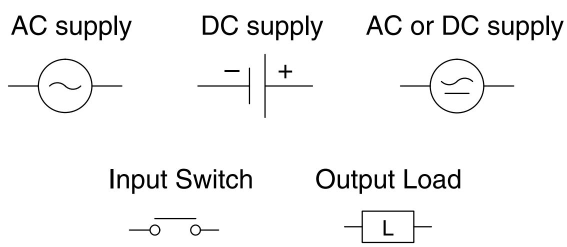


NOTE: In the circuit above, the current in the common path is 4 times any channel's input current when all inputs are energized. This is especially important in output circuits, where heavier gauge wire is sometimes necessary on commons.

Most DL205 input and output modules group their I/O points into banks that share a common return path. The best indication of I/O common grouping is on the wiring label, such as the one shown to the right. The miniature schematic shows two circuit banks with eight input points in each. The common terminal for each is labeled "CA" and "CB", respectively.

In the wiring label example, the positive terminal of a DC supply connects to the common terminals. Some symbols you will see on the wiring labels, and their meanings are:



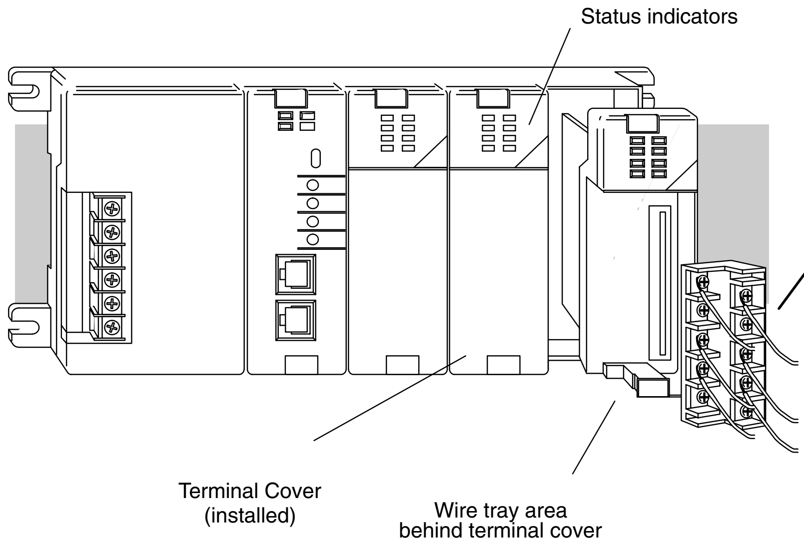


Special Placement Considerations for Analog Modules

In most cases, the analog modules can be placed in any slot. However, the placement can also depend on the type of CPU you are using and the other types of modules installed *to the left* of the analog modules. If you're using a DL230 CPU (or a DL240 CPU with firmware earlier than V1.4) you should check the DL205 Analog I/O Manual for any possible placement restrictions related to your particular module. You can order the DL205 Analog I/O Manual by ordering part number D2–ANLG–M.

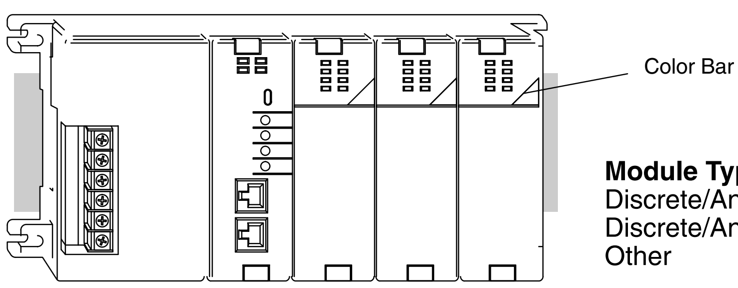
Discrete Input Module Status Indicators

The discrete modules provide LED status indicators to show the status of the input points.



Color Coding of I/O Modules

The DL205 family of I/O modules have a color coding scheme to help you quickly identify if a module is either an input module, output module, or a specialty module. This is done through a color bar indicator located on the front of each module. The color scheme is listed below:



Module Type	Color Code
Discrete/Analog Output	Red
Discrete/Analog Input	Blue
Other	White

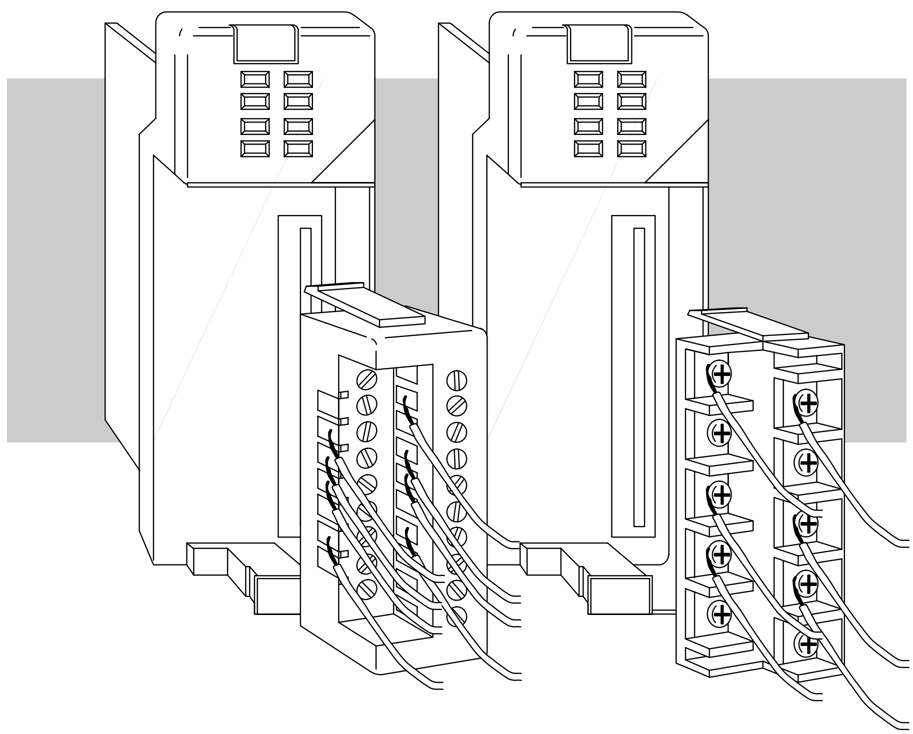
Wiring the Different Module Connectors

There are two types of module connectors for the DL205 I/O. Some modules have normal screw terminal connectors. Other modules have connectors with recessed screws. The recessed screws help minimize the risk of someone accidentally touching active wiring.

Both types of connectors can be easily removed. If you examine the connectors closely, you'll notice there are squeeze tabs on the top and bottom. To remove the terminal block, press the squeeze tabs and pull the terminal block away from the module.

We also have DIN rail mounted terminal blocks, DINnectors (refer to our catalog for a complete listing of all available products). ZIPLinks come with special pre–assembled cables with the I/O connectors installed and wired.

WARNING: For some modules, field device power may still be present on the terminal block even though the PLC system is turned off. To minimize the risk of electrical shock, check all field device power *before* you remove the connector.



I/O Wiring Checklist

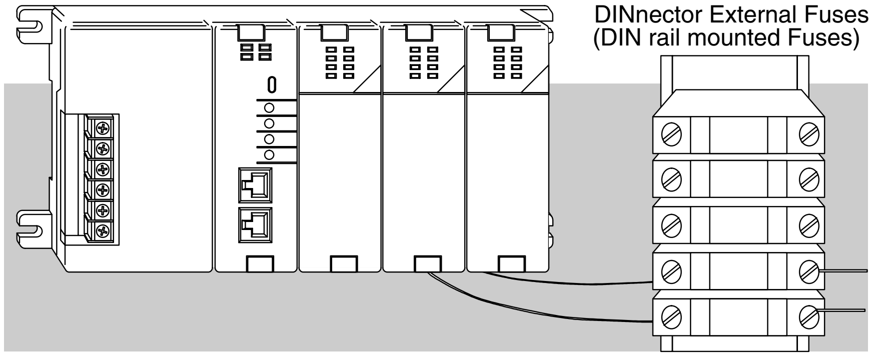
Use the following guidelines when wiring the I/O modules in your system.

1. There is a limit to the size of wire the modules can accept. The table below lists the **suggested** AWG for each module type. When making terminal connections, follow the suggested torque values.

Module type	Suggested AWG Range	Suggested Torque
4 point	16* – 24 AWG	7.81 lb-inch (0.882 N•m)
8 point	16* – 24 AWG	7.81 lb-inch (0.882 N•m)
12 point	16* – 24 AWG	2.65 lb-in (0.3 N•m)
16 point	16* – 24 AWG	2.65 lb-in (0.3 N•m)

***NOTE: 16 AWG Type TFFN or Type MTW is recommended**. Other types of 16 AWG may be acceptable, but it really depends on the thickness and stiffness of the wire insulation. **If the insulation is too thick or stiff and a majority of the module's I/O points are used, then the plastic terminal cover may not close properly or the connector may pull away from the module. This applies especially for high temperature thermoplastics such as THHN.**

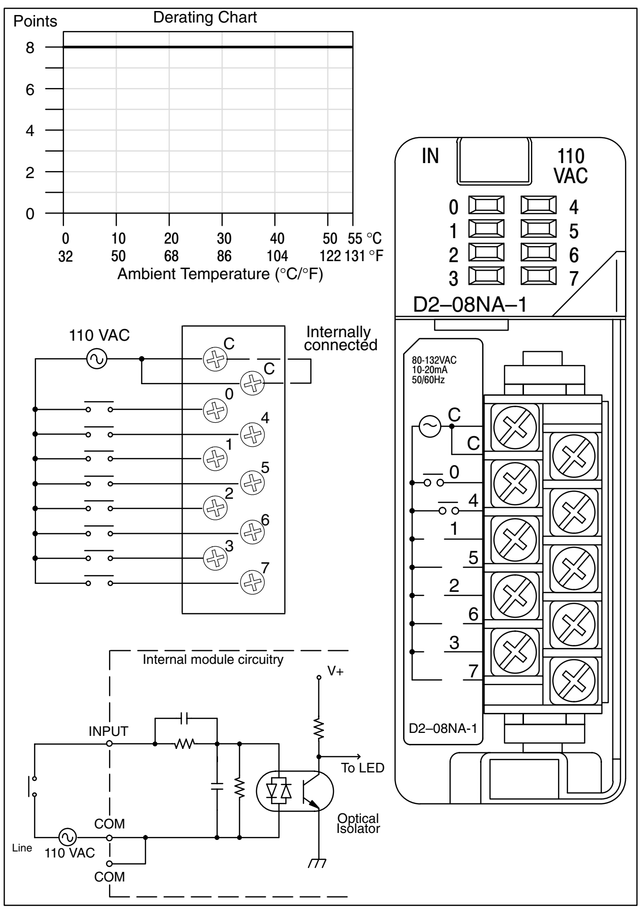
2. Always use a continuous length of wire, do not combine wires to attain a needed length.
3. Use the shortest possible wire length.
4. Use wire trays for routing where possible.
5. Avoid running wires near high energy wiring. Also, avoid running input wiring close to output wiring where possible.
6. To minimize voltage drops when wires must run a long distance , consider using multiple wires for the return line.
7. Avoid running DC wiring in close proximity to AC wiring where possible.
8. Avoid creating sharp bends in the wires.
9. To reduce the risk of having a module with a blown fuse, we suggest you add external fuses to your I/O wiring. A fast blow fuse, with a lower current rating than the I/O module fuse can be added to each common, or a fuse with a rating of slightly less than the maximum current per output point can be added to each output. Refer to our catalog for a complete line of DINnectors, DIN rail mounted fuse blocks.



NOTE: For modules which have soldered or non-replaceable fuses, we recommend you return your module to us and let us replace your blown fuse(s) since disassembling the module will void your warranty.

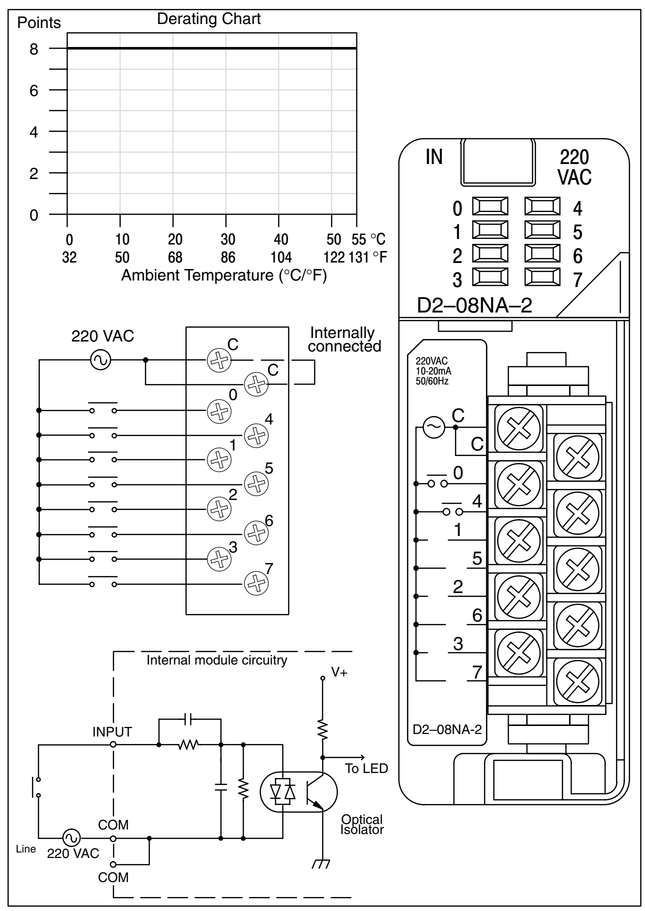
D2–08NA-1 AC Input

Inputs per module	8
Commons per module	1 (2 I/O terminal points)
Input voltage range	80–132 VAC
Peak voltage	132 VAC
AC frequency	47–63 Hz
ON voltage level	75 VAC minimum
OFF voltage level	20 VAC maximum
Input impedance	12K @ 60 Hz
Input current	13mA @ 100VAC, 60Hz 11mA @ 100VAC, 50Hz
Minimum ON current	5 mA
Maximum OFF current	2 mA
Base power required	50 mA Max
OFF to ON response	5 to 30 ms
ON to OFF response	10 to 50 ms
Terminal type	Removable
Status indicator	Logic side
Weight	2.5 oz. (70 g)



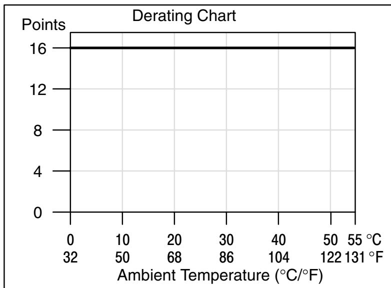
D2–08NA–2 AC Input

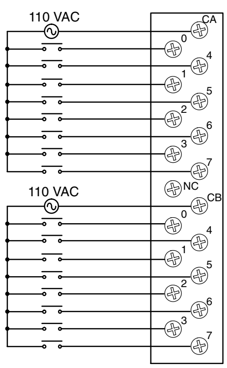
Inputs per module	8
Commons per module	2 (internally connected)
Input voltage range	170–265 VAC
Peak voltage	265 VAC
AC frequency	47–63 Hz
ON voltage level	150 VAC minimum
OFF voltage level	40 VAC maximum
Input impedance	18K @ 60 Hz
Input current	9mA @ 220VAC, 50Hz 11mA @ 265VAC, 60Hz 10mA @ 220VAC, 60Hz 12mA @ 265VAC, 60Hz
Minimum ON current	10 mA
Maximum OFF current	2 mA
Base power required	100 mA Max
OFF to ON response	5 to 30 ms
ON to OFF response	10 to 50 ms
Terminal type	Removable
Status indicator	Logic side
Weight	2.5 oz. (70 g)

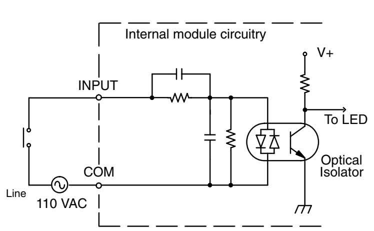


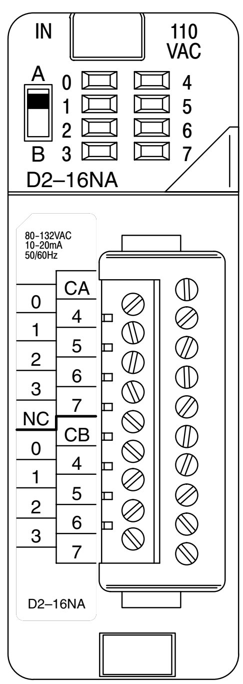
D2–16NA AC Input

Inputs per module	16
Commons per module	2 (isolated)
Input voltage range	80–132 VAC
Peak voltage	132 VAC
AC frequency	47–63 Hz
ON voltage level	70 VAC minimum
OFF voltage level	20 VAC maximum
Input impedance	12K @ 60 Hz
Input current	11mA @ 100VAC, 50Hz 13mA @ 100VAC, 60Hz 15mA @ 132VAC, 60Hz
Minimum ON current	5 mA
Maximum OFF current	2 mA
Base power required	100 mA Max
OFF to ON response	5 to 30 ms
ON to OFF response	10 to 50 ms
Terminal type	Removable
Status indicator	Logic side
Weight	2.4 oz. (68 g)





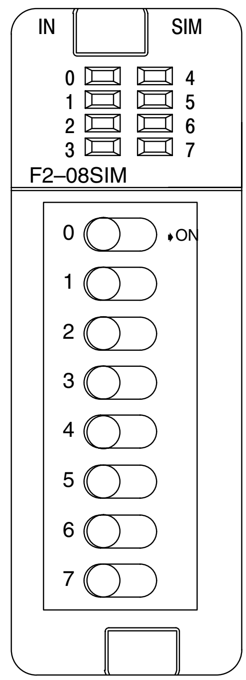




When the AB switch is in the A position, the LEDs display the input status of the module's first 8 input points. Positon B displays the input status of the module's second group of 8 input points.

