Algas-SDI™

...Innovative liquid vaporizing and gas mixing solutions

ISO 9001 Certified

AQUAVAIRE

Vertical Waterbath Vaporizer
Models: Q320V through Q1650V

Operations & Maintenance Manual

151 South Michigan Street, Seattle, Washington, USA 98108
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FILE: MANUAL PN 52640 REV 07-13-07 QV.DOC

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. Vendors have supplied literature contained in the Operation Manual. 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.**
- **Anytime a component must be replaced, use the same type, model, etc. DO NOT SUBSTITUTE! The consequences 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.**

WARRANTY REGISTRATION

Fill out the Warranty Registration information on the last page of this manual. Refer to the nameplate on the unit to fill out the product registration. 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.

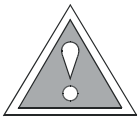
COPYRIGHT

APPROVALS

FM
APPROVED

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

This symbol 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

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

ELECTRICAL DISCONNECT REQUIRED

This symbol 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**

Facsimile: **206.789.5414**

Email: **sales@algas-sdi.com**

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

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Warranty Registration - Refer to the nameplate on the unit to fill out the product registration. Then Photocopy and mail to address shown.

Introduction 1

Description/Overview

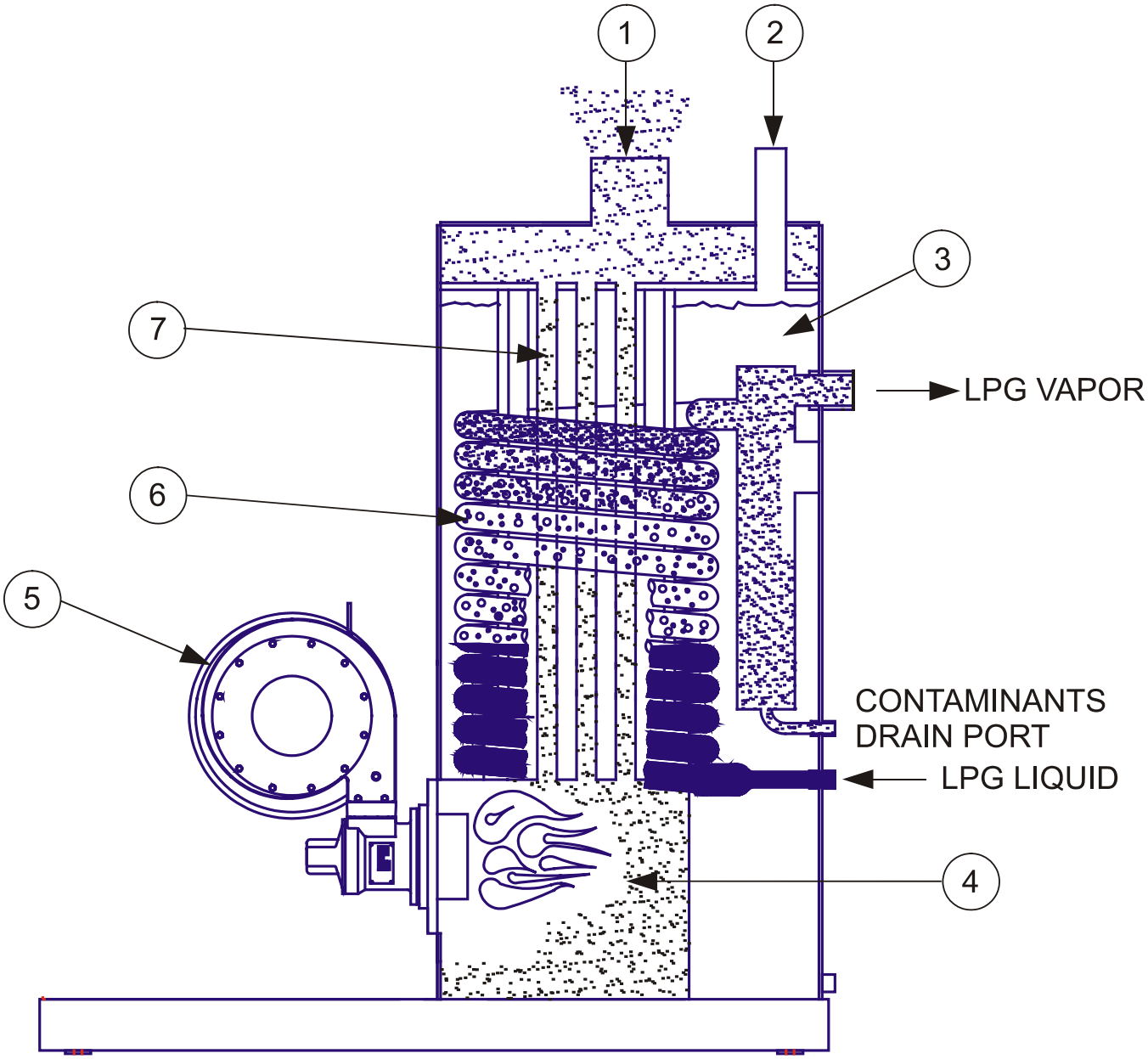
The Algas-SDI **QV** models are indirect fired waterbath LPG vaporizers. The units vaporize liquid LPG from a storage source by passing it through a heat exchanger immersed in a heated water/glycol mixture. A fixed air forced draft burner keeps the waterbath at the required temperature. The QV is designed for outdoor installation as a baseload or standby system, and is offered in sizes ranging from 320 to 1650 gallons of propane per hour.

The standard unit is FM (Factory Mutual) approved. Optional features include Industrial Risk Insurers (IRI), or Canadian Gas Association (CGA) burner controls, and a standby electric bath heater.

QV SYSTEM BASIC FEATURES

- An indirect fired **LPG VAPORIZER** composed of two heat exchangers, burner, and a waterbath heat transfer medium.
- A cabinet houses the **ANNUNCIATOR ALARM DISPLAY** and **FUSES**. Should a safety circuit fail, the annunciator displays the alarm.
- 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 on high waterbath temperature, liquid LPG level carryover, high and/or low burner gas supply pressure, low waterbath level, or burner failure. A time delay relay will prevent the vaporizer from shutting down if there is a momentary loss of power or a momentary opening of one of the safety switches.

Figure 1 – *Visual Representation of QV System*

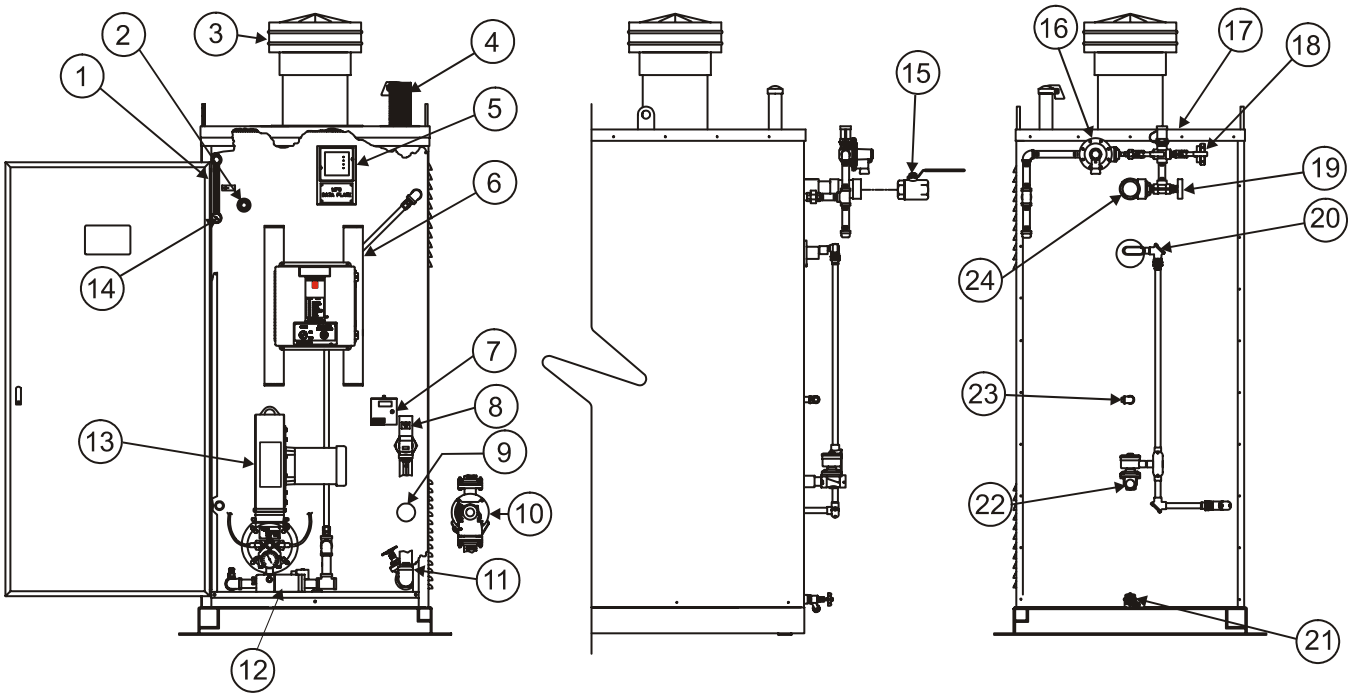


QV System Dynamics.wmf

1. Flue gas outlet
2. Waterbath fill and vent opening
3. Waterbath
4. Combustion chamber
5. Burner/blower assembly
6. LPG heat exchanger
7. Fire tubes (typical)

Major Components Drawings 2

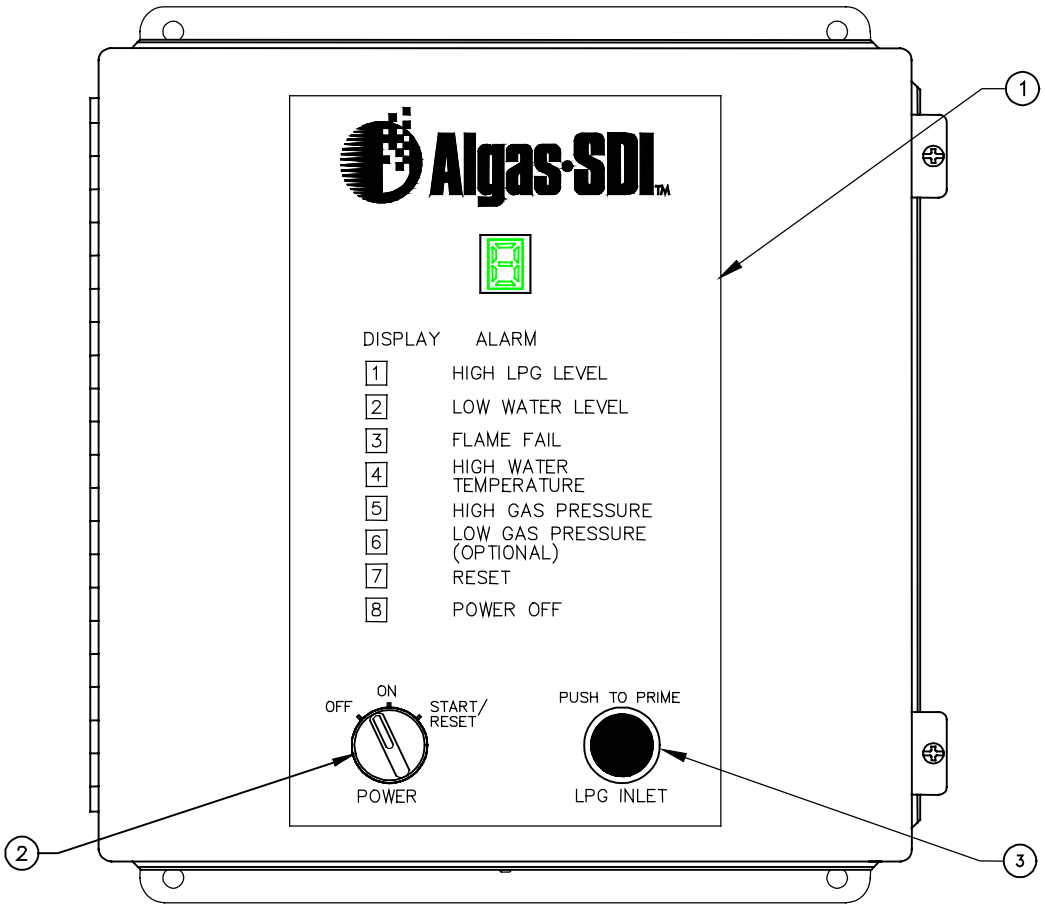
Figure 2 – *QV Major Component Drawing*



QV Major Components.wmf

1. **Waterbath fill sight glass**
2. **Low waterbath level safety switch**
3. **Flue outlet**
4. **Waterbath fill and vent opening**
5. **Flame safeguard**
6. **Control panel**
7. **High/low waterbath temperature safety switch**
8. **Waterbath Operating Temperature Control Switch**
9. **Standby electric bath heater (optional)**
10. **Waterbath circulation pump**
11. **Waterbath circulation shutoff valve**
12. **Burner gas train, *see Fig. 4 and 5***
13. **Burner**
14. **Waterbath temperature gauge**
15. **Outlet shutoff valve (customer supplied)**
16. **Burner regulator**
17. **LPG vapor relief valve (250 PSIG)**
18. **LPG vapor pressure gauge**
19. **LPG vapor temperature gauge**
20. **LPG liquid level float switch**
21. **Waterbath drain**
22. **LPG inlet safety solenoid backflow valve**
23. **LPG / contaminant drain**
24. **LPG vapor outlet**

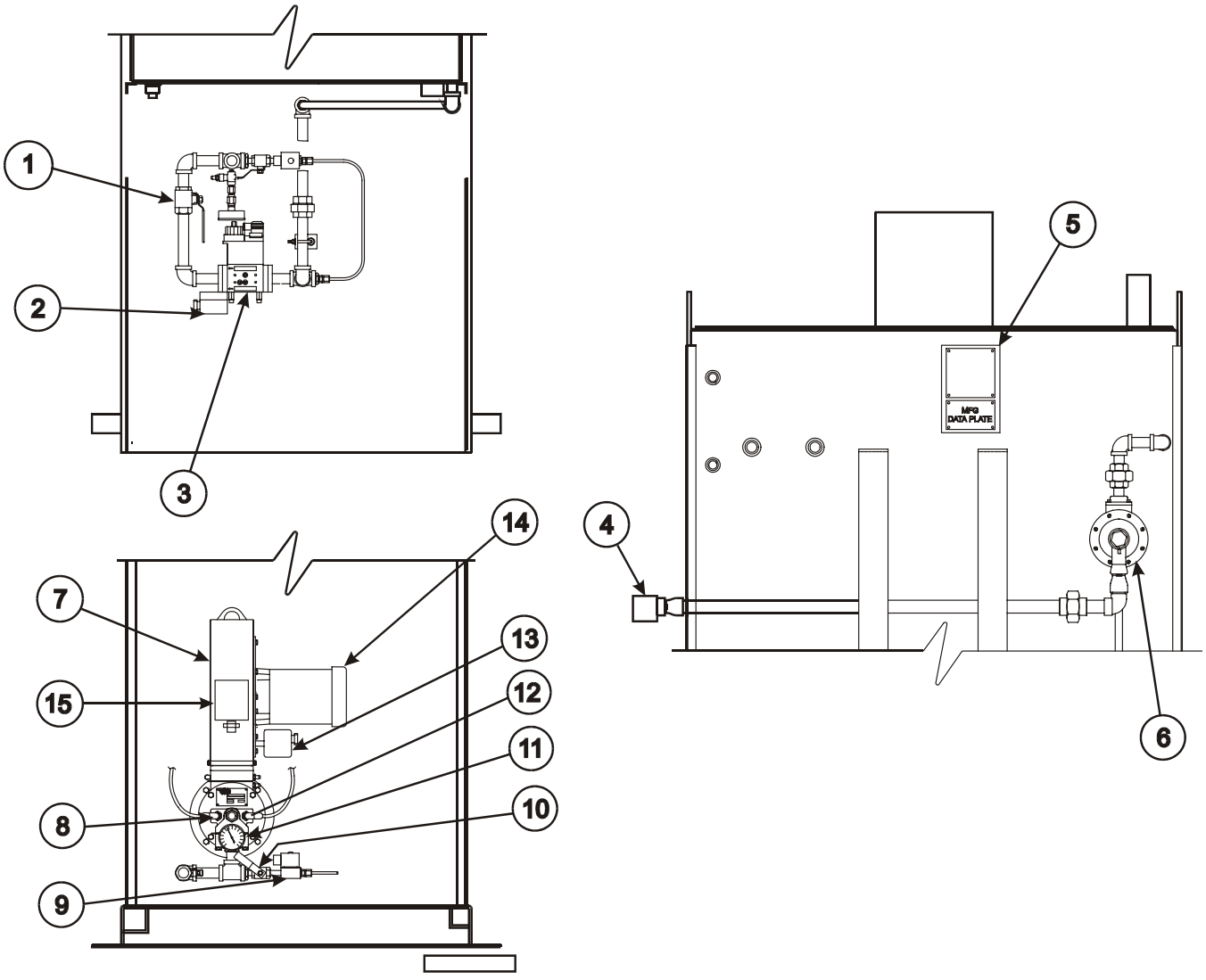
Figure 3 – *Control Panel Components*



Control Panel Comp.wmf

1. **Annunciator Alarm Display**
2. **On/Off power START/RESET switch and lamp**
3. **Push to prime, LPG inlet solenoid open switch and lamp**

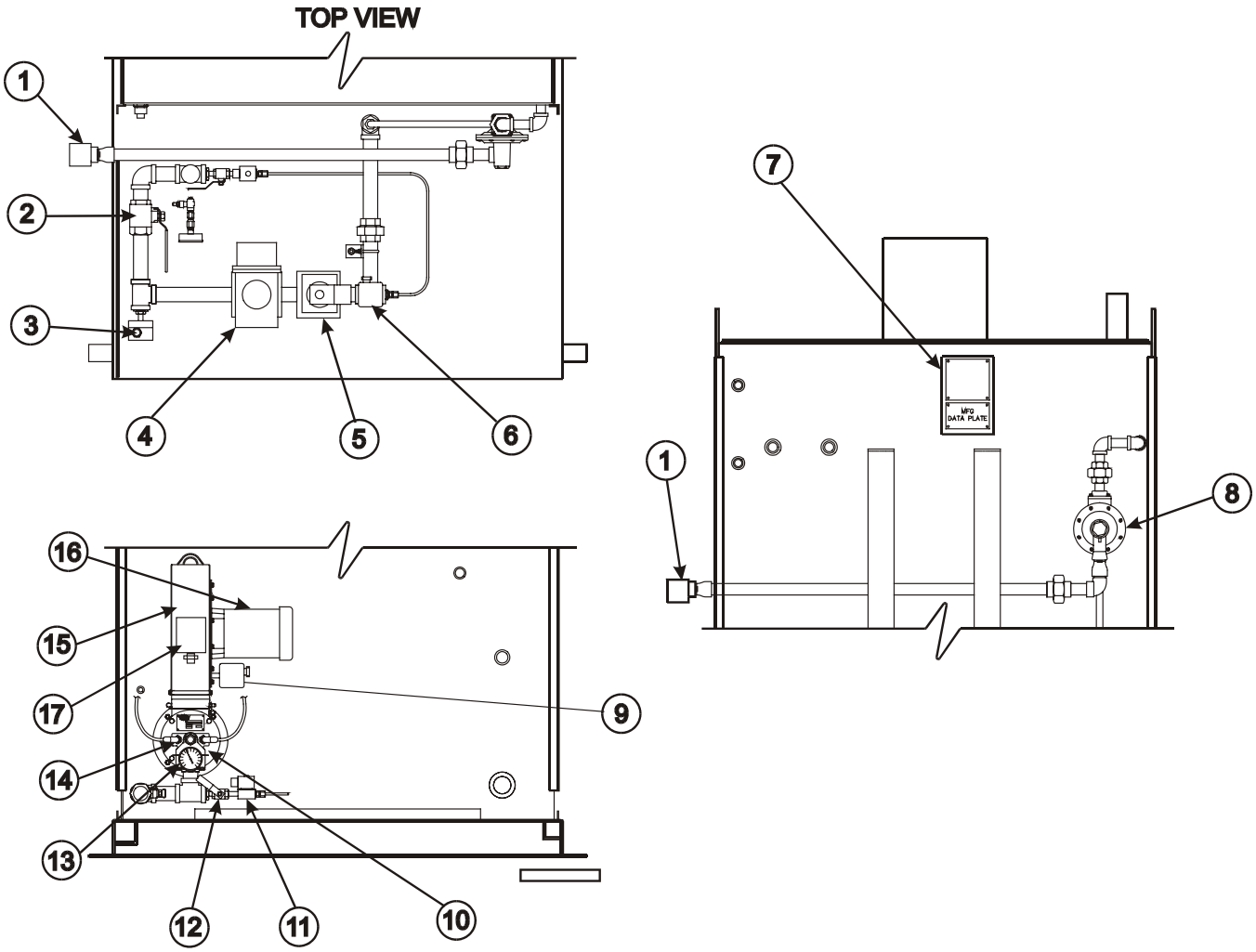
Figure 4 – *Burner Train Component Layout*
Standard Q320V through Q1650V and Minnesota Q320V through Q960V



QV Burner Train.wmf

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

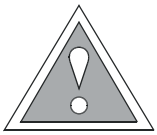
Figure 5 – *Burner Train Component Layout*
Q1120V – Q1650V Minnesota option



QV Minnesota Burner.wmf

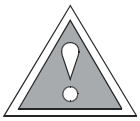
1. **2nd stage regulator relief vent**
2. **Main gas supply valve**
3. **High gas pressure switch**
4. **Main gas valve**
5. **2nd gas valve**
6. **Low gas pressure switch**
7. **Flame safeguard**
8. **2nd stage burner regulator**
9. **Air flow switch**
10. **Spark plug**
11. **Gas pilot solenoid valve**
12. **Pilot supply valve**
13. **Burner inlet pressure gauge**
14. **Flame rod (UV scanner for Q1650V)**
15. **Blower housing assembly**
16. **Blower motor**
17. **Ignition transformer**

Installation 3



WARNING

The equipment described in this manual is designed to operate with LP-gas, a flammable fuel under pressure. The nature of the application involves inherent hazards that could result in injury. ONLY a trained and fully qualified person should service this equipment.



CAUTION

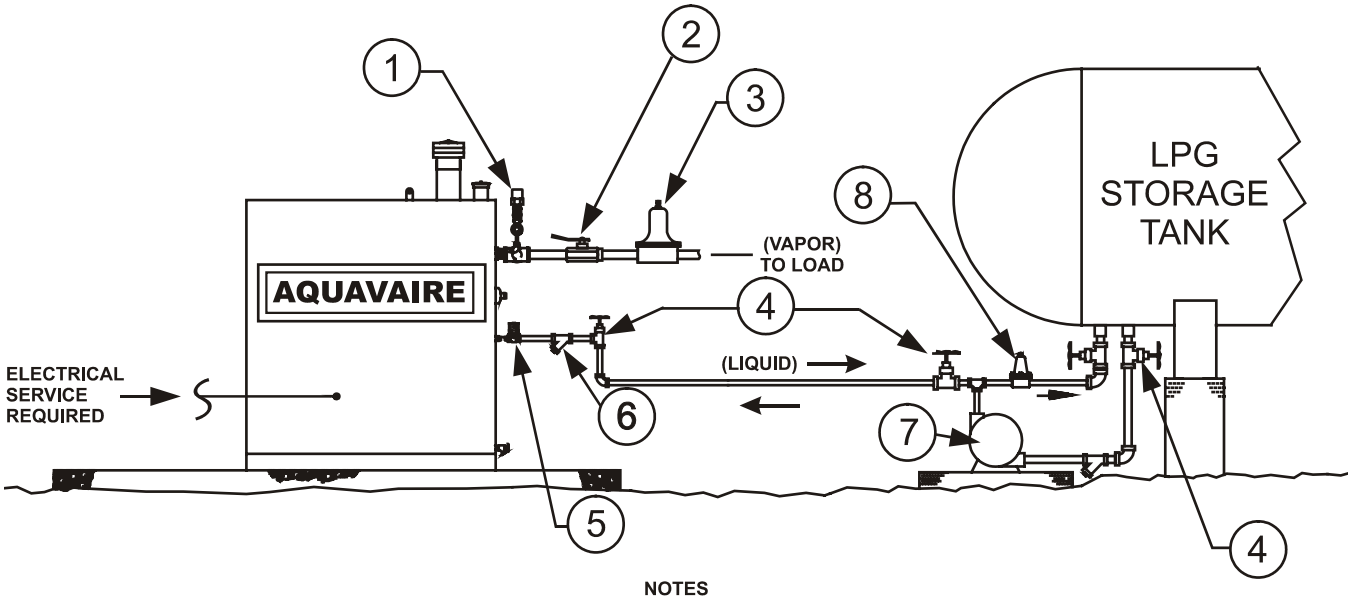
Qualified technicians should perform all servicing of LPG equipment.

QV SYSTEM INSTALLATION PROCEDURE

- Place unit on a solid, flat concrete base.
- Connect all required liquid piping from the LPG source.
- Connect system electrical power to the control panel and LPG pump if used.
- Add adequate waterbath freeze and corrosion protection products.

Install the QV 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.

Figure 6 – *Typical QV System Installation with External Components*



Installation.wmf

1. **Relief valve with rain cap**
2. ***System outlet valve**
3. ***Vaporizer outlet regulator**
4. ***Isolation valve with hydrostatic relief**
5. **LPG Inlet solenoid valve**
6. ***Strainer**
7. ***LPG pump (optional)**
8. ***Back pressure control valve**

***Customer supplied**

Physical Requirements

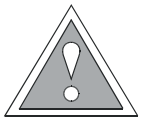
A typical installation configuration of a QV system with external components is shown above. Install the system on a firm, level base, and preferably a reinforced concrete pad that meets local regulation requirements for the system. Bolt the system securely through the mounting holes provided. Prior 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 regulations 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. Determine the minimum LPG supply pressure required (***See Data Sheet***) and install a suitable pump if needed.

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.

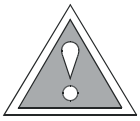
LIQUID PUMP

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 QV unit at the vaporizer's liquid inlet.
- Connect the liquid LPG supply line **(Figure 6)** to the vaporizers liquid inlet **(Figure 2, Item 22)**.

NOTE



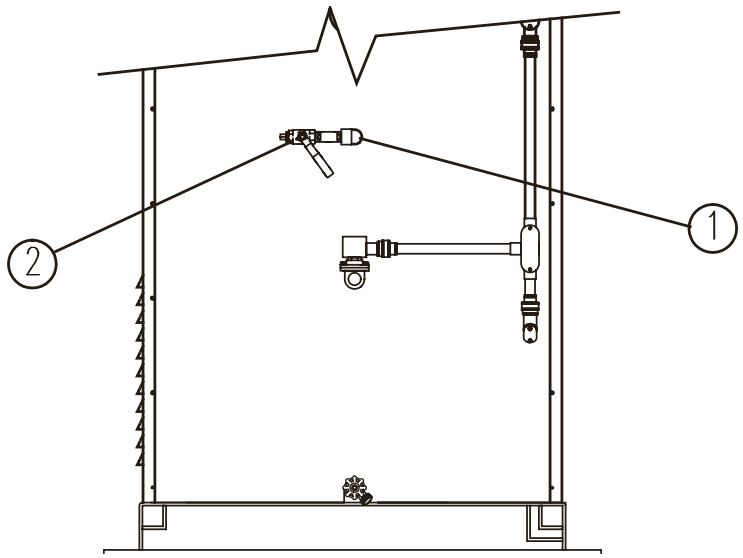
Do not install check valves or other devices that prevent backflow in the liquid LPG line.