F2–08SIM Input Simulator

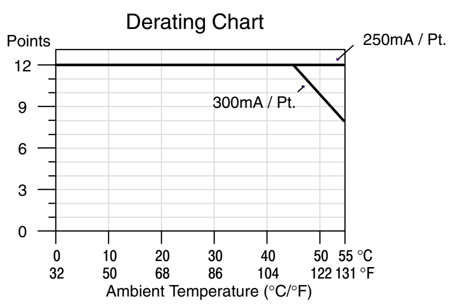
Inputs per module	8
Base power required	50 mA Max
Terminal type	None
Status indicator	Switch side
Weight	2.65 oz. (75 g)



D2–12TA AC Output

Outputs per module	12
Output Points Consumed	16 (4 unused, see chart below)
Commons per module	2 (isolated)
Operating voltage	15–132 VAC
Output type	SSR (Triac)
Peak voltage	132 VAC
AC frequency	47 to 63 Hz
ON voltage drop	< l.5 VAC (> 50mA) < 4.0 VAC (< 50mA)
Max load current	0.3A / point, 1.8A / common

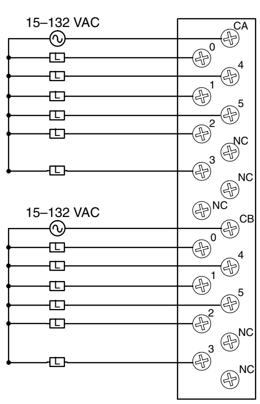
Max leakage current	2mA (132VAC, 60Hz)
Max inrush current	10A for 10 ms
Minimum load	10 mA
Base power required	350 mA Max
OFF to ON response	1 ms
ON to OFF response	1 ms +1/2 cycle
Terminal type	Removable
Status indicators	Logic Side
Weight	3.8 oz. (110 g)
Fuses	(2) 1 per common 3.15A slow blow, replaceable Order D2–FUSE–1 (5 per pack)

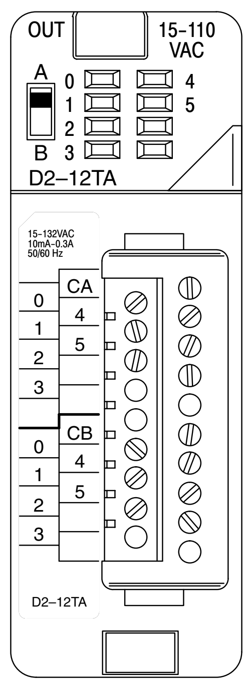


Addresses Used

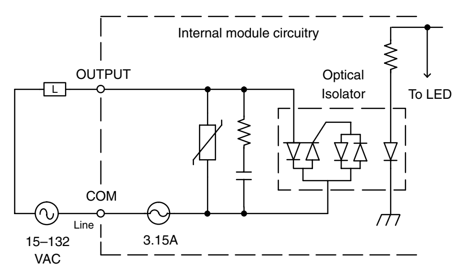
Points	Used?	Points	Used?
Yn+0	Yes	Yn+10	Yes
Yn+1	Yes	Yn+11	Yes
Yn+2	Yes	Yn+12	Yes
Yn+3	Yes	Yn+13	Yes
Yn+4	Yes	Yn+14	Yes
Yn+5	Yes	Yn+15	Yes
Yn+6	No	Yn+16	No
Yn+7	No	Yn+17	No

n is the starting address





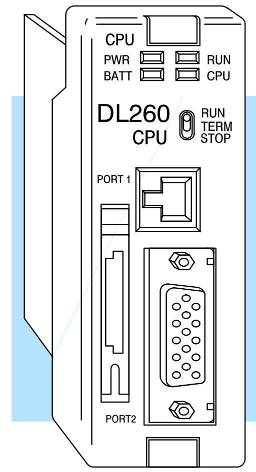
When the AB switch is in the A position, the LEDs display the output status of the module's first 6 output points. Positon B displays the output status of the module's second group of 6 output points.



Overview

The CPU is the heart of the control system. Almost all system operations are controlled by the CPU, so it is important that it is set-up and installed correctly. This chapter provides the information needed to understand:

- the differences between the different models of CPUs
- the steps required to setup and install the CPU



General CPU Features

The DL230, DL240, DL250–1 and D2–260 are modular CPUs which can be installed in 3, 4, 6, or 9 slot bases. All I/O modules in the DL205 family will work with any of the CPUs. The DL205 CPUs offer a wide range of processing power and program instructions. All offer RLL and Stage program instructions (See Chapter 5). They also provide extensive internal diagnostics that can be monitored from the application program or from an operator interface.

DL230 CPU Features

The DL230 has 2.4K words of memory comprised of 2.0K of ladder memory and approximately 400 words of V-memory (data registers). It has 90 different instructions available for programming, and supports a maximum of 256 I/O points.

Program storage is in the EEPROM which is installed at the factory. In addition to the EEPROM there is also RAM on the CPU which will store system parameters, V-memory, and other data which is not in the application program.

The DL230 provides one built-in RS232C communication port, so you can easily connect a handheld programmer or a personal computer without needing any additional hardware.

DL240 CPU Features

The DL240 has a maximum of 3.8K of memory comprised of 2.5K of ladder memory and approximately 1.3K of V-memory (data registers). There are129 instructions available for program development and a maximum of 256 points local I/O and 896 points with remote I/O are supported.

Program storage is in the EEPROM which is installed at the factory. In addition to the EEPROM there is also RAM on the CPU which will store system parameters, V-memory and other data which is not in the application program.

The DL240 has two communication ports. The top port is the same port configuration as the DL230. The bottom port also supports the ***Direct***NET protocol, so you can use the DL240 in a ***Direct***NET network. Since the port is RS232C, you must use an RS232C/RS422 converter for multi-drop connections.

DL250–1 CPU Features

The DL250–1 replaces the DL250 CPU. It offers all the DL240 features, plus more program instructions, a built–in Remote I/O Master port. It offers all the features of the DL250 CPU with the addition of supporting Local expansion I/O. It has a maximum of 14.8K of program memory comprised of 7.6K of ladder memory and 7.2K of V-memory (data registers). It supports a maximum of 256 points of local I/O and a maximum of 768 I/O points (max. of two local expansion bases). In addition, port 2 supports up to 2048 points if you use the DL250–1 as a Remote master. It includes an internal RISC–based microprocessor for greater processing power. The DL250–1 has 174 instructions. The additional instructions to the DL240 instruction set include drum timers, a print function, floating point math, and PID loop control for 4 loops.

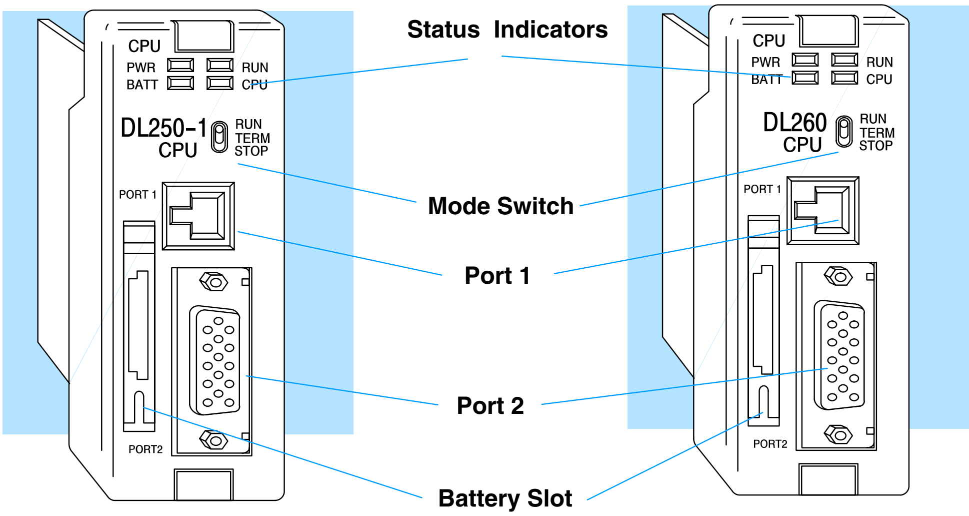
The DL250–1 has a total of two built–in communications ports. The top port is identical to the top port of the DL240/DL250 with the exception of ***Direct***Net slave feature. The bottom port is a 15–pin RS232C/RS422 port. It will interface with ***Direct***SOFT32, and operator interfaces, and provides ***DirectNet*** and MODBUS RTU Master/Slave connections.

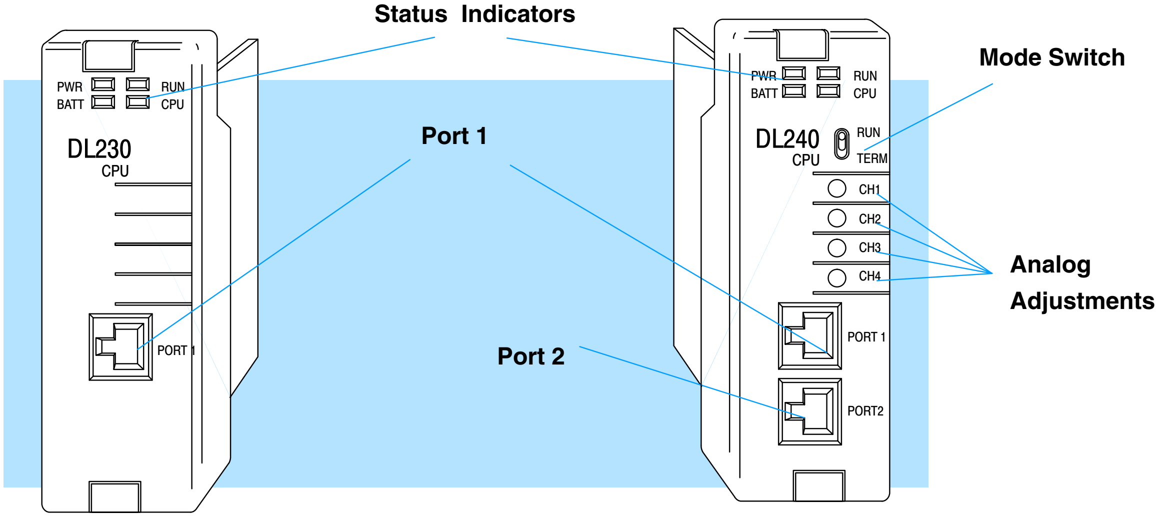
DL260 CPU Features

The DL260 offers all the DL250–1 features, plus ASCII IN/OUT and expanded MODBUS instructions. It also supports up to 1280 local I/O points by using up to four local expansion bases. It has a maximum of 30.4K of program memory comprised of 15.8K of ladder memory and 14.6K of V-memory (data registers). It also includes an internal RISC–based microprocessor for greater processing power. The DL260 has 231 instructions. The additional instructions to the DL250–1 instruction set includes table instructions, trigonometric instructions and support for 16 PID loops.

The DL260 has a total of two built–in communications ports. The top port is identical to the top port of the DL250–1. The bottom port is a 15–pin RS232C/RS422/RS485 port. It will interface with ***Direct***SOFT32 (version 4.0 or later), operator interfaces, and provides ***DirectNet***, MODBUS RTU Master/Slave connections. Port 2 is also support ASCII IN/OUT instructions.

CPU Hardware Features





Mode Switch Functions

The mode switch on the DL240, DL250–1 and DL260 CPUs provide positions for enabling and disabling program changes in the CPU. Unless the mode switch is in the TERM position, RUN and STOP mode changes will not be allowed by any interface device, (handheld programmer, ***Direct***SOFT32 programing package or operator interface). Programs may be viewed or monitored but no changes may be made. If the switch is in the TERM position and no program password is in effect, all operating modes as well as program access will be allowed through the connected programming or monitoring device.

Modeswitch Position	CPU Action
RUN (Run Program)	CPU is forced into the RUN mode if no errors are encountered. No changes are allowed by the attached programming/monitoring device.
TERM (Terminal)	RUN, PROGRAM and the TEST modes are available. Mode and program changes are allowed by the programming/monitoring device.
STOP (DL250–1 and DL260 only Stop Program)	CPU is forced into the STOP mode. No changes are allowed by the programming/monitoring device.

There are two ways to change the CPU mode.

1. Use the CPU mode switch to select the operating mode.
2. Place the CPU mode switch in the TERM position and use a programming device to change operating modes. In this position, you can change between Run and Program modes.

NOTE: If the CPU is switched to the RUN Mode without a program in the PLC, the PLC will produce a FATAL ERROR which can be cleared by cycling the power to the PLC.

Status Indicators

The status indicator LEDs on the CPU front panels have specific functions which can help in programming and troubleshooting.

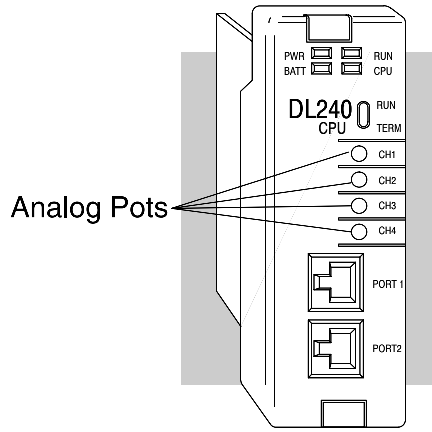
Indicator	Status	Meaning
PWR	ON	Power good
	OFF	Power failure
RUN	ON	CPU is in Run Mode
	OFF	CPU is in Stop or program Mode
CPU	ON	CPU self diagnostics error
	OFF	CPU self diagnostics good
BATT	ON	CPU battery voltage is low
	OFF	CPU battery voltage is good or disabled

Adjusting the Analog Potentiometers

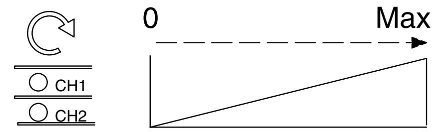
230	240	250–1	260
✗	✓	✗	✗

There are 4 analog potentiometers (pots) on the face plate of the DL240 CPU. These pots can be used to change timer constants, frequency of pulse train output, etc. Each analog channel has corresponding V-memory locations for setting lower and upper limits for each analog channel. The setup procedures are covered later in this chapter.

To increase the value associated with the analog pot, turn the pot clockwise. To decrease the value, turn the pot counter clockwise.

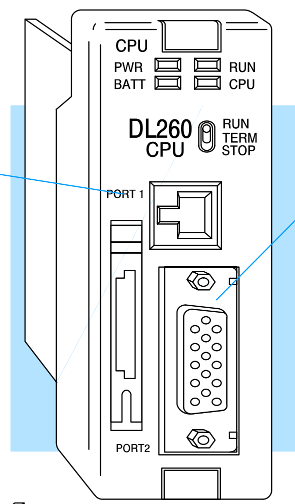


Turn clockwise to increase value



Communication Ports

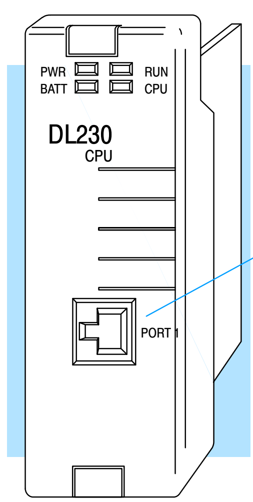
The DL240, DL250–1 and DL260 CPUs have two ports while the DL230 has only one.



Port 1
DL250–1 and DL260
6P6C Phone Jack
RS232C, 9600 baud
Communication Port
–K-sequence
–*Direct*NET™ slave
–MODBUS RTU slave
–easily connect *Direct*SOFT32, handhelds, operator interfaces, any *DirectNet* master

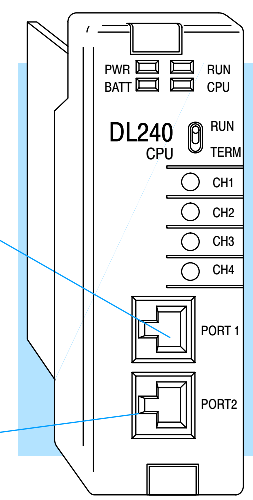
Port 2
DL250–1 and DL260
15-pin SVGA Connector
RS232C/RS422, up to 38.4K baud
Communication Port
–K-sequence
–*Direct*NET™ Master/Slave
–MODBUS RTU Master/Slave
–easily connect *Direct*SOFT32, handhelds, operator interfaces, any *DirectNet* or MODBUS master or slave

Port 2
Additional DL260 Features
–ASCII IN/OUT Instructions
–Extended MODBUS Instructions
–RS485 support



Port 1
6P6C Phone Jack
RS232C, 9600 baud
Communication Port
–K-sequence
–easily connect *Direct*SOFT, handhelds, operator interfaces, etc.

Port 2
6P6C Phone Jack
RS232C, up to 19.2K baud
Communication Port
–K-sequence
–*Direct*NET™ Slave
–easily connect *Direct*SOFT, handhelds, operator interfaces, or any *DirectNet* master

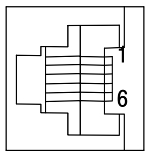


Port 1 Specifications

230	240	250–1	260
✓	✓	✗	✗

The operating parameters for Port 1 on the DL230 and DL240 CPUs are fixed.

- 6 Pin female modular (RJ12 phone jack) type connector
- K–sequence protocol (slave only)
- RS232C, 9600 baud
- Connect to ***Direct***SOFT32, D2–HPP, DV–1000, OI panels
- Fixed station address of 1
- 8 data bits, one stop
- Asynchronous, Half–duplex, DTE
- Odd parity



6-pin Female
Modular Connector

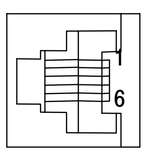
Port 1 Pin Descriptions (DL230 and DL240)		
1	0V	Power (–) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive Data (RS232C)
4	TXD	Transmit Data (RS232C
5	5V	Power (+) connection
6	0V	Power (–) connection (GND)

Port 1 Specifications

230	240	250–1	260
✗	✗	✓	✓

The operating parameters for Port 1 on the DL250–1 and DL260 CPU are fixed. This applies to the DL250 as well.

- 6 Pin female modular (RJ12 phone jack) type connector
- K–sequence protocol (slave only)
- ***Direct***Net (slave only)
- MODBUS RTU (slave only)
- RS232C, 9600 baud
- Connect to ***Direct***SOFT32, D2–HPP, DV1000 or ***DirectNet*** master
- 8 data bits, one start, one stop
- Asynchronous, Half–duplex, DTE
- Odd parity



6-pin Female
Modular Connector

Port 1 Pin Descriptions (DL250–1 and DL260)		
1	0V	Power (–) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive Data (RS232C)
4	TXD	Transmit Data (RS232C
5	5V	Power (+) connection
6	0V	Power (–) connection (GND)

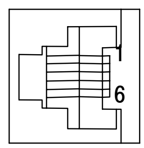
NOTE: The 5V pins are rated at 200mA maximum, primarilly for use with some operator interface units.

Port 2 Specifications

230	240	250–1	260
✗	✓	✗	✗

The operating parameters for Port 2 on the DL240 CPU is configurable using Aux functions on a programming device.

- 6 Pin female modular (RJ12 phone jack) type connector
- K–sequence protocol, ***Direct***Net (slave),
- RS232C, Up to 19.2K baud
- Address selectable (1–90)
- Connect to ***Direct*** SOFT32, D2–HPP, DV1000, MMI, or ***DirectNet*** master
- 8 data bits, one start, one stop
- Asynchronous, Half–duplex, DTE
- Odd or no parity



6-pin Female
Modular Connector

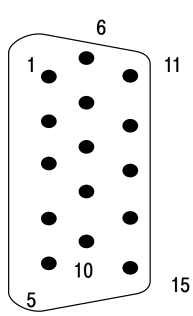
Port 2 Pin Descriptions (DL240 only)		
1	0V	Power (–) connection (GND)
2	5V	Power (+) connection (200mA max.)
3	RXD	Receive Data (RS232C)
4	TXD	Transmit Data (RS232C
5	RTS	Request to Send
6	0V	Power (–) connection (GND)

Port 2 Specifications

230	240	250–1	260
✗	✗	✓	✓

Port 2 on the DL250 and DL260 CPUs is located on the 15 pin D-shell connector. It is configurable using AUX functions on a programming device. This applies to the DL250 as well

- 15 Pin female D type connector
- Protocol: K sequence, ***DirectNet*** Master/Slave, MODBUS RTU Master/Slave, Remote I/O, (ASCII IN/OUT DL260 only)
- RS232C, non-isolated, distance within 15 m (approx. 50 feet)
- RS422, non-isolated, distance within 1000 m
- RS485, non–isolated, distance within 1000m (DL260 only)
- Up to 38.4K baud
- Address selectable (1–90)
- Connects to ***Direct***SOFT32, D2–HPP, operator interfaces, any ***DirectNet*** or MODBUS master/slave, (ASCII devices DL260 only)
- 8 data bits, one start, one stop
- Asynchronous, Half–duplex, DTE Remote I/O
- Odd/even/none parity



15-pin Female
D Connector

Port 2 Pin Descriptions (DL250–1 / DL260)		
1	5V	5 VDC
2	TXD2	Transmit Data (RS232C)
3	RXD2	Receive Data (RS232C)
4	RTS2	Ready to Send (RS–232C)
5	CTS2	Clear to Send (RS–232C)
6	RXD2–	Receive Data – (RS–422) (RS–485 DL260)
7	0V	Logic Ground
8	0V	Logic Ground
9	TXD2+	Transmit Data + (RS–422) (RS–485 DL260)
10	TXD2 –	Transmit Data – (RS–422) (RS–485 DL260)
11	RTS2 +	Request to Send + (RS–422) (RS–485 DL260)
12	RTS2 –	Request to Send – (RS–422)(RS–485 DL260)
13	RXD2 +	Receive Data + (RS–422) (RS–485 DL260)
14	CTS2 +	Clear to Send + (RS422) (RS–485 DL260)
15	CTS2 –	Clear to Send – (RS–422) (RS–485 DL260)

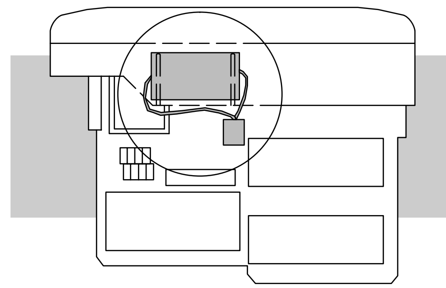
Using Battery Backup

An optional lithium battery is available to maintain the system RAM retentive memory when the DL205 system is without external power. Typical CPU battery life is five years, which includes PLC runtime and normal shutdown periods. However, consider installing a fresh battery if your battery has not been changed recently and the system will be shutdown for a period of more than ten days.

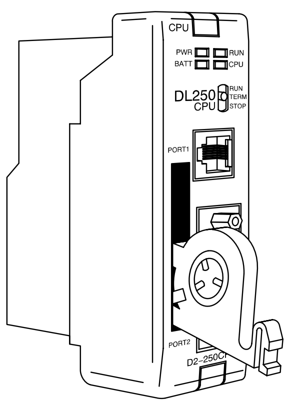
NOTE: Before installing or replacing your CPU battery, back-up your V-memory and system parameters. You can do this by using ***Direct***SOFT32 to save the program, V-memory, and system parameters to hard/floppy disk on a personal computer.

To install the D2–BAT CPU battery in DL230 or DL240 CPUs:

1. Gently push the battery connector onto the circuit board connector.
2. Push the battery into the retaining clip. Don't use excessive force. You may break the retaining clip.
3. Make a note of the date the battery was installed.



DL230 and DL240



DL250–1 and DL260

To install the D2–BAT–1 CPU battery in the DL250–1 / DL260 CPUs: (#CR2354)

1. Press the retaining clip on the battery door down and swing the battery door open.
2. Place the battery into the coin–type slot with the (+) side outward.
3. Close the battery door making sure that it locks securely in place.
4. Make a note of the date the battery was installed.

WARNING: Do not attempt to recharge the battery or dispose of an old battery by fire. The battery may explode or release hazardous materials.

Enabling the Battery Backup

In the DL205 CPUs, the battery can be enabled by setting bit 12 in V7633 On. In this mode the battery Low LED will come on when the battery voltage is less than 2.5VDC (SP43) and error E41 will occur. In this mode the CPU will maintain the data in C,S,T,CT, and V memory when power is removed from the CPU, provided the battery is good. The use of a battery can also determine which operating mode is entered when the system power is connected. See CPU Setup, which is discussed later in this chapter.

Even if you have installed a battery, the battery circuit can be disabled by turning off bit 12 in V7633. However, if you have a battery installed and select "No Battery" operation, the battery LED will not turn on if the battery voltage is low.

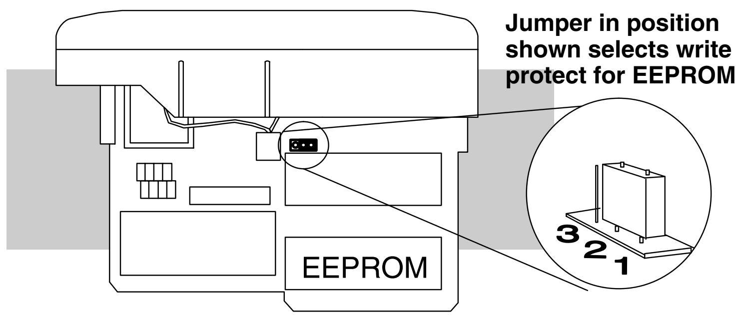
Selecting the Program Storage Media

Built-in EEPROM

230	240	250–1	260
✓	✓	×	×

The DL230 and DL240 CPUs provide built-in EEPROM storage. This type of memory is non-volatile and is not dependent on battery backup to retain the program. The EEPROM can be electrically reprogrammed without being removed from the CPU. You can also set Jumper 3, which will write protect the EEPROM. The jumper is set at the factory to *allow* changes to EEPROM. If you select write protection by changing the jumper position, you cannot make changes to the program.

WARNING: Do NOT change Jumper 2. This is for factory test operations. If you change Jumper 2, the CPU will not operate properly.



EEPROM Sizes

The DL230 and DL240 CPUs use different sizes of EEPROMs. The CPUs come from the factory with EEPROMs already installed. However, if you need extra EEPROMs, select one that is compatible with the following part numbers.

CPU Type	EEPROM Part Number	Capacity
DL230	Hitachi HN58C65P–25	8K byte (2Kw)
DL240	Hitachi HN58C256P–20	32K byte (3Kw)

EEPROM Operations

There are many AUX functions specifically for use with an EEPROM in the Handheld Programmer. This enables you to quickly and easily copy programs between a program developed offline in the Handheld and the CPU. Also, you can erase EEPROMs, compare them, etc. See the DL205 Handheld Programmer Manual for details on using these AUX functions with the Handheld Programmer.

NOTE: If the instructions are supported in *both* CPUs and the program size is within the limits of the DL230, you can move a program between the two CPUs. However, the EEPROM installed in the Handheld Programmer *must* be the same size (or larger) than the CPU being used. For example, you could not install a DL240 EEPROM in the Handheld Programmer and download the program to a DL230. Instead, if the program is within the size limits of the DL230, use a DL230 chip in the Handheld when you obtain the program from the DL240.

Setting the CPU Network Address

✗	✓	✓	✓
230	240	250–1	260

The DL240, DL250–1 and DL260 CPUs have built in ***DirectNet*** ports. You can use the Handheld Programmer to set the network address for the port and the port communication parameters. The default settings are:

- Station Address 1
- Hex Mode
- Odd Parity
- 9600 Baud

The ***DirectNet*** Manual provides additional information about choosing the communication settings for network operation.

Setting Retentive Memory Ranges

The DL205 CPUs provide certain ranges of retentive memory by default. The default ranges are suitable for many applications, but you can change them if your application requires additional retentive ranges or no retentive ranges at all. The default settings are:

Memory Area	DL230		DL240		DL250–1		DL260	
	Default Range	Avail. Range	Default Range	Avail. Range	Default Range	Avail. Range	Default Range	Avail. Range
Control Relays	C300 – C377	C0 – C377	C300 – C377	C0 – C377	C1000 – C1777	C0 – C1777	C1000 – C1777	C0 – C3777
V Memory	V2000 – V7777	V0 – V7777	V2000 – V7777	V0 – V7777	V1400 – V3777	V0 – V17777	V1400 – V3777	V0 – V37777
Timers	None by default	T0 – T77	None by default	T0 – T177	None by default	T0 – T377	None by default	T0 – T377
Counters	CT0 – CT77	CT0 – CT77	CT0 – CT177	CT0 – CT177	CT0 – CT177	CT0 – CT177	CT0 – CT377	CT0 – CT377
Stages	None by default	S0 – S377	None by default	S0 – S777	None by default	S0 – S1777	None by default	S0 – S1777

You can use AUX 57 to set the retentive ranges. You can also use ***Direct***SOFT32 menus to select the retentive ranges.

WARNING: The DL205 CPUs do not come with a battery. The super capacitor will retain the values in the event of a power loss, but only for a short period of time, depending on conditions. If the retentive ranges are important for your application, make sure you obtain the optional battery.

Password Protection

The DL205 CPUs allow you to use a password to help minimize the risk of unauthorized program and/or data changes. The DL240, DL250–1 and DL260 offer multi–level passwords for even more security. Once you enter a password you can “lock” the CPU against access. Once the CPU is locked you must enter the password before you can use a programming device to change any system parameters.

You can select an 8-digit numeric password. The CPUs are shipped from the factory with a password of 00000000. All zeros removes the password protection. If a password has been entered into the CPU you cannot enter all zeros to remove it. Once you enter the correct password, you can change the password to all zeros to remove the password protection.

For more information on passwords, see the appropriate appendix on auxiliary functions.

WARNING: Make sure you remember your password. If you forget your password you will not be able to access the CPU. The CPU must be returned to the factory to have the password removed.

Network Connections to MODBUS® and *Direct*Net

Configuring Port 2 For DirectNet

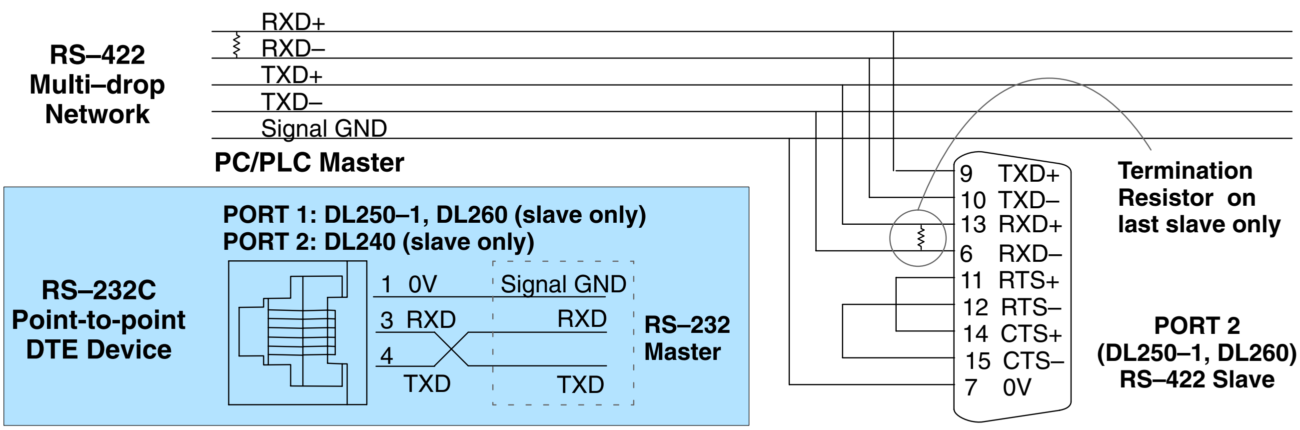
230	240	250–1	260
✗	✓	✓	✓

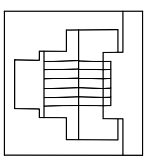
For MODBUS RTU

230	240	250–1	260
✗	✗	✓	✓

This section describes how to configure the CPU's built-in networking ports for either MODBUS or ***Direct***NET. This will allow you to connect the DL205 PLC system directly to MODBUS networks using the RTU protocol, or to other devices on a ***Direct***NET network. MODBUS hosts system on the network must be capable of issuing the MODBUS commands to read or write the appropriate data. For details on the MODBUS protocol, please refer to the Gould MODBUS Protocol reference Guide (P1–MBUS–300 Rev. J). In the event a more recent version is available, check with your MODBUS supplier before ordering the documentation. For more details on ***Direct***NET, order our ***Direct***NET manual, part number DA–DNET–M.

You will need to determine whether the network connection is a 3-wire RS–232 type, or a 5-wire RS–422 type. Normally, the RS–232 signals are used for shorter distances (15 meters max), for communications between two devices. RS–422 signals are for longer distances (1000 meters max.), and for multi-drop networks (from 2 to 247 devices). Use termination resistors at both ends of RS–422 network wiring, matching the impedance rating of the cable (between 100 and 500 ohms).

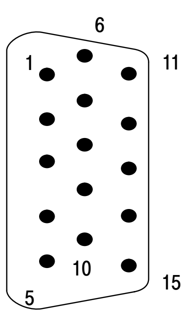




6-pin Female Modular Connector

Port 1 Pinouts (DL250–1 / DL260)		
1	0V	Power (–) connection (GND)
2	5V	Power (+) conection
3	RXD	Receive Data (RS232C)
4	TXD	Transmit Data (RS232C
5	5V	Power (+) conection
6	0V	Power (–) connection (GND)

Port 2 Pin Descriptions (DL240 only)		
1	0V	Power (–) connection (GND)
2	5V	Power (+) conection
3	RXD	Receive Data (RS232C)
4	TXD	Transmit Data (RS232C
5	RTS	Request to Send
6	0V	Power (–) connection (GND)



15-pin Female D Connector

Port 2 Pin Descriptions (DL250–1 / DL260)		
1	5V	5 VDC
2	TXD2	Transmit Data (RS232C)
3	RXD2	Receive Data (RS232C)
4	RTS2	Ready to Send (RS–232C)
5	CTS2	Clear to Send (RS–232C)
6	RXD2–	Receive Data – (RS–422) (RS–485 DL260)
7	0V	Logic Ground
8	0V	Logic Ground
9	TXD2+	Transmit Data + (RS–422) (RS–485 DL260)
10	TXD2 –	Transmit Data – (RS–422) (RS–485 DL260)
11	RTS2 +	Request to Send + (RS–422) (RS–485 DL260)
12	RTS2 –	Request to Send – (RS–422)(RS–485 DL260)
13	RXD2 +	Receive Data + (RS–422) (RS–485 DL260)
14	CTS2 +	Clear to Send + (RS422) (RS–485 DL260)
15	CTS2 –	Clear to Send – (RS–422) (RS–485 DL260)

The recommended cable for RS422 is Belden 9729 or equivalent.

Note: The DL260 supports **RS–485** multi–drop networking. See the Network Master Operation (DL260 0nly) section later in this chapter for details.

Hardware Maintenance

Standard Maintenance

The DL205 is a low maintenance system requiring only a few periodic checks to help reduce the risks of problems. Routine maintenance checks should be made regarding two key items.

- Air quality (cabinet temperature, airflow, etc.)
- CPU battery

Air Quality Maintenance

The quality of the air your system is exposed to can affect system performance. If you have placed your system in an enclosure, check to see that the ambient temperature is not exceeding the operating specifications. If there are filters in the enclosure, clean or replace them as necessary to ensure adequate airflow. A good rule of thumb is to check your system environment every one to two months. Make sure the DL205 is operating within the system operating specifications.

Low Battery Indicator

The CPU has a battery LED that indicates the battery voltage is low. You should check this indicator periodically to determine if the battery needs replacing. You can also detect low battery voltage from within the CPU program. SP43 is a special relay that comes on when the battery needs to be replaced. If you are using a DL240 CPU, you can also use a programming device or operator interface to determine the battery voltage. V7746 contains the battery voltage. For example, a value of 32 in V7746 would indicate a battery voltage of 3.2V.

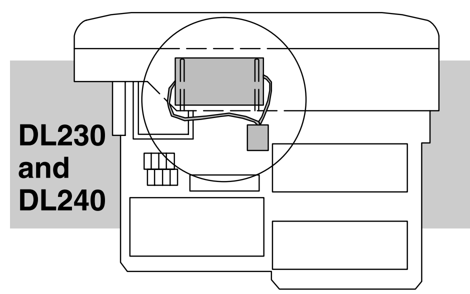
CPU Battery Replacement

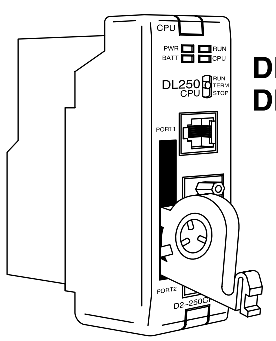
The CPU battery is used to retain program V memory and the system parameters. The life expectancy of this battery is five years.

NOTE: Before installing or replacing your CPU battery, back-up your V-memory and system parameters. You can do this by using ***Direct***SOFT32 to save the program, V-memory, and system parameters to hard/floppy disk on a personal computer.