LIQUID PIPING INSTALLATION

Piping connections will begin at the LPG storage tank and enter the QV unit at the vaporizer's liquid inlet.

- Connect the **LIQUID LPG SUPPLY LINE** to the **VAPORIZER'S LIQUID INLET**. Do not install check valves or other devices that prevent back flow in the liquid LPG line. Determine the minimum LPG supply pressure required and install a suitable pump if needed.
- Install a **LIQUID LINE STRAINER WITH A MAGNETIC PLUG (Figure 6, Item 6)** approximately five (5) feet upstream of the vaporizer. The strainer should be 40 mesh.

Figure 7 – *Installation Position of Plugged Drain at LPG Contaminants Drain*



Plugged Drain.dxf

1. LPG/contaminant drain. **2. Plugged drain valve.**

- Clean all foreign material from all pipelines 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 150 PSIG (10.5 kg/cm2) and 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

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 capacity. Undersized inlet pipes can reduce 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.

VAPOR LINE

Install an appropriate regulator immediately downstream of the vapor outlet port. Pipe from the outlet port of the regulator to the distribution system. Further reduction of downstream pressure requires a “Second Stage” regulator close to the consuming equipment. Properly sized piping and regulators will insure satisfactory service.

NOTE

For safety reasons both FIRST and SECOND stage regulators must be 250 psig (17.58 cm/kg^2) inlet pressure rated!

SAFETY RELIEF VALVE

If the vaporizer is to be installed within an enclosure or building**, VENT THE SAFETY RELIEF VALVE OUTSIDE THE ENCLOSURE AND REDIRECT THE DISCHARGE UPWARD.** A pipe-away adapter must be used at the relief valve. Always install a rain-cap or similar device to prevent water and other debris from entering the relief discharge. If water enters, it may freeze and prevent the relief valve from proper discharge, creating a potentially hazardous situation.

Electrical

- Make **ELECTRICAL SERVICE CONNECTIONS** to the **CONTROL PANEL**. Conduit should be brought through the side of the QV cabinet enclosure. Connections to the control panel must be watertight. A disconnect should be provided by the installer. Check your QV system **ELECTRICAL RATING**. ***See the Rating Plate or Data Sheet for electrical service requirements.***

- For Vaporizers operating on voltages other than 120VAC, a transformer is installed in the vaporizers enclosure. Make **ELECTRICAL SERVICE CONNECTIONS** to the Transformers enclosure. A disconnect should be provided by the installer. Check your QV system ELECTRICAL RATING. ***See the Rating Plate or Data Sheet for electrical service requirements.***

An opening has been provided in the bottom of the control box for the 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 job site. 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 lug is located on the inside bottom of the control panel and is identified by a green ground label. Applicable codes and standards determine the size of the ground wire.

- If the system is equipped with the **OPTIONAL WATERBATH ELECTRIC 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. Motors have a high inrush current every time the motor turns on. If the wire is not sized correctly, voltage drops on the line can affect the operation of the vaporizer. 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 and/or overheating. 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.

Waterbath Freeze and Corrosion Protection

The QV is an open system waterbath vaporizer, meaning it is vented to atmosphere and requires a little greater corrosion protection than closed systems. This is accomplished by increasing the percentage of corrosion inhibitor from manufacturer recommendations, which are normally for closed systems.

NOTE

The QV 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 is 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 1/2 inch to 3/4 inch below the fill line from 60°F (15.6°C). To -20°F (-28.9°C) and a total of 2 inches to 2 1/2 inches from -20°F (-28.9°C) to 170°F (76.7°C). Because of this, 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 chapter.***

- **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 Calculating Freeze and Corrosion Protection to determine proper amounts of product for protection.

Never use pure ethylene or propylene glycol without a corrosion inhibitor. Glycol breaks down under use to form acidic end products which will cause major corrosion to occur. Dow products and **CH20's HYDRO-TREAT** have chemicals in them 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 to protect it from the corrosive effect of dissolved gases.

Calculating Freeze and Corrosion Protection

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 % volume of anti-freeze product required in final mix for chosen product from Table #1.
- Determine total waterbath gallons required from Table #2.
- Multiply the total waterbath gallons by % volume/100 to determine gallons of anti-freeze product required.

EXAMPLE:

-10°F (15°C) is the lowest operating temperature for a Q640V 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}

  $TCG \times P_V = GAL_{SR-1}$

  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 minimum quality requirements below.

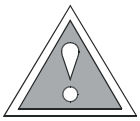
Chlorides	25 PPM (max)
Sulfates	25 PPM (max)
Calcium	50 PPM (max)
Magnesium	50 PPM (max)

- Total amount of above constituents should not exceed 100 PPM.

CORROSION PROTECTION

Freeze protection that requires less than 50%, by volume, of **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/water mix or 100% water, use Table # 2 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 1 – *Pure Glycol and Dow 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
-50	228	55.7	57.2	60.6	-50	224	57.2	59.8	60.8

Table 2 – *Total Waterbath Gallons*

QV Models	Total Waterbath Gallons	CH20 Hydro-treat Corrosion Inhibitor Gallons
Q320V	107	0.5
Q480V	129	0.5
Q640V	221	1.0
Q800V	279	1.25
Q960V	279	1.25
Q1120V	475	2.0
Q1375V	475	2.0
Q1650V	475	2.0

ORDERING INFORMATION

- DOW

  Phone: 1-800-447-4369

- DOW ANALYSIS KITS

  The Dow Chemical Company
  Larkin Lab
  C/O Thermal Fluids Testing Lab
  1691 North Swede Road
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- CH20

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- MISCO PRODUCTS

  MISCO PRODUCTS
  3401 Virginia Road
  Cleveland, OH 44122-4218

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  OMEGA
  One Omega Drive
  Stamford, CT 06907-0047

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  Fax: 1-800-848-4271

Initial Startup 4

NOTE

This procedure is for starting the vaporizer for the first time. For subsequent startups, See Section 5: Operation.

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.**

All initial settings were made at the ASDI factory. However, due to vibration inherent in transportation, some settings may need adjustment upon setup ***Refer to the Data Sheet for all control settings.***

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 QV OPERATIONS AND MAINTENANCE MANUAL before starting the system.

Only a qualified startup specialist should perform the startup.

Initial Start-Up Instructions

INITIAL VAPORIZER STARTUP

- Turn on the customer provided **DISCONNECT** for the equipment.
- Check for correct **VOLTAGE** to the control panel by testing input terminals with a voltmeter. The voltage should be **100-130 VOLTS**. During burner start, the input voltage should never drop below 100 volts.
- Manually close **VAPORIZER OUTLET HAND VALVE**, which is located downstream of the vaporizer outlet.
- Purge air from the **LPG LIQUID LINE** between the LPG storage tank, the LPG pump (if used), and the vaporizer.
- Verify **OPERATING COMPONENTS** and **SAFETY SETTINGS**. ***Refer to the Data Sheet for factory settings.***
- Turn control **POWER SWITCH ON** to **START** while simultaneously pressing and holding the LPG PRIME button for 1-2 seconds to allow LPG to enter the heat exchanger. If the burner fails to light, repeat the above step again until the burner starts.
- As the LPG pressure drops press the **PRIME** button 1-2 seconds to build up pressure. Repeat as necessary until the vaporizer reaches 120°F (48.9°C). (Low waterbath temperature safety switch setting) and the LPG solenoid valve remains open.)

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 union on the gas train. When the air is purged from the burner gas train, tighten the union and test for leaks.

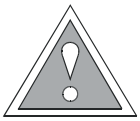
NOTE

The PUSH TO PRIME button opens the LPG inlet solenoid valve. Hold it in only 1-2 seconds to build up pressure. Holding it in longer may flood the vaporizer with LPG.

- The **BURNER INLET PRESSURE GAUGE** setting should be the same as indicated on the Data Sheet.
- The **VAPORIZER** will now warm up to its **SETPOINT** as set on the control operating switch: factory set at 160°F for all models.

TO SHUT DOWN THE VAPORIZER

- Close the **VAPORIZER OUTLET VALVE**.
- Turn the **POWER CONTROL SWITCH** to **OFF**.
- Shutdown is complete.



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, which could cause a pressure build-up in the vaporizer, and opening of the safety relief valve.

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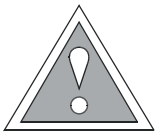
Operation 5



WARNING

The equipment described in this manual is designed to operate with LP-gas, a flammable fuel under pressure. The nature of the application involves inherent hazards that could result in injury. ONLY a trained and fully qualified person should service this equipment.

CAUTION

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

OVERVIEW

- Start/stop and standby operating sequence steps.
- Burner, flame safeguard and Annunciator Alarm Display operation.
- Waterbath circulation system and operation.
- Component operation and adjustment.

For safe operation, please thoroughly read this section before use is initiated.

Start/Stop and Standby Sequence

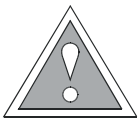
RESTART THE VAPORIZER

- Insure the **VAPORIZER OUTLET VALVE** is closed.
- Check the LPG vapor pressure gauge on the rear of the unit.
- If pressure is present:
  - Turn **POWER** control switch to **START/RESET** and release.
  - As the LPG pressure drops, press the **PRIME** button 1-2 seconds to build up pressure, repeat as necessary. When the vaporizer reaches 120°F (48.9°C) (low waterbath temperature safety switch setting) the LPG solenoid valve will remain open.
- If no pressure is present:
  - Turn control panel **POWER** switch to **START/RESET** while simultaneously pressing and holding the **LPG PRIME** button for 1-2 seconds to allow LPG to enter the heat exchanger.
  - As the LPG pressure drops, press the **PRIME** button 1-2 seconds to build up pressure, repeat as necessary. When the vaporizer reaches 120°F (48.9°C) (low waterbath temperature safety switch setting) the LPG solenoid valve will remain open.
- After the vaporizer attains operating temperature, slowly **OPEN** the **VAPORIZER OUTLET VALVE**.

STANDBY CONDITION

The vaporizer will take about 20 to 30 minutes to reach operating temperature, depending on ambient temperature. For quicker start-up, the system can be put in standby condition. Restart the system as described above, but leave the outlet valve closed to keep the waterbath at operating temperature. To begin operation, slowly open the outlet valve.

WARNING

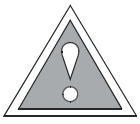


Always put the vaporizer in standby condition before temperatures fall below 0°F (-17.8°C).

SHUTDOWN THE VAPORIZER

- Close the vaporizer outlet valve.
- Turn the power switch to **OFF**.

WARNING



Do not close the outlet and inlet valves when shutting off the system. Closing both valves may trap liquid propane in the vaporizer, which could cause a pressure build-up and opening of the safety relief valve.

Burner and Flame Safeguard Systems

TYPICAL BURNER OPERATION SEQUENCE
SAFETY PILOT SOLENOID VALVE
IGNITION TRANSFORMER
SAFETY SOLENOID VALVES

For all standard models, Q320V through Q1650V, and Minnesota option Q320V through Q960V, the burner uses a fixed fire start. This 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. A regulator controls gas pressure. Combustion air is fixed in the high fire position 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 the 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 closes, the blower motor shuts off and the burner is ready for the next cycle.

Q1120V and Q1650V Minnesota option burners use a low fire start, high fire run system. The only difference will be that 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.

The regulator pressure can be set by measuring the inlet pressure to the orifice. The pressure to the inlet orifice is measured at tap “A” (***See Figure 8***). The pressure gauge on the burner measures the inlet pressure to the orifice the same as tap “A”. A manometer is required to measure the pressure at the tap and to check the pressure gauge. Tap “A” is a needle type valve. Before attaching the manometer, insert a screwdriver into the tap opening and rotate the screw counterclockwise three turns to open the valve. Make sure to close the valve when the regulator setting is complete. Check the Data Sheet for the correct burner orifice inlet pressure.

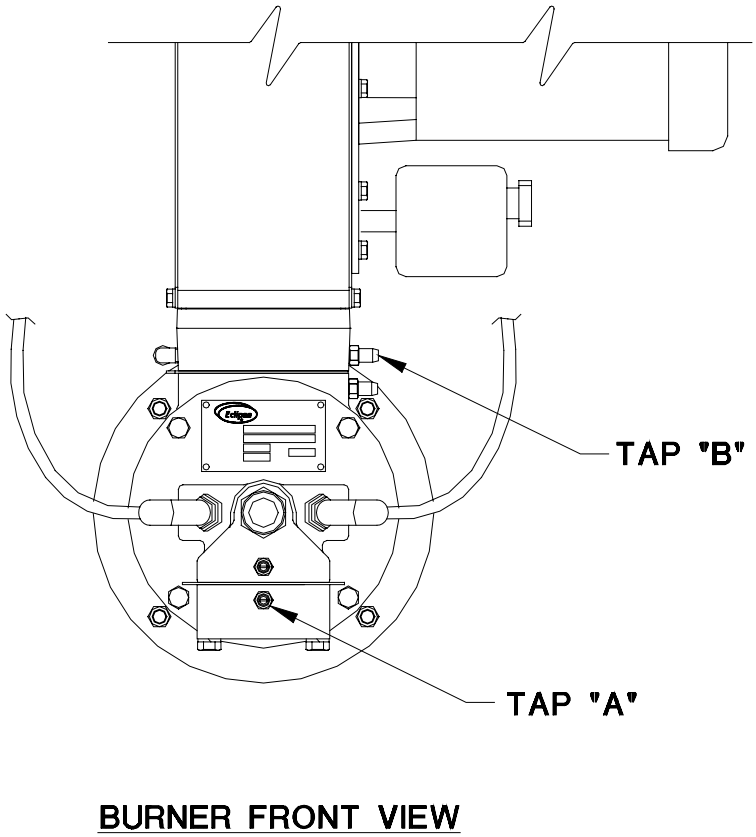


Figure 8 – *Burner Regulator Adjustment*

Burner Reg Adj.wmf

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 counter-clockwise to decrease the pressure.
- Adjust the regulator to achieve the desired burner pressure 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 the 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 Sheets for the correct setting of the air flow switch.

The static pressure can also be checked by using an inches water column (WC) pressure gauge or a manometer attached to tap 'B'. Tap 'B' is a needle type valve. Before attaching the manometer, insert a screwdriver into the tap opening and rotate counterclockwise three turns to open. Make sure to close the valve when done. The pressure should be at least 4 inches water column.

PILOT FLAME STRENGTH ADJUSTMENT

When the **PILOT TEST BUTTON**, located on the flame safeguard, is pressed in, the pilot flame will stay on indefinitely without opening 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 pilot test/reset button again. For more information on pilot testing and set up, ***Refer to Appendix for the Veri-flame Manual.*** Test procedures are located in Section 7.

Notice: Press the test button again to re-establish normal burner operation.

DUNGS DUAL MULTI-VALVE VISUAL INDICATORS AND ADJUSTMENTS

Both safety shutoff gas valves, one quick opening and one slow opening, are combined in the Dual Dungs 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.

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 as the pressure regulator controls the gas flow and the initial fast lift adjustment has little appreciable effect on the valves total opening time. If adjustment is necessary, ***Refer to the Dungs Valve in Appendix, Component information for instructions.***

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

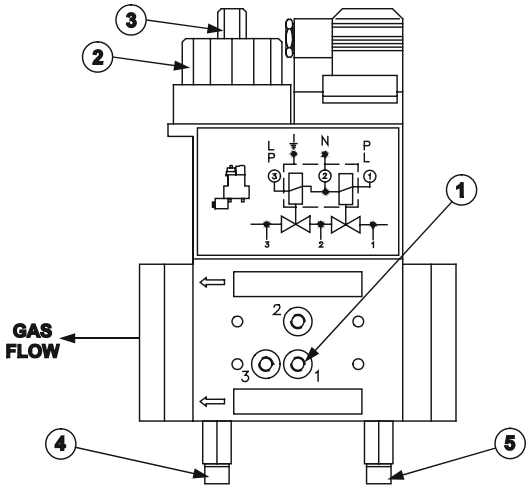


Figure 9 – *Dungs Dual Multi-Valve and Visual Indicators*

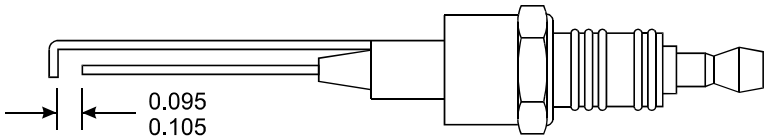
Dungs.wmf

1. **Pressure taps**
2. **Main flow setting adjustment cap**
3. **Initial fast lift adjustment cap**
4. **Slow opening visual indicator**
5. **Fast opening visual indicator**

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 10 - *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. LEDs on the flame safeguard show the current operating status. The push button is for putting the burner in pilot test mode and resetting the flame safeguard. It is a two-position button, **IN** and **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 error 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 burner 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. ***Refer to the VERI-FLAME SAFEGUARD MANUAL for further information as well as the maintenance checklist and troubleshooting guides, 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.

Waterbath Circulation System

WATERBATH

The waterbath is normally a mixture of water and glycol in varying mixture ratios plus corrosion inhibiting additives. It is vented to the atmosphere so 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. For maintenance, ***See the appropriate pump/motor in Appendix, Component Information.***

WATER TRAIN

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.

WATERBATH OPERATING TEMPERATURE CONTROL SWITCH

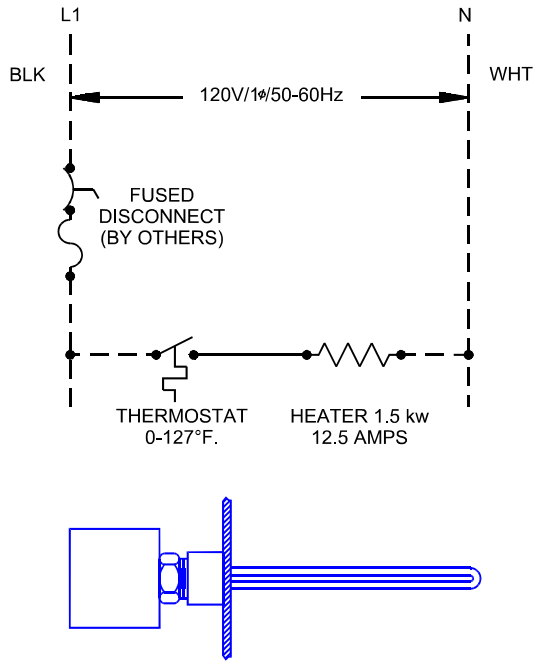
The Operating Temperature Control Switch is mounted on the water train for optimized Waterbath temperature measurement. This switch controls the call for heat to the burner. Both the temperature setting main dial, seen through the front opening, and temperature differential, accessed by removing the cover, can be adjusted. The control will turn the burner off at the temperature setting and back on at the temperature setting minus the differential. For complete adjustment instructions ***See the Aquastat Controller in Appendix*** **of this manual.**

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 (53°C). A 120VAC 12.5 amp independent service is required for the heater.
See Options Section in this manual.

Figure 11 - *Optional Backup Heater*



Backup Heater.wmf

Safety and Operating Switches

NOTE

The Annunciator Alarm Display must be reset whenever a fault is registered on the display in addition to clearing the error and resetting the switch if necessary.

ANNUNCIATOR ALARM DISPLAY

The **ANNUNCIATOR ALARM DISPLAY** is located on the control panel door and will indicate which safety switch has been tripped. When any of the safety switches are activated, the burner will shut off and not restart until the problem has been corrected. To reset the Annunciator Alarm Display after the problem has been corrected, turn the power switch to START/RESET on the control panel and hold 5-10 seconds.

See Troubleshooting Section to resolve any of the following faults.

THE FAILURE CONDITIONS ARE NUMBERED AS FOLLOWS:

Blank Display - LOSS OF VOLTAGE

The Display is blank when the vaporizer is operating normally. When the vaporizer is not operating, a blank display will occur when there is a loss of voltage and or open fuse.

1 - HIGH LPG LEVEL SAFETY

The **LIQUID FLOAT SWITCH** will open and shut off the burner when liquid LPG has filled the heat exchanger and is passing through the unit outlet. When the switch is open, the Annunciator Alarm Display will show **1**.

2 - LOW WATER LEVEL SAFETY

When the water level is too low to safely operate the vaporizer, the Low Water Level Safety Switch opens shutting off the burner. Some models of vaporizers are equipped with two Low Water Safety Switches. When the Low Water Level Safety Switch is open the Annunciator Alarm Display will show **2**.

3 - FLAME FAILURE SAFETY

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. LED's on the flame safeguard show the current operating status. The push button is for putting the burner in pilot test mode and resetting the flame safeguard. It is a two-position button, **IN** and **OUT**. When a #3 failure code is displayed, ***Refer to the Troubleshooting Section*** for possible failure causes.

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, the air failure alarm will display on the flame safeguard, and the Annunciator Alarm Display will show **3**, flame failure.

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

4 - HIGH WATERBATH TEMPERATURE SAFETY

The High Waterbath Safety Switch opens and the turns off the burner when waterbath temperature reaches the setpoint 200°F (93.3°C). The Annunciator Alarm Display will show a **4**. Reset occurs when the water temperature drops to 190°F (87.8°C). To adjust the high waterbath temperature switch, remove the cover using your fingers. Turn the adjustment screw to 200°F (93.3°C) using your fingers. Lock this adjustment in place using the collar provided. Reinstall the cover.

5 - HIGH GAS PRESSURE SAFETY

Every unit has a high gas pressure switch to protect the burner from regulator failure but only certain models, mainly Minnesota Q1120V and Q1650V, have a low gas pressure switch. The two switches look similar but are individually labeled. If the labels are missing, refer to 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.
See 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. The Annunciator Alarm Display will show **5** for high gas pressure fault.

6 - LOW GAS PRESSURE SAFETY

Certain models, mainly Minnesota Q1120V and Q1650V, have a low gas pressure switch. The switch looks similar to the High Gas Pressure Safety Switch but are individually labeled. If the labels are missing, refer to the appropriate burner train schematic in the Major Component Section for location. The switch 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.
Refer to the Data Sheet for correct setting.

The Low Gas Pressure Safety Switch has a manual reset button in the center of the pressure setting dial. When the switch has been tripped, the fault must be corrected first. Then the reset button must be pushed to reset the switch. The Annunciator Alarm Display will show **6** for Low Gas Pressure Safety Switch fault.

7 - RESET

A Reset Display of **7** occurs when there is a loss of voltage or a voltage drop below 100VAC for more that 3 seconds.

8 - POWER OFF

When the Power Switch is in the Off Position the Annunciator Alarm Display reads an **8.** Typically occurs when the power disconnect is first turned on. Turning the vaporizer On and then turn the switch to the Start / Reset Position to clear the **8** displayed.

LOW WATERBATH TEMPERATURE SAFETY SWITCH ADJUSTMENT LPG INLET SOLENOID

The low waterbath temperature safety switch closes at 120°F (48.9°C) on rising waterbath temperature opening the LPG inlet solenoid. This will eliminate overfilling the heat exchanger with pure liquid at low temperatures. To adjust the low waterbath temperature switch, remove the cover using your fingers. Turn the adjustment screw to 120°F (48.9°C). Lock this adjustment in place using the collar provided. Reinstall the cover.

TIME DELAY RELAY

The **TIME DELAY RELAY** allows the vaporizer to remain operating if there is a short temporary power loss, voltage drop and if the float switch bounces from water movement in the waterbath. The time delay relay is fixed at 3 seconds and no adjustment is required. If the vaporizer operation is randomly shutting down due to power loss that exceeds 3 seconds the Auto Restart Option may be used to Auto Restart the vaporizer without operator intervention. When power returns after a loss of power, the Time Delay Relay (TDR) will reset the safety circuit and the Annunciator Alarm Display. The Power Switch should be in the Off position when power is initially applied or when doing maintenance to the vaporizer or the vaporizer will automatically restart.
See Options Section.

Maintenance 6

Maintenance Checklist

Check these items weekly to ensure safe and proper operation:

- Glycol/water level.
- Verify water pump operation.
- Gas valve operation.
- Flame safeguard status.
- Smooth light-off and smooth burner operation.
- Solenoid operation.

VAPORIZER SAFETY CHECK

1. **START AND STOP THE BURNER** several times to insure proper operation. Check for proper functioning of low-water cutoff, high limit and operating control.
2. **CHECK OPERATION OF FLAME SAFEGUARD** by simulating a flame failure by shutting off the **MAIN GAS SUPPLY VALVE** in the gas train, making certain the burner locks out on safety within the time limits of the control. ***Refer to the Veri-flame Manual in Appendix.***
3. **START THE BURNER** in accordance with the step by step operating sequence procedure. As the burner enters the flame safeguard sequence, verify each burner function at the timing indicated. ***Refer to the Veri-flame Manual.***

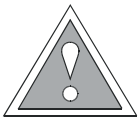
HOW TO FIND INFORMATION

- To locate a component on the QV system, ***See Section 2***.
- For an overview of component operation in system and minor adjustments, ***See Section 5.***
- For more specific information on a component, ***See Appendix.***

Table 3 - *Maintenance Schedule*

DESCRIPTION	WEEKLY	EVERY MONTH	EVERY SIX MONTHS	EVERY YEAR
Blower wheel.				Check that wheel is tight on the shaft. Check for dirt.
Blower air flow switch.			Check adjustment. Test shutdown.	
Burner fuel supply lines.			Visually inspect.	Pressurize and check for leaks.
Burner.		Visually check flame.		Check bolts on mounting flange.
Flame safeguard and spark plug.		Flame failure test. Check & clean spark plug gap.	Check spark electrode and gap. Flame signal strength test.	Visually check ignition cable and connector. Check burner nozzle, spark plug, flame sensor, and flame tube.
Operating controls and safety set points.				Check settings, operation and set point.
Vaporizer housing.				Check for leaks.
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.
Liquid inlet solenoid		Check operation.		Rebuild.
Burner Regulators.		Check settings, operation.		Clean and rebuild if required.
Burner gas valves			Perform leak test, Replace if leaking	
Float chamber	Remove drain plug, drain heavy ends.			
Inlet and outlet lines.				Purge all lines and test for leaks.
Pumps and pump motors.	Check operation.	Apply 5-10 drops of SAE 20 non-detergent oil (3 holes).		
Low-water cutoff	Drain waterbath until float opens.			
High-low gas pressure interlocks.				Check settings, operation.
Control box electrical components.			Open box. Check for corrosion and moisture damage.	Replace moisture desiccant packet.
Unit connections (all)			Visually inspect.	Leak test with soapy solution.

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!

WATERBATH / 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 a while.

PH control is important because glycol's 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. PH should be checked with a PH monitor or indicating paper. These are available from Omega or Misco Products (***See Ordering section for address information***). When ordering paper, the necessary PH range to check for is 7 to 10.

The PH range should be kept between 8.0 and 10.0. Adjustments need to be made if PH falls below 8.0. This indicates the coolant is approaching the acidic range. If using Dow products, adjustments can be made by adding a 50% solution of sodium hydroxide or 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 4-ounce containers and labels to fill with fluid samples 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 from Dow 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, per Table #2, of **HYDRO-TREAT** and retest after circulating about 30 minutes. Repeat if necessary.