To install the D2–BAT CPU battery in DL230 or DL240 CPUs:

1. Gently push the battery connector onto the circuit board connector.
2. Push the battery into the retaining clip. Don't use excessive force. You may break the retaining clip.
3. Make a note of the date the battery was installed.





**DL250–1
DL260**

To install the D2–BAT–1 CPU battery in the DL250–1 and DL260 CPUs: (#CR2354)

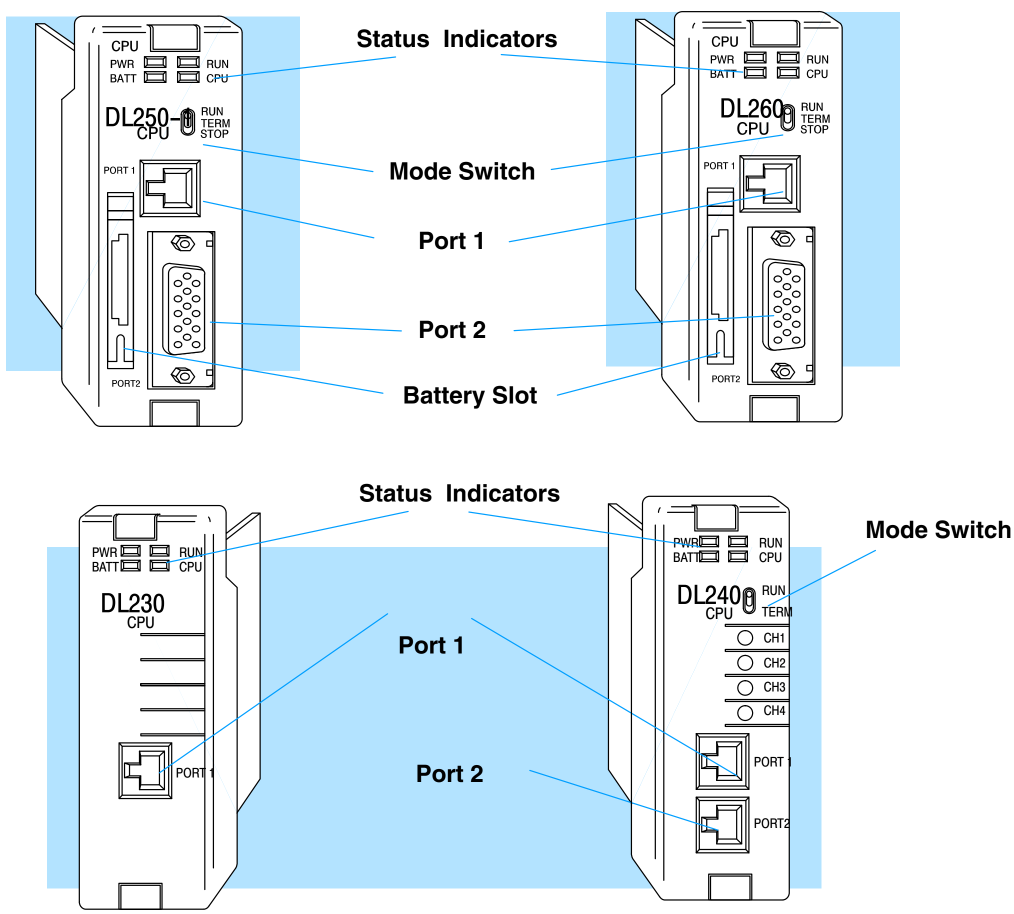
1. Press the retaining clip on the battery door down and swing the battery door open.
2. Remove old battery and insert the new battery into the coin–type slot with the larger (+) side outwards.
3. Close the battery door making sure that it locks securely in place.
4. Make a note of the date the battery was installed.

WARNING: Do not attempt to recharge the battery or dispose of an old battery by fire. The battery may explode or release hazardous materials.

CPU Indicators

The DL205 CPUs have indicators on the front to help you diagnose problems with the system. The table below gives a quick reference of potential problems associated with each status indicator. Following the table will be a detailed analysis of each of these indicator problems.

Indicator Status	Potential Problems
PWR (off)	1. System voltage incorrect. 2. Power supply/CPU is faulty 3. Other component such an I/O module has power supply shorted 4. Power budget exceeded for the base being used
RUN (will not come on)	1. CPU programming error 2. Switch in TERM position 3. Switch in STOP position (DL250–1, DL260 only)
CPU (on)	1. Electrical noise interference 2. CPU defective
BATT (on)	1. CPU battery low 2. CPU battery missing, or disconnected



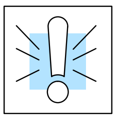
PWR Indicator

There are four general reasons for the CPU power status LED (PWR) to be OFF:

1. Power to the base is incorrect or is not applied.
2. Base power supply is faulty.
3. Other component(s) have the power supply shut down.
4. Power budget for the base has been exceeded.

Incorrect Base Power

If the voltage to the power supply is not correct, the CPU and/or base may not operate properly or may not operate at all. Use the following guidelines to correct the problem.



WARNING: To minimize the risk of electrical shock, always disconnect the system power before inspecting the physical wiring.

1. First, disconnect the system power and check all incoming wiring for loose connections.
2. If you are using a separate termination panel, check those connections to make sure the wiring is connected to the proper location.
3. If the connections are acceptable, reconnect the system power and measure the voltage at the base terminal strip to insure it is within specification. If the voltage is not correct shut down the system and correct the problem.
4. If all wiring is connected correctly and the incoming power is within the specifications required, the base power supply should be returned for repair.

Faulty CPU

There is not a good check to test for a faulty CPU other than substituting a known good one to see if this corrects the problem. If you have experienced major power surges, it is possible the CPU and power supply have been damaged. If you suspect this is the cause of the power supply damage, a line conditioner which removes damaging voltage spikes should be used in the future.

Device or Module causing the Power Supply to Shutdown

It is possible a faulty module or external device using the system 5V can shut down the power supply. This 5V can be coming from the base or from the CPU communication ports.

To test for a device causing this problem:

1. Turn off power to the CPU.
2. Disconnect all external devices (i.e., communication cables) from the CPU.
3. Reapply power to the system.

If the power supply operates normally you may have either a shorted device or a shorted cable. If the power supply does not operate normally then test for a module causing the problem by following the steps below:

If the PWR LED operates normally the problem could be in one of the modules. To isolate which module is causing the problem, disconnect the system power and remove one module at a time until the PWR LED operates normally.

Follow the procedure below:

- Turn off power to the base.
- Remove a module from the base.
- Reapply power to the base.

Bent base connector pins on the module can cause this problem. Check to see the connector is not the problem.

Power Budget Exceeded

If the machine had been operating correctly for a considerable amount of time prior to the indicator going off, the power budget is not likely to be the problem. Power budgeting problems usually occur during system start-up when the PLC is under operation and the inputs/outputs are requiring more current than the base power supply can provide.

WARNING: The PLC may reset if the power budget is exceeded. If there is any doubt about the system power budget please check it at this time. Exceeding the power budget can cause unpredictable results which can cause damage and injury. Verify the modules in the base operate within the power budget for the chosen base. You can find these tables in Chapter 4, Bases and I/O Configuration.

RUN Indicator

If the CPU will not enter the Run mode (the RUN indicator is off), the problem is usually in the application program, unless the CPU has a fatal error. If a fatal error has occurred, the CPU LED should be on. (You can use a programming device to determine the cause of the error.)

If you are using a DL240, DL250–1 or DL260 and you are trying to change the modes with a programming device, make sure the mode switch is in the TERM position.

Both of the programming devices, Handheld Programmer and ***Direct***SOFT32, will return a error message describing the problem. Depending on the error, there may also be an AUX function you can use to help diagnose the problem. The most common programming error is “Missing END Statement”. All application programs require an END statement for proper termination. A complete list of error codes can be found in Appendix B.

CPU Indicator

If the CPU indicator is on, a fatal error has occurred in the CPU. Generally, this is not a programming problem but an actual hardware failure. You can power cycle the system to clear the error. If the error clears, you should monitor the system and determine what caused the problem. You will find this problem is sometimes caused by high frequency electrical noise introduced into the CPU from an outside source. Check your system grounding and install electrical noise filters if the grounding is suspected. If power cycling the system does not reset the error, or if the problem returns, you should replace the CPU.

BATT Indicator

If the BATT indicator is on, the CPU battery is either disconnected or needs replacing. The battery voltage is continuously monitored while the system voltage is being supplied.

Communications Problems

If you cannot establish communications with the CPU, check these items.

- The cable is disconnected.
- The cable has a broken wire or has been wired incorrectly.
- The cable is improperly terminated or grounded.
- The device connected is not operating at the correct baud rate (9600 baud for the top port. Use AUX 56 to select the baud rate for the bottom port on a DL240, DL250–1 and DL260).
- The device connected to the port is sending data incorrectly.
- A grounding difference exists between the two devices.
- Electrical noise is causing intermittent errors.
- The CPU has a bad communication port and the CPU should be replaced.

If an error occurs the indicator will come on and stay on until a successful communication has been completed.

Noise Troubleshooting

Electrical Noise Problems

Noise is one of the most difficult problems to diagnose. Electrical noise can enter a system in many different ways and falls into one of two categories, conducted or radiated. It may be difficult to determine how the noise is entering the system but the corrective actions for either of the types of noise problems are similar.

- Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection ,etc. It may enter through an I/O module, a power supply connection, the communication ground connection, or the chassis ground connection.
- Radiated noise is when the electrical interference is introduced into the system without a direct electrical connection, much in the same manner as radio waves.

Reducing Electrical Noise

While electrical noise cannot be eliminated it can be reduced to a level that will not affect the system.

- Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible. Insure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system. Loose ground wires are more susceptible to noise than the other wires in your system. Review Chapter 2 Installation, Wiring, and Specifications if you have questions regarding how to ground your system.
- Electrical noise can enter the system through the power source for the CPU and I/O. Installing a isolation transformer for all AC sources can correct this problem. DC sources should be well grounded good quality supplies. Switching DC power supplies commonly generate more noise than linear supplies.
- Separate input wiring from output wiring. Never run I/O wiring close to high voltage wiring.

ELECTRIC LEVEL CONTROLS
PRODUCT DESCRIPTION

Scope Of This Manual:

This manual describes and provides instructions and parts lists for the LINC-L471, LINC-L471SC, LINC-LV471 and LINC-L971 Series Electric Level Controls.

Product Description:

Used as a high & low level control, the L471 & L471SC can activate alarms, provide a switch input for control systems, or perform a variety of desired electrical switch operations actuated by a liquid or liquid interface.

Operation:

As the float is moved by varying liquid height, a magnet is moved closer to or further away from a switch enclosure. As the magnet moves closer, a reed switch in the enclosure closes. As the magnet moves further away, the switch opens. The arm containing the magnet also acts as a counterweight for the float.

The float is small and will operate in liquids with a specific gravity as low as 0.4. The interface type float will operate with a specific gravity differential as low as 0.1. The small float permits an economical installation in locations where other controls would be cost prohibitive. With the optional relay mounted in an explosion-proof case, the control of larger electrical loads can be obtained. The manual override option allows the operator to manually move the float arm to the test switch position.

The SC Series is designed to eliminate the threaded control connection in mounting with the use of a bolted ring per API recommended practice RP14E. The external cage allows for installation of the control at any elevation.

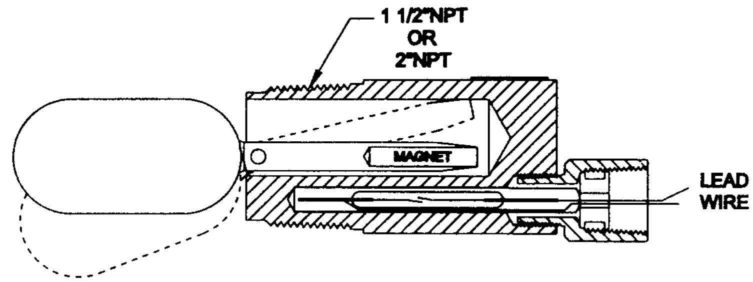


Figure 1

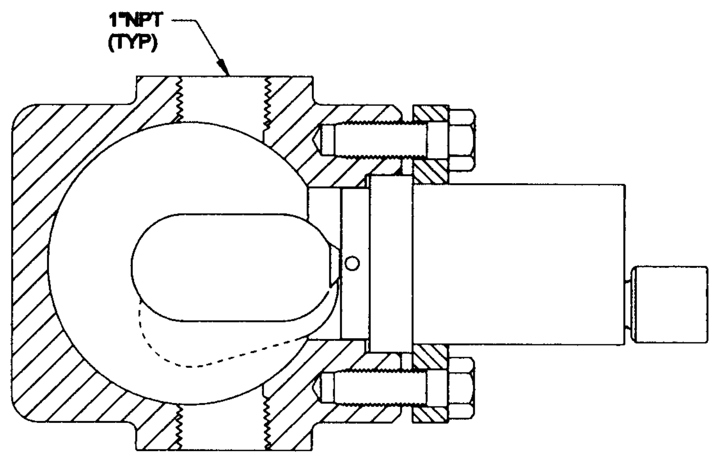


Figure 2

Features:

- *All wetted parts isolated from the environment. These level controls are safe even in the event of fire.*
- **Certified as explosion proof for Hazardous Locations: Class I, Div. 1, Groups A, B, C, D; Class II, Div. 1, Groups E, F, G; & Class III, Div. 1.*
- *All 316 stainless steel wetted parts provide corrosion resistance. Also available in Monel, Kynar and other plastics.*
- *Our sealed switch assembly prevents dust, dirt, or moisture from affecting the level control's operation. Classified "Factory Sealed" by CSA/NRTL/C.*
- *Cartridge switch assembly provides easy field replacement and servicing.*
- *High or low alarm, normally open or normally closed operation simply by inverting the level control.*

**When a relay assembly is used, Class I, Div. 1, is limited to groups C and D.*

Installation

Before installing the level control, inspect the unit for any damage. The float arm must pivot freely. Thread the level control into the desired connection. See Figure 3 for suggested installations. The float requires a minimum clearance of 1 1/4" from the center line of the unit for proper operation. For operation as a high level alarm, the conduit connection must be positioned to the lowest possible location. For operation as a low level alarm, the conduit connection must be positioned to the highest possible location. Wiring connections may now be made. Do not allow the wiring connections to pull on the switch assembly.

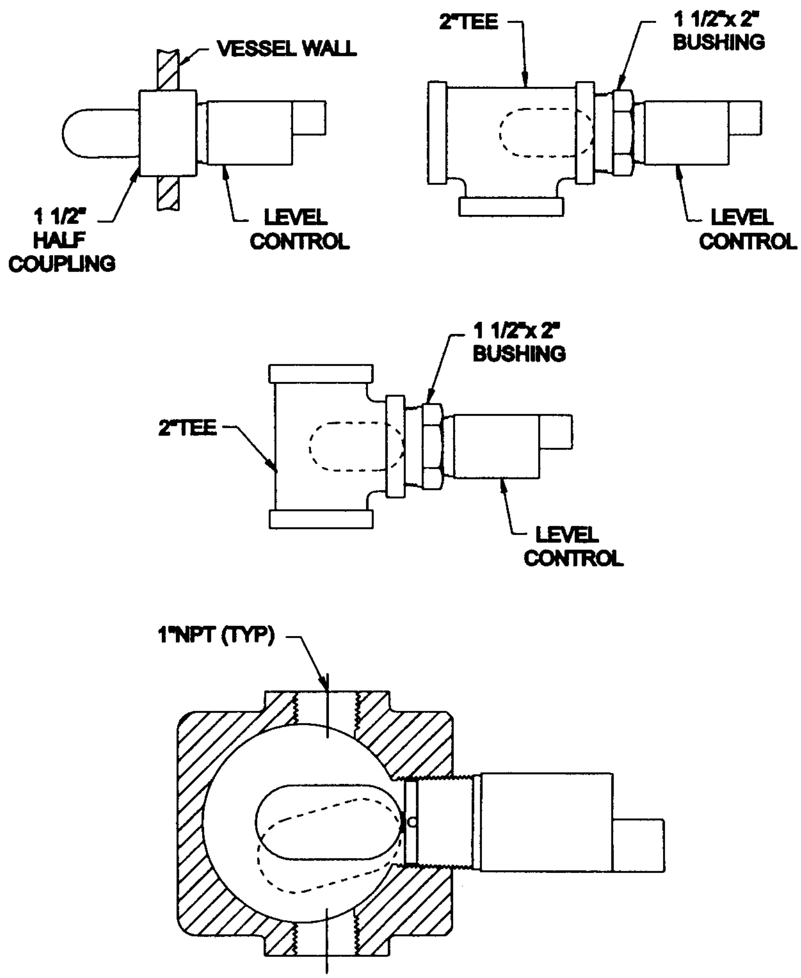


Figure 3

Caution: *Do not exceed switch ratings.*

LINC-L471, LINC-L471SC:
SPST, 100 VA AC with 3 AMP inrush capability, maximum 250 volts.

Breakdown voltage is 300 volts. Electrical ratings are given for resistive loads. For inductive loads, de-rate the switch rating by 50% and do not exceed the VA ratings on the inrush current. If the applied load is inductive, such as a relay or coil, then a protective device should be used to prevent "inductive kick," which may burn the switch contacts. The protective device recommended is dependent on the voltage used. For DC operation, a diode similar to an IN34A should be wired in parallel with the switch. See Figure 4, wiring schematic. For AC operation, a Varistor should be wired in parallel with the switch. Recommended Varistor for 110 VAC is a G.E. #V150-LA1 and for 220 VAC a G.E. #V300-LA2. See Figure 4, Wiring Schematic.

For SPDT Switch Cartridge Wiring:
White - Common
Black - Normally Closed
Red - Normally Open

Maintenance:

The LINC-L471 and LINC-L471SC Series electric level controls have been designed to be as maintenance free as possible. However, the component parts are subject to normal wear and must be inspected and replaced as necessary. Inspection and maintenance frequency depend upon the severity of service conditions. Instructions are provided in this section for maintaining the controls as units, i.e., float and float arm, relay and switch cartridge.

All the maintenance procedures below assume that the control has been removed from service. The switch and relay can be serviced with the control installed. The power must be disconnected before removing the relay enclosure cover or opening the conduit fitting.

Float & Float Arm:

Check the physical clearance for float operation. The float must swing freely. Solvent cleaning of the float arm chamber may be required if used in viscous or dirty liquids. If the float has collapsed or is perforated, unscrew the float from the float arm and replace with a new float. Use Loctite® to secure the float to the float arm. To remove the float arm, drive out the pivot pin using a 1/8" punch. When installing the float arm, make certain that the threaded offset of the float arm is against the thick wall of the body.