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 and inhibitor level (for Hydro-treat) immediately after installation, after 2 months or 200 hours use, whichever occurs first, and after six months or 500 hours use, whichever occurs first.

NOTE

When the LPG system is in a standby condition or when it is shut down for prolonged periods, it is recommended that the system be started at least once per month and run for period of one hour. This procedure familiarizes the operator with the operation of the system and provides a good test of the system.

WATER PUMP REPLACEMENT

- Shut off power at the main disconnect for the vaporizer, then disconnect the wiring and the flex conduit from the pump.
- Shut off the two isolation gate valves above and below the water pump.
- Remove the four (4) flange bolts and slide the pump out of the flanges.
- Lubricate the new flanges and the "O" rings on the new pump.
- Reinstall the pump. Reconnect the power and test the pump.

BLOWER MOTOR REPLACEMENT

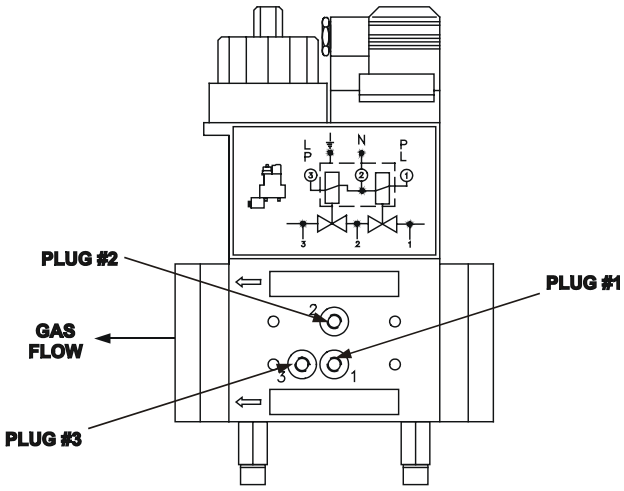
- Disconnect electrical connections to blower motor and air flow switch.
- Remove entire blower housing by removing 4 bolts at base of housing, where it attaches to the burner, and lifting out of cabinet.
- Remove motor and blower wheel from housing.
- Loosen blower wheel set screw and remove.
- Remove blower motor mounting plate.
- To install reverse steps. Before reattaching 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.

SAFETY SHUT OFF VALVE LEAK TEST PROCEDURE

For Dungs DMV:

- The burner must be off to perform a leak test on the safety gas valves.
- Shut off the main gas shutoff valve.
- Open the burner supply valve on the rear of the unit. This is the ball valve supplying the regulator.
- To check the fast opening valve loosen, plug #2 three turns with a 3 mm hexagon socket wrench.
- Spray soapy water around the plug. If bubbles appear, the valve is leaking. Follow manufacturer instructions for corrective action.

Figure 12 – *Dungs Dual Multi-Valve and Visual Indicators*



Dungs (2).wmf

- To check the slow opening valve power the fast opening valve terminals L and N on the valve from L1 and N on the terminal strip located in the control panel. This will open the fast opening valve. Loosen plug # 3 three turns.
- Spray soapy water around the plug. If bubbles appear, the valve is leaking. Follow manufacturer instructions for corrective action.

For Q1120V through Q1650V Minnesota Option:

- These two models use the same basic procedure with the exception that the two valves are separate, the fast opening valve is a solenoid type and the slow opening valve is a motorized type. Test as follows. The burner must be off to perform a leak test on the safety gas valves.
- Shut off the main gas supply valve.
- Open the burner supply valve on the rear of the unit. This is the ball valve supplying the regulator.
- Check the fast opening valve first by removing the plug from the upstream pressure tap in the slow opening motorized valve body and installing 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 instructions for corrective action.
- To check the slow opening valve, power the fast opening solenoid valve to open it.
- Remove plug from the downstream pressure tap in the slow opening 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 instructions for corrective action.

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 pilot solenoid valve and install a compressor fitting and short hose.
- Immerse the hose and just below the surface of a container of water. If bubbles appear, the valve is leaking, follow manufacturer instruction for corrective action. Re-install plug after testing.

Troubleshooting 7

CAUTION

When making any burner adjustments or tests, follow the instructions in this manual. Read all notes and follow all WARNINGS and CAUTIONS.

NOTE

Whenever a problem occurs check the fuses in the control box and wiring first. See the diagram for the location of the fuses.

The troubleshooting table uses the QV units visual outputs to pinpoint the problem. These outputs are:

- **FLAME SAFEGUARD LED**'s:
  - Interlocks closed
  - System error
  - Flame failure
  - Air failure
- **ANNUNCIATOR ALARM DISPLAY**:
  - **1** - High LPG Level
  - **2** - Low water Level
  - **3** - Flame Fail
  - **4** - High Waterbath Temperature
  - **5** - High Gas Pressure
  - **6** - Low Gas Pressure
  - **7** - Reset
  - **8** - Power Off
- **SWITCH LIGHTS**:
  - Power On-Off, Start/Reset
  - LPG Inlet Open.

Power switch light will be on when there is voltage to the power switch and Annunciator Alarm Display board. The light on the LPG inlet button is only on when the **LPG INLET SOLENOID IS OPEN**.

The status of these outputs must be checked in order to locate the problem.

Table 4 – *Troubleshooting Checklists*

CHECKLIST #1 / CONDITIONS:

Flame Safeguard LED's: **ALL LED's OFF**
Annunciator Alarm Display: **Blank**
Switch Lights: **POWER-OFF, LPG INLET-OFF**

TROUBLE	PROBABLE CAUSE	SOLUTION
UNIT WON'T OPERATE.	No power to unit.	Check power at control panel.
	No power to power switch or Alarm.	Check fuse F3.
	Display.	

CHECKLIST #2 / CONDITIONS:

Flame Safeguard LED's: **ALL LED's OFF**
Annunciator Alarm Display: **8**
Switch Lights: **POWER-OFF, LPG INLET-OFF**

TROUBLE	PROBABLE CAUSE	SOLUTION
UNIT WON'T OPERATE.	Power Switch in the Off Position.	Switch the Power Switch to the On position, then START/RESET to clear Display.
	Power Switch faulty.	Check wiring. Replace switch if necessary.

CHECKLIST #3 / CONDITIONS:

Flame Safeguard LED's: **ALL LED's OFF**
Annunciator Alarm Display: **1, 2, 4, 5, 6, or 7**
Switch Lights: **POWER-ON, LPG INLET-OFF**

ANNUNCIATOR ALARM DISPLAY	PROBABLE CAUSE	SOLUTION
7 - RESET.	Power outage or voltage dropped below 100VAC for more than 3 seconds.	Reset Annunciator Alarm Display and flame safeguard.
	START/RESET switch faulty.	Check wiring. Replace switch if necessary.
1 - HIGH LPG LEVEL	Heavy ends filling outlet manifold.	Drain heavy ends.
	Vaporizer capacity exceeded.	Reduce load to vaporizer.
	LPG level switch contact magnet dirty.	Remove float and clean contact.
	LPG level switch float perforated.	Replace float.
	LPG level switch wiring faulty.	Check for loose connection and/or repair wiring.
	Waterbath Operating Temperature Control Switch set too high.	Reset temperature per Data Sheet.
	Waterbath Operating Temperature Control Switch differential too high.	Adjust to 5 degrees.
	Water pump failure.	Check fuse F2 and/or replace or repair pump.
2 - LOW WATER LEVEL	Water level too low.	Fill waterbath to fill line.
	Waterbath level switch float perforated.	Replace float.
	Waterbath level switch wiring faulty.	Check for loose connection and/or repair wiring.

4 - HIGH WATER TEMPERATURE	High waterbath temperature switch set too high.	Reset temperature per Data Sheet.
	High waterbath temperature switch faulty.	Repair or replace switch.
	Waterbath Operating Temperature Control Switch set too high.	Reset temperature per Data Sheet.
	Waterbath Operating Temperature Control Switch faulty.	Repair or replace switch.
	Water pump failure.	Check fuse F2 and/or replace or repair pump.
5 - HIGH GAS PRESSURE	Regulator set incorrectly.	Reset per Data Sheet.
	Regulator failure.	Repair or replace regulator.
	Regulator vent plugged.	Make sure vent is open and clean.
	High gas pressure switch set too low.	Reset per Data Sheet.
	High gas pressure switch faulty.	Check wiring and/or repair or replace switch.
	High gas pressure switch not reset.	Reset switch.
6 - LOW GAS PRESSURE On Minnesota Q1120V thru Q1650V models	Regulator set incorrectly.	Reset per Data Sheet.
	Regulator failure.	Repair or replace regulator.
	Regulator vent plugged.	Make sure vent is open and clean.
	Low gas pressure switch set too high.	Reset per Data Sheet.
	Low gas pressure switch faulty.	Check wiring and/or repair or replace switch.
	Low gas pressure switch not reset.	Reset switch.
	Low LPG pressure in vaporizer.	Check LPG pressure on rear gauge.

CHECKLIST #4 / CONDITIONS:

Flame Safeguard LED's: **AIR FAILURE-ON, ALL OTHERS OFF**
Annunciator Alarm Display: **3**
Switch Lights: **POWER-ON, LPG INLET-OFF**

TROUBLE	PROBABLE CAUSE	SOLUTION
BLOWER MOTOR RUNS BUT PILOT DOES NOT LIGHT.	Air flow switch set too low.	Reset per Data Sheet.
	Air flow switch faulty.	Check wiring and/or repair or replace switch.
BLOWER MOTOR FAILS TO START	No power to motor.	Check fuse F3 and/or wiring.
	Defective motor.	If voltage to motor is correct, replace motor.

CHECKLIST #5 / CONDITIONS:

Flame Safeguard LED's: **FLAME FAILURE-ON, ALL OTHERS OFF**
Annunciator Alarm Display: **3**
Switch Lights: **POWER-ON, LPG INLET-OFF**

TROUBLE	PROBABLE CAUSE	SOLUTION
MOTOR RUNS BUT IGNITION DOES NOT OCCUR.	No power to spark plug.	Check transformer wiring and input voltage.
	No spark.	Clean spark plug and check gap.
MOTOR RUNS BUT PILOT DOES NOT LIGHT.	No gas.	Check to insure manual pilot valves are open.
	Low LPG pressure in vaporizer.	Check LPG pressure on rear gauge.
	Pilot solenoid does not open.	Check voltage to coil. Replace coil if needed.
MOTOR RUNS, IGNITION OCCURS BUT MAIN FLAME DOES NOT LIGHT.	Flame sensor faulty.	Check wiring, make sure not close to ignition wire. Clean lens. Replace if necessary.
MOTOR RUNS, BUT PILOT ESTABLISHES BUT MAIN FLAME DOES NOT LIGHT.	No gas.	Insure manual supply gas valve open.
	Fast and/or slow gas valve not opening.	Check voltage to coil or valve terminal (Dungs). Repair or replace valve as needed.
MOTOR RUNS, PILOT ESTABLISHES BUT MAIN FLAME IS WEAK.	Regulator set incorrectly.	Reset per Data Sheet.
	Regulator failure.	Repair or replace regulator.
	Regulator vent plugged.	Make sure vent is open and clean.
	Low LPG pressure in vaporizer.	Check LPG pressure on rear gauge.

TROUBLE	PROBABLE CAUSE	SOLUTION
MOTOR RUNS, GAS PILOT ESTABLISHES, PILOT FLAME DOES NOT PROVE (FOR UV SCANNER ON Q1650V ONLY)	Weak flame signal.	Refer to flame safeguard control manufacturer's bulletin. Check flame signal strength.
	Flame sensor lens dirty	Clean lens.
	Flame sensor defective.	Replace flame sensor.

CHECKLIST #6 / CONDITIONS:

Flame Safeguard LED's: **SYSTEM ERROR-ON, ALL OTHERS OFF**
Annunciator Alarm Display: **BLANK**
Switch Lights: **POWER-ON, LPG INLET-ON**

TROUBLE	PROBABLE CAUSE	SOLUTION
UNIT WON'T RUN	Internal flame safeguard fault.	Replace flame safeguard.

CHECKLIST #7 / CONDITIONS:

Flame Safeguard LED's: **SYSTEM ERROR-ON, ALL OTHERS OFF**
Annunciator Alarm Display: **BLANK**
Switch Lights: **POWER-ON, LPG INLET-ON**

TROUBLE	PROBABLE CAUSE	SOLUTION
CARBON MONOXIDE DURING OPERATION GREATER THAN 50 PPM.	Gas pressure too high.	Reset regulator per Data Sheet.
	Air flow insufficient.	Check blower wheel rotation. Reset air flow switch per Data Sheet. Check for blockage.

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OPTIONS

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AUTO RESTART

If the vaporizer operation is randomly shutting down due to power loss that exceeds 3 seconds the Auto Restart Option may be used to Auto Restart the vaporizer without operator intervention. When power returns after a loss of power, the Time Delay Relay (TDR) will reset the safety circuit and the Annunciator Alarm Display. The Power Switch should be in the Off position when power is initially applied or when doing maintenance to the vaporizer or the vaporizer will automatically restart.

For all QV vaporizers use: ASDI PN 83240 Auto Restart Kit

Field Installation requires some wiring. See Figure 14.

LIQUID PUMP

Contact Algas-SDI international for Stabilaire Pump Packages.

STANDBY ELECTRIC BATH HEATER

ASDI PN 30578 Heater, 1.5kw @ 120Vac, 1"MNPT, 0-127F

Or

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

FILTAIRE - CONTAMINANT SEPARATOR

Contact Algas-SDI international for Filtaire Packages.

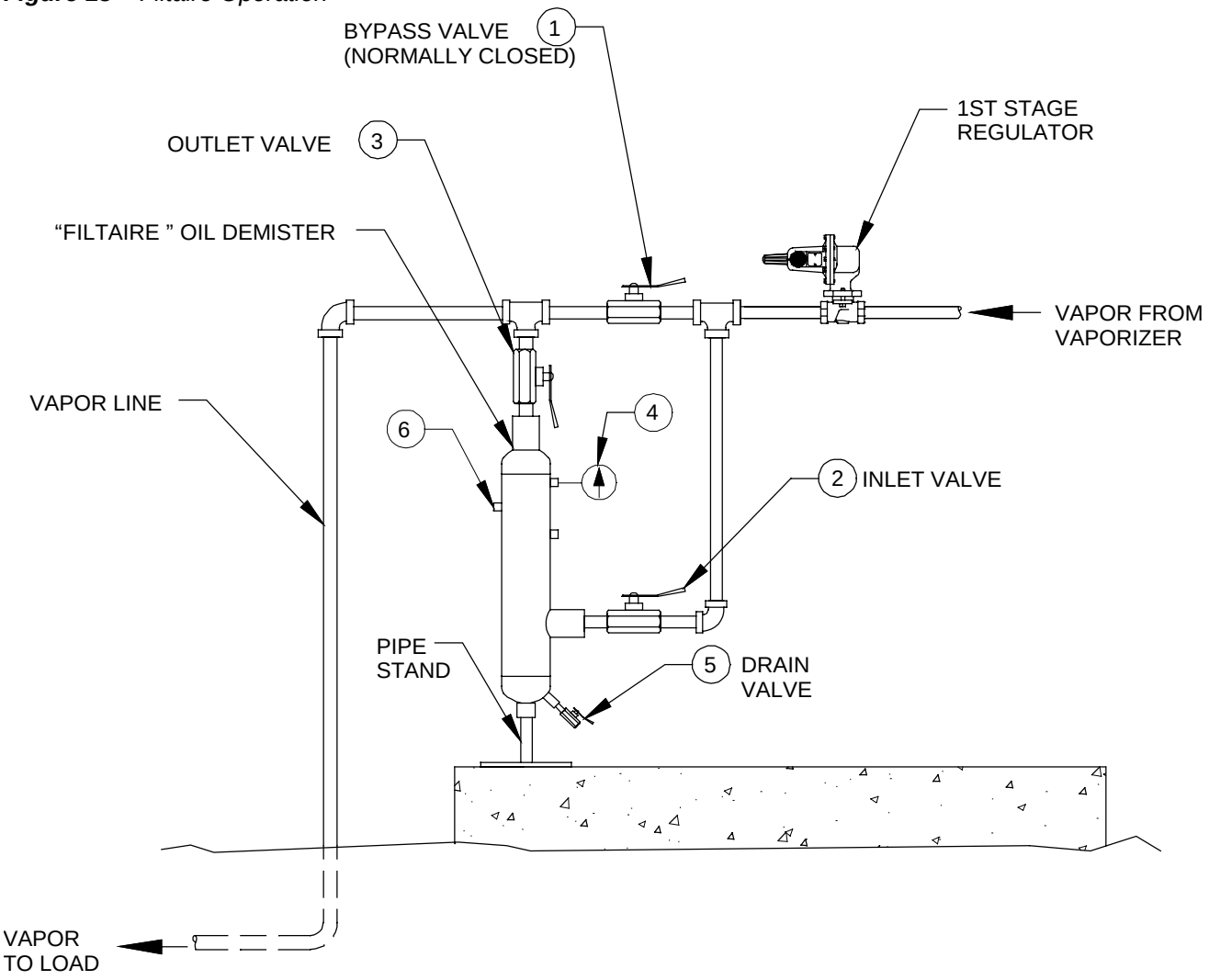
The **FILTAIRE** is a filtering device designed to trap heavy hydrocarbons commonly present in LPG gas vapor. It also traps other materials, which may be in the gas due to storage conditions and internal condition of the equipment.

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 13 – *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

COMPONENT INFORMATION

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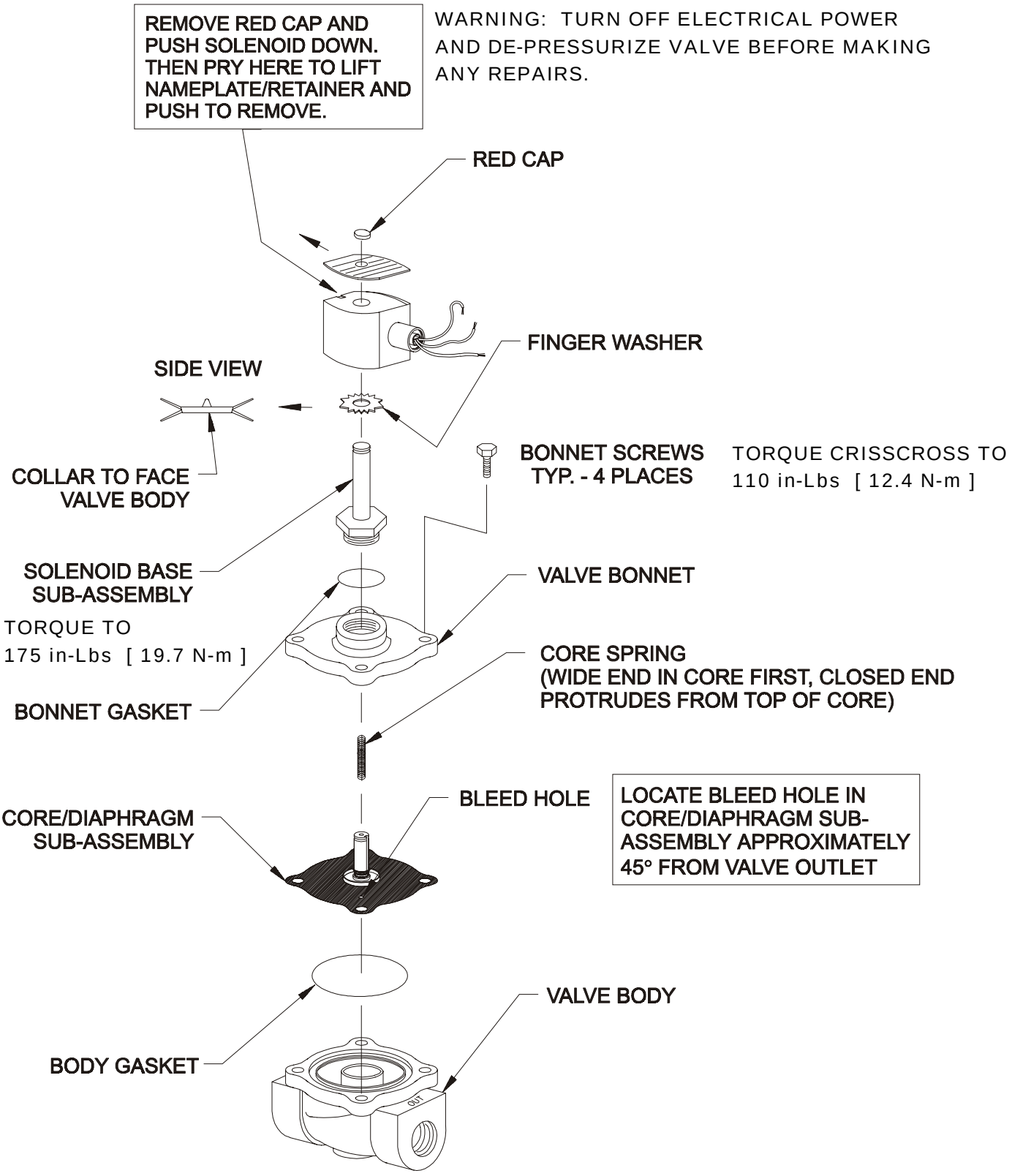
Figure 20 *- ASCO Valve used by Algas-SDI 2.9.98*



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.

Installation & Maintenance Instructions

GENERAL PURPOSE AND RAINTIGHT/WATERTIGHT/EXPLOSIONPROOF SOLENOIDS

SERIES 8017

Form No.V5381R7

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

DESCRIPTION

Solenoid Catalog Numbers 80171 and 80172 have a Type 1, General Purpose Solenoid Enclosure. Solenoid Catalog Numbers EF80171, EF80172, 80173, and 80174 meet the requirements of Enclosure Type 3 – Raintight, Type 7 (C & D) Explosionproof, and Type 9 (E, F, & G) Dust – Ignitionproof. When constructed with a cover gasket and solenoid bonnet gasket they also meet the requirement of Enclosure Type 4 – Watertight. Series 8017 solenoids (when installed as a solenoid and not as part of an ASCO valve) are supplied with a core which has a 0.250–28 UNF–2B tapped hole, with 0.38 inch minimum full thread.

OPERATION

When the solenoid is energized, the core is drawn into the solenoid base sub–assembly.

IMPORTANT: When the solenoid is de–energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 1 pound, 12 ounces and 5 ounces for DC construction.

INSTALLATION

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

Enclosure Types 3, 4, 7, and 9

⚠ CAUTION: To prevent fire or explosion, do not install solenoid enclosure and/or valve where ignition temperature of hazardous atmosphere is less than 160° C. On valves used for steam service or when a class "H" solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180°C. See nameplate for service.

Enclosure Types 3,4,7, and 9 Used in –40°C Ambient Temperature Applications

⚠ WARNING: To prevent fire or explosion, use only conduit runs 1/2″ in size with a sealing fitting connected within 3 feet of the solenoid enclosure.

IMPORTANT: To protect the solenoid operator or valve, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions.

Positioning

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

Wiring

Wiring must comply with local codes and the National Electrical Code.

⚠ CAUTION: Do not use the solenoid enclosure as a splice box.

The general purpose solenoid housing has a 7/8″ diameter hole to accommodate 1/2″ conduit. To facilitate wiring, the general purpose solenoid enclosure may be rotated 360° by removing the retaining cap or clip.

⚠ CAUTION: When metal retaining clip disengages, it will spring upward.

Rotate solenoid enclosure to desired position. Then replace retaining cap or clip before operating. On some solenoids, a grounding wire which is green or green with yellow stripes is provided. Use rigid metallic conduit to ground all enclosures not provided with a green grounding wire. For the raintight/watertight/ explosionproof solenoid enclosure, electrical fittings must be approved for use in hazardous locations. This enclosure has a 1/2″ conduit connection and may be rotated 360° to facilitate wiring.

⚠ WARNING: To prevent the possibility of death, serious injury or property damage from accidental disengagement of solenoid from valve body, hold housing securely by wrenching flats while removing or replacing housing cover.

To rotate enclosure, loosen housing cover using a 1″ socket wrench. Two wrenching flats are provided on the housing to hold it securely in place while the cover is being loosened or tightened. Rotate housing to desired position and tighten cover before operating. Torque cover to 135 ± 15 in–lbs [15,3 ± 1,7 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the core and solenoid base sub–assembly, not just the coil. Consult ASCO.

Solenoid Enclosure Assembly

Solenoid Catalog Numbers 80171 and 80172 may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid enclosure.

Solenoid Catalog Numbers EF80171, EF80172, 80173, and 80174 must be assembled in the following manner:

1. The solenoid enclosure must be completely disassembled. For disassembly, see the instructions given in ***Coil Replacement*** section.
2. After disassembly, the solenoid base sub–assembly is placed inside the housing over the assembly location.
3. The assembly is then tightened in place by means of two (2) slots in the bonnet adjacent to the tube on the solenoid base sub–assembly. Use special adapter wrench provided with solenoid. For ASCO wrench kit only, Order No.K218950. Exercise care during tightening procedure to prevent deforming or raising of bonnet surface adjacent to slots.
4. Reassemble solenoid,follow instructions in ***Coil Replacement*** section.

Solenoid Temperature

Standard solenoids are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched by hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

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

Cleaning

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

Preventive Maintenance

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

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

Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* indicates loss of power supply. Check for loose or blown fuses, open−circuited or grounded coil, broken lead wires or splice connections.
- **Burned−Out Coil:** Check for open−circuited coil. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate and as marked on the coil.
- **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.

Coil Replacement for Solenoid Catalog Numbers 80171 and 80172 General Purpose Enclosure

1. Disconnect coil lead wires and grounding wire if present.
2. Remove retaining cap or clip from top of solenoid.

⚠ **CAUTION: When metal retaining clip disengages, it will spring upward.**

3. Remove nameplate (if present), cover, and spring washer (alternate construction only).
4. For AC construction, slip yoke containing coil, sleeves, insulating washers, and grounding wire (if present,) off solenoid base sub−assembly. For DC construction, slip grounding wire (if present), flux washer and coil off the solenoid base sub−assembly.
   NOTE: Insulating washers are omitted when a molded coil is used.
5. Coil is now accessible for replacement.