Relay:

To test for proper relay function, disconnect the switch leads from the relay socket. Apply appropriate voltage to the coil terminals and observe the relay contact closure with an ohmmeter connected across the common and normally closed contacts. Interrupt the coil power supply several times while observing the ohmmeter. No movement indicates a defective relay, coil or contacts. This procedure should be repeated for each set of contacts in service.

To remove a defective relay, simply pull the relay from the socket and replace with a new relay.

When ordering a replacement relay, be certain to specify coil voltage. After installing a new relay, reconnect the switch leads.

Switch:

To test for switch malfunction, connect an ohmmeter across the electrical leads and observe the meter as the float assembly is mechanically operated. No meter movement indicates a switch failure.

To replace a switch on the LINC-L471 or LINC-L471SC Series, pull out the switch cartridge along with the grommet through the conduit adapter. Slide the new switch cartridge into the body. Route the switch wired through the grommet and seat the grommet in the conduit adapter.

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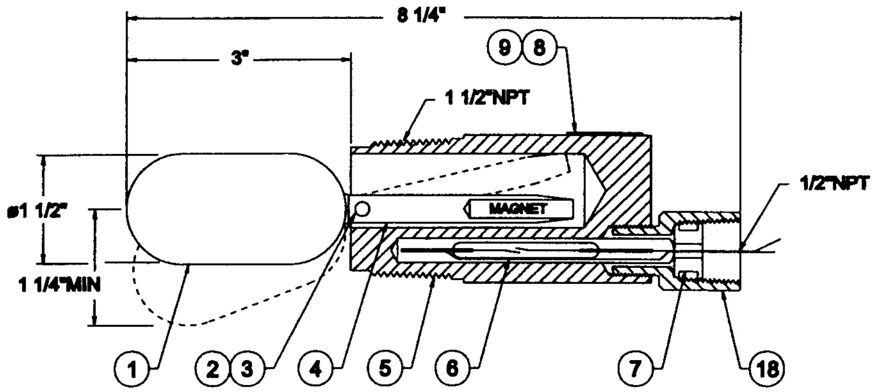
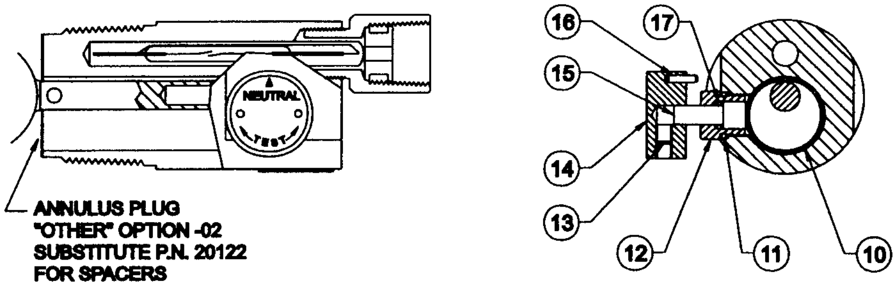
ELECTRIC LEVEL CONTROLS

L I N C - L 4 7 1 - 0 1



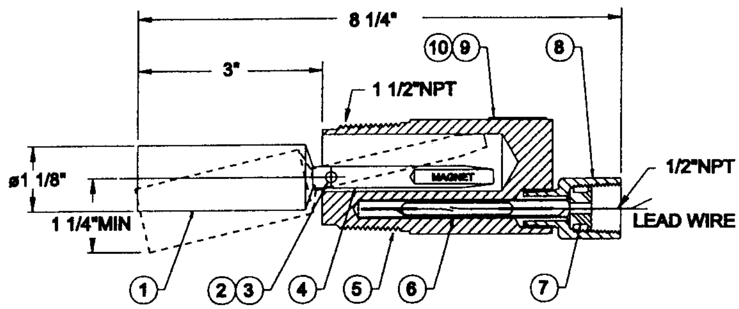
Model LINC-L471-01



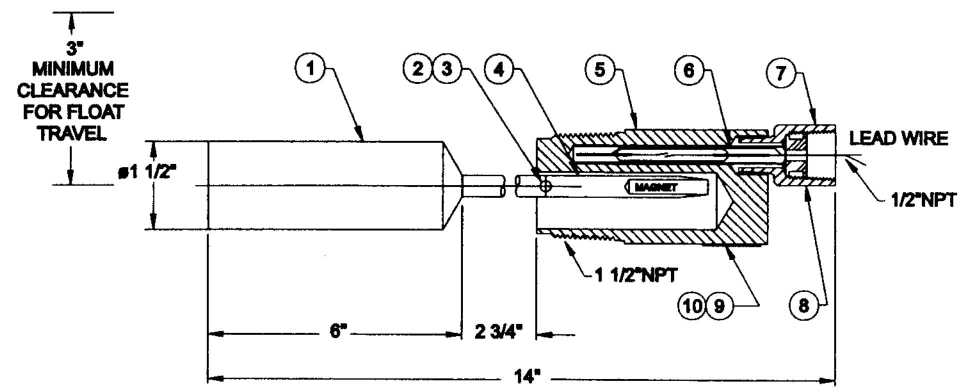
MANUAL OVERRIDE, STANDARD BODY
Body Style -2, -4

Model Item	L471-01 Part #	L471-21 Part #	Description	Material	Qty
1	10245	10245	Float	316 ss	1
2	20120	20120	Pin	316 ss	1
3	20121	20121	Spacer	316 ss	2
4	20853	24883	Float Arm Assembly	316 ss	1
5	30313	30715	Body	316 ss	1
6*	20495	20495	Switch Cartridge	304 ss	1
7	10087	10087	Grommet	Nitrile	1
8	10012	10012	Name Plate	316 ss	1
9	10324	10324	Drive Screw (not shown)	18-8 ss	4
10		24885	Ring Weldment	316 ss	1
11		10996	O-Ring	Fluorocarbon	1
12		22271	Packing Gland	316 ss	1
13		10621	Set Screw	18-8 ss	1
14		22577	Knob	303 ss	1
15		24875	Stem	316 ss	1
16		11192	Roll Pin	18-8 ss	3
17		10108	O-Ring	Fluorocarbon	1
18	20119	20119	Conduit Adapter	303 ss	1
19		11193	Name Plate (not shown)	Sealed	1
20	24834	24834	Switch Cartridge SPST 500°F (Optional)	Sealed	1
21	24835	24835	Switch Cartridge SPDT 500°F (Optional)	Sealed	1
22	24836	24836	Switch Cartridge SPDT 400°F (Optional)	Sealed	1

*Recommended spare



Model LINC-L471-02



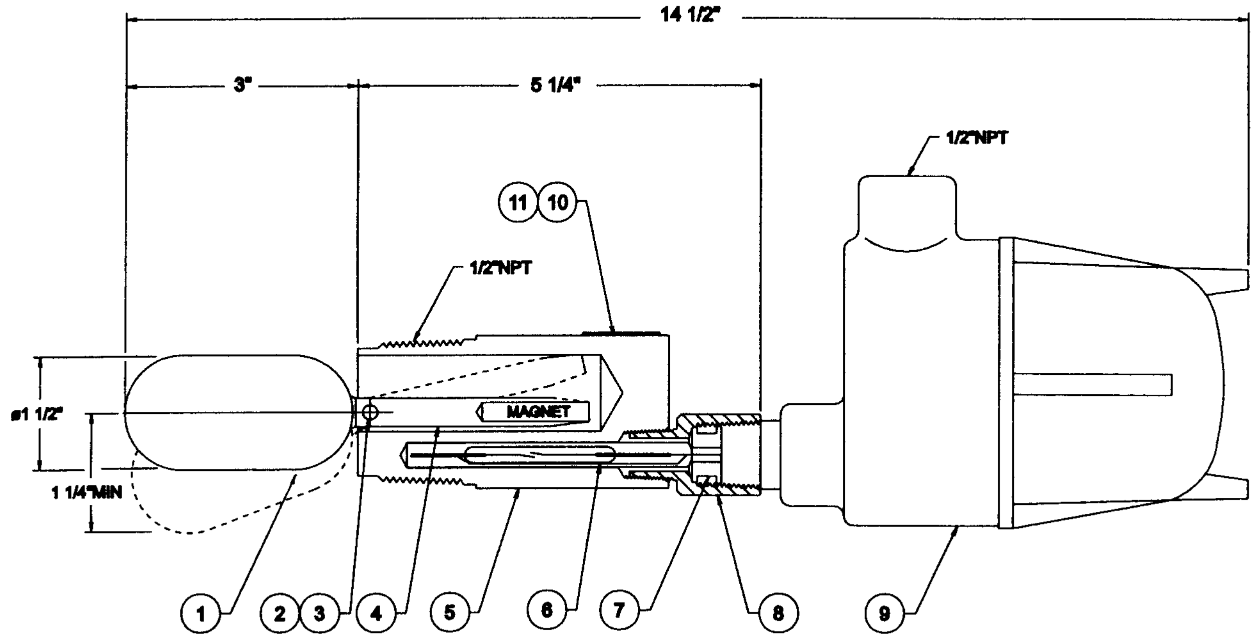
Model LINC-L471-03

Model Item	*L471-02 Part #*	*L471-03 Part #*	*Description*	*Material*	*Qty*
1	*20149*	*20136*	*Float*	*Polypropylene*	*1*
2	*20120*	*20120*	*Pin*	*316 ss*	*1*
3	*20121*	*20121*	*Spacer*	*316 ss*	*2*
4	*20853*	*21671*	*Float Arm Assembly*	*316 ss*	*1*
5	*30313*	*30313*	*Body*	*316 ss*	*1*
*6**	*20495*	*20495*	*Switch Cartridge*	*Sealed*	*1*
7	*10087*	*10087*	*Grommet*	*Nitrile*	*1*
8	*20119*	*20119*	*Conduit Adapter*	*303 ss*	*1*
9	*10012*	*10012*	*Name Plate*	*316 ss*	*1*
10	*10324*	*10324*	*Drive Screw (not shown)*	*18-8 ss*	*2*
11	*24834*	*24834*	*Switch Cartridge SPST 500°F (Optional)*	*Sealed*	*1*
12	*24835*	*24835*	*Switch Cartridge SPDT 500°F (Optional)*	*Sealed*	*1*
13	*24836*	*24836*	*Switch Cartridge SPDT 400°F (Optional)*	*Sealed*	*1*

**Recommended spare*

ELECTRIC LEVEL CONTROLS

L I N C - L 4 7 1 - 0 1 - 0 4



Model	LINC-L471-01-04			
Item	***Part #***	***Description***	***Material***	***Qty***
1	10245	Float	316 ss	1
2	20120	Pin	316 ss	1
3	20121	Spacer	316 ss	2
4	20853	Float Arm Assembly	316 ss	1
5	30313	Body	316 ss	1
6*	20495	Switch Cartridge	Sealed	1
7	10087	Grommet	Nitrile	1
8	20119	Conduit Adapter	303 ss	1
9	21593	Relay Assembly (110 VAC see relays)		1
10	10419	Name Plate	316 ss	1
11	10324	Drive Screw (not shown)	18-8 ss	2
12	24834	Switch Cartridge SPST 500°F (Optional)	Sealed	1
13	24835	Switch Cartridge SPDT 500°F (Optional)	Sealed	1
14	24836	Switch Cartridge SPDT 400°F (Optional)	Sealed	1

*Recommended spare

SAFETY WARNING INSTRUCTIONS

FOR MAXITROL GAS PRESSURE REGULATORS

NOTE: GAS PRESSURE REGULATORS WILL ***NOT*** TURN OFF THE FLOW OF GAS.

SPECIAL WARNINGS

IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.
NO UNTRAINED PERSON SHOULD ATTEMPT TO INSTALL, MAINTAIN OR SERVICE GAS PRESSURE REGULATORS.

To minimize the possibility of FIRE, EXPLOSION, and OTHER HAZARDS:

1. All products, including gas pressure regulators, used with combustible gas must be installed and used strictly in accordance with the instructions of the manufacturer, with government codes and regulations, and plumbing codes and practices.

2. Do not use a gas pressure regulator if it appears to have been subjected to high temperatures, damaged in any way, or to have been taken apart or tampered with. Any of these may be signs of possible leakage or other damage that may affect proper operation and cause potentially dangerous combustion problems

3.
a. Install the regulator properly with gas flowing as indicated by the arrow on the casting.
b. Use pipe compound or thread sealant, properly threaded pipes and careful assembly procedure so that there is no cross threading, etc., which might cause damage or leakage.
c. Apply wrench or vise pressure only to the flat areas around the pipe tappings at the end being threaded to the pipe to avoid possible fracture of the regulator body which could result in leakage
d. Make sure markings or wording on regulator are not painted over or obliterated.

4. Check carefully for gas leaks immediately after the regulator has been installed and the gas turned on. Do this before attempting to operate the appliance or other gas burning device. Use a rich soap solution (or other accepted leak tester) around the diaphragm flanges, bottom plate, vent opening, seal cap, pipe connections, and all other joints. Wipe clean with a damp rag. It is a good practice to periodically check for leakage during use of the appliance. Absolutely no leakage should occur, otherwise there is a danger of fire or explosion depending upon conditions. Never use if leakage is detected.

CAUTION

NEVER CONNECT REGULATOR DIRECTLY TO THE PROPANE SUPPLY SOURCE. MAXITROL REGULATORS REQUIRE AN EXTERNAL REGULATOR (NOT SUPPLIED). INSTALL THE EXTERNAL REGULATOR BETWEEN THE PROPANE SUPPLY SOURCE AND MAXITROL REGULATOR.

5. Very high pressure surges in the gas supply line (or as a result of exposing the system to high pressure) may result in serious internal damage and cause leakage or affect regulator operation. If you suspect that a Maxitrol regulator has been exposed to more than twice the maximum operating inlet pressure, as shown in the following chart, turn off the gas and have the system checked by an expert.

(over)

INSTRUCCIONES PARA PRECAUCIONES DE SEGURIDAD

PARA REGULADORES DE PRESION DE GAS MAXITROL

NOTA: LOS REGULADORES DE PRESION DE GAS **NO** CORTAN EL FLUJO DE GAS

¡PRECAUCIONES ESPECIALES!

SI USTED NO SIGUE ESTAS INSTRUCCIONES EXACTAMENTE, PUEDE OCURRIR UN INCENDIO O UNA EXPLOSION, CAUSANDO DAÑOS A LA PROPIEDAD, LESIONES PERSONALES O PERDIDA DE VIDAS. NADIE QUE NO HAYA SIDO ENTRENADO DEBERA DE TRATAR DE INSTALAR, DAR SERVICIO O DAR MANTENIMIENTO A LOS REGULADORES DE PRESION DE GAS

Para reducir la posibilidad de INCENDIO, EXPLOSION Y OTROS RIESGOS:

1. Todos los productos, incluyendo los reguladores de presión de gas, que se usan con gases combustibles **deberán** instalarse y usarse **estrictamente** de acuerdo con las instrucciones del fabricante, usando los códigos y reglamentos gubernamentales así como los códigos y prácticas de plomería.

2. **No** usar un regulador de presión de gas si parece haber estado expuesto a altas temperaturas, dañado en alguna forma o que se haya desmantelado o maltratado. Cualquiera de éstas pueden ser señales de posibles fugas u otros daños que pueden afectar el funcionamiento correcto y causar problemas de combustión potencialmente peligrosos.

3.
a. Instalar el regulador correctamente con el gas fluyendo como se indica en la flecha en la carcasa de fundición.
b. Usar un compuesto sellador de tubería o hilo sellador de rosca, tuberías correctamente roscadas y procedimientos de ensamble cuidadoso, asegurándose de que no haya trasroscados, lo cual podría causar daños o fugas.
c. Aplicar únicamente la presión de una llave o tornillo de banco en las áreas planas alrededor de las roscas de la tubería del extremo a enroscar para evitar la posible rotura del cuerpo del regulador que podría resultar en fugas.
d. Asegurarse de que no se pinten o tachen las marcas o escritura en el regulador.

4. Verificar inmediatamente que no haya fugas de gas después de que el regulador haya sido instalado y se haya abierto el paso del gas. **Esto deberá hacerse antes de tratar de operar el aparato electrodoméstico o cualquier otro dispositivo quemador de gas.** Usar una solución espesa de jabón (u otro probador de fugas aceptado) alrededor de las bridas del diafragma, el fondo del plato, la apertura de ventilación, la tapa selladora y las conexiones de la tubería y todas las demás juntas. Limpiar con un trapo húmedo. Es una buena práctica verificar periódicamente que no haya fugas durante el uso del aparato electrodoméstico. **Absolutamente no deberá haber ninguna fuga. De otra forma hay peligro de incendio o explosión dependiendo de las condiciones. Nunca deberá usarse si se detectan fugas.**

¡PRECAUCION!

NUNCA CONECTAR EL REGULADOR DIRECTAMENTE AL SUMINISTRO DE PROPANO. LOS REGULADORES MAXITROL REQUIEREN UN REGULADOR EXTERNO (NO PROVISTO). INSTALAR EL REGULADOR EXTERNO ENTRE EL SUMINISTRO DE PROPANO Y EL REGULADOR MAXITROL

5. Aumentos grandes de presión en la línea de suministro de gas (o como resultado de exponer el sistema a alta presión) pueden resultar en daños internos y causar fugas o afectar el funcionamiento del regulador. Si usted sospecha que un regulador Maxitrol ha sido expuesto a más del doble de la presión máxima de entrada, como se muestra en la tabla siguiente, cierre el paso del gas y haga que el sistema sea verificado por un experto.

(a la vuelta)

maxitrol company®

www.maxitrol.com

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23555 Telegraph Rd., P.O. Box 2230
Southfield, MI 48037-2230 U.S.A.
248.356.1400 • Fax 248.356.0829

CERTIFIED ISO 9001

6. Venting must be controlled in accordance with government and plumbing codes and regulations to avoid the danger of escaping gas should there be internal leakage. Vent pipes must be open and the open end protected against entry of foreign matter, including water.

7. The outlet pressure of the regulator must be measured to make sure it is in accordance with intended usage. If a spring change is required to develop the required outlet pressure, the spring must be one specified by MAXITROL

8. Caution should be used to guarantee that there is sufficient inlet pressure to achieve the desired outlet pressure and no readjustment of the outlet pressure setting should be made unless the inlet pressure is within the proper limits for the regulator. Failure to follow this may result in overfiring of the appliance or other gas burning device. The MAXITROL bulletin for the regulator should be consulted for specific inlet and outlet pressure relationships.