⚠ **CAUTION: Solenoid must be fully reassembled because the housing and internal parts complete the magnetic circuit. Place an insulating washer at each end of non−molded coil.**

Coil Replacement for Solenoid Catalog Numbers EF80171, EF80172, 80173, and 80174 Raintight/ Watertight/Explosionproof Enclosure

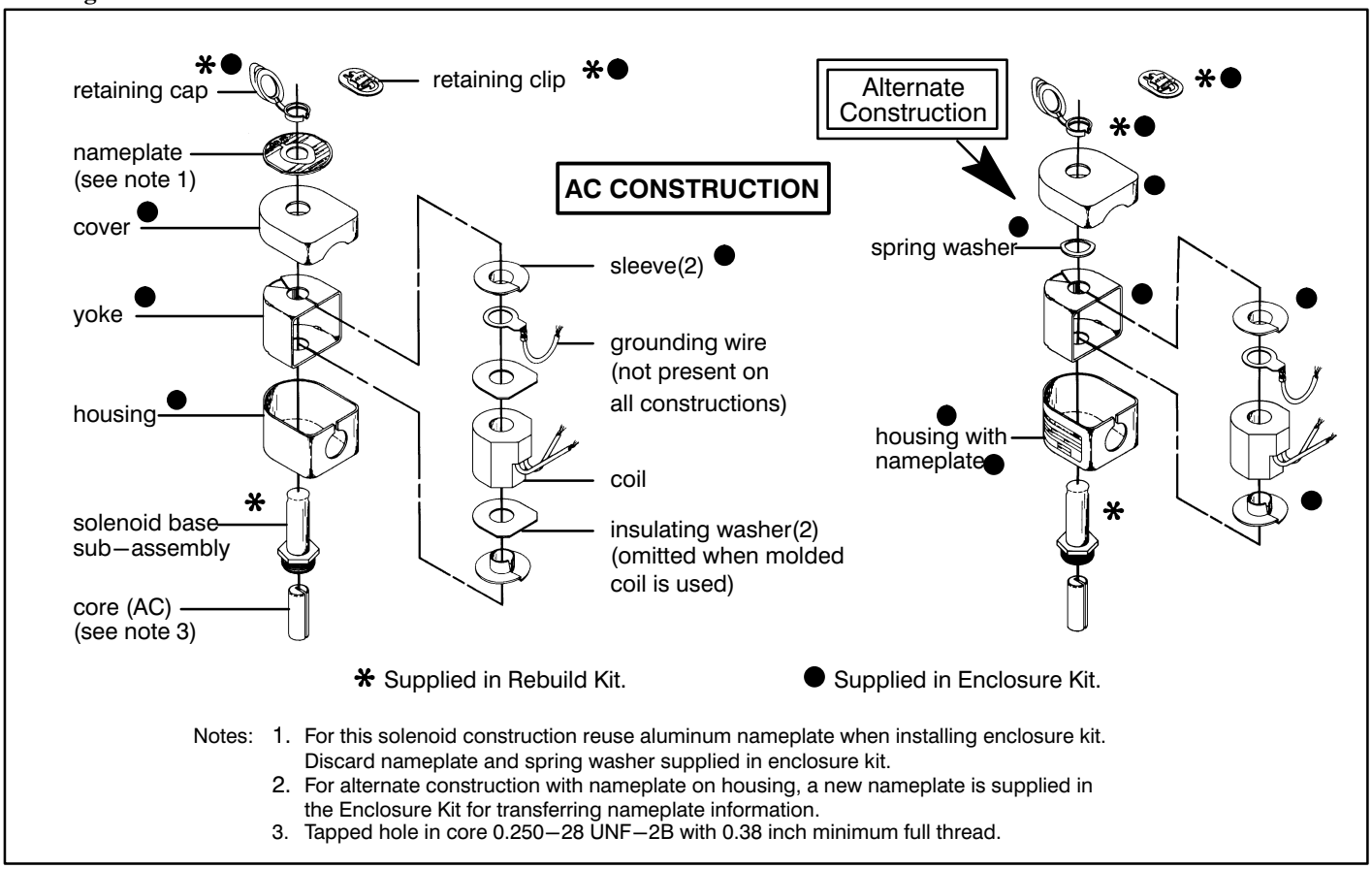
1. Disconnect coil lead wires and grounding wire if present.

⚠ **WARNING: To prevent the possibility of death, serious injury or property damage from accidental disengagement of solenoid from valve body, hold housing securely by wrenching flats while removing or replacing housing cover.**

2. Unscrew housing cover with cover gasket and nameplate attached. Two wrenching flats are provided to hold the housing securely in place while the cover is being loosened or tightened.
   NOTE: Some older solenoid constructions do not have a cover gasket or solenoid bonnet gasket present.
3. Remove retainer from top of solenoid base sub−assembly.
4. For AC construction, slip yoke containing coil, sleeves, insulating washers, and grounding wire, (if present) off the solenoid base sub−assembly. For DC construction, remove grounding wire (if present), yoke, insulating washer, coil and insulating washer.
   NOTE: Insulating washers are omitted when a molded coil is used.
5. Coil is now accessible for replacement.
6. If additional disassembly is required, unscrew solenoid base sub−assembly using special wrench adapter supplied in ASCO Enclosure or Rebuild Kit. For ASCO wrench kit only, Order No.K218950.
7. Remove solenoid base sub−assembly with solenoid bonnet gasket.
8. Reassemble using exploded view for identification and placement of parts. Before reassembly, see note below for cleaning and greasing requirements.
9. Torque solenoid base sub−assembly to 175 ± 25 in−lbs [19, 8 ± 2, 8 Nm].
10. Torque housing cover to 135 ± 15 in−lbs [15,3 ± 1,7 Nm].

⚠ **CAUTION: Solenoid must be fully reassembled because the housing and internal parts complete the magnetic circuit. Place an insulating washer at each end of non−molded coil.**

NOTE: Solenoid Catalog Numbers EF80171, EF80172, 80173, and 80174—Installation and maintenance of raintight/watertight/explosionproof equipment requires more than ordinary care to insure safe performance. All finished surfaces of the solenoid are constructed to provide flame−proof seal. Be sure that the surfaces are wiped clean before reassembling. Grease the cover gasket, solenoid bonnet gasket, and the joints of the raintight/watertight/explosionproof solenoid enclosure with DOW CORNING® 111 Compound lubricant or an equivalent high−grade silicone grease. Grease all joints thoroughly including the underside of the solenoid base sub−assembly flange and internal threads of the housing cover.



Notes:
1. For this solenoid construction reuse aluminum nameplate when installing enclosure kit. Discard nameplate and spring washer supplied in enclosure kit.
2. For alternate construction with nameplate on housing, a new nameplate is supplied in the Enclosure Kit for transferring nameplate information.
3. Tapped hole in core 0.250−28 UNF−2B with 0.38 inch minimum full thread.

Figure 1. Catalog Nos. 80171 and 80172 General Purpose Solenoid Enclosure, AC Construction.

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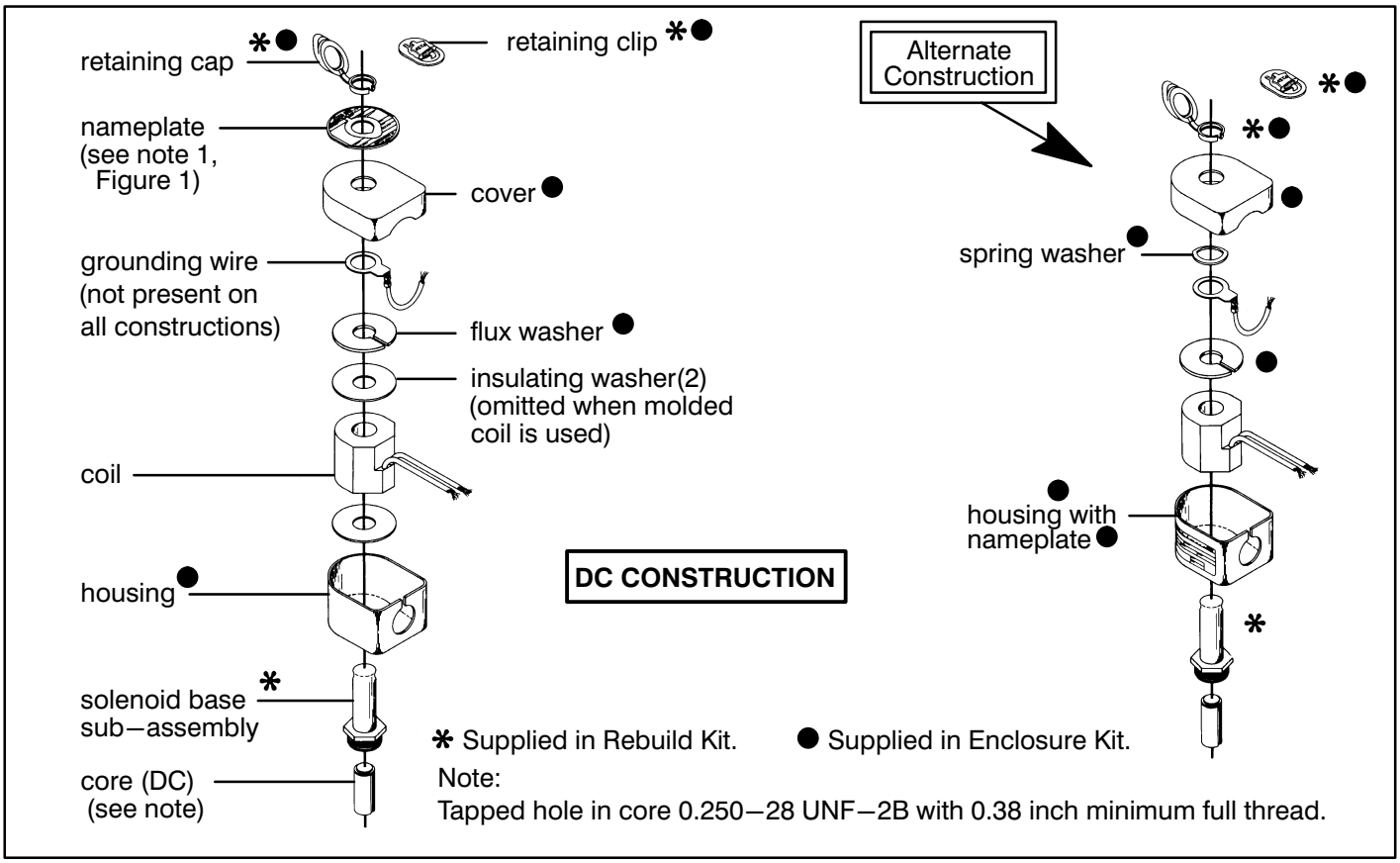

Figure 2. Catalog Nos. 80171 and 80172 General Purpose Solenoid Enclosure, DC Construction.

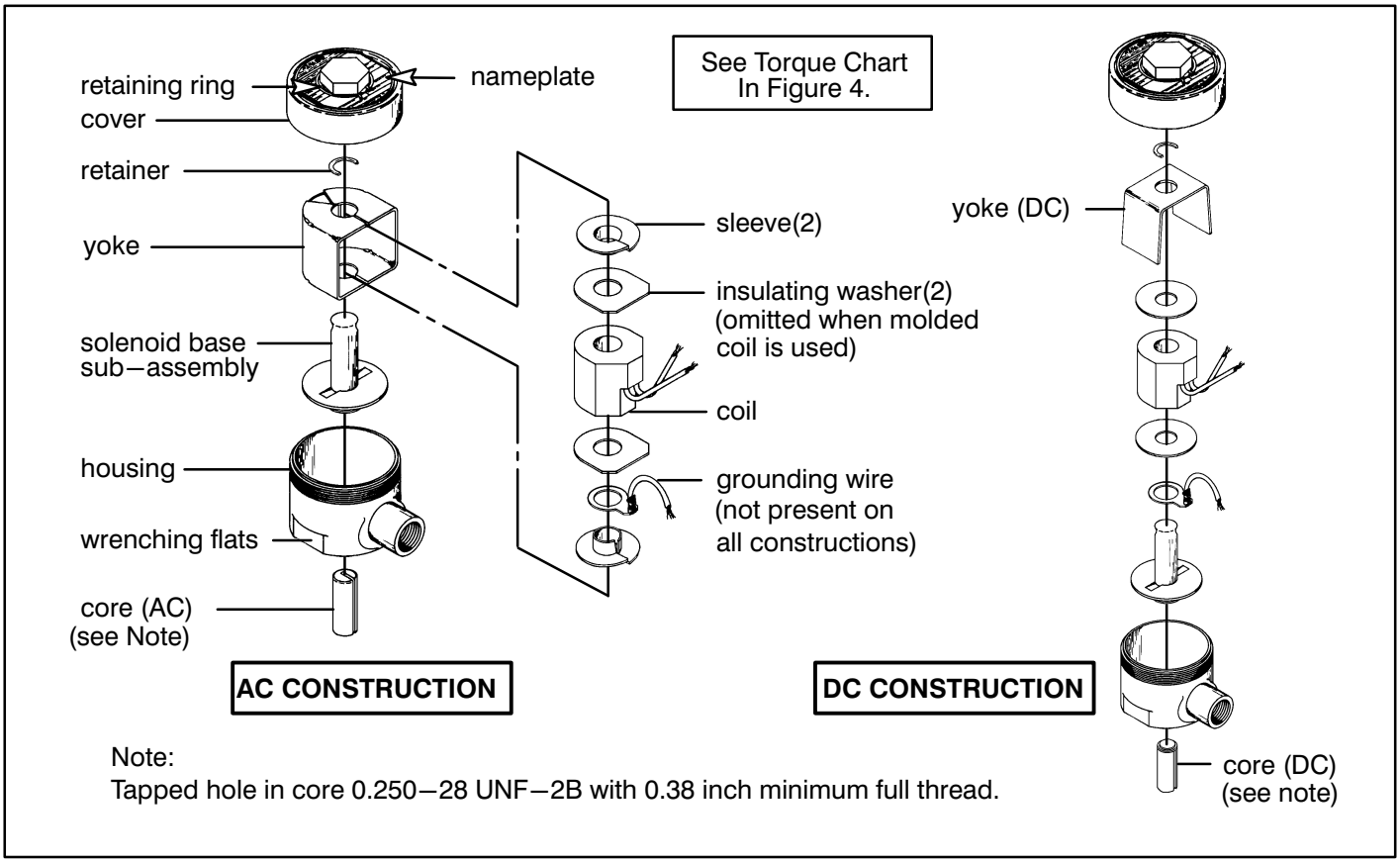

Figure 3. Catalog Nos. EF80171, EF 80172, 80173 and 80174 Raintight/Explosionproof Solenoid Enclosure.

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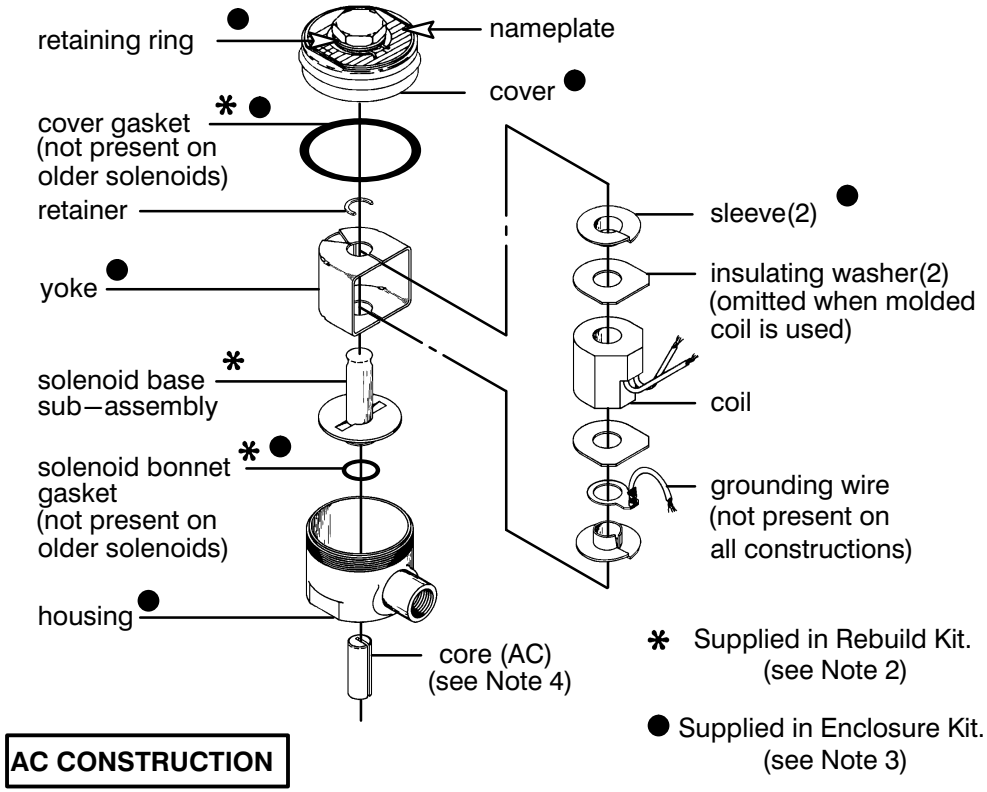
Notes:

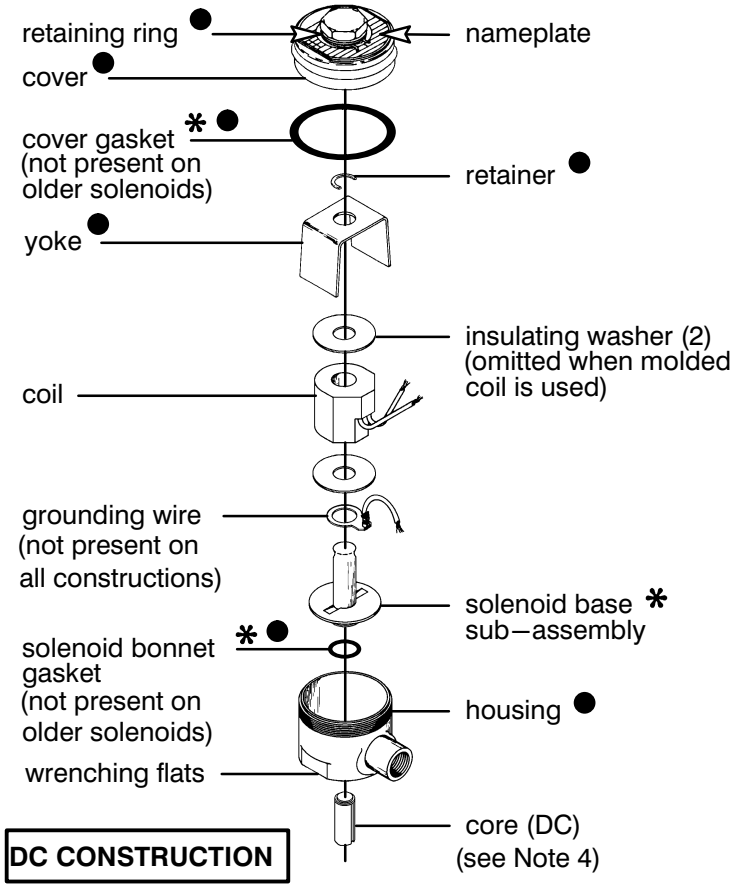
1. These Catalog Nos. meet watertight requirements only when cover gasket and solenoid bonnet gasket are used.
2. A solenoid base sub—assembly with a solenoid bonnet gasket are supplied in the Rebuild Kit. These two parts are a direct replacement for the existing solenoid base sub—assembly.
   The cover gasket is also supplied in Rebuild Kit, but may be omitted if cover does not use a gasket.
3. Install all parts supplied in Enclosure Kit except omit the solenoid bonnet gasket if the existing solenoid base sub—assembly does not use a gasket.
4. Tapped hole in core 0.250—28 UNF—2B with 0.38 inch minimum full thread.
5. Special wrench adapter for solenoid base sub—assembly is supplied in Rebuild Kit and Enclosure Kit.

Torque Chart		
Part Name	Inch—Pounds	Newton—Meters
cover	135 ± 15	15,3 ± 1,7
solenoid base sub—assembly ▲	175 ± 25	19,8 ± 2,8

▲ To order special wrench adapter for solenoid base sub—assembly, specify Kit No. K218950



AC CONSTRUCTION



DC CONSTRUCTION

Figure 4. Catalog Nos. EF80171, EF80172, 80173, and 80174 Raintight/Watertight/Explosionproof Solenoid Enclosure.

Installation & Maintenance Instructions

2–WAY INTERNAL PILOTED–OPERATED SOLENOID VALVES
BRASS AND STAINLESS STEEL CONSTRUCTION
NORMALLY CLOSED OPERATION — 1″, 1 1/4″, & 1 1/2″ NPT

SERIES
8210
8211

Form No.V5455R4

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

DESCRIPTION

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

OPERATION

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

NOTE: No minimum operating pressure differential required.

Manual Operator (optional feature)

Manual operator allows manual operation when desired or during an electrical power outage. To engage manual operator (open the valve), remove operator cap and gasket base of valve. Turn manual operator stem clockwise as far as possible. Do not force operator stem. Valve will then be in the same position as when the solenoid is energized. To disengage manual operator, turn stem counterclockwise as far as possible.

⚠ CAUTION: Stem must be fully retracted counterclockwise before operating valve electrically.

Replace manual operator cap gasket and cap.

INSTALLATION

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

Future Service Considerations

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

Temperature Limitations

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

Watt Rating AC/DC	Catalog Number Prefix	Coil Class	Maximum Ambient Temp.	Maximum Fluid Temp.
15.1 & 16.1 AC	None, KF, SF or SC	F	125°F (51.7°C)	180°F (82°C)
	HT, KH, ST or SU	H	140°F (60°C)	180°F (82°C)
30.6 DC	HT	H	104°F (40°C)	77°F (25°C)

Positioning

AC Construction (Alternating Current): Valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area.

DC Construction (Direct Current): Valve must be mounted with solenoid vertical and upright.

Piping

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

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

MAINTENANCE

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

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

Cleaning

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

Preventive Maintenance

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

Causes of Improper Operation

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

Valve Disassembly

1. Disassemble valve in an orderly fashion using exploded views for identification and placement of parts. Refer to Figure 2 for AC construction; Figure 3 for DC construction.
2. Remove solenoid enclosure. See separate instructions.
3. Unscrew solenoid base sub−assembly. For DC construction, a special wrench is supplied in ASCO Rebuild Kit. For wrench only, Order ASCO Wrench Kit No. K168146−001.
4. Remove bonnet screws, valve bonnet,bonnet gasket, spring retainer (AC construction only) core spring, core/diaphragm sub−assembly and body gasket.
5. For valves equipped with a manual operator, remove cap, cap gasket, bonnet and bonnet gasket. Remove stem assembly with stem gasket from bonnet.
6. All parts are now accessible for cleaning or replacement. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Valve Reassembly

1. Lubricate all gaskets and the disc at the base of the core /diaphragm sub−assembly with DOW CORNING 111® Compound lubricant or an equivalent high−grade silicone grease.
2. Replace body gasket and core/diaphragm sub−assembly. Locate bleed hole in core/diaphragm sub−assembly directly over valve outlet. For 1 1/2″ NPT construction, locate bleed hole in core/diaphragm sub−assembly approximately 30° from valve outlet.
3. Replace core spring and spring retainer (AC construction only). Install small end of core spring in core first, wide end protruding from top of core. For DC construction, install core spring, small end down toward valve body.
4. Replace valve bonnet and bonnet screws. Hand tighten bonnet screws as far as possible.

IMPORTANT: Press firmly down on core/diaphragm sub−assembly to seat diaphragm assembly against valve seat. While holding this position, torque bonnet screws in a crisscross manner to 144 ± 15 in−lbs [16,3 ± 1,7 Nm].

5. Replace bonnet gasket and solenoid base sub−assembly. Torque solenoid base sub−assembly to 175 ± 25 in−lbs [19,8 ± 2,8 Nm]. For DC construction, the solenoid base sub−assembly must be placed inside the housing before assembling into the valve body. Before doing this, read separate lubrication instructions in ***Solenoid Installation & Maintenance Instructions***.
6. For valves provided with a manual operator, replace stem assembly and bonnet (with gaskets). Torque bonnet to 75 ± 10 in−lbs [8,5 ± 1,1 Nm]. Replace cap gasket and cap.
7. Install solenoid. See separate instructions.

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

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

ORDERING INFORMATION

FOR ASCO REBUILD KITS

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

Torque Chart

Part Name	Torque Value Inch−Pounds	Torque Value Newton−Meters
Manual operator bonnet	75 ± 10	8,5 ± 1,1

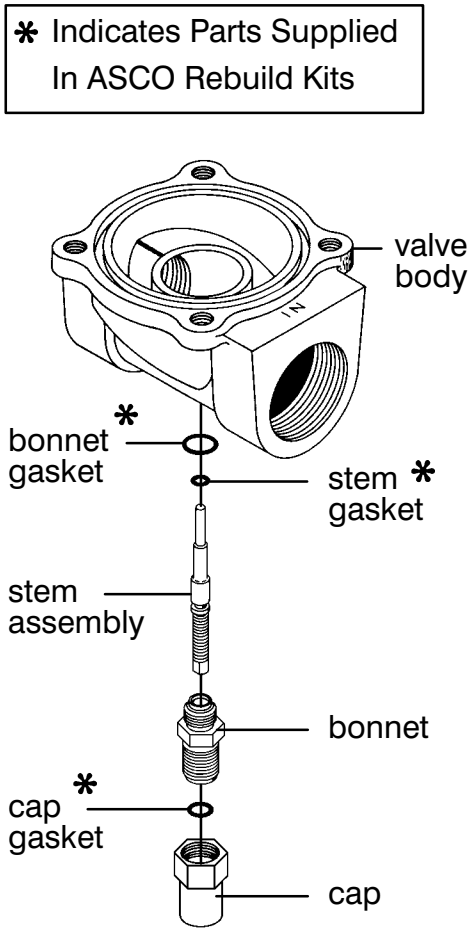


Figure 1. Manual operator (optional feature)

Torque Chart

Part Name	Torque Value Inch−Pounds	Torque Value Newton−Meters
Solenoid base sub−assembly	175 ± 25	19,8 ± 2,8
Bonnet screw	144 ± 15	16,3 ± 1,7

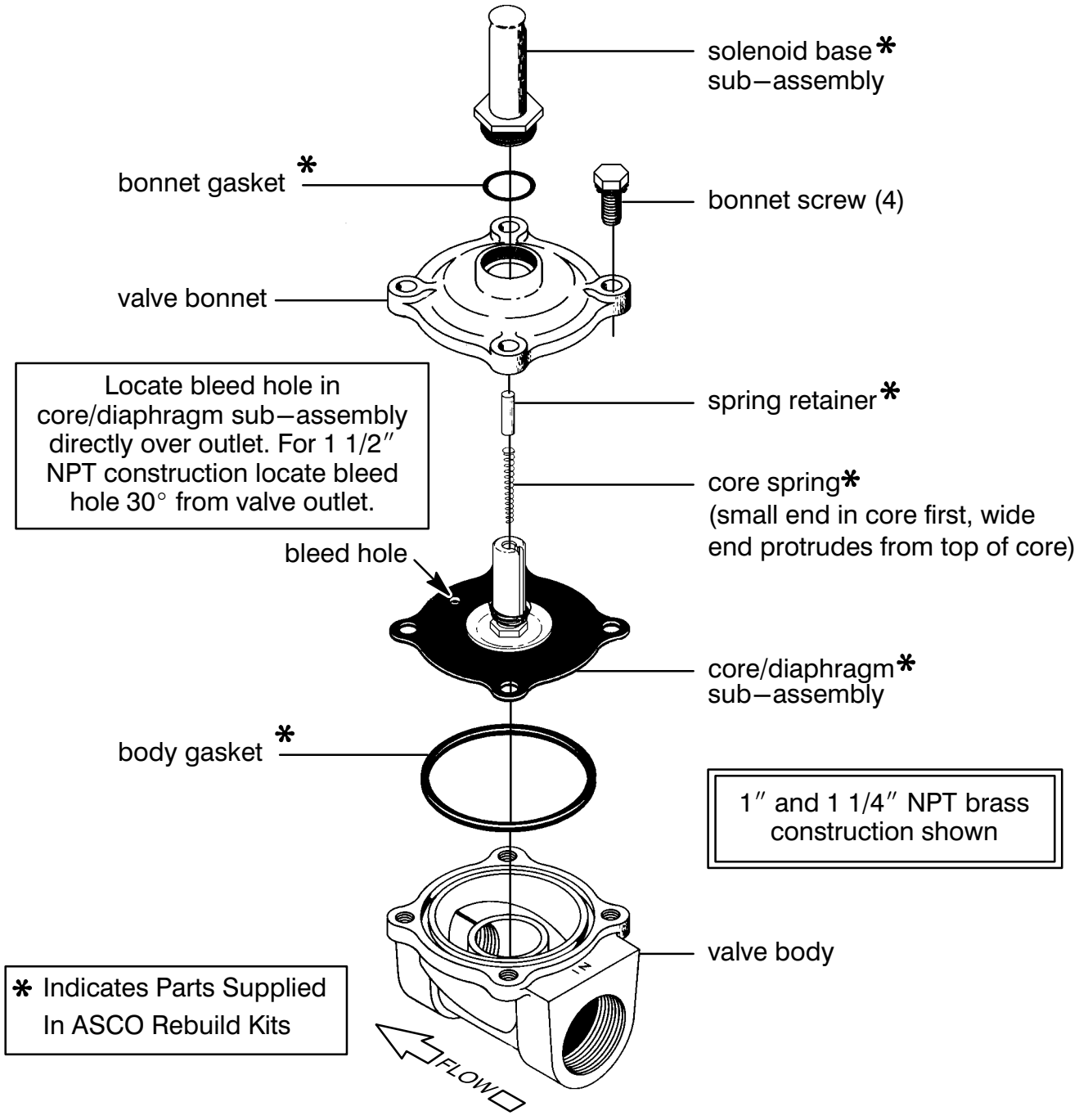


Figure 2. Series 8210 valve without solenoid (AC construction shown).

Torque Chart

Part Name	Torque Value Inch–Pounds	Torque Value Newton–Meters
Solenoid base sub–assembly	175 ± 25	19,8 ± 2,8
Bonnet screw	144 ± 15	16,3 ± 1,7

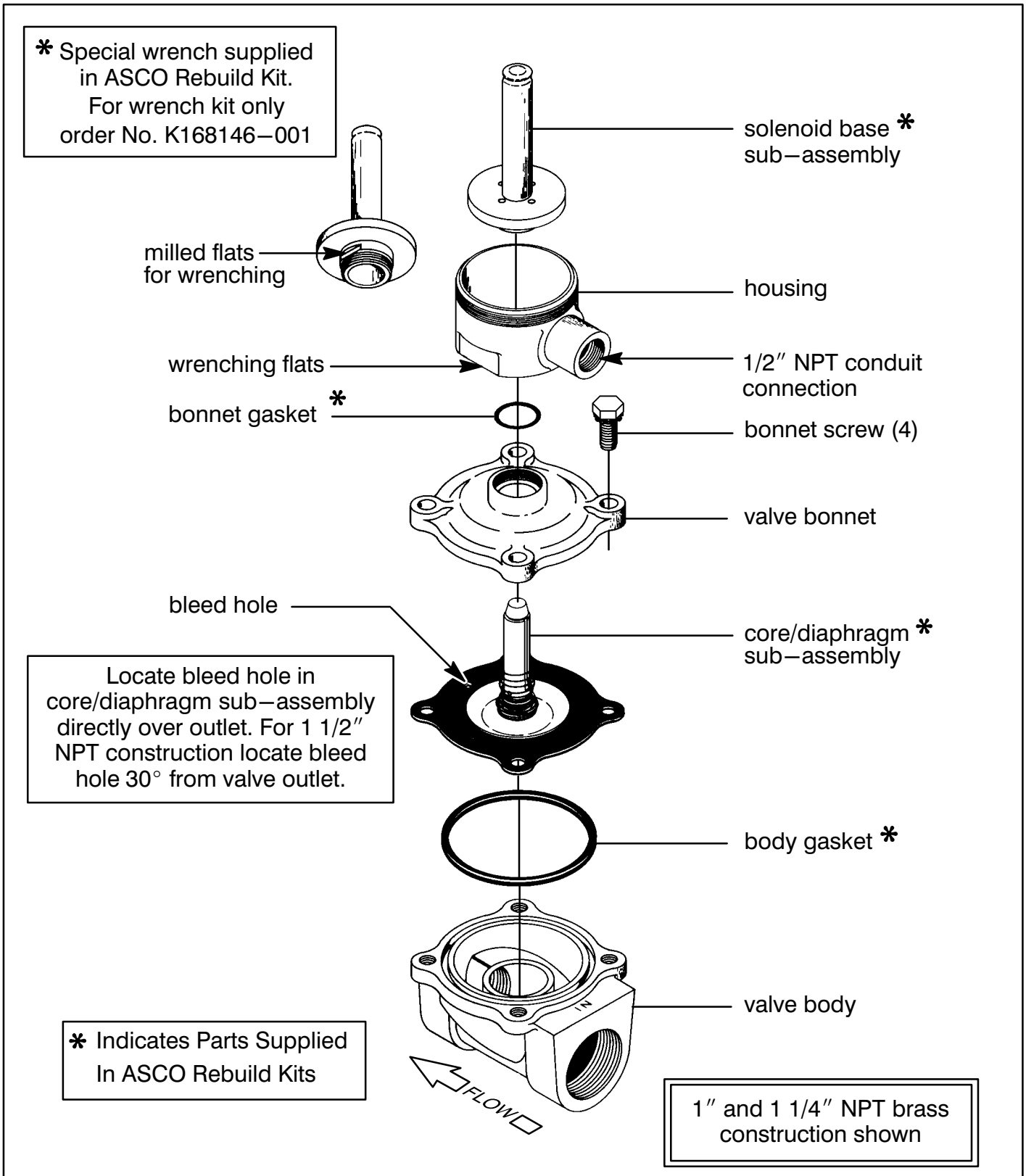


Figure 3. Series 8210 valve without solenoid (DC construction shown).

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Installation & Maintenance Instructions

2-WAY INTERNAL PILOT-OPERATED SOLENOID VALVES
HUNG DIAPHRAGM — 3/8, 1/2 AND 3/4 NPT
NORMALLY CLOSED OPERATION

BULLETINS
8210
8211

Form No.V5825R1

DESCRIPTION

Bulletin 8210's are 2-way, normally closed, internal pilot operated solenoid valves. Valve body and bonnet are of brass construction. Standard valves have a General Purpose, NEMA Type 1 Solenoid Enclosure.

Bulletin 8211's are the same as Bulletin 8210's except the solenoids are equipped with an enclosure which is designed to meet NEMA Type 4 Watertight, NEMA Type 7 (C or D) Hazardous Locations - Class I, Group C or D, and NEMA Type 9 (E, F or G) Hazardous Locations - Class II, Group E, F or G. The explosion-proof/watertight solenoid enclosure is shown on a separate sheet of Installation and Maintenance Instructions, Form No. V-5380.

Bulletin 8210 and 8211 valves with suffix 'HW' in the catalog number are specifically designed for hot water service.

OPERATION

Normally Closed: Valve is closed when solenoid is de-energized and opens when solenoid is energized.

MANUAL OPERATOR (Optional)

Valves with suffix 'MO' in catalog number are provided with a manual operator which allows manual operation when desired or during an interruption of electrical power. To operate valve manually, push in knurled cap and rotate clockwise 180°. Disengage manual operator by rotating knurled cap counterclockwise 180° before operating electrically.

MANUAL OPERATOR LOCATION (Refer to Figure 3)

Manual operator (when shipped from factory) will be located over the valve outlet. Manual operator may be relocated at 90° increments by rotating valve bonnet. Remove bonnet screws (4) and rotate valve bonnet with solenoid to desired position. Replace bonnet screws (4) and torque in a crisscross manner to 110 ± 10 inch pounds.

If valve is installed in system and is operational, proceed in the following manner:

WARNING: Depressurize valve and turn off electrical power supply.

1. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Remove bonnet screws (4) and rotate valve bonnet to desired position.
3. Replace bonnet screws (4) and torque in a crisscross manner to 110 ± 10 inch pounds.
4. Replace solenoid enclosure and retaining clip or cap.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures refer to chart. The temperature limitations listed are for UL applications. For non UL applications, higher ambient and fluid temperature limitations are available. Consult factory. Check catalog number on nameplate to determine maximum temperatures.

Construction	Coil Class	Catalog Number Prefix	Maximum Ambient Temp. °F.	Maximum Fluid Temp. °F.
A-C Construction (Alternating Current)	A	None or DA	77	180
	F	DF or FT	122	180
	H	HT	140	180
D-C Construction (Direct Current)	A, F or H	None, FT or HT	77	150
Catalog Numbers Suffixed 'HW' A-C Construction (Alternating Current)	A	None or DA	77	210
	F	DF or FT	77	210
	H	HT	122	210

POSITIONING/MOUNTING

Valve may be mounted in any position. For mounting bracket (optional feature) dimensions, refer to Figure 1.

PIPING

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening the pipe do not use valve as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point. **IMPORTANT: Valves with suffix 'HW' in the catalog number have a special diaphragm material which is specifically compounded for hot water service. This material can be attacked by oil and grease. Wipe the pipe threads clean of cutting oils and use teflon tape to seal pipe joints.**

IMPORTANT: For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. Housings for all solenoids are provided with connections for 1/2 inch conduit. The general purpose solenoid enclosure may be rotated to facilitate wiring by removing the retaining cap or clip. CAUTION: When metal retaining clip disengages it will spring upwards. Rotate to desired position. Replace retaining cap or clip before operating.

NOTE: Alternating Current (A-C) and Direct Current (D-C) Solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the solenoid base sub-assembly and core assembly.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand for only an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power and depressurize valve before making repairs. It is not necessary to remove valve from pipe line for repairs.

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CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive leakage or noise will indicate that cleaning is required.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, operate valve at least once a month to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

IMPROPER OPERATION

1. **Faulty Control Circuit:** Check electrical system by energizing solenoid. A metallic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to the valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

COIL REPLACEMENT (Refer to Figure 2)

Turn off electrical power supply and disconnect coil leads. Proceed in the following manner:

1. Remove retaining cap or clip, nameplate and cover. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Remove spring washer, insulating washer and coil. Insulating washers are omitted when a molded coil is used.
3. Reassemble in reverse order of disassembly paying careful attention to exploded view provided for identification and placement of parts.

CAUTION: Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place insulating washer at each end of coil if required.

VALVE DISASSEMBLY (Refer to Figures 2 and 3)

Depressurize valve and turn off electrical power supply. Proceed in the following manner:

1. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Unscrew solenoid base sub-assembly and remove bonnet gasket.
3. Remove valve bonnet screws (4) and valve bonnet.
4. For normal maintenance, it is not necessary to disassemble the manual operator (optional feature) unless external leakage is evident. To disassemble remove stem pin, manual operator stem, stem spring and stem gasket.
5. Remove core spring, core/diaphragm sub-assembly and body gasket. CAUTION: Do not damage or distort hanger spring between core/diaphragm sub-assembly.
6. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

VALVE REASSEMBLY

1. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.
2. Replace body gasket and core/diaphragm sub-assembly. Locate the bleed hole in core/diaphragm sub-assembly approximately 45° from the valve outlet.
3. Replace core spring with wide end in core first; closed end protrudes from top of core.
4. If removed, replace manual operator stem, stem spring, stem gasket and stem pin.
5. Replace valve bonnet and bonnet screws (4). Torque bonnet screws (4) in a crisscross manner to 110 ± 10 inch pounds.
6. Replace bonnet gasket and solenoid base sub-assembly. Put solenoid base sub-assembly to 175 ± 25 inch pounds.
7. Replace solenoid enclosure and retaining cap or clip.
8. After maintenance, operate the valve a few times to be sure of proper opening and closing.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves.
Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS
When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

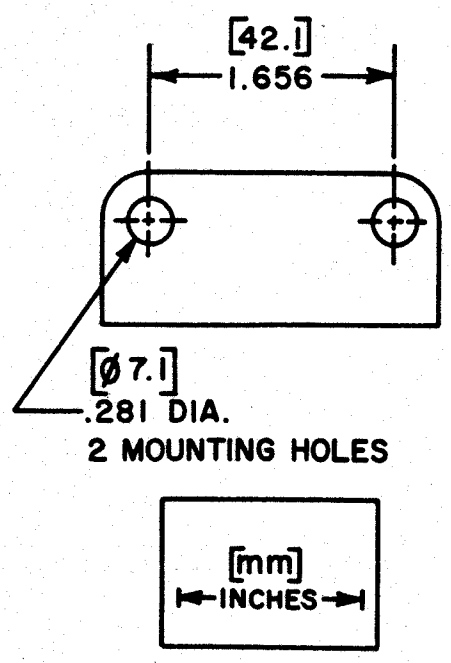

Figure 1. Dimensions For Mounting Bracket (Optional Feature)

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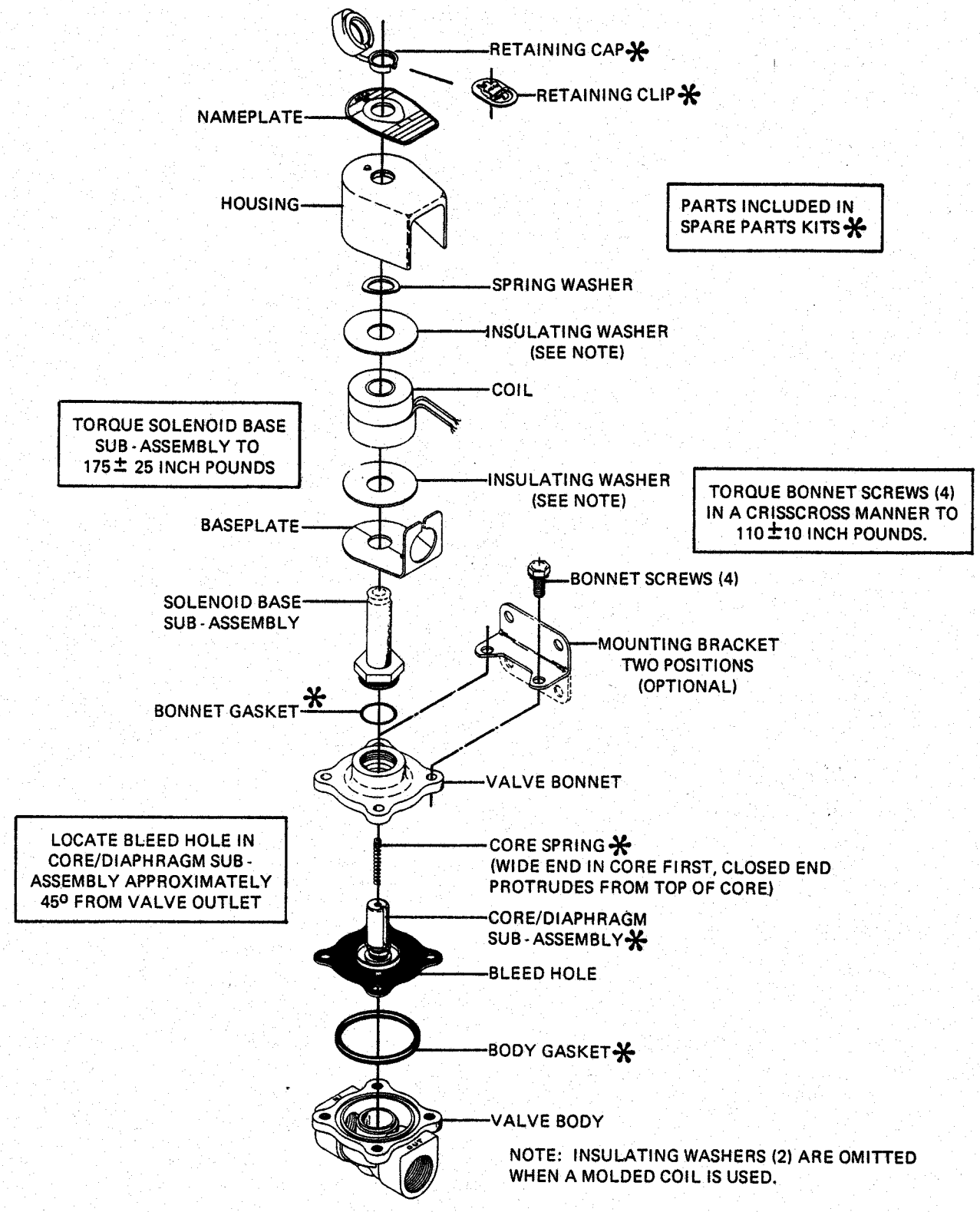

Bulletin 8210 — 3/8, 1/2 & 3/4 N.P.T. — A-C Construction
General purpose solenoid enclosure shown.

Figure 2. **For explosion-proof/watertight solenoid enclosure used on Bulletin 8211, see Form No. V-5380.**

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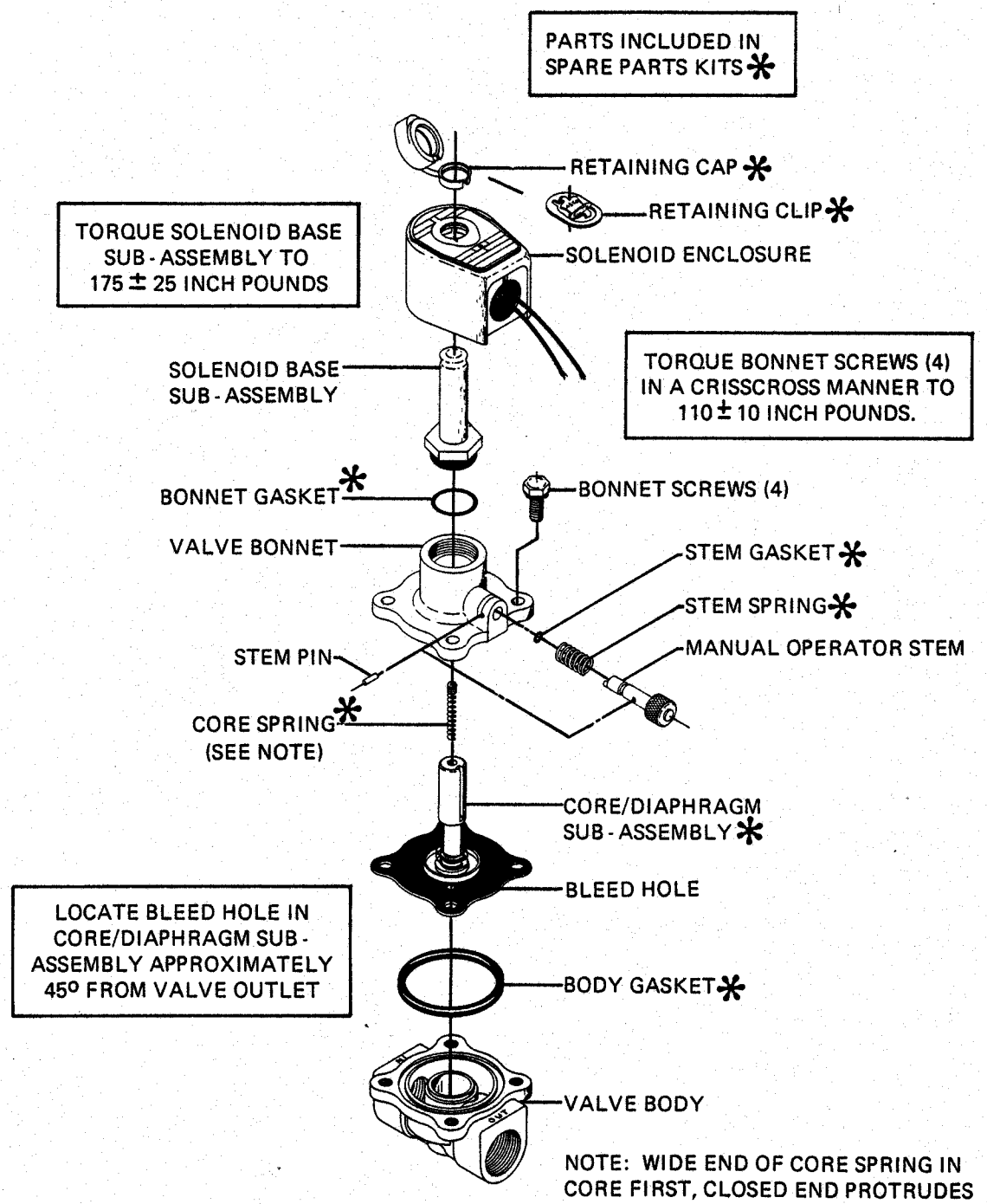

Bulletin 8210 — Manual Operator
General purpose solenoid enclosure shown.
For explosion-proof/watertight solenoid enclosure used on Bulletin 8211, see Form No. V-5380.

Figure 3.

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Installation & Maintenance Instructions

ASCO Red-Hat II®

OPEN–FRAME, GENERAL PURPOSE, WATERTIGHT/EXPLOSIONPROOF SOLENOIDS

SERIES
8003G
8202G
Form No.V6584R8

— SERVICE NOTICE —

ASCO® solenoid valves with design change letter "G" or "H" in the catalog number (ex. 8210G 1) have an epoxy encapsulated ASCO® Red Hat II® solenoid. This solenoid replaces some of the solenoids with metal enclosures and open–frame constructions. Follow these installation and maintenance instructions if your valve or operator uses this solenoid.

See separate instructions for basic valve.

DESCRIPTION

Catalog numbers 8003G and 8202G are epoxy encapsulated pull–type solenoids. The green solenoid with lead wires and 1/2″ conduit connection is designed to meet Enclosure Type 1–General Purpose, Type 2–Dripproof, Types 3 and 3S–Raintight, and Types 4 and 4X–Watertight. The black solenoid on catalog numbers prefixed "EF" or "EV" is designed to meet Enclosure Types 3 and 3S–Raintight, Types 4 and 4X–Watertight, Types 6 and 6P–Submersible, Type 7 (A, B, C & D) Explosionproof Class I, Division 1 Groups A, B, C, & D and Type 9 (E, F, & G)–Dust–Ignitionproof Class II, Division 1 Groups E, F & G. The Class II, Groups F & G Dust Locations designation is not applicable for solenoids or solenoid valves used for steam service or when a class "H" solenoid is used. See *Temperature Limitations* section for solenoid identification and nameplate/retainer for service. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250–28 UNF–2B tapped hole, 0.38 or 0.63 minimum full thread.

NOTE: Catalog number prefix "EV" denotes stainless steel construction.

Catalog numbers 8202G1, 8202G3, 8202G5 and 8202G7 are epoxy encapsulated push–type, reverse–acting solenoids having the same enclosure types as previously stated for Catalog numbers 8003G1 and 8003G2.

Series 8003G and 8202G solenoids are available in:

- **Open–Frame Construction:** The green solenoid may be supplied with 1/4″ spade, screw or DIN terminals. (Refer to Figure 4)
- **Panel Mounted Construction:** These solenoids are specifically designed to be panel mounted by the customer through a panel having a .062 to .093 maximum wall thickness. Refer to Figure 1 and section on *Installation of Panel Mounted Solenoid.*

Optional Features For Type 1 – General Purpose Construction Only

- **Junction Box:** This junction box construction meets Enclosure Types 2,3,3S,4, and 4X. Only solenoids with 1/4″ spade or screw terminals may have a junction box. The junction box provides a 1/2″ conduit connection, grounding and spade or screw terminal connections within the junction box (See Figure 5).
- **DIN Plug Connector Kit No.K236034:** Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 6).

OPERATION

Series 8003G – When the solenoid is energized, the core is drawn into the solenoid base sub–assembly. **IMPORTANT: When the solenoid is de–energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 11 ounces, and 5 ounces for DC construction.**

Series 8202G – When the solenoid is energized, the disc holder assembly seats against the orifice. When the solenoid is de–energized , the disc holder assembly returns. **IMPORTANT: Initial return force for the disc or disc holder assembly, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force is 1 pound, 5 ounces.**

INSTALLATION

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

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

FOR BLACK ENCLOSURE TYPES 7 AND 9 ONLY

⚠ CAUTION: To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 165° C. On valves used for steam service or when a class "H" solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180°C. See nameplate/retainer for service.

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

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

Temperature Limitations

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

Temperature Limitations For Series 8003G or 8202G Solenoids for use on Valves Rated at 10.1, 11.6, 17.1, or 22.6 Watts

Watt Rating	Catalog Number Coil Prefix	Class of Insulation	Maximum † Ambient Temp.
10.1 & 17.1	None, FB, KF, KP SC, SD, SF, & SP,	F	125°F (51.7°C)
10.1 & 17.1	HB, HT, KB, KH, SS, ST, SU,	H	140°F (60°C)
11.6 & 22.6	None, FB,KF, KP, SC, SD, SF, & SP.	F	104°F (40°C)
11.6 & 22.6	HP, HT, KB, KH, SS, ST, SU, & SV	H	104°F (40°C)

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

Positioning

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

Wiring

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2″ conduit connection. To

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facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

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

Additional Wiring Instructions For Optional Features:

- **Open−Frame solenoid with 1/4″ spade terminals.**

For solenoids supplied with screw terminal connections use #12−18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to 10 ± 2 in−lbs [1,0 ± 1,2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10−32 machine screw. Torque grounding screw to 15 − 20 in−lbs [1,7 − 2,3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 − 20 in−lbs [1,7 − 2,3 Nm] with a 5/32″ hex key wrench.

- **Junction Box**

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

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

1. The open−frame solenoid is provided with DIN terminals to accommodate the plug connector kit.
2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.
3. Use #12−18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4″ for installation in socket terminals. The use of wire−end sleeves is also recommended for these socket terminals. Maximum length of wire−end sleeves to be approximately 1/4″. Tinning of the ends of the lead wires is not recommended.
4. Thread wire through gland nut, gland gasket, washer and connector cover.

NOTE: Connector housing may be rotated in 90° increments from position shown for alternate positioning of cable entry.

5. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.
6. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in−lbs [0,6 ± 1,1 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it may be necessary to change the complete solenoid including the core and solenoid base sub−assembly, not just the solenoid. Consult ASCO.

Installation of Solenoid

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

Installation of Panel Mounted Solenoid (See Figure 1)

1. Disassemble solenoid following instruction under *Solenoid Replacement* then proceed.
2. Install solenoid base sub−assembly through customer panel.
3. Position spring washer on opposite side of panel over solenoid base sub−assembly.
4. Replace solenoid, nameplate/retainer and red cap.
5. Make electrical hookup, see *Wiring* section.

Solenoid Temperature

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

MAINTENANCE

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

Cleaning

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

Preventive Maintenance

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

Causes of Improper Operation

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

Solenoid Replacement

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

NOTE: Any optional parts attached to the old solenoid must be reinstalled on the new solenoid. For 3−way construction, piping or tubing must be removed from pipe adapter.

2. Disassemble solenoids with optional features as follows:

- **Spade or Screw Terminals**

Remove terminal connections, grounding screw, grounding wire, and terminal block (screw terminal type only).

NOTE: For screw terminals, the socket head screw holding the terminal block serves as a grounding screw.

- **Junction Box**

Remove conduit and socket head screw (use 5/32″ hex key wrench) from center of junction box. Disconnect junction box from solenoid.

- **DIN Plug Connector**

Remove center screw from DIN plug connector. Disconnect DIN plug connector from adapter. Remove socket head screw (use 5/32″ hex key wrench), DIN terminal adapter, and gasket from solenoid.

3. Snap off red cap from top of solenoid base sub−assembly. For 3−way construction with pipe adapter (Figure 3), remove pipe adapter, nameplate and solenoid. Omit steps 4 and 5.
4. Push down on solenoid. Then using a suitable screwdriver, insert blade between solenoid and nameplate/retainer. Pry up slightly and push to remove.