9. A MAXITROL regulator must be used within the temperature range and not in excess of the maximum inlet pressure shown in the following table and should be in the mounting position indicated. Maxitrol regulators can be used with all fuel gases.

10. In case of any doubt, please contact the Service Manager, Maxitrol Company, Southfield, MI USA. Phone: 248/356-1400.

6. La ventilación **deberá** estar controlada de acuerdo con los códigos y reglamentos gubernamentales de plomería para evitar el peligro de que se escape el gas en caso de una fuga interna. Los tubos de ventilación deberán estar abiertos y el extremo abierto deberá estar protegido contra cualquier materia extraña, incluyendo el agua.

7. La presión de salida del regulador **deberá** medirse para asegurarse que está de acuerdo para el uso que se pretende. Si se necesita cambiar un resorte para desarrollar la presión de salida requerida, el resorte **deberá ser especificado por MAXITROL** y la nueva presión de salida deberá anotarse en el regulador.

8. Deberá usarse precaución para garantizar que hay suficiente presión interna para alcanzar la presión de salida deseada y no deberá hacerse ningún reajuste en la presión de salida a menos que la presión interna esté dentro de los límites correctos para el regulador. Si esto no se lleva a cabo podría resultar en una llama excesiva del aparato electrodoméstico u otro dispositivo quemador de gas. **Deberá consultarse el boletín MAXITROL para el regulador** para ver la relación específica entre la presión de entrada y la de salida.

9. **Un regulador MAXITROL deberá usarse** dentro del rango de temperatura y no deberá excederse la presión máxima de entrada que se muestra en la tabla siguiente y deberá estar en la posición indicada de montaje. Los reguladores MAXITROL pueden usarse con todo tipo de gases combustibles.

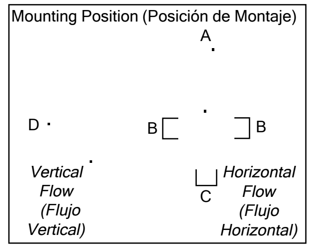
10. En caso de dudas, favor de comunicarse con el Service Manager (Gerente de Servicio), Maxitrol Company, Southfield, MI USA. Teléfono: 248-356-1400.

Model Number (Número de Modelo)	**Maximum Operating Inlet Pressure (Presión Máxima de Entrada para Operación)**	**Ambient Temperature Range (Rango de Temperatura Ambiente)**	**Mounting Position [see below] (Posiciónde Montaje) [ver abajo]**
RV12LT, RV20LT	1/2 psi (34 mbar)	-40° to 275° F (-40° to 135° C)	A, B, C, D
RV20L	2 psi (138 mbar)	-40° to 225° F (-40° to 107° C)	A, B, C, D
RV47, RV48 (*1)	1/2 psi (34 mbar)	32° to 225° F (0° to 107° C)	A, B, C, D, (*1)
RV48T (*1)	1/2 psi (34 mbar)	32° to 275° F (0° to 135° C)	A, B, C, D, (*1)
RV52, RV53, (*1)	1/2 psi (34 mbar)	-40° to 205° F (-40° to 96° C)	A, B, C, D, (*1)
RV61, (*1)	1 psi (69 mbar)	-40° to 205° F (-40° to 96° C)	A, B, C, D, (*1)
RV81, RV91	1 psi (69 mbar)	-40° to 205° F (-40° to 96° C)	A only (únicamente)
RV111	1 psi (69 mbar)	-40° to 205° F (-40° to 96° C)	A only (únicamente)
RV131	2 psi (138 mbar)	-40° to 125° F (-40° to 52° C)	A only (únicamente)
R400, R500, R600, (*1)	1 psi (69 mbar)	-40° to 205° F (-40° to 96° C)	A, B, C, D, (*1)
R400S, R500S, R600S, (*1)	5 psi (345 mbar)	-40° to 205° F (-40° to 96° C)	A, B, C, D, (*1)
R400Z, R500Z, R600Z	1psi (69 mbar)	-40° to 205° F (-40° to 96° C)	A, B, C, D, (*1)
210D, E, G, J	10 psi (690 mbar)	-40° to 205° F (-40° to 96° C)	A only (únicamente)
210DZ, EZ, GZ, JZ	5 psi (345 mbar)	-40° to 205° F (-40° to 96° C)	A only (únicamente)
220D, E, G, J	10 psi (690 mbar)	-40° to 205° F (-40° to 96° C)	A only (únicamente)
325-3 (*1), 325-5A (*1), 325-7	10 psi (690 mbar) (*1)	-40° to 205° F (-40° to 96° C)	A, B, C, D, (*1)

(*1) When equipped with a ball-check type automatic vent limiting device (12A04, 12A09, 12A39), regulators must be in upright position (A) with non-integral vent limiter installed directly into vent threads. Any other mounting position may interfere with lockup or cause pilot outage, where applicable. Maximum inlet pressure for regulators with 12A09 or 12A39 is 2 psi (LP) or 5 psi (natural). Inlet pressures exceeding 2 psi (LP) or 5 psi (natural) require a vent line.

(*1) Para estar seguro que el regulador responde con rapidez cuando está equipado con un dispositivo limitador de ventilación automático tipo bola (12A04, 12A09,12A39), los reguladores deberán estar en posición vertical (A) con el limitador de ventilación instalado directamente a las roscas del tubo de ventilación. **Si se usa cualquier otra posición durante su instalación, esto podrá interferir con el cierre o causar que el piloto se apague.** La presión máxima de admisión para reguladores con los dispositivos 12A09 o 12A39 es de 2 psi (gas licuado) o 5 psi (gas natural). Las presiones de admisión que excedan 2 psi (gas licuado) o 5 psi (gas natural) requerirán una línea de ventilación.

Mounting Position (Posición de Montaje)



LITHO IN U.S.A. 110MMP

"H" Series Relief Valves

FISHER®

May 1994 Form MCK-1089

Give this instruction manual to your customer.

WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

A person should *NEVER* stand directly over or in front of, or look directly into a relief valve when the tank is pressurized. The relief valve could suddenly "pop" open blowing gas, dirt, and other debris into the person's face and eyes.

Fisher equipment must be installed, operated, and maintained in accordance with federal, state, and local codes and Fisher instructions. In addition, in most states the installation must also comply with NFPA No. 58, NFPA 501C, DOT, and ANSI K61.1 standards.

Only personnel trained in the proper procedures, codes, standards, and regulations of the LP-gas industry should install and inspect this equipment.

Introduction

Scope of Manual

This manual covers instructions for the "H" series relief valves which can be used in various vapor and liquid applications. Most "H" series relief valves must be used on vapor service only. Use only advertised hydrostatic relief valves for liquid applications. The valves are typically installed in ASME tanks, DOT cylinders, and piping applications.

Things To Tell The Gas Customer

1. The purpose of a relief valve is to keep the tank from rupturing from excessive tank pressure by venting gas to the atmosphere until the tank pressure drops. Excessive tank pressure can be caused by the following:
   1. Exposure to fire or radiant heat including hot summer days.
   2. New or refilled tanks not fully purged of air.
   3. Tank colors (other than white) increase the heat absorption of the tank raising the pressure in the tank.
   4. Propane with "vapor pressures" out of specification, i.e., "Hot Gas."
   5. Overfilling the tank.
2. Do not beat, pound, or hit the relief valve with hammers or other tools or attempt to force the valve closed as this will not stop gas discharge and could damage relief valve parts or rupture the tank.
3. Call your gas dealer if the relief valve discharges gas.

Specifications

CAUTION

If the valve is to be for service other than LP-gas, anhydrous ammonia, or air; contact the factory to determine if the valve materials are suitable for the particular service. Valves with brass materials must not be used on anhydrous ammonia service.

"H" Series relief valves range in size from 1/4 to 3 inch NPT inlet connections. Set pressures and flow capacities vary by size and application. Materials of construction are typically brass, steel, and stainless steel with nitrile discs. Consult your Fisher Catalog for size, set pressure and flow capacity combinations.

Underwriters' Laboratories listed valves are required by most states, although some states require ASME capacity rated valves. Be sure the valve is rated and stamped to meet the requirements of the state where it will be used. The valve should also have sufficient capacity for the container size where it is used. Required relief valve capacity is a function of the container surface area. Consult NFPA #58 or other appropriate product standards.

The start-to-discharge pressure stamped on the valve must be correct for the design pressure of the container. Do not use a valve with a start-to-discharge pressure higher than the design pressure of the container.

When a valve has an inlet dip tube (such as used in motor fuel applications) or an outlet pipeaway stack (such as used in motor fuel and bulk storage applications), a restriction may result that reduces valve capacity below that stamped on the valve. In these

Part Number D450014T012

cases, the total system capacity must be sufficient to meet the sizing requirements for the container being used.

Installation

Installed valves must have direct contact with the vapor space of the containers.

Install the valve so that flow is unobstructed. Be certain that any discharge from the valve will not impinge on the container, adjacent containers, or any source of ignition. **Each application will dictate whether discharge stacks or deflectors are required. Deflectors and adaptors are separate devices mounted to the outlet of the valve to control discharge direction. Consult the applicable standard to determine if these additional devices are required.**

Coat the male threads of the valve with an Underwriters' Laboratories listed sealing compound. Do not allow excess compound to drip into the container or flow around the bottom edge of the pipe threads.

Pull the valve into the coupling hand tight, and then wrench tighten it for approximately two additional turns. Do not install the valve with such extreme torque that the coupling can cut threads into the valve. This could cause valve distortion and affect the internal working parts. Larger size valves (especially if of steel construction) may require an additional amount of torque to obtain a leak free connection.

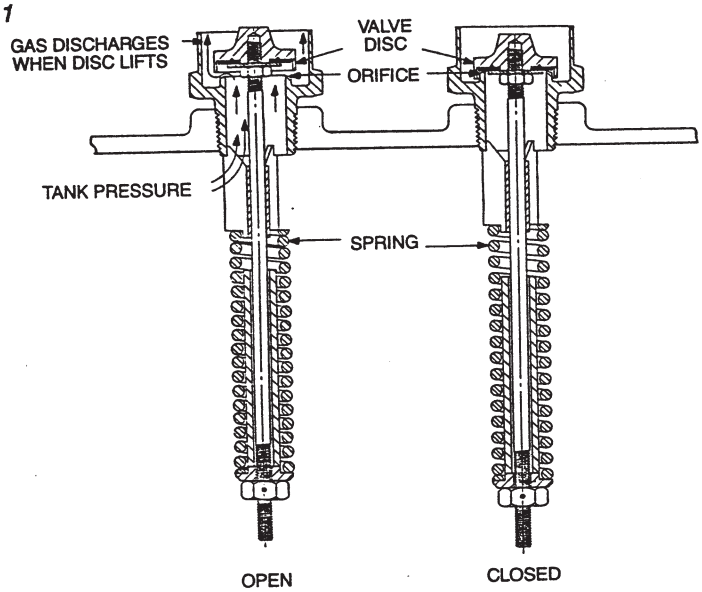
Raincaps are required on all valves. The raincap should be kept in place; an out-of-place raincap indicates the valve may have opened to relieve overpressure. Most relief valves have a drain hole in the body which must remain open at all times.

Relief valves on bobtails, transports and motor fuel applications must be protected as specified by DOT, NFPA #58, and other applicable laws, codes, and standards.

New containers must be purged to remove air from the container. Failure to properly purge may result in excessive pressure and the possibilty of "popping" the relief valve when the container is filled. Follow NFPA #58 and NLPGA Pamphlet 133-80 guidelines for purging containers.

PRINCIPLE OF OPERATIONS

Fig. 1



The relief valve is held closed by the spring force seating the rubber valve disc against the orifice.

When the tank pressure exceeds the spring force, the valve disc lifts off the orifice allowing gas to discharge through the valve to the air.

Gas discharge initially may be small producing only seepage and a light "hissing" sound. As pressure increases and gas volume discharge continues, a "popping" condition occurs with large volumes of gas discharge and a loud "hissing or roaring" sound.

When the tank pressure decreases enough, the spring force closes the valve disc back against the orifice stopping further discharge.

Maintenance and Replacement

Safety relief valves are nonrepairable valves and cannot be adjusted in the field.

WARNING

Any valve that has fully opened "popped" should be tested to see if it is within the allowable start-to-discharge pressure setting. If it is not within the correct range, it *must be replaced.* Relief valve start-to-discharge and reseat pressures may be lower if the valve has fully opened (popped).

Some relief valve installations require periodic testing or replacement, such as those required by DOT, NFPA #58, NFPA Pamphlet 59 (LP-Gas Utility Gas Plants) and ANSI K61.1. It is recommended that all relief valves be regularly inspected for visible damage, dirt, corrosion, missing raincaps, paint inside outlet, tampering, etc. If any of the preceding is evident or questionable, the valve should be retested or replaced immediately.

The discharge side of the relief valve body must be kept free of dirt, water and other foreign matter which can damage the valve seat or "weld" some "wing style" poppets to the valve body. This can prevent the valve from opening. Replace valves when this occurs.

Relief valves are precisely set by the manufacturer for the correct start-to-discharge setting, and field repair should never be attempted. Since the disc in a relief valve is subject to normal deterioration, Fisher recommends that a relief valve not be used for longer than 15 years. (All Fisher valves carry the date of manufacture.) Earlier replacement may be required due to severe service conditions or code requirements.

FISHER® Fisher Controls

For further information, write:
Fisher Controls
P.O. Box 8004, McKinney, Texas 75069-8004, U.S.A.

Printed in U.S.A.

Safety Warning — LP-Gas Pressure Relief Valves

Purpose

In its continuing quest for safety, Engineered Controls International, Inc. is publishing safety warning bulletins explaining the hazards associated with the use, misuse and aging of *ECII®/ RegO® Products*. LP-Gas dealer managers and service personnel must realize that the failure to exercise the utmost care and attention in the installation, inspection and maintenance of these products can result in personal injury and property damage.

The National Fire Protection Association Pamphlet #58 "Storage and Handling of Liquefied Petroleum Gases" states: "In the interests of safety, all persons employed in handling LP-Gases shall be trained in proper handling and operating procedures." *ECII®* Warning Bulletins are useful in training new employees and reminding older employees of potential hazards.

This Warning Bulletin should be provided to all purchasers of ECII® / RegO® Products and all personnel using or servicing these products. Additional copies are available from Engineered Controls International, Inc. and your Authorized *ECII®/ RegO® Products* Distributor.

⚠ WARNING

What You Must Do:

- Read This Entire Warning
- Install Properly
- Inspect Regularly
- Replace In 10 Years or Less

Scope

This bulletin applies to pressure relief valves installed on stationary, portable and cargo containers and piping systems utilized with these containers. This bulletin is not intended to be an exhaustive treatment of this subject and does not cover all safety practices that should be followed in the installation and maintenance of LP-Gas systems. Each LP-Gas employee should be provided with a copy of NPGA Safety Pamphlet 306 "LP-Gas Regulator and Valve Inspection and Maintenance" as well as the NPGA "LP-Gas Training Guidebooks" relating to this subject.

Warnings should be as brief as possible. If there is a simple warning, it is:

Inspect pressure relief valves regularly. Replace unsafe or suspect valves immediately. Use common sense.

Install Properly

Consult NFPA Pamphlet #58 and/or any applicable regulations governing the application and use of pressure relief valves. Make sure you are thoroughly trained before you attempt any valve installation, inspection or maintenance.

Proper installation is essential to the safe operation of pressure relief valves. When installing *ECII®/ RegO®* pressure relief valves, consult warning # 8545-500 which accompanies each valve. Check for damage and proper operation after valve installation. Check that the valve is clean and free of foreign material.

Pipeaways and deflectors may be required by local codes, laws and regulations depending on the installation. Use only *ECII®/ RegO®* adapters on *ECII®/ RegO®* relief valves. Adapters not designed specifically for piping away *ECII®/ RegO®* relief valves, such as those with 90° turns or reduced internal diameters, will decrease flow dramatically. These should never be used as they can cause the relief valve to chatter and eventually destroy itself.

The addition of deflectors, pipeaway adapters and piping will restrict the flow. To properly protect any container, the total system flow must be sufficient to relieve pressure at the pressure setting of the relief valve in accordance with all applicable codes.

Inspect Regularly

A pressure relief valve discharges when some extraordinary circumstance causes an over pressure condition in the container. If a pressure relief valve is known to have discharged, the relief valve, as well as the entire system, should be immediately and thoroughly inspected to determine the reason for the discharge. In the case of discharge due to fire, the valve should be removed from service and replaced.

Relief valves should be inspected each time the container is filled but no less than once a year. If there is any doubt about the condition of the valve, it must be replaced.

Eye protection must be worn when performing inspection on relief valves under pressure. Never look directly into a relief valve under pressure or place any part of your body where the relief valve discharge could impact it. In some cases a flashlight and a small mirror are suggested to assist when making visual inspections.

To Properly Inspect A Pressure Relief Valve, Check For:

1. A rain cap. Check protective cap located in valve or at end of pipeaway for a secure fit. Protective caps help protect the relief valve against possible malfunction caused by rain, sleet, snow, ice, sand, dirt , pebbles, insects, other debris and contamination. REPLACE DAMAGED OR MISSING CAPS AT ONCE AND KEEP A CAP IN PLACE AT ALL TIMES.
2. Open weep holes. Dirt, ice, paint and other foreign particles can prevent proper drainage from the valve body. IF THE WEEP HOLES CANNOT BE CLEARED, REPLACE THE VALVE.
3. Deterioration and corrosion on relief valve spring. Exposure to high concentrations of water, salt, industrial pollutants, chemicals and roadway contaminants could cause metal parts to fail. IF THE COATING ON THE RELIEF VALVE SPRING IS CRACKED OR CHIPPED, REPLACE THE VALVE.
4. Physical damage. Ice accumulations and improper installation could cause mechanical damage. IF THERE ARE ANY INDICATIONS OF DAMAGE, REPLACE THE VALVE.
5. Tampering or readjustment. Pressure relief valves are factory set to discharge at specified pressures. IF THERE ARE ANY INDICATIONS OF TAMPERING OR READJUSTMENT, REPLACE THE VALVE.
6. Seat leakage. Check for leaks in the seating area using a non-corrosive leak detection solution. REPLACE THE VALVE IF THERE IS ANY INDICATION OF LEAKAGE. Never force a relief valve closed and continue to leave it in service. This could result in damage to the valve and possible rupture of the container or piping on which the valve is installed.
7. Corrosion and contamination. REPLACE THE VALVE IF THERE ARE ANY SIGNS OF CORROSION OR CONTAMINATION ON THE VALVE.
8. Moisture, foreign particles or contaminants in the valve. Foreign material such as paint, tar or ice in relief valve parts can impair the proper functioning of the valves. Grease placed in the valve body may harden over time or collect contaminants, thereby impairing the proper operation of the relief valve. DO NOT PLACE GREASE IN THE VALVE BODY, REPLACE THE VALVE IF THERE ARE ANY INDICATIONS OF MOISTURE OR FOREIGN MATTER IN THE VALVE.
9. Corrosion or leakage at container connection. Check container to valve connection with a non-corrosive leak detection solution. REPLACE THE VALVE IF THERE IS ANY INDICATION OF CORROSION OR LEAKAGE AT THE CONNECTION BETWEEN THE VALVE AND CONTAINER.