NOTE: Series 8202G solenoids have a spacer between the nameplate/retainer and solenoid.

5. Remove solenoid from solenoid base sub−assembly.
6. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.
7. Torque pipe adapter to 90 inch−pounds maximum [10,2 Nm maximum]. Then make up piping or tubing to pipe adapter on solenoid.

Disassembly and Reassembly of Solenoids

1. Remove solenoid, see *Solenoid Replacement*.
2. Remove spring washer from solenoid base sub−assembly. For 3−way construction, remove plugnut gasket.
3. Unscrew solenoid base sub−assembly from valve body.
4. Remove internal solenoid parts for cleaning or replacement. Use exploded views for identification and placement of parts.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Torque solenoid base sub−assembly and adapter to 175±25 in−lbs [19,8±2,8 Nm].

ORDERING INFORMATION FOR ASCO SOLENOIDS

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

Torque Chart

Part Name	Torque Value Inch—Pounds	Torque Value Newton—Meters
solenoid base sub—assembly & adapter	175 ± 25	19,8 ± 2,8
pipe adapter	90 maximum	10,2 maximum

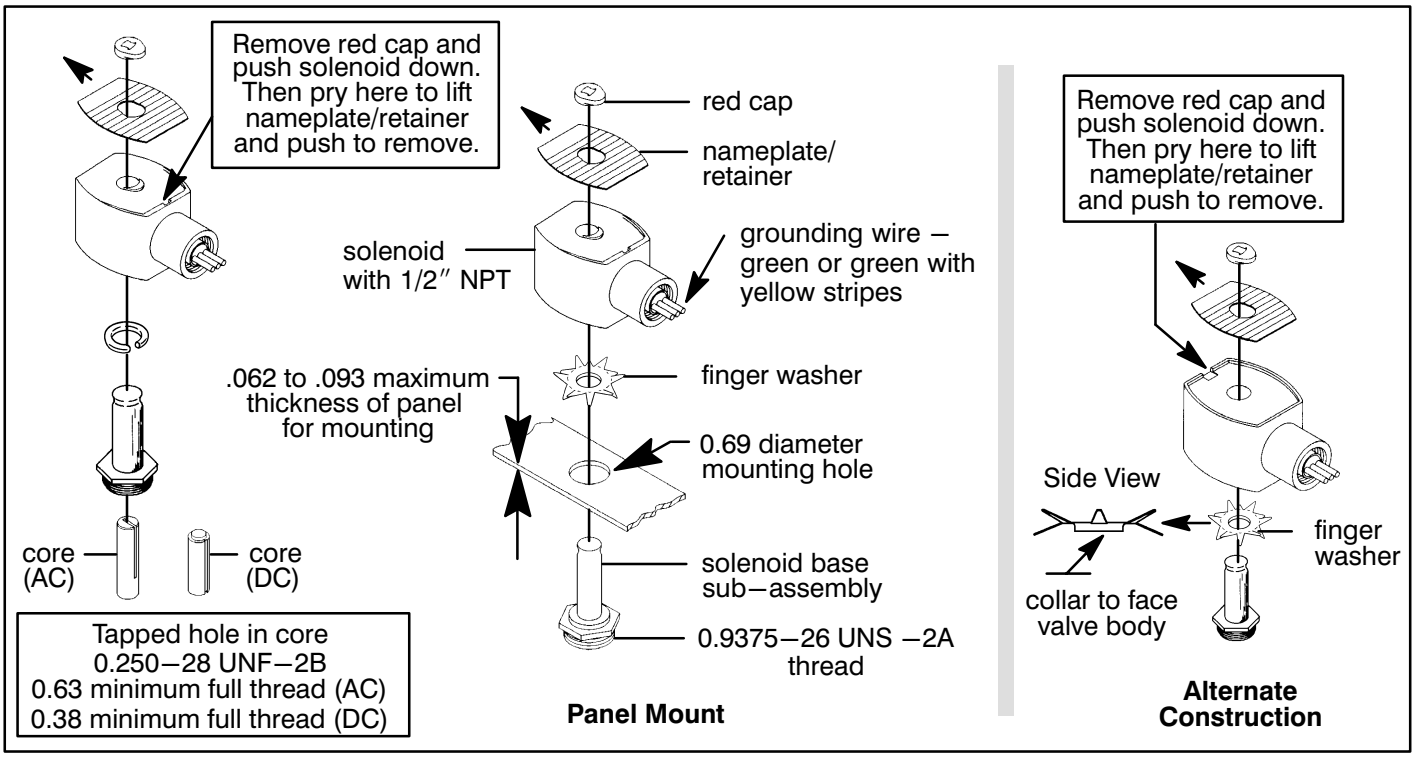

Figure 1. Series 8003G solenoids

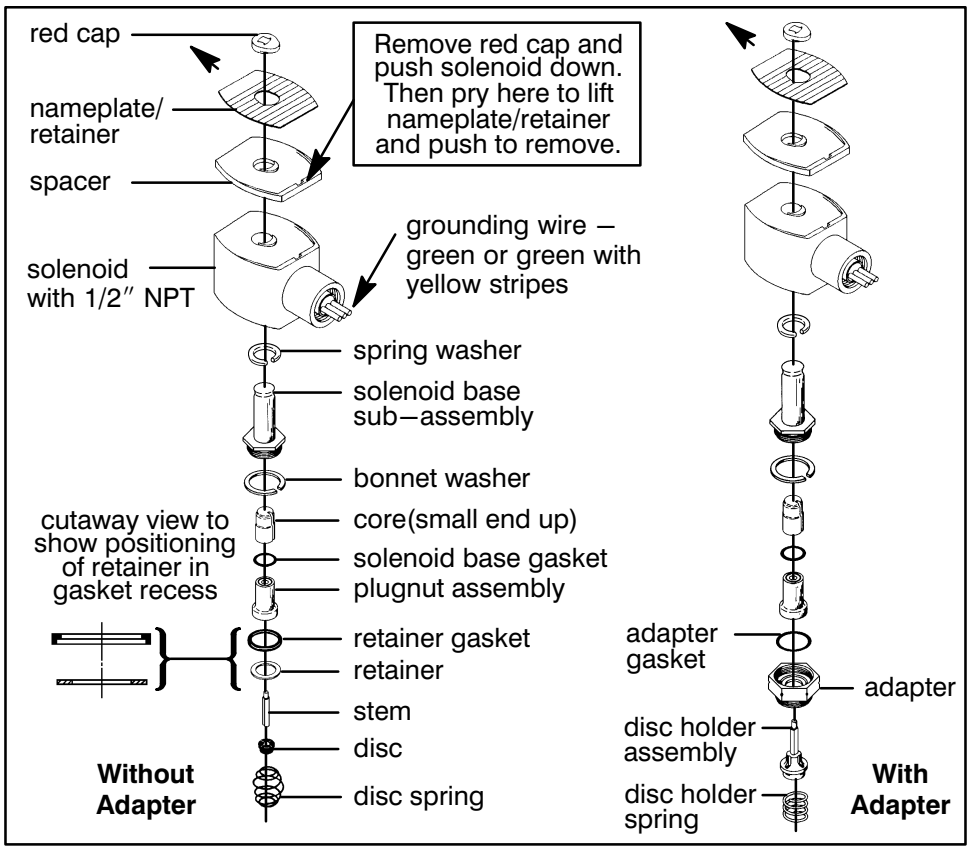

Figure 2. Series 8202G solenoids

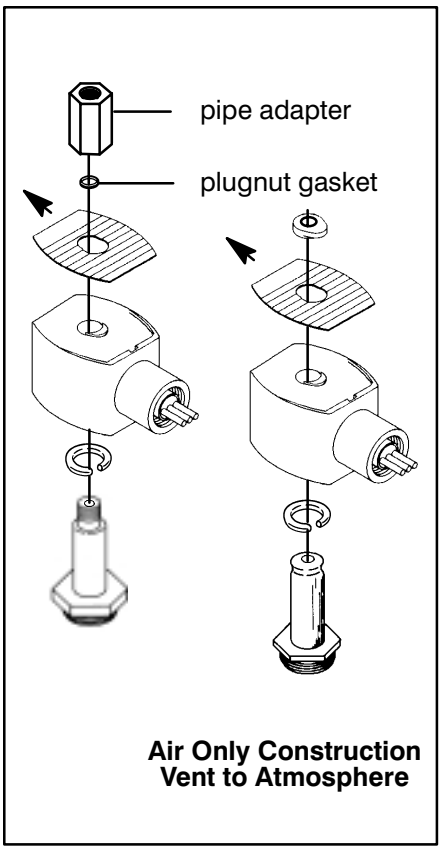

Figure 3. 3—Way Construction

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Torque Chart

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

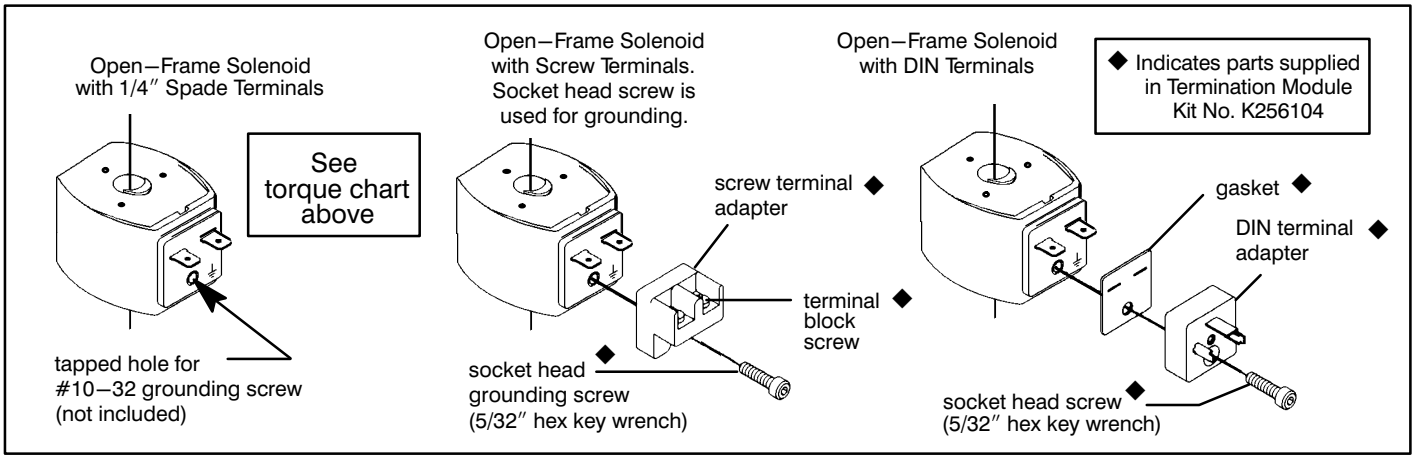

Figure 4. Open—frame solenoids

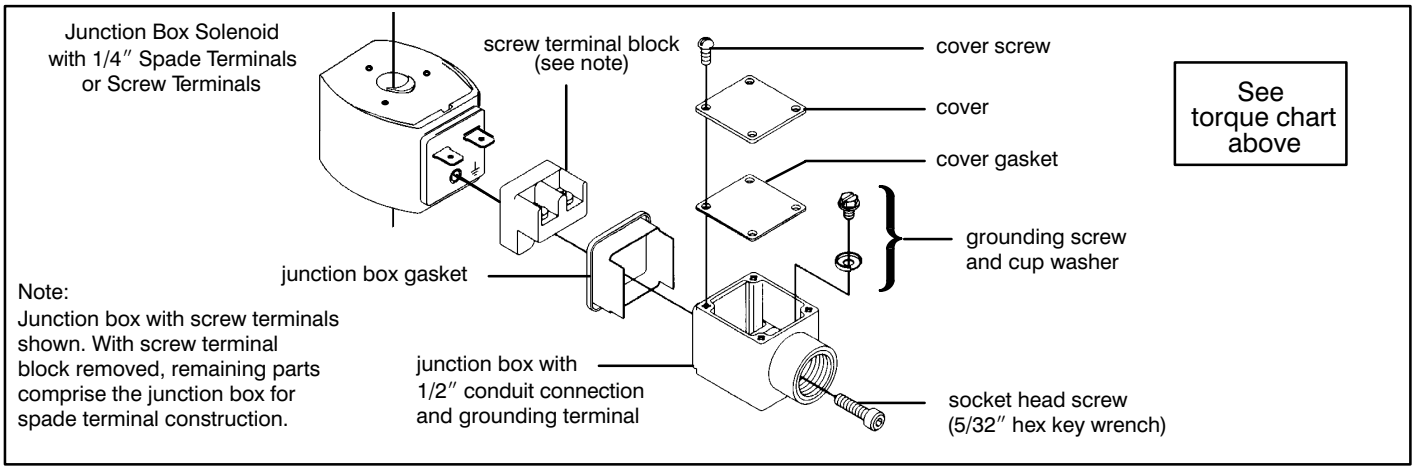

Figure 5. Junction box (optional feature)

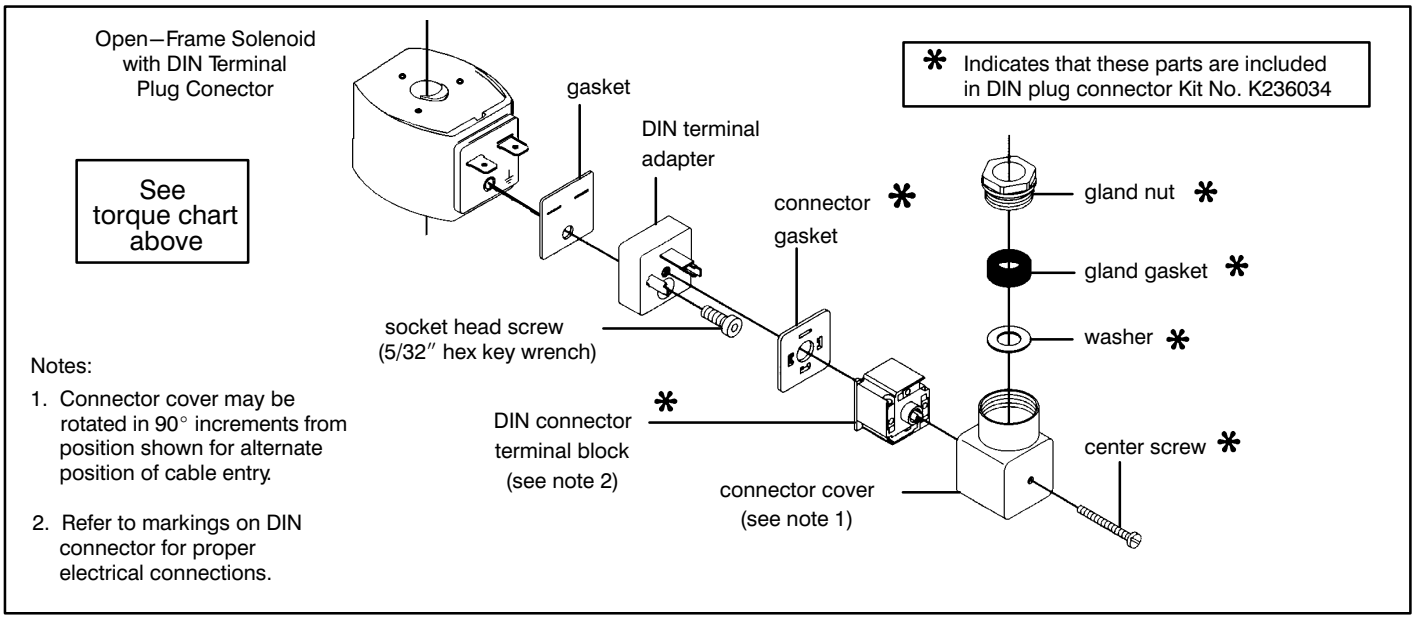

Figure 6. DIN plug connector kit No. K236034 (optional feature)

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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

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

MATERIAL SAFETY DATA SHEET

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

SECTION I

CODE NUMBER: A0600 DATE 970917

TRADE NAME: MIL-H-5606G HYD FLUID QMLS 96-99 SUPERCEDES 970915

CHEMICAL FAMILY: PETROLEUM "MIXTURE"

CARCINOGENIC INGREDIENTS/OSHA/NTP/IARC: NONE C.A.S. NO.:

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

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

FLAMMABLE LIMITS: LEL – UEL N/A

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

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	
SKIN ACUTE	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	
SKIN CHRONIC	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

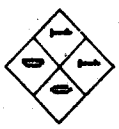
LSC Lubricating Specialties Company

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

Manufactured by TECHNOLUBE PRODUCTS DIVISION

CODE NUMBER A0600

PERSONAL PROTECTION (NFPA)



DEFINITIONS

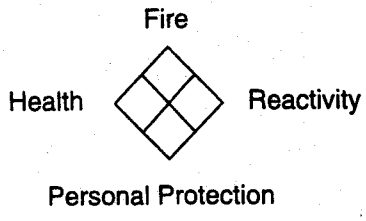
ACGIH: American Conference of Governmental Industrial Hygienists

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

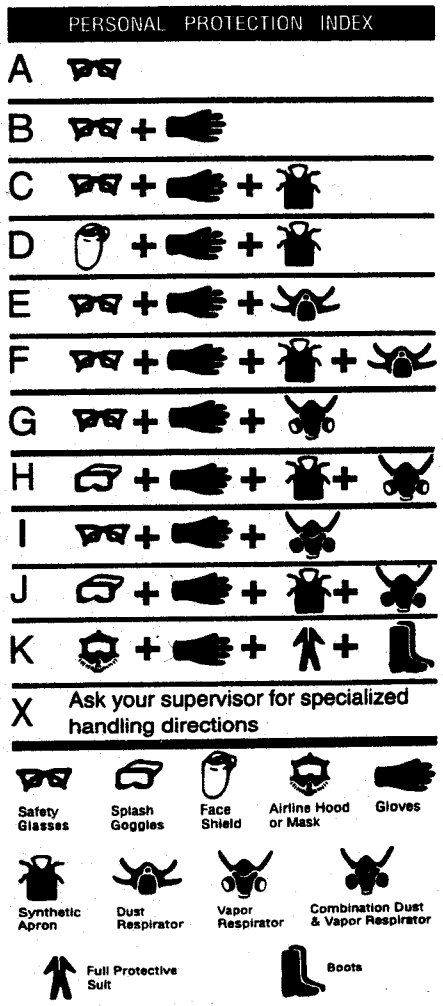
TLV: Threshold Limit Value. A recommended upper limit or TWA concentration of a substance to which most workers can be exposed with out adverse effect.

TWA: Time Weighted Average

ING: Ingestion

INH: Inhalation

CON: Contact



Lubricating Specialties Company

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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.

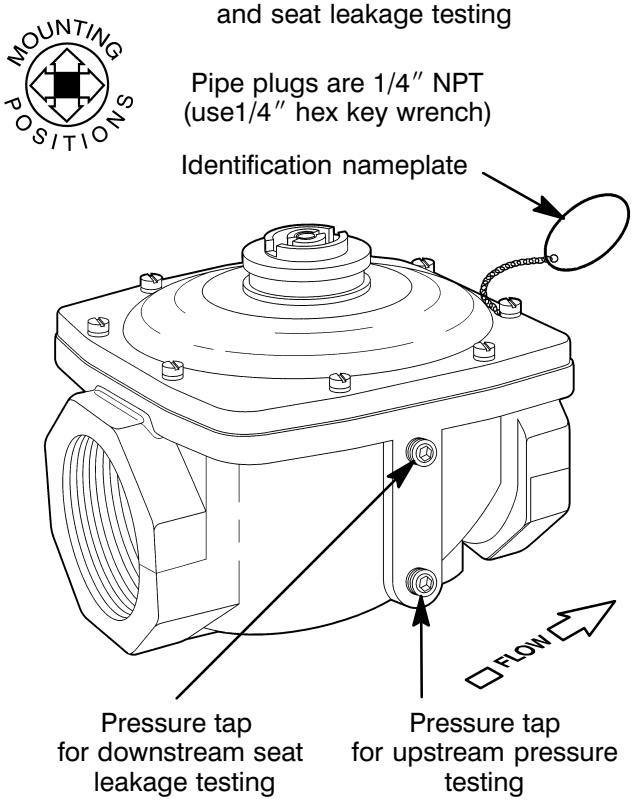
The valves are equipped with aluminum seats and Nitrile seals. A quick–opening poppet is standard. Both overtravel seals and linear trim are available as options, i.e. ***Quick Opening With Overtravel Seal, Linear Opening or Linear Opening With Overtravel Seal.***

⚠ 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.

View of valve assembly showing location of tapped and plugged holes for pressure and seat leakage testing



Note: Upstream and downstream pressure taps are on either side of valve body.

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.

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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

ASCO® General Controls Automatic Switch Co. 50–60 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

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.

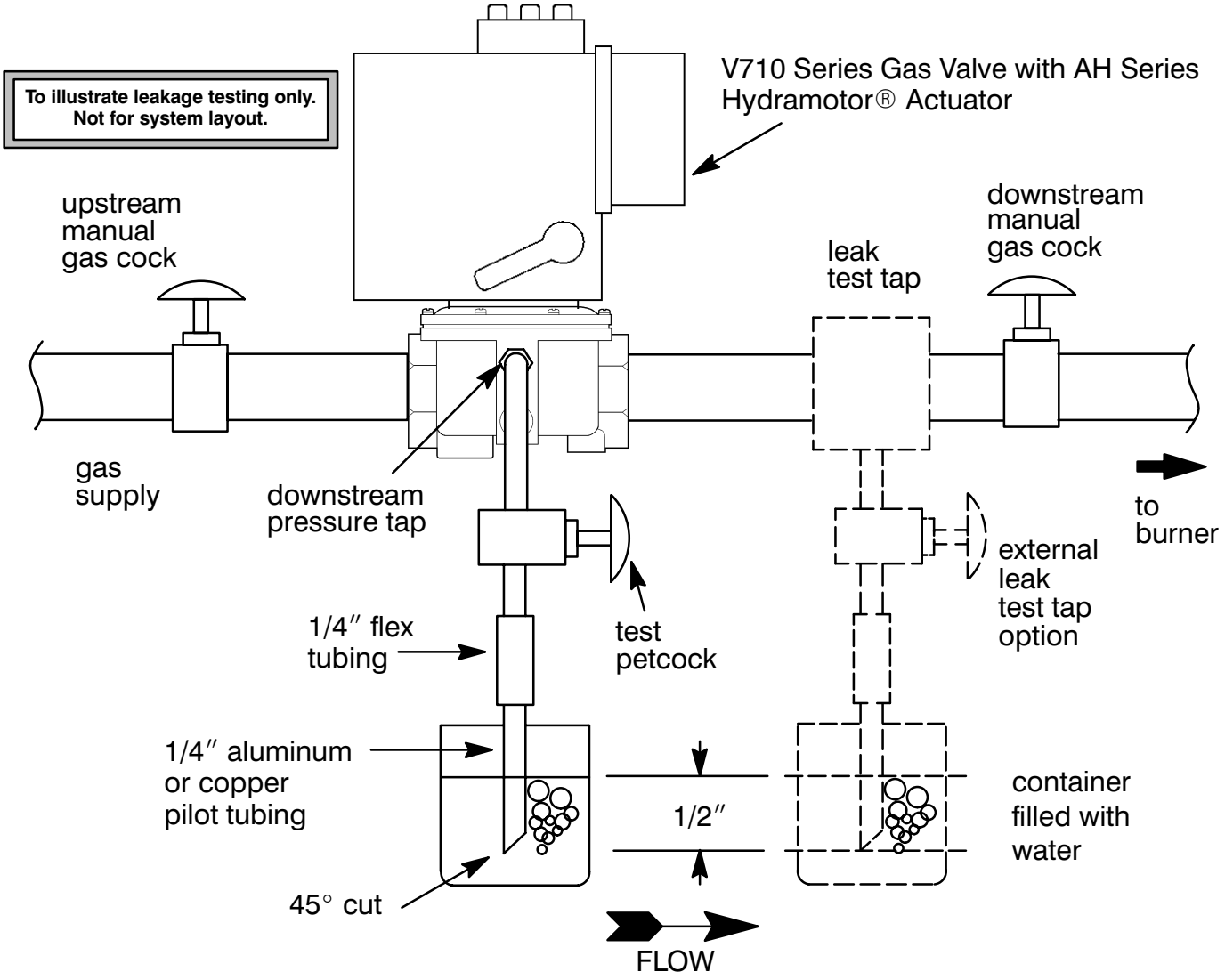

Figure 2. Testing for Internal Seat Leakage.

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Installation & Maintenance Instructions

HYDRAMOTOR® PUSH−TYPE LINEAR ACTUATOR WITH WATERTIGHT ENCLOSURE

AH2D SERIES

Form No.V8714−Sec. 1
(Section 1 of 2)

⚠ WARNING

To prevent the possibility of death, serious injury or property damage, the Hydramotor® Actuator must be installed and serviced 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 actuator or valve from service.**
- **Explosion, fire or toxic gas hazards. Extinguish all open flames and avoid any type of sparking or ignition during leakage testing.**

Service Notices

These instructions are divided into two sections. Be sure to read, understand and follow all instructions on Form No. V8714 − Section 1 and 2.

See separate V710 Gas Valve Installation and Maintenance Instructions for information on: Operation, Positioning, Mounting, Piping, Strainer or Filter Requirements, Flow Controls, Preventive Maintenance, and Cause of Improper Operation.

DESCRIPTION

AH2D 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. AH2D actuators position V710 Series gas valve assemblies.

OPERATION

Application of electrical power simultaneously drives an electric pump and closes a normally−open dump valve, resulting in up to 250 pounds of force on the actuator stem. This extends the actuator stem and attached valve poppet, to open the valve and/or damper.

Upon reaching the fully extended position, a 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, the dump valve opens releasing hydraulic pressure, allowing the return spring to retract the stem and close the valve fully. Closing time is one second or less.

OPTIONAL FEATURES

- **Damper Shaft Arm** All components to mount damper arm on right side of actuator. Available with or without return spring.
- **Auxiliary Switch** One or two integral SPDT switches, field adjustable to actuate at any position of stroke.
- **Overtravel Proof−of−Closure Switch** A single factory set non−field adjustable SPDT switch to be used in conjunction with V710 Series Gas Valves with overtravel seal (V22 or V25 suffix in catalog number).