CAUTION: Never plug the outlet of a pressure relief valve. Any device used to stop the flow of a properly operating pressure relief valve that is venting an overfilled or overpressurized container - raises serious safety concerns!

Replace Pressure Relief Valves In 10 Years Or Less

The safe useful life of pressure relief valves can vary greatly depending on the environment in which they live.

Relief valves are required to function under widely varying conditions. Corrosion, aging of the resilient seat disc and friction all proceed at different rates depending upon the nature of the specific environment and application. Gas impurities, product misuse and improper installations can shorten the safe life of a relief valve.

Predicting the safe useful life of a relief valve obviously is not an exact science. The conditions to which the valve is subjected will vary widely and will determine its useful life. In matters of this kind, only basic guidelines can be suggested. For example, the Compressed Gas Association Pamphlet S-1.1 Pressure Relief Device Standards — Cylinders, section 9.1.1 requires all cylinders used in industrial motor fuel service to have the cylinder's pressure relief valves replaced by new or unused relief valves within twelve years of the date of manufacture of cylinder and within each ten years thereafter. *The LP-Gas dealer must observe and determine the safe useful life of relief valves in his territory.* The valve manufacturer can only make recommendations for the continuing safety of the industry.

WARNING: Under normal conditions, the useful safe service life of a pressure relief valve is 10 years from the original date of manufacture. However, the safe useful life of the valve may be shortened and replacement required in less than 10 years depending on the environment in which the valve lives. Inspection and maintenance of pressure relief valves is very important. Failure to properly inspect and maintain pressure relief valves could result in personal injuries or property damage.

For Additional Information Read:

1. CGA Pamphlet S-1.1 Pressure Relief Standards — Cylinders, Section 9.1.1.
2. *ECII*® Catalog L-500.
3. *ECII*® Warning # 8545-500.
4. NPGA Safety Pamphlet 306 "LP-Gas Regulator and Valve Inspection and Maintenance" and "LP-Gas Training Guidebooks".
5. NFPA # 58, "Storage and Handling of Liquefied Petroleum Gases".
6. NFPA # 59, "LP-Gases at Utility Gas Plants".
7. ANSI K61.1 Safety Requirements for Storage and Handling of Anhydrous Ammonia.

Requirements for Pressure Relief Valves

Every container used for storing or hauling LP-Gas and anhydrous ammonia must be protected by a pressure relief valve. These valves must guard against the development of hazardous conditions which might be created by any of the following:

- Hydrostatic pressures due to overfilling or the trapping of liquid between two points.
- High pressures resulting from exposure of the container to excessive external heat.
- High pressures due to the use of incorrect fuel.
- High pressures due to improper purging of the container.

Consult NFPA Pamphlet #58 for LP-Gas and ANSI #K61.1 for anhydrous ammonia, and/or any applicable regulations governing the application and use of pressure relief valves.

Operation of Pressure Relief Valves

Pressure relief valves are set and sealed by the manufacturer to function at a specific "start-to-discharge" pressure in accordance with regulations. This set pressure, marked on the relief valve, depends on the design requirement of the container to be protected by the relief valve. If the container pressure reaches the start-to-discharge pressure, the relief valve will open a slight amount as the seat disc begins to move slightly away from the seat. If the pressure continues to rise despite the initial discharge through the relief valve, the seat disc will move to a full open position with a sudden "pop". This sharp popping sound is from which the term "pop-action" is derived.

Whether the relief valve opens a slight amount or pops wide open, it will start to close if the pressure in the container diminishes. After the pressure has decreased sufficiently, the relief valve spring will force the seat disc against the seat tightly enough to prevent any further escape of product. The pressure at which the valve closes tightly is referred to as the "re-seal" or "blow-down" pressure. Generally, the re-seal pressure will be lower than the start-to-discharge pressure.The re-seal pressure can be, and in most cases is, adversely affected by the presence of dirt, rust, scale or other foreign particles lodging between the seat and disc. They interfere with the proper mating of the seat and disc and the pressure in the container will usually have to decrease to a lower pressure before the spring force embeds foreign particles into the resilient seat disc material and seals leak-tight. The degree by which the presence of dirt decreases the re-seal pressure, is, of course, dependent on the size of the interfering particles.

Once particles have been trapped between the disc and seat, the start-to-discharge pressure is also affected. For example, the pressure relief valve will start-to-discharge at some pressure lower than its original start-to-discharge pressure. Again, the pressure at which the valve will start to discharge is dependent on the size of the foreign particles.

In the case of a pressure relief valve that has opened very slightly due to a pressure beyond its start-to-discharge setting, the chances of foreign material lodging between the seat and disc is negligible although the possibility is always present. If the relief valve continues to leak at pressures below its start-to-discharge setting it must be replaced.

Relief valves which have "popped" wide open must also be checked for foreign material lodged between the seat and disc, as well as for proper reseating of the seat and disc. Continued leakage at pressures below the start-to-discharge setting indicate the relief valve must be replaced.

The pressure at which a pressure relief valve will start to discharge should never be judged by the reading of the pressure gauge normally furnished on the container.

The reasons for this are two-fold:

- If the relief valve is called upon to open, the resulting discharge produces an increased vaporization of the product in the container with the result that the liquid cools to a certain extent and the vapor pressure drops. A reading taken at this time would obviously not indicate what the pressure was when the relief valve opened.
- The pressure gauges usually on most containers provide somewhat approximate readings and are not intended to provide an indication of pressure sufficiently accurate to judge the setting of the relief valve.

Repair and Testing

RegO® Pressure Relief Valves are tested and listed by Underwriters Laboratories, Inc., in accordance with NFPA Pamphlet #58. Construction and performance of RegO® Pressure Relief Valves are constantly checked at the factory by U.L. inspectors. Therefore, testing of RegO® Pressure Relief Valves in the field is not necessary.

Never attempt to repair or change the setting of RegO® Pressure Relief Valves. Any changes in settings or repairs in the field will void the UL® listing and may create a serious hazard.

While the functioning of a pressure relief valve appears to be relatively simple, the assembly and test procedure used to manufacture these RegO® products is rather complex. Highly specialized test fixtures and specially trained personnel are necessary to attain proper relief valve settings. These fixtures and personnel are available only at the factory.

Any pressure relief valve which shows evidence of leakage, other improper operation or is suspect as to its performance must be replaced immediately using approved procedures.

Pipe-Away Adapters

Pipe-away adapters are available for most RegO® Pressure Relief Valves, where it is required or desirable to pipe the discharge above or away from the container. Each adapter is designed to sever if excessive stress is applied to the vent piping – thus leaving the relief valve fully operative.

Weep hole deflectors are available on larger relief valves. These deflectors provide protection against flame impinging on adjacent containers which could occur from ignition of LP-Gas escaping through the relief valve drain hole when the valve is discharging.

Selection of RegO® Pressure Relief Valves For ASME Containers

The rate of discharge required for a given container is determined by the calculation of the surface area of the container as shown in "Chart A" for LP-Gas and "Chart B" for anhydrous ammonia. See page D9.

Setting - The set pressure of a pressure relief valve depends upon the design pressure of the container. Refer to NFPA Pamphlet #58 for more information.

Selection of RegO® Pressure Relief Valves for DOT Containers

To determine the proper relief valve required for a given DOT container, refer to the information shown with each pressure relief valve in the catalog. This information will give the maximum size (pounds water capacity) DOT container for which the relief valve has been approved.

Setting - The standard relief valve setting for use on DOT cylinders is 375 PSIG.

Ordering RegO® Pressure Relief Valves

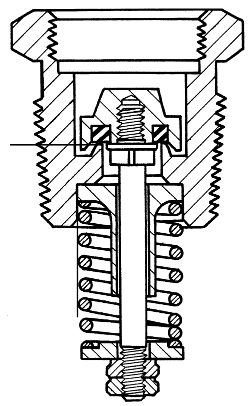
When ordering RegO® Pressure Relief Valves, be sure you are certain that it will sufficiently protect the container as specified in the fore-wording information, NFPA Pamphlet #58 and any other applicable standards or specifications.

All adapters, protective caps and deflectors must be ordered separately, unless specified otherwise.

Part Number Explanation

Products carrying an "A" or "AA" prefix contain no brass parts and are suitable for NH_3. Hydrostatic relief valves carrying an "SS" prefix are of stainless steel construction and are suitable for use with NH_3. The products are also suitable for use with LP-Gas service except relief valves carrying an "AA" prefix. These are of partial aluminum construction and are listed by U.L. for NH_3 service only.

Safety Information — Relief Valves Don't Last Forever



RegO® Relief Valve for lift truck containers

The internal spring is protected from external contamination but the other external parts must be protected with a cap. Circular rubber seat disc ring seats on brass shoulder approximately 3⁄64" wide.

This article was prepared by the engineers of RegO® products, after technical consultation with valve manufacturers and other industry sources. Its purpose is to alert and remind the LP-Gas industry of the importance of proper maintenance of pressure relief valves. It applies most particularly to separate relief valves with emphasis on lift truck and motor fuel containers where the hazards of contamination are greatest.

Since the beginning of our industry, manufacturers of equipment and distributors of LP-Gas have worked diligently to provide a safe environment for employees and consumers. The history of the industry testifies to the success of their efforts.

But the industry is now entering its sixth decade and equipment installed years ago is failing because of age. Every year, additional equipment will fail unless it is replaced. Pressure relief valves are no exception. The valve manufacturers and LP-Gas dealers are naturally concerned about this situation.

Causes of Relief Valve Failure

A relief valve is designed to have a safe useful life of many years, but that life will vary greatly depending on the environment in which it "lives." To attempt to estimate the safe useful life of a relief valve and the effect of environment on its performance, a brief discussion of the materials used and the nature of its performance should be helpful.

Relief valve bodies are generally made of brass or steel. Springs are made from various spring wires which are plated or painted, or made of stainless steel. Valve seat discs are made of synthetic rubber compounds which will remain serviceable in an atmosphere of LP-Gas. Relief valve stems, guides, etc. are generally made from brass or stainless steel.

Relief valves, over the years, may not function properly in several ways:

- They may leak at pressures below the set pressure.
- They may open and fail to properly reseat.
- They may open at higher than the set pressure.

These failures to function properly are due primarily to four "environmental" conditions:

1. Corrosion of metal parts (particularly springs) which result in the component parts failing to perform.
2. Deterioration of the synthetic rubber seat disc material.
3. Clogging or "cementing" of the movable relief valve components so that their movement is restricted.
4. Debris on the valve seat after the relief valve opens, effectively preventing the valve from reseating.

Corrosion is caused by water, corrosive atmospheres of salt and industrial pollutants, chemicals, and roadway contaminants. High concentrations can attack the metal parts vigorously. No suitable metals are totally resistant to such corrosion.

Synthetic rubber and seat disc materials can also be attacked by impurities in the gas and corrosive atmospheres, particularly those with sulphur dioxide. There are no suitable rubber materials which resist all contaminants.

"Cementing" of relief valve parts has been caused by normal industrial atmospheres containing particles of dirt, iron oxide, metal chips, etc. combined with water, oil, or grease. Ice collecting in recessed valves could cause relief valves to fail to open. Paint and tar in relief valves also cause failure to function properly.

Debris on valve seats which prevents reseating can occur whenever the valve collects material in the relief valve opening which is not blown out when the relief valve opens.

Inspection of Relief Valves

Unfortunately many of the above problems may not be easily observed because of the compact nature of some relief valve designs.

A casual visual inspection of a relief valve may not necessarily disclose a potential hazard. On the other hand, a visual inspection will often disclose leakage, corrosion, damage, plugging and contamination.

If additional light is required, a flashlight should be used.

If there is any doubt about the condition of the valve, or if there is a suspicion that the valve has not been protected by a cap for some time, it should be replaced before refilling the container.

Eye protection must be used when examining relief valves under pressure.

Smaller Relief Valves

The industry's requirement for a small full-flow safety relief valve challenged design engineers some years ago:

- The valve must be leakproof before operating and must reseat leakproof each time after each operation. The only known satisfactory seat disc materials to accomplish this have been special synthetic rubber compounds.
- Valve discharge settings are relatively high and require high spring loads to keep the valve closed.
- Because of the small interior diameter of the valve, the round metal seating area is small.

All of these parameters may result in the development of a significant indentation in the rubber seat disc after some years. The seat disc may have a tendency to cling to the metal seat. This may result in the relief valve not opening at the set pressure as the seat disc ages.

Test have been conducted on small LP-Gas relief valves of all the U.S. valve manufacturers. Valves over 10 years old were removed from service and tested to determine at what pressure the valves discharged. In many of the valves, the pressure required to open the valve exceeded the set pressure.

Because of the critical importance of proper functioning of relief valves, common sense and basic safety practice dictate that small relief valves should be replaced in about 10 years.

Some larger relief valves on bulk storage tanks can be replaced with rebuilt valves obtained from the manufacturers. Small relief valves cannot be rebuilt economically, thus, new valves are required. Most LP-Gas dealers find it impractical and costly to test relief valves and field repairing of relief valves is not sanctioned by the manufacturers, Underwriter's Laboratories, or ASME.

Use of Protective Caps

Many of the problems that cause inoperative relief valves could be prevented if proper protective caps were kept in place *at all times.*

Collection of debris would be prevented. Contamination caused by corrosive atmospheres would be reduced. Water collection in the valves would be eliminated. Relief valves protected with caps from the time of installation in the container would obviously have a much longer safe useful life, but they still should be replaced at some time because of the gradual deterioration of the rubber seat disc due to age alone.

NFPA 58 requires that protective caps must be kept in place as a protective cover on some relief valves. This is a mandatory requirement on several types of relief valves. The fact that use of caps may make inspection more time consuming should not be viewed as a reason for either not using the caps, or not making required periodic inspections.

In the event a relief valve has been used without the required cap, the relief valve should be thoroughly inspected and the required cap placed on the relief valve. If damage is noted to the relief valve, it should be replaced and the replacement valve should be capped.

Relief valves with pipe-away adapters or deflectors used on lift truck containers have been found choked with debris. Inspection of relief valves with deflectors can only be accomplished by removing the deflector.

Similarly, larger relief valves with vent stacks have been found choked with debris and water. Valves have failed because springs rusted through. The weep hole was plugged. It was obvious that the relief valves had not been inspected in many years. These conditions must be alleviated by periodic inspections and replacement of relief valves as needed.

Summary Recommendations

Predicting the safe useful life of a relief valve is obviously not an exact science. The conditions to which the valve is subjected will vary widely and will largely control its life. In matters of this kind, only basic guidelines can be suggested. The LP-Gas dealer must observe and determine the safe useful life of relief valves in his territory. The valve manufacturers can only make recommendations for the continuing safety of the industry:

1. Make sure proper protective caps are in place at all times. Do not release a container for service or fill a container unless it has a protective cap in place.
2. Replace relief valves periodically, at least every 10 years. Every relief valve has the month and year of manufacture stamped on the valve. This is most particularly true of small *separate* relief valves.
3. Carefully inspect valves each time before the container is filled. Replace valves showing any signs of contamination, corrosion, damage, plugging, leakage, or any other problem. Eye protection must be used when examining relief valves under pressure.

Chart A — Minimum Required Rate of Discharge for LP-Gas Pressure Relief Valves Used on ASME Containers

From NFPA Pamphlet #58, Appendix D (1986).

Minimum required rate of discharge in cubic feet per minute of air at 120% of the maximum permitted start-to-discharge pressure for pressure relief valves to be used on containers other than those constructed in accordance with Interstate Commerce Commission specification.

Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air
20 or less	626	85	2050	150	3260	230	4630	360	6690	850	13540	1500	21570
25	751	90	2150	155	3350	240	4800	370	6840	900	14190	1550	22160
30	872	95	2240	160	3440	250	4960	380	7000	950	14830	1600	22740
35	990	100	2340	165	3530	260	5130	390	7150	1000	15470	1650	23320
40	1100	105	2440	170	3620	270	5290	400	7300	1050	16100	1700	23900
45	1220	110	2530	175	3700	280	5450	450	8040	1100	16720	1750	24470
50	1330	115	2630	180	3790	290	5610	500	8760	1150	17350	1800	25050
55	1430	120	2720	185	3880	300	5760	550	9470	1200	17960	1850	25620
60	1540	125	2810	190	3960	310	5920	600	10170	1250	18570	1900	26180
65	1640	130	2900	195	4050	320	6080	650	10860	1300	19180	1950	26750
70	1750	135	2990	200	4130	330	6230	700	11550	1350	19780	2000	27310
75	1850	140	3080	210	4300	340	6390	750	12220	1400	20380		
80	1950	145	3170	220	4470	350	6540	800	12880	1450	20980		

Surface area =Total outside surface area of container in square feet.

When the surface area is not stamped on the name plate or when the marking is not legible, the area can be calculated by using one of the following formulas:

1. Cylindrical container with hemispherical heads. Area (in sq. ft.) = overall length (ft.) x outside diameter (ft.) x 3.1416.
2. Cylindrical container with semi-ellipsoidal heads. Area (in sq. ft.) = [overall length (ft.) + .3 outside diameter (ft.)] x outside diameter (ft.) x 3.1416.
3. Spherical container. Area (in sq. ft.) = outside diameter (ft.) squared x 3.1416.

Flow Rate CFM Air = Required flow capacity in cubic feet per minute of air at standard conditions, 60ºF. and atmospheric pressure (14.7 psia).

The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2000 square feet, the required flow rate can be calculated using the formula, Flow Rate in CFM Air = 53.632 $A^{0.82}$. Where A = total outside surface area of the container in square feet.