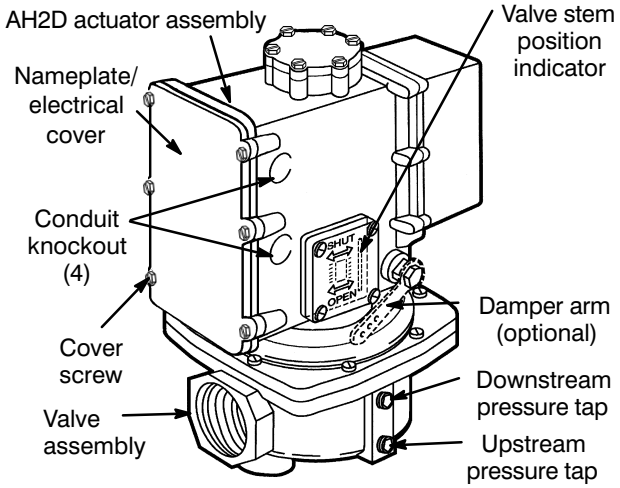

Figure 1. AH2D Actuator (shown mounted on V710 Series Gas Valve)

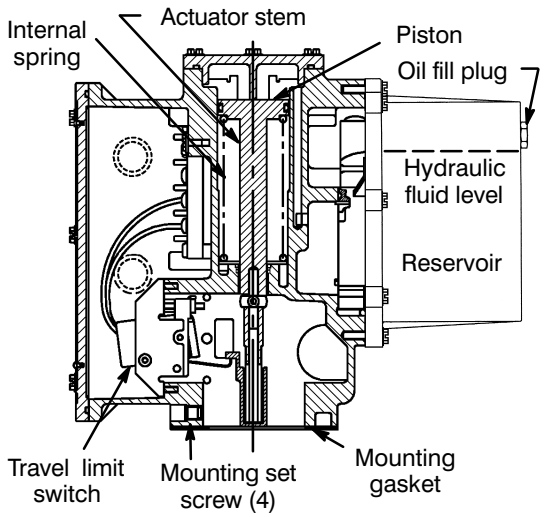

Figure 2. Cutaway View (de−energized)

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SPECIFICATIONS

Force Output: 250 lbs

Stroke: 1 1/8″ maximum

Electrical Characteristics:

Operating Voltage *	Amperes (nominal)		
	Inrush	Running	Holding
24V/50−60Hz	28.00	8.00	0.73
120V/50−60Hz	5.60	1.85	0.11
240V/50−60Hz	2.80	0.92	0.05

*50 Hz construction increases opening time 20%.

Opening Time: Fast Opening: 6 to 14 seconds
Slow Opening: 14 to 26 seconds

Note: Opening time doubles between −30°F to −40°F (−34°C to −40°C). Timing not field adjustable.

Maximum Closing Time: One second

Temperature Limitations: Ambient −40°F to 150°F (−40°C to 66°C)

Damper Arm Rating: Drives damper in one direction only. 20 lb maximum at 2.85 in. radius at 20°F to 150°F (−7°C to 65°C) and 10 lb maximum at −40°F to 20°F (−40°C to −7°C).

Damper Arm Travel: 2″ maximum

INSTALLATION

Before installation, check nameplates to verify actuator and valve selected are appropriate for the application. **IMPORTANT: After actuator installation, test all functions and check out complete system before putting actuator/valve into service.**

Positioning/Mounting

Follow the V710 Series Gas valve and/or damper manufacturer's instructions when installing the Hydramotor®.

1. AH2D actuators can be installed to operate in any position.
2. Install mounting gasket and position the actuator to operate the valve (and damper if appropriate). Secure actuator with the four mounting set screws. Torque set screws to 80 ± 5 in−lbs [9,0 ± 0,5 Nm] using a 5/32″ hex key wrench.
3. For damper applications requiring the damper arm to return upon power failure, the optional return spring and spring plug (kit 440018) must be installed on the damper arm. Connect linkage so that damper returns to the desired position.

Wiring (Refer to Figure 3)

⚠ WARNING: Electrical hazard. To prevent the possibility of death, serious injury or property damage, open all circuits before inspection, service or disassembly. Reassemble before operating.

Wiring must comply with local codes and the National Electrical Code. Limit controls must conform to actuator rating (voltage, amperage, hertz). Wiring to meet NEC Class I, suitable for 75° C. Wire limit controls to the hot side of power supply.

1. Route wiring through one of the conduit knockout openings. Install appropriate electrical fittings.
2. Connect the power wiring to terminals N (neutral) and L1 (hot). A green grounding screw with a cup washer is provided beside the terminal strip for grounding.
3. Torque terminal screws to 8 to 12 in−lbs [0,9 to 1,3 Nm].
4. Connect auxiliary or valve overtravel proof−of−closure switch wiring to the common and normally open or normally closed switch terminals.
5. Install nameplate/electrical cover with gasket and screws (6) on actuator housing. Hand thread screws as far as possible, then torque screws evenly in a crisscross manner to 30 to 35 in−lbs [3,4 to 4,0 Nm].
6. Operate actuator (complete system) through five cycles to verify proper operation.

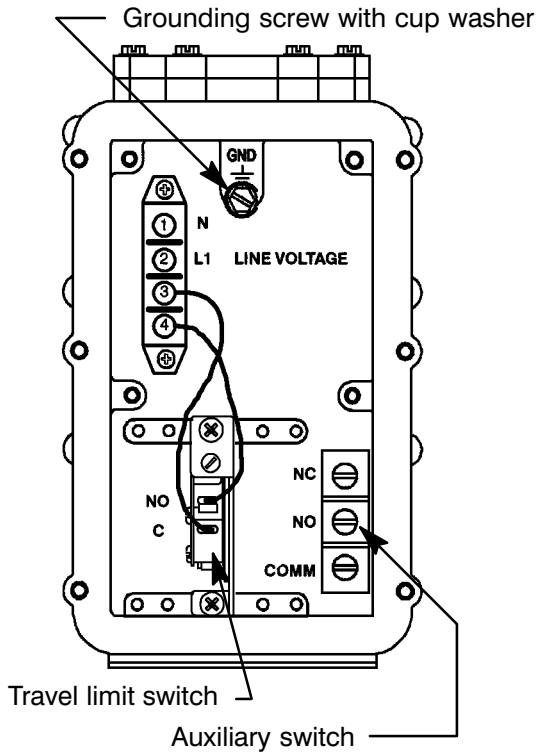


Figure 3. Typical AH2D Actuator Wiring.

Auxiliary and Overtravel Proof−of−Closure Switch Ratings

15 Amps 120 Vac
7.5 Amps 240 Vac

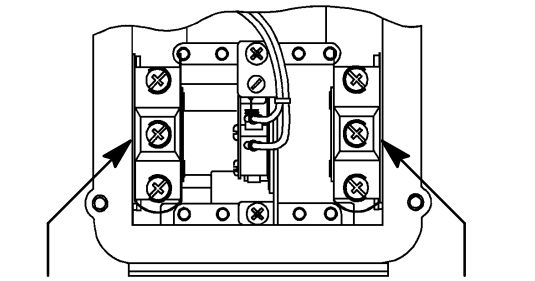
Total connected load of auxiliary and overtravel proof−of−closure switches not to exceed 1800 VA.

⚠ CAUTION: Overtravel Proof−of−closure switch must only be used with V710 Series Gas Valves having an overtravel seal (V22 or V25 Suffix in catalog number).

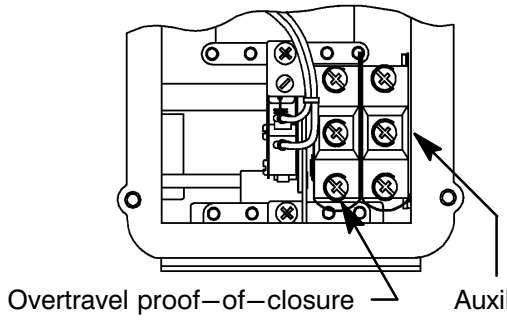
Overtravel Proof−of−Closure Switch

The optional valve overtravel proof−of−closure switch is set at the factory to provide both a mechanical and electrical means of proving valve closed position interlock to the primary control. This switch is not to be field adjusted.

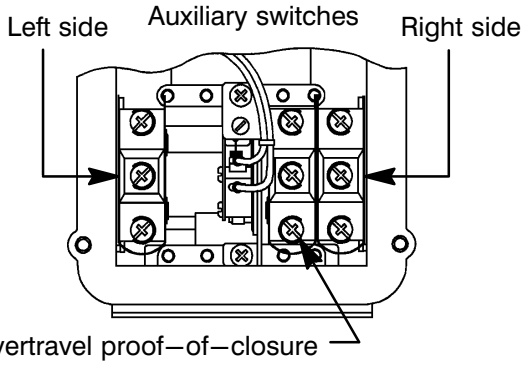
Optional Auxiliary and Overtravel Proof−of−Closure Switch Combinations (Partial Views)



Two Auxiliary Switches



Overtravel Proof−of−Closure & Auxiliary Switches



Two Auxiliary and One Proof−of−Closure Switch

Auxiliary Switch Adjustment (Refer to Figure 4)

1. Remove window screws(4) and window with gasket.
2. Loosen the camlock screw no more than 1/2 turn.
3. Reset the cam adjustment screw to the desired switching point and hold this screw until camlock screw is tightened.
4. Tighten the camlock screw. Cycle the actuator to verify the switch setting and readjust as required.
5. Reinstall the window with gasket and torque screws evenly to 14 to 16 in−lbs [1,6 to 1,8 Nm].

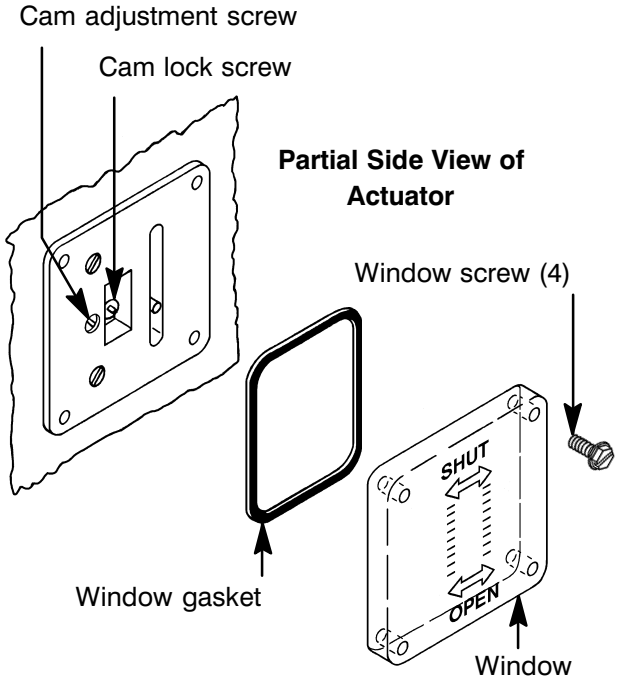


Figure 4. Auxiliary Switch Adjustment.

MAINTENANCE

Maintenance should include annual inspection and cleaning. Use a cleaning fluid compatible with actuator components to remove dirt and oil. Organize a maintenance schedule based on environment and frequency of use. Check for loose electrical and mechanical connections and replace damaged parts. **Before inspection, maintenance or rebuild, review WARNING statements on page 1.**

Field Service Notice

Field service replacement kits are limited to the following:

1. Travel limit switch Replacement Kit 440014.
2. Left side auxiliary switch Replacement Kit 440002.
3. Right side auxiliary switch Replacement Kit 440003.
4. Overtravel proof−of−closure switch Replacement Kit 440004*.
5. Right side combination auxiliary and overtravel proof−of−closure switch Replacement Kit 440012*.
6. Damper arm Replacement Kit 440018 (with spring and spring plug) or 440019 (without spring and spring plug).
7. Oil Replacement Kit 440008.
8. All gaskets and screws for enclosure Replacement Kit 440020. This kit contains the following:
   - Nameplate/electrical cover gasket and screws
   - Right & left window gasket and screws.
   - Valve/actuator mounting gasket and mounting set screws.

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

*Separate instructions provided with replacement kit.

Travel Limit Switch Replacement (Refer to Figure 5)

1. Remove the six cover screws and nameplate/electrical cover with gasket.
2. Disconnect wiring from travel limit switch.

⚠ CAUTION: Label wires before disconnecting.

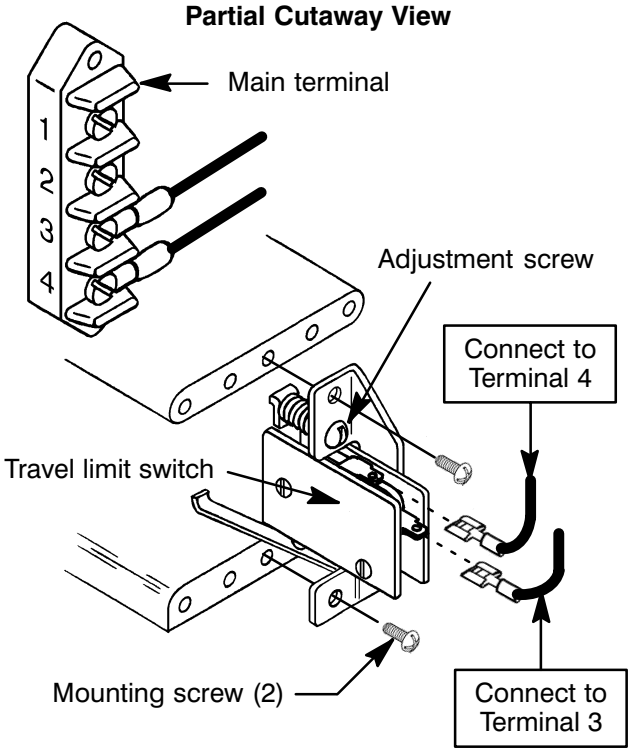
3. Remove two mounting screws and the travel limit switch.
4. Reinstall new travel limit switch in actuator. Torque mounting screws (2) evenly to 20 to 25 in−lbs [2,3 to 2, 8 Nm].
5. The required stroke is 1 1/8″ ± 1/16″. Turn adjustment screw located above limit switch until the desired stroke is achieved. Turn the adjustment screw clockwise to decrease stroke and counterclockwise to increase stroke.
6. Operate actuator (complete system) through five cycles to verify proper operation.
7. Reinstall nameplate/electrical cover with gasket and screws (6) on actuator housing. Hand thread screws as far as possible, then torque screws evenly in a crisscross manner to 30 to 35 in−lbs [3 ,4 to 4, 0 Nm].

Auxiliary Switch Replacement (Refer to Figure 6)

1. Remove six cover screws and nameplate/electrical cover with gasket.
2. Disconnect auxiliary switch wiring.

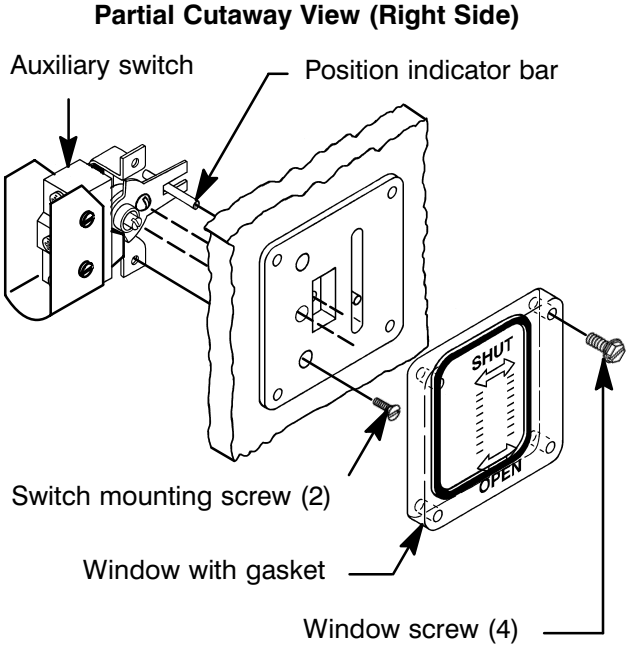
⚠ CAUTION: Label wires before disconnecting.

3. On auxiliary switch side of actuator, remove window screws (4) and window with gasket.
4. Remove auxiliary switch mounting screws (2) from side of actuator.
5. Disengage auxiliary switch from indicator bar and remove switch from actuator.
6. Install new auxiliary switch and reassemble in reverse order of disassembly.
7. Torque auxiliary switch mounting screws (2) evenly to 14 to 16 in−lbs [1, 6 to 1,8 Nm].
8. Torque terminal screws 8 to 12 in−lbs [0, 9 −1, 3 Nm].
9. Reinstall the window with gasket and torque screws evenly to 14 to 16 in−lbs [1,6 to 1,8 Nm].
10. Reinstall nameplate/electrical cover with gasket and screws (6) on actuator housing. Hand thread screws as far as possible, then torque screws evenly in a crisscross manner to 30 to 35 in−lbs [3 ,4 to 4, 0 Nm].
11. Operate actuator (complete system) through five cycles to verify proper operation.



⚠ CAUTION: Label wires before disconnecting.

Figure 5. Travel Limit Switch Replacement.



⚠ CAUTION: Label wires before disconnecting.

Figure 6. Auxiliary Switch Replacement.

Continued on Form No. V8714−Section 2.

Installation & Maintenance Instructions

HYDRAMOTOR® PUSH–TYPE LINEAR ACTUATOR WITH WATERTIGHT ENCLOSURE

AH2D SERIES

Form No.V8714–Sec. 2 (Section 2 of 2)

NOTICE: For instructions, see Form No. V8714–Section 1.

Damper Shaft Arm and Spring Replacement

(Refer to Figure 7)

1. Disconnect damper shaft arm from existing system linkage.
2. Remove retaining ring from end of damper shaft.
3. Slip damper shaft arm, spring plug and return spring (if present) off damper shaft.
4. Reassembly in reverse order of disassembly paying careful attention to exploded view in Figure 7.
5. Reconnect existing system linkage to damper shaft arm.
6. Operate actuator (complete system) through five cycles to verify proper operation.

Note: Damper shaft arm replacement kits are supplied with or without return spring and spring plug. See ***Field Service Notice*** in Section 1 page 3 of 6.

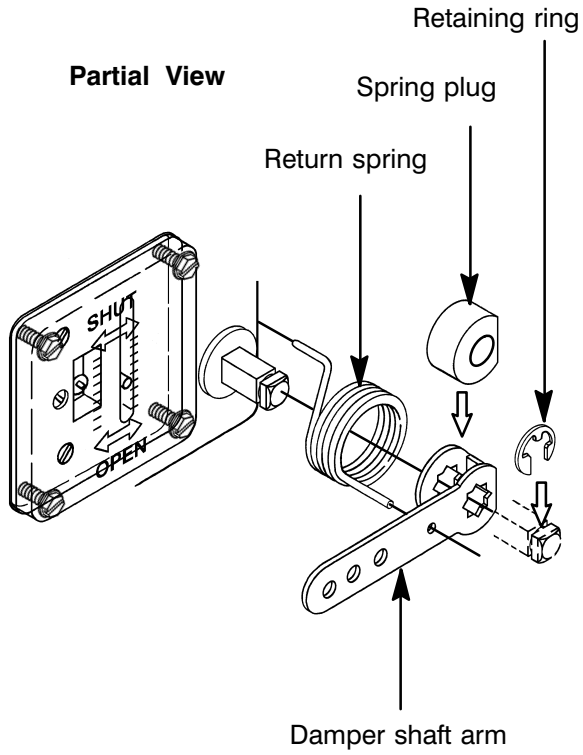


Figure 7. Damper Shaft Arm & Return Spring.

Refilling Hydramotor® Actuator with Hydraulic Oil and Purging Entrapped Air

1. When refilling a Hydramotor® Actuator with oil, it is recommended that the actuator be energized and de–energized during filling (if possible). This is particularly important if the oil level in the reservoir is very low or empty. By operating the actuator, entrapped air is purged from the hydraulic system. If upon energizing the Hydramotor® Actuator the actuator fails to move, delays or operates slowly, chances are air has become entrapped in the hydraulic system.

   Remove entrapped air from the hydraulic system by cycling the actuator 4 to 5 times successively over the full stroke. As air is purged, check oil level and add oil if necessary. All of the air has been removed when the actuator stem moves immediately upon energizing.
2. ***With Actuator Mounted Upright,*** (Figure 2), remove oil fill plug and fill to bottom of fill port, follow instructions provided in step 1.
3. ***With Actuator Mounted On Its Side,*** and oil fill plug uppermost, remove the oil fill plug. The oil level should be 5/8″ from the top of the pump cover. Follow instructions provided in step 1.
4. Reinstall fill plug and torque to 114 to 120 in–lbs 13 to 14 Nm].
5. If actuator has been repositioned, return unit to normal orientation.
6. Operate actuator (complete system) through five cycles to verify proper operation.

Continued on page 6 of 6.

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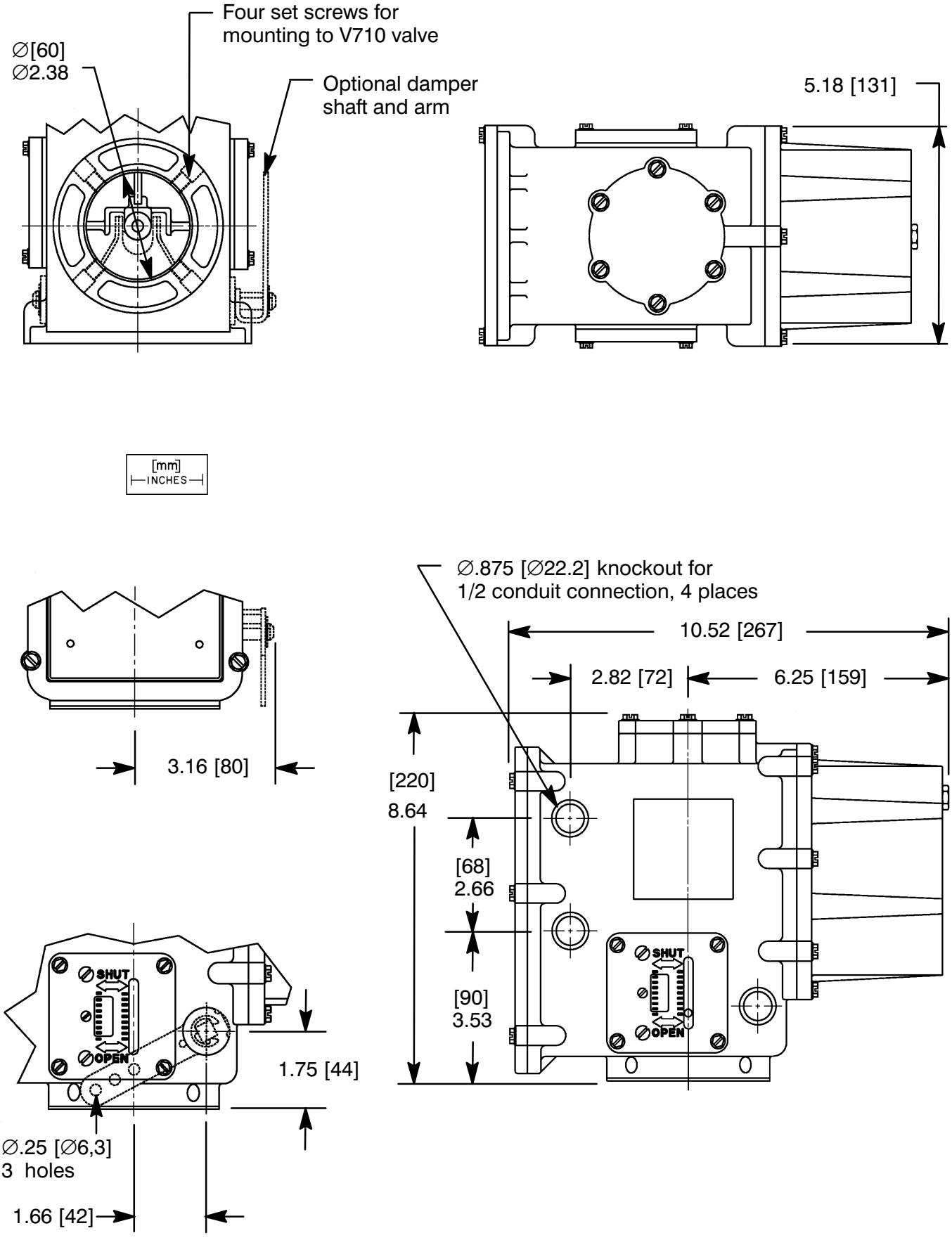

Figure 8. Dimensions

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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.

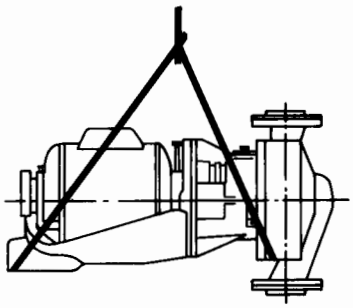
WARNING: EXCESSIVE PRESSURE HAZARD – VOLUMETRIC EXPANSION. The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release high temperature fluids. This can be prevented by installing properly sized and located compression tanks 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.

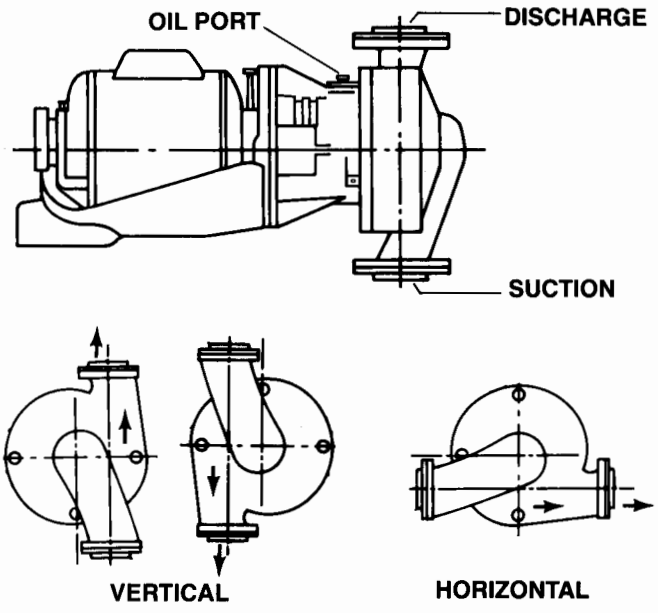
If it is required to lift the entire pump, do so with slings placed around the pump assembly as shown.



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.

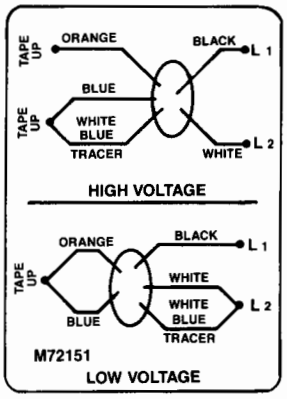
WIRING INSTRUCTIONS

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

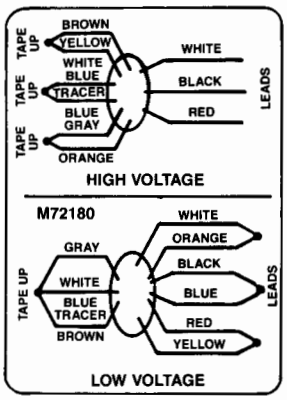
The single phase motor can operate at low voltage (115V) as well as at high voltage (230V). Determine the voltage at which you choose to operate your B&G pump and make wiring connections according to the following diagrams (these diagrams are also found in the conduit box cover):



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.