Valves not marked "Air" have flow rate marking in cubic feet per minute of liquefied petroleum gas. These can be converted to ratings in cubic feet per minute of air by multiplying the liquefied petroleum gas ratings by the factors listed below. Air flow ratings can be converted to ratings in cubic feet per minute of liquefied petroleum gas by dividing the air ratings by the factors listed below.

Air Conversion Factors

Container Type	100	125	150	175	200
Air Conversion Factor	1.162	1.142	1.113	1.078	1.010

Chart B — Minimum Required Rate of Discharge for Anhydrous Ammonia Pressure Relief Valves Used on ASME Containers

From ANSI K61.1-1981, Appendix A (1981).

Minimum required rate of discharge in cubic feet per minute of air at 120% of the maximum permitted start-to-discharge pressure for pressure relief valves to be used on containers other than those constructed in accordance with United States Department of Transportation cylinder specifications.

Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air	Surface Area Sq. Ft.	Flow Rate CFM Air
20	258	95	925	170	1500	290	2320	600	4200	1350	8160	2100	11720
25	310	100	965	175	1530	300	2380	650	4480	1400	8410	2150	11950
30	360	105	1010	180	1570	310	2450	700	4760	1450	8650	2200	12180
35	408	110	1050	185	1600	320	2510	750	5040	1500	8900	2250	12400
40	455	115	1090	190	1640	330	2570	800	5300	1550	9140	2300	12630
45	501	120	1120	195	1670	340	2640	850	5590	1600	9380	2350	12850
50	547	125	1160	200	1710	350	2700	900	5850	1650	9620	2400	13080
55	591	130	1200	210	1780	360	2760	950	6120	1700	9860	2450	13300
60	635	135	1240	220	1850	370	2830	1000	6380	1750	10090	2500	13520
65	678	140	1280	230	1920	380	2890	1050	6640	1800	10330		
70	720	145	1310	240	1980	390	2950	1100	6900	1850	10560		
75	762	150	1350	250	2050	400	3010	1150	7160	1900	10800		
80	804	155	1390	260	2120	450	3320	1200	7410	1950	11030		
85	845	160	1420	270	2180	500	3620	1250	7660	2000	11260		
90	885	165	1460	280	2250	550	3910	1300	7910	2050	11490		

Surface area = Total outside surface area of container in square feet.

When the surface area is not stamped on the name plate or when the marking is not legible, the area can be calculated by using one of the following formulas:

1. Cylindrical container with hemispherical heads. Area (in sq. ft.) = overall length (ft.) x outside diameter (ft.) x 3.146.
2. Cylindrical container with other than hemispherical heads. Area (in sq. ft.) = [overall length (ft.) + .3 outside diameter (ft.)] x outside diameter (ft.) x 3.1416.
3. Spherical container. Area (in sq. ft.) = outside diameter (ft.) squared x 3.1416.

Flow Rate CFM Air = Required flow capacity in cubic feet per minute of air at standard conditions, 60°F. and atmospheric pressure (14.7 psia).

The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2,500 square feet, the required flow rate can be calculated using the formula, Flow Rate in CFM Air = 22.11 $A^{0.82}$ where A = outside surface area of the container in square feet.

Conversion Factor

ft^2 x 0.092 903 = m^2
CFM x 0.028 317 = m^3/min
ft x 0.304 8 = m

REGO PRODUCTS

Instruction Sheet

102-054

"00" Cartridge Circulators
Models 005, 006, 007, 008, 009, 0010

SUPERSEDES: 102-054 DATED SEPTEMBER 1, 1989 EFFECTIVE: JULY 1, 1992

Plant I.D. 001-934

APPLICATION:

1. Maximum operating pressure is 125 psi (862kPa).
2. Maximum water temperature not to exceed nameplate rating.
3. Cast iron circulators are to be used for closed loop systems. Bronze circulators are to be used for open loop, fresh water, or potable water systems.
4. Taco cartridge circulator pumps are for indoor use only—employer uniquement a l'interieur.

INSTALLATION:

1. Mounting position—Circulator must be mounted with the motor in a horizontal position. They may be mounted vertically with the motor up, provided that the system pressure is at least 20psi(138kPa).
2. Rotating body—Body has an arrow on the front that indicates direction of flow. To rotate body, remove the four body bolts, rotate body and replace bolts. Make sure that the junction box is NOT located underneath the circulator. (The junction box must NOT be located in the 6 o'clock position, as viewed from the motor end.)
3. Electrical connections—Observe all applicable codes when connecting to power supply. The motor is impedance protected and does not require overload protection.

WARNING: Do not use in swimming pool or spa areas; pump has not been investigated for this application.

WARNING: In the event the retaining screws have been pulled out of the housing, DO NOT replace them. Use of any other screw may short out the stator windings, creating a risk of electrical shock.

CAUTION: When installing electrical connections, do not apply mechanical loads to the capacitor box; otherwise, retaining screws may be pulled out of the housing, making circulator unusable.

4. Fill system with tap water.—The system must be filled before operating the circulator. The bearings are water lubricated and should not be allowed to operate dry. Filling the system will result in immediate lubrication of the bearings. It is always good practice to flush a new system of foreign matter before starting the circulator.
5. Circulator operation—Operate the circulator for 5 minutes immediately after filling system to purge remaining air from the bearing chamber. This is especially important when installing the circulator during the off-season.

REPLACING MOTOR ASSEMBLY:

1. Disconnect the electrical supply.
2. Reduce system pressure to 0psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove body bolts and swing motor assembly away from the body.
4. Install replacement motor, and reassemble circulator using new gasket and bolts.
5. Follow the "Installation" procedure to start up the circulator.

CAUTION:

1. **The addition of petroleum based fluids or certain chemical additives to systems utilizing TACO equipment voids the warranty.**
2. **Use supply wires suitable for 90°C—ATTENTION: Employer des fils d'alimentation adequats pour 90°C.**

COMPARE. YOU'LL TAKE TACO.

TACO, INC., 1160 Cranston Street, Cranston, RI 02920 • (401) 942-8000 • FAX: (401) 942-2360.
TACO (Canada), Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W1B2 • Telephone: 416/625-2160 • FAX: 416/625-8616.

Q320V/Q480V

REPLACING CARTRIDGE ASSEMBLY:

1. Disconnect the electrical supply.
2. Reduce system pressure to Øpsi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove the body bolts and swing motor assembly away from the body.
4. Pull cartridge out of the motor housing.
5. Install replacement cartridge, making sure that the cover plate is between the cartridge flange and motor.
6. Make sure that the circulator product number corresponds to the replacement cartridge part number indicated in the chart below.
7. Reassemble circulator using the new gasket and new bolts.
8. Follow the "Installation" procedure to start up the circulator.

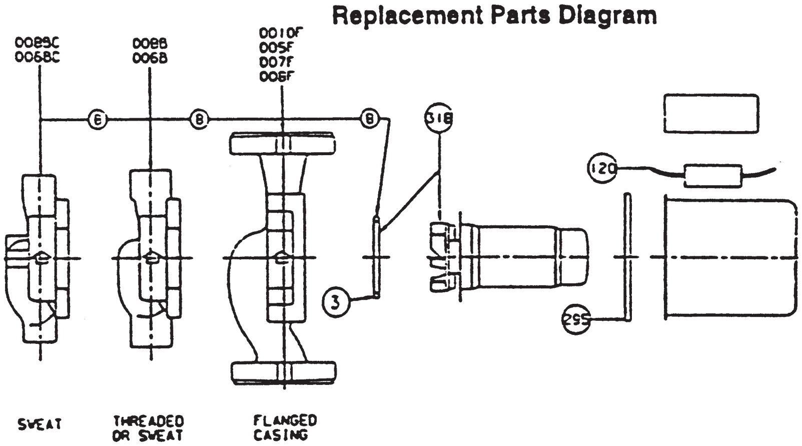
Circulator Product No.	Replacement Cartridge Part Number	
	Cast Iron Units	Bronze Units
005-1,2	005-019RP	005-020RP
006-3,4	N/A	005-020RP
*007-3,4	007-039RP	006-027RP
008-5	008-040RP	008-041RP
009-4	009-001RP	009-007RP
0010-1	0010-001RP	0010-005RP

*007-BF4-J use Cast Iron Replacement Cartridge.

REPLACING CAPACITOR:

1. Replacement capacitor must have same rating as originally furnished. See instructions provided with replacement capacitor.

Replacement Parts Diagram



8–Body

318–Replaceable Cartridge Assembly

3–Body Gasket

295–Cover Plate

120–Capacitor

LIMITED WARRANTY STATEMENT

LIMITED WARRANTY—Taco, Inc. will repair or replace without charge (at the Company's option) any Taco product or part which is proven defective under normal use within one year of the date of shipment from Taco, Inc. For the replaceable cartridge assembly only, Taco will repair or replace without charge (at the company's option) any replaceable cartridge assembly which is proven defective under normal use within three years of date of shipment.

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the Company in writing and promptly deliver the item in question, delivery prepaid, to the factory. The address for notification and delivery is Taco, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920. If the product or part in question contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subject to misuse, misapplication, the addition of petroleum-based fluids or certain chemical additives to the system, or other abuse will not be covered by this warranty.

TACO, INC. OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE PARAGRAPH ENTITLED "LIMITED WARRANTY" AS SHOWN ABOVE.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR STATUTORY, OR ANY OTHER WARRANTY OBLIGATION ON THE PART OF TACO, INC.

TACO, INC. WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS OR ANY INCIDENTAL COSTS OF REMOVING OR REPLACING DEFECTIVE PRODUCTS.

This warranty gives you specific rights, and you may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

Instruction Sheet

102-063

"00" Cartridge Circulators
Models 0011 & 0012

SUPERSEDES: NEW | EFFECTIVE JANUARY 1, 1991

Plant I.D. 001-969

APPLICATION:

1. Maximum operating pressure is 125psi (862kPa).
2. Maximum water temperature not to exceed nameplate rating.
3. Cast iron circulators are to be used for closed loop systems. Bronze circulators are to be used for open loop, fresh water, or potable water systems.
4. Taco cartridge circulator pumps are for indoor use only—employer uniquement a l'interieur.

INSTALLATION:

1. Mounting position-Circulator must be mounted with the motor in a horizontal position. They may be mounted vertically with the motor up, provided that the system pressure is at least 20psi(138kPa).
2. Rotating body-Body has an arrow on the front that indicates direction of flow. To rotate body remove the four body bolts, rotate body and replace bolts. Make sure that the junction box is NOT located underneath the circulator. (The junction box must NOT be located in the 6 o'clock position, as viewed from the motor end.)
3. Electrical connections—Observe all applicable codes when connecting to power supply. The motor is impedance protected, and does not require overload protection. Warning: Do not use in swimming pool or spa areas; pump has not been investigated for this application.
4. Fill system—The system must be filled before operating the circulator. The bearings are water lubricated and should not be allowed to operate dry. Filling the system will result in immediate lubrication of the bearings. It is always good practice to flush a new system of foreign matter before starting the circulator. Fill the system with tap water.
5. Circulator operation—Operate the circulator for 5 minutes immediately after filling system to purge remaining air from the bearing chamber; this is especially important when installing the circulator during the off season.

REPLACING MOTOR ASSEMBLY:

1. Disconnect the electrical supply.
2. Reduce system pressure to 0psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove body bolts and swing motor assembly away from the body.
4. Install replacement motor, and reassemble circulator using new gasket and bolts.
5. Follow the "Installation" procedure to start up the circulator.

CAUTION: 1. The addition of petroleum based fluids or certain chemical additives to systems utilizing TACO Equipment voids the warranty.
2. Use supply wires suitable for 90°C—ATTENTION: Employer des fils d'alimentation adequats pour 90°C.

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Q140V / Q500V

REPLACING CARTRIDGE ASSEMBLY:

1. Disconnect the electrical supply.
2. Reduce system pressure to 0psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove body bolts and swing motor assembly away from the body.
4. Pull cartridge out of the motor housing.
5. Install replacement cartridge making sure that the cover plate is between the cartridge flange and motor.
6. Make sure that the circulator product number corresponds to the replacement cartridge part number indicated in the Replacement Parts sheet.
7. Reassemble circulator using the new gasket and new bolts.
8. Follow the "Installation" procedure to start up the circulator.

REPLACING CAPACITOR:

1. Replacement capacitor must have same rating as originally furnished, see instructions provided with replacement capacitor.

LIMITED WARRANTY STATEMENT

LIMITED WARRANTY — Taco, Inc. will repair or replace without charge (at the Company's option) any Taco product or part which is proven defective under normal use within one year of the date of shipment from Taco, Inc.

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the Company in writing and promptly deliver the item in question, delivery prepaid, to the factory. The address for notification and delivery is Taco, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920. If the product or part in question contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subject to misuse, misapplication, the addition of petroleum based fluids or certain chemical additives to the system, or other abuse will not be covered by this warranty.

TACO, INC. OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE PARAGRAPH ENTITLED "LIMITED WARRANTY" AS SHOWN ABOVE.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR STATUTORY, OR ANY OTHER WARRANTY OBLIGATION ON THE PART OF TACO, INC.

TACO, INC. WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS OR ANY INCIDENTAL COSTS OF REMOVING OR REPLACING DEFECTIVE PRODUCTS.

This warranty gives you specific rights, and you may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

Instruction Sheet

102-052

Horizontal Circulators Nos. 110 thru 120

Plant I.D. No. 001-318

APPLICATION:

1. Maximum recommended working pressure is 125 psi (862 K Pa).
2. Maximum water temperature must not exceed 240°F.
3. Cast Iron Circulators should be used for closed systems only.
4. Bronze circulators must be used in open or fresh water systems and potable water systems.

INSTALLATION:

1. Mounting position — Circulators must be mounted with motor in a horizontal position.
2. Rotating casing — Casing has an arrow on front which indicates direction of flow. To rotate casing remove the casing bolts, rotate casing and replace bolts. Make sure gasket is properly located before tightening bolts.
3. Electrical connections — Observe all applicable codes when connecting to power supply. The motors do not require overload protection.
4. Fill system — It is good practice to flush a new system of foreign matter before starting circulator.

TO REPLACE MOTORS:

1. Disconnect wiring.
2. Loosen the two set screws at pump end of spring coupling, remove bolts between bracket and motor and separate.
3. Loosen other set screw of coupling and remove coupling from old motor.
4. Slide coupler with single set screw over new motor shaft and tighten against flat surface of shaft.
5. Place new motor assembly into bracket and replace bolts.
6. Extend pump end of spring coupling over impeller shaft 3/16" and tighten both set screws. If impeller and shaft move into body during this operation, water will flow from weep hole in bracket. If this does occur, extend spring coupler a little more or until water stops flowing. CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE WEEP HOLE BE PLUGGED.
7. Rewire motor.

TO REPLACE SPRING COUPLING

Follow same procedure outline above.

LUBRICATING INSTRUCTIONS

Re-oil pump and motor annually with SAE No. 30 oil.

*CAUTION: The addition of certain chemical additives to systems utilizing TACO Equipment, voids the warranty.

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F102-052 Effective 2/1/86 Supersedes: IS 100-

9960V

REPLACING SEALS

Water flowing from weep hole in bracket normally indicates dirt on the seat or seal needs replacement. Before taking pump apart extend spring coupling and impeller shaft into body as far as it will go. This will separate the seal halves and permit a greater flow thru the weeping hole and wash any foreign matter off the seats. Release and if flow stops, it indicates that the seals do not require replacement. If the flow does not stop, loosen the two set screws on the coupling and extend as far as it will go. If leak stops it means there was insufficient tension on the coupling. If leak continues, indications are that the seal needs replacement. Proceed as follows: —

1. Disconnect wiring.
2. Valve off or drain system.
3. Remove body bolts and pull entire assembly out of body.
4. Loosen the two set screws at pump end of spring coupler, file off any burrs on shaft and pull impeller and shaft from bracket.
5. Pry out old seal seat from bracket with a screwdriver and old part from impeller shaft with a pair of pliers.
6. Clean shaft and seal bearing surfaces thoroughly with clean cloth.
7. Dip CARBON part of seal in water to lubricate, place on top of impeller shaft with carbon facing up. Push down on shaft with palm of hand as far as it will go. Then with both thumbs push all the way down making certain that prongs engage the two holes in the impeller. If there are no holes in the impeller, break off the prongs with a pair of pliers and smooth burrs with a file.
8. Separate rubber from ceramic part, wet it and set into recess in bracket. Set ceramic seal into rubber with seat facing out by starting at a slight angle first, then pushing away and down simultaneously. The rubber rings should not be folded over during the operation. Make certain that both the rubber and ceramic are "bottomed" squarely.
9. Clean both seal surfaces with a clean lintless cloth.
10. Place a few drops of oil along the impeller shaft and push slowly with a twisting motion through ceramic part intr bracket and spring coupling.
11. While holding impeller and shaft with seal faces mating, insert an Allen wrench into one of the set screws in the coupling, extend spring — 3/16".
12. Remove old body gasket, clean surfaces and replace with new gasket.
13. Place entire assembly into body, replace and tighten bolts gradually and evenly all around.
14. Refill system. If water leaks from weep hole in bracket increase tension on spring coupling slightly more or until leak stops.
15. Rewire motor.

Algas·SDI™

ISO 9001 Certified

Innovative Liquid Vaporizing and Gas Mixing Solutions

WARRANTY REGISTRATION

Type of Equipment: ______________________ Serial Number: ______________________

ASDI Sales Order #: ______________________ Order Date: ______________________

Purchased By: ____

To help us give you better service, please fill out this warranty registration form and return it to ASDI to register your purchase and for follow up on the performance of ASDI equipment. We are dedicated to producing a quality product and if a problem occurs, ASDI wants to know about it. Please help us with a small amount of information about your company and how the equipment will be used. When contacting ASDI, please have the type of equipment and the serial number handy so we can give you accurate information. If you have had any kind of problem with this equipment, or you have any comments, please attach a separate sheet to this form. Keep a copy for your records.

End Customer/Company Name: ______________________________________

Address: ______________________________ Tel: ______________

City: ______________________________ Fax: ______________

State: ______________________________ Zip: ______________

Name of individual to contact for follow up information: ______________________

Title: ______________________

Usage - Circle one: Base Load Standby System Peak Shaving

Other: ____

In what application is the equipment being used? ______________________

When was the equipment put in service? ______ / ______ / ______

Note: If you have more than one piece of ASDI equipment, fill out one warranty sheet and staple the others to it, ASDI will do the rest.

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