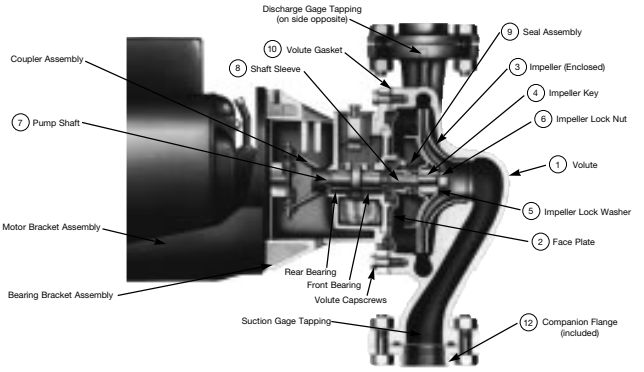
WARNING: HIGH PRESSURE HAZARD.
Pressure may be present in the pump body. This pressure can be relieved by loosening the eight volute capscrews and shifting the bearing assembly slightly to allow the pressurized water to escape. Failure to follow these instructions could result in serious personal injury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

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

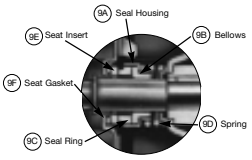
DETERMINE THE SEAL TYPE

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

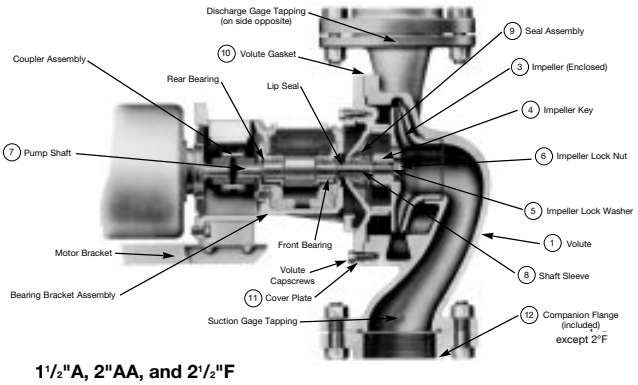


1AA, 1¼"AA, 1½"AA and 2"AA construstion details



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:

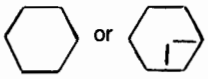
    a. check the PH of the system water,
    b. to check the rotation of the pump and,
    c. to prime the system prior to starting.

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		4	10	17	27	42	83	130	200	300
SAE Grade 5		10	20	35	60	90	180	325	525	800

YOUR BELL & GOSSETT REPRESENTATIVE IS...

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.)

Ensure Quality and Performance with ...

GENUINE BELL & GOSSETT REPLACEMENT PARTS

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.

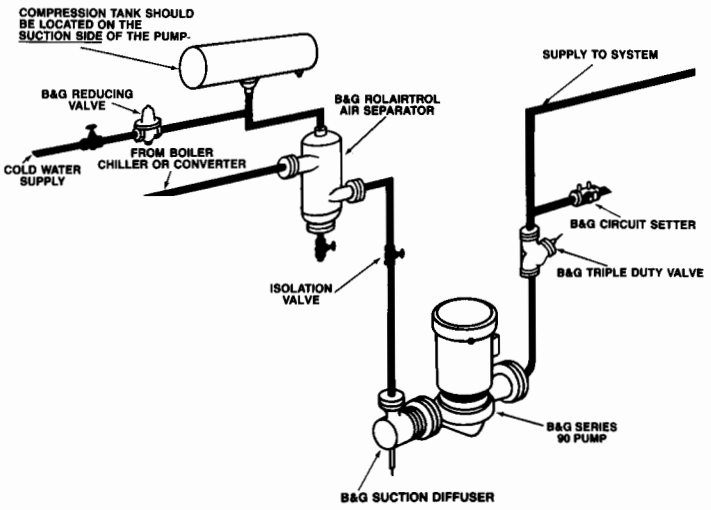
SYSTEM PIPING

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 $7\frac{1}{2}$, 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.

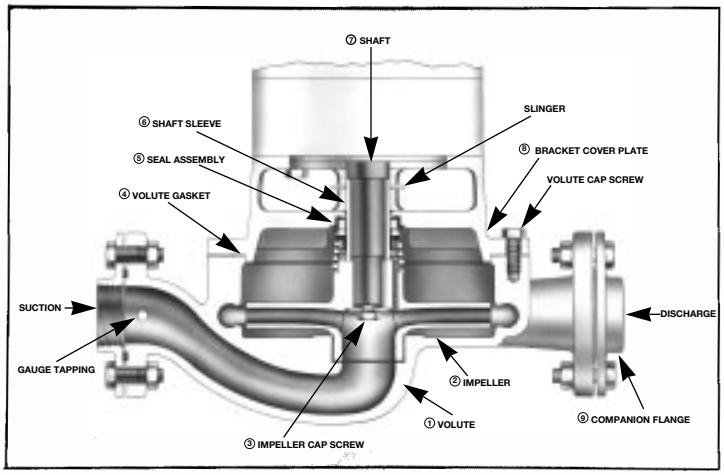
> **WARNING:** EXCESSIVE PRESSURE HAZARD.
> Make certain that the internal pressure is relieved before continuing. Failure to follow these instructions could result in serious personal injury and/or property damage.

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

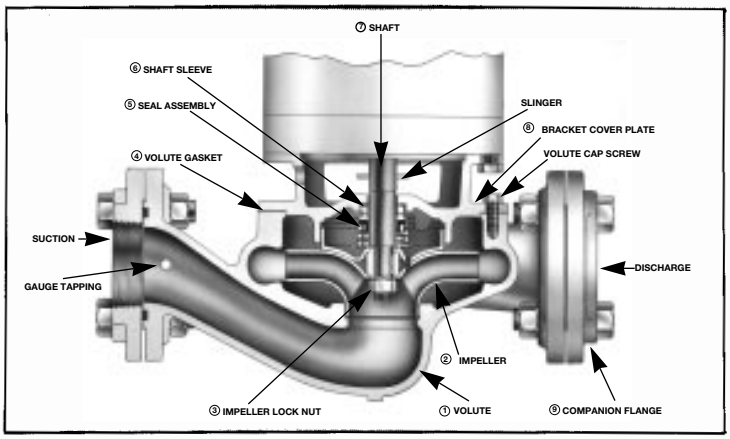
DETERMINE THE SEAL SIZE

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.

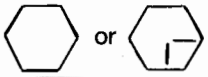
   For the 1 1/4 seals, set the seal insert into the elastomeric seat cup. Lubricate the seat cup with soapy water and set it into the face plate recess.
5. Lubricate the rubber seal collar with soapy water. The entire rotating seal assembly, which includes a seal ring, bellows and seal housing, is to be 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		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.

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)

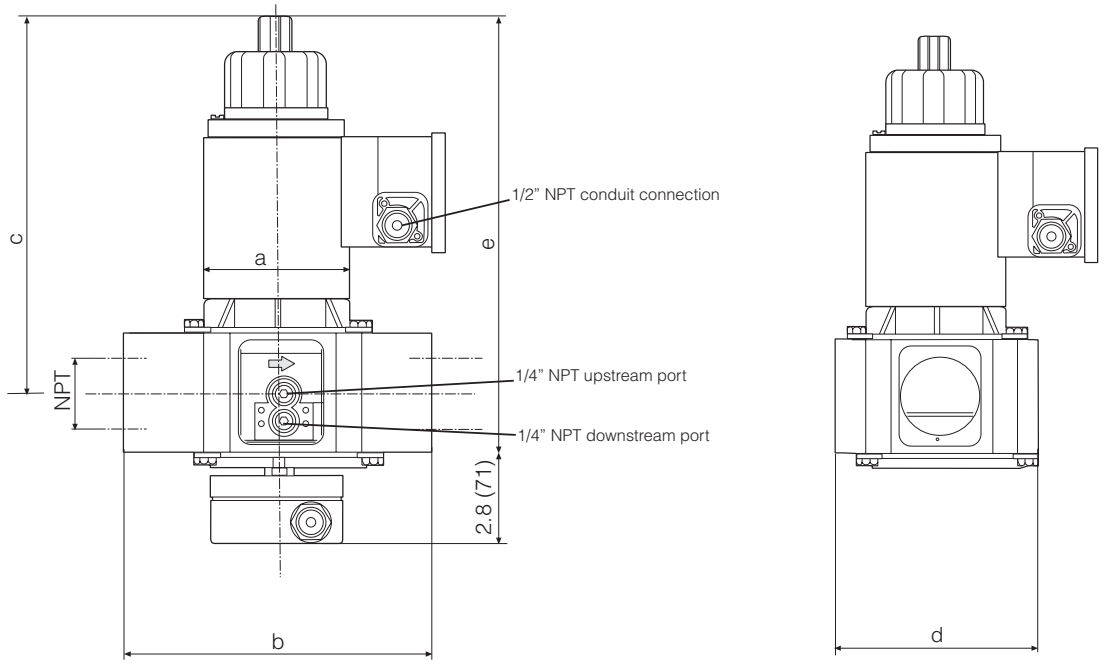
** Maximum Operating Pressure Differential

Type	PSI	NPT	Sole-noid No.	Order No.	$P_{max.}$** [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	46030-2	15	approx. 10 s	**1.97**	**2.95**	**5.31**	**2.76**	**6.10**	**2.43**
			100	46031-2*			50	75	135	70	155	1,10
MVDLE 207/6*	3	3/4"	200	46030-3	25	approx. 10 s	**2.76**	**3.94**	**6.50**	**3.15**	**7.48**	**5.62**
			200	46031-3*			70	100	165	80	190	2,55
MVDLE 210/6*	3	1"	200	46030-4	25	approx. 10 s	**2.95**	**4.33**	**6.50**	**3.54**	**7.68**	**6.06**
			200	46031-4*			75	110	165	90	195	2,75
MVDLE 212/6	3	1 1/4"	300	46030-5	60	approx. 10 s	**3.74**	**5.91**	**8.07**	**4.57**	**9.65**	**9.70**
							95	150	205	116	245	4,40
MVDLE 215/6	3	1 1/2"	300	46030-6	60	approx. 10 s	**3.74**	**5.91**	**8.07**	**4.57**	**9.65**	**12.13**
							95	150	205	116	245	5,50
MVDLE 220/6	3	2"	300	46030-8	60	approx. 10 s	**4.53**	**6.69**	**8.07**	**5.12**	**9.84**	**13.67**
							115	170	205	130	250	6,20
MVDLE 225/6	3	2 1/2"	400	46030-10	80	approx. 10 s	**5.12**	**9.06**	**11.61**	**6.50**	**13.78**	**25.13**
							130	230	295	165	350	11,40
MVDLE 230/6	3	3"	500	46030-12	90	approx. 10 s	**5.91**	**10.43**	**14.21**	**7.87**	**16.97**	**38.14**
							150	265	361	200	431	17,31
MVD 505/6*	7	1/2"	100	46040-2	15	< 1 s	**1.97**	**2.95**	**3.54**	**2.76**	**4.45**	**2.20**
			100	46041-2*			50	75	90	70	113	1,00
MVD 507/6*	7	3/4"	200	46040-3	25	< 1 s	**2.36**	**3.94**	**5.31**	**3.15**	**6.30**	**5.29**
			200	46041-3*			60	100	135	80	160	2,40
MVD 510/6*	7	1"	200	46040-4	25	< 1 s	**2.95**	**4.33**	**5.31**	**3.54**	**6.50**	**5.73**
			200	46041-4*			75	110	135	90	165	2,60
MVD 512/6	7	1 1/4"	300	46040-5	60	< 1 s	**3.74**	**5.91**	**6.89**	**4.57**	**8.27**	**11.91**
							95	150	175	116	210	5,40
MVD 515/6	7	1 1/2"	300	46040-6	60	< 1 s	**3.74**	**5.91**	**6.89**	**4.57**	**8.27**	**11.91**
							95	150	175	116	210	5,40
MVD 520/6	7	2"	400	46040-8	100	< 1 s	**4.53**	**6.69**	**6.89**	**5.12**	**9.25**	**19.40**
							115	170	175	130	235	8,80
MVD 525/6	7	2 1/2"	500	46040-10	80	< 1 s	**5.12**	**9.06**	**8.46**	**6.50**	**10.63**	**31.97**
							130	230	215	165	270	14,50
MVD 530/6	7	3"	550	46040-12	100	< 1 s	**5.91**	**10.43**	**11.22**	**7.87**	**13.94**	**55.11**
							150	265	285	200	354	25,00

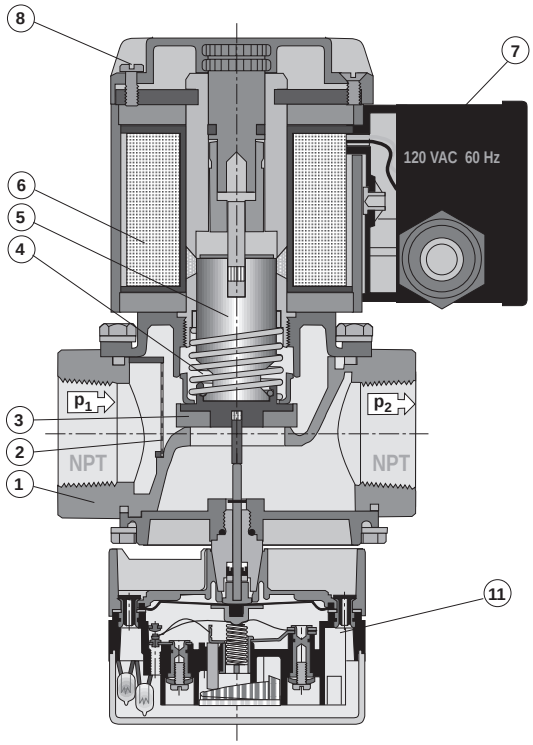
* Designates model is also available in 24VAC/60 Hz. Part Number also shown.

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

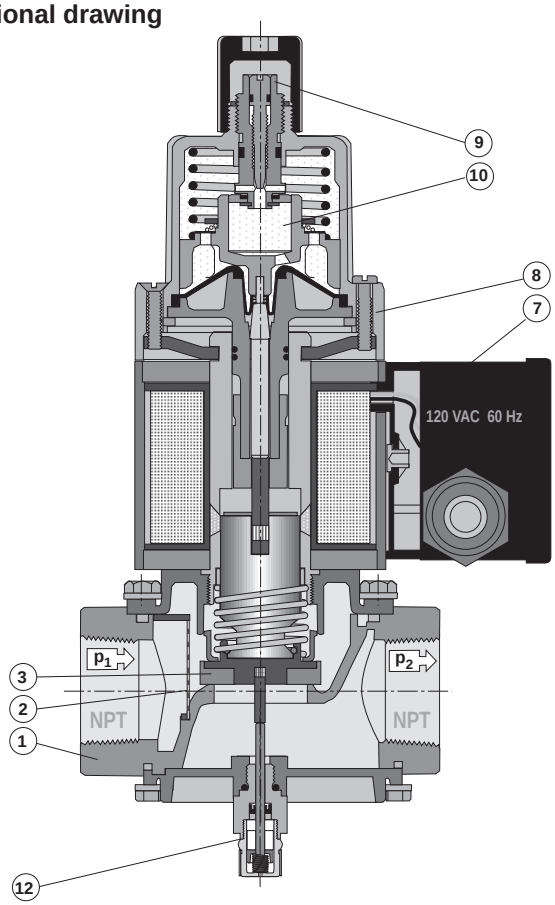
Dimensions inch (*mm*)



Type MVD
sectional drawing



Type MVDLE
sectional drawing



1	Housing	6	Solenoid	11	CPI 400 position interlock switch
2	Strainer	7	Electrical connection		
3	Valve disc	8	Max flow adjustment	12	Visual indicator (VI)
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)

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

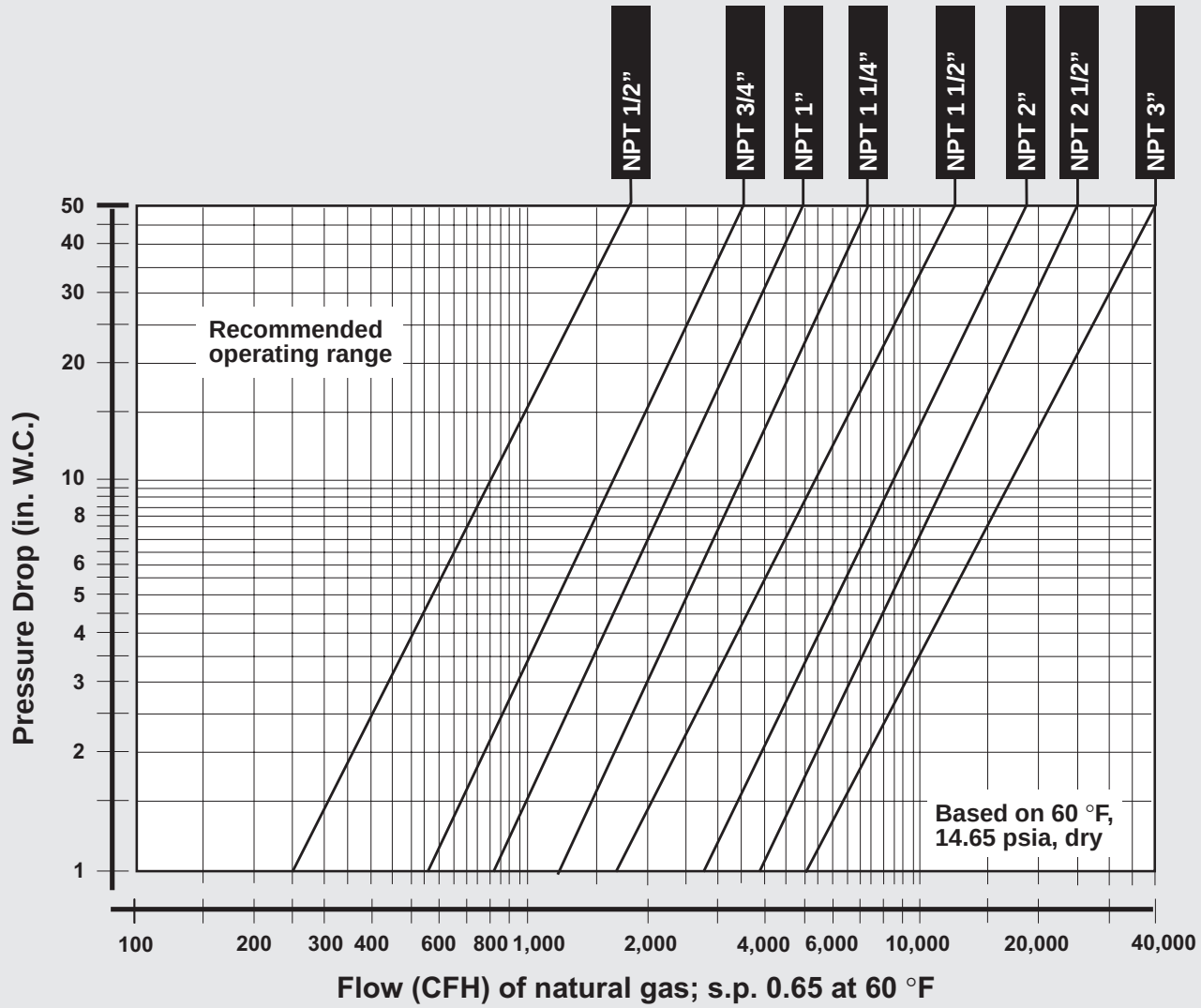
f = correction factor to determine flow through valves with other gases.

$$f = \sqrt{\frac{\text{Spec. gravity of Natural Gas}}{\text{Spec. gravity of gas used}}}$$

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 QUALITY SYSTEM
REG.NO 14 313

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Pressure switch for gas and air

GAO A4
GMH A4
GML A4

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 EN 1854 per Gas Appliance Directive 90/396/ EEC.

DUNGS is an ISO 9001 manufacturing facility.

Description
The DUNGS GAO, GMH and GML A4 pressure switches are adjustable pressure switches for automatic burner controls.

A4 pressure switches are suitable for making and/or breaking a circuit relative to changes in medium pressure relative to the set point. The set point can be set in the field by an adjustable dial with an integrated scale. Test nipple integrated in metal housing to verify setpoint.

Application
The DUNGS GAO, GMH, and GML A4 pressure switch is recommended for industrial and commercial heating, ventilation, and air-conditioning systems.

The GAO, GMH, and GML A4 pressure switch is suitable for natural gas, propane, butane, air and other inert gases.

Printed in Germany • Rösler Druck • Edition 01.01 • Nr. 226 357

GAO A4 SPDT pressure switch that requires no auxiliary power. The GAO A4 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.

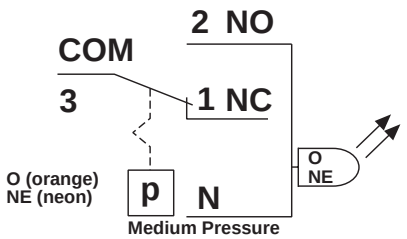
GMH A4 SPDT pressure switch that requires no auxiliary power. The GMH A4 is suitable for making and/or breaking a circuit when the set point is exceeded. A tripped switch is indicated by a neon light after set point is exceeded. **Manual reset** is required to reset the switch.

GML A4 SPDT pressure switch that requires no auxiliary power. The GML A4 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

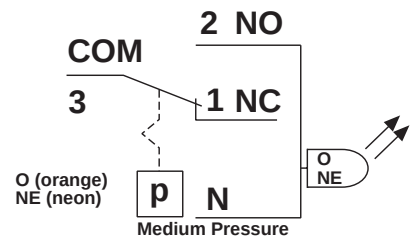
Max. operating pressure	GAO A4-4-2,3,5,6 GMH, GML A4-4-4,6 GAO, GMH and GML A4-4-8	7 PSI (500mbar) 7 PSI (500mbar) 14 PSI (1000 mbar)
Max. body pressure	15 PSI (1033 mbar)	
Pressure connection	Standard: 1/4" NPT female thread centered underside of housing.	
Temperature range GAO, GMH and GML GAO, GMH and GML A4-4-8	Ambient temperature Medium temperature Ambient temperature Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C) -40 °F to +140 °F (-40 °C to +60 °C) -22 °F to +140 °F (-10 °C to +60 °C) -22 °F to +140 °F (-10 °C to +60 °C)
Materials	Housing Switch Diaphragms Switching contact	Aluminium Polycarbonate NBR-based rubber Silver or Gold
Electrical ratings	AC eff. DC min. 24 V max. 48 V	min. 24 Vac max. 240 V
Current ratings	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 min. 5 mA @ 5 Vdc DC max. 10mA @ 24 Vdc
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA 4	
Setting tolerance	±15% switching point deviation referred to set point, adjusted as pressure rises, 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

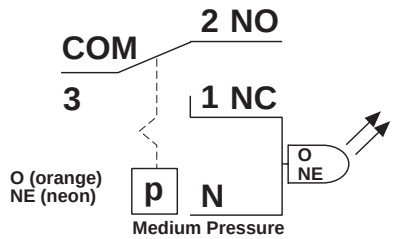


GMH switching function

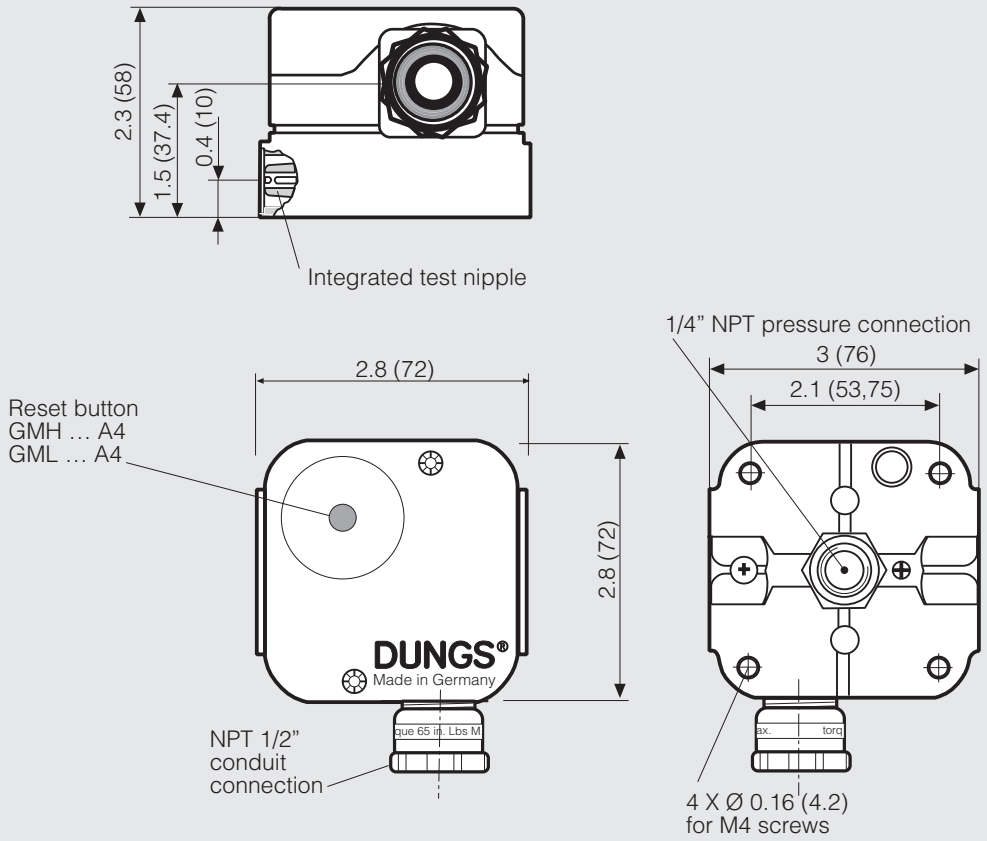
As pressure rises
2 NO closes, 1 NC opens
Neon light ON, tripped.



GML switching function shown in operating state.
As pressure falls
2 NO opens, 1 NC closes
Neon light ON, tripped.

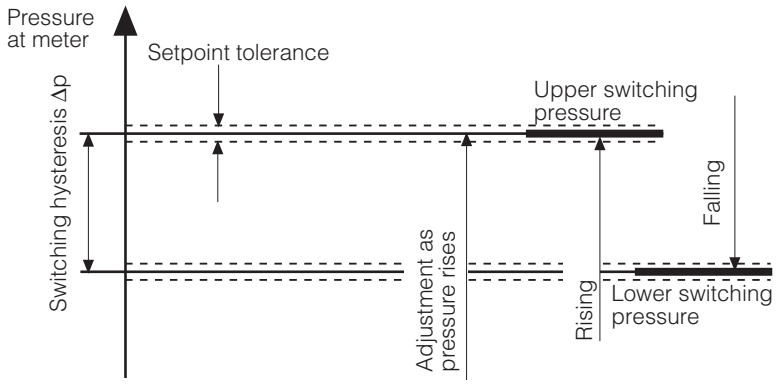


Dimensions inch (mm)
GAO, GMH, GML ...A4

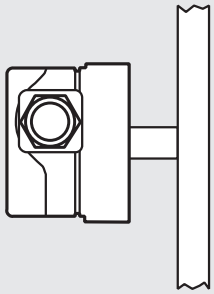


A4 Accessories	Order No.	For equipment	Notes
Replacement Cover	D223 798	GAO	NEMA 4
	D233 116	GMH, & GML	NEMA 4
Replacement Conduit Adapter	46000-14	GAO, GMH, & GML	1/2“ NPT
Replacement Neon Light	46000-7	GAO, GMH, & GML	120 Vac, Red bulb
Replacement Neon Light	D231 771	GAO, GMH, & GML Gold contact versions	24 Vac / Vdc, Red bulb
Electrical Plug for A4 (For use with D210 318)	D219 659	GAO	N/A
Electrical Plug for A4 (For use with D210 318)	D227 664	GMH & GML	N/A
Din Connector for A4 (For use with D210 659 & D227 664)	D210 318	GAO, GMH, & GML	N/A
Double pressure switch mounting kit	D239 812	GAO, GMH, & GML	N/A
Metal mounting bracket	D230 288	GAO, GMH, & GML	N/A

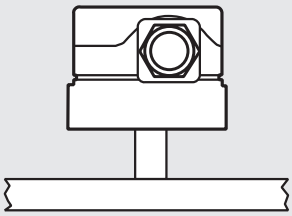
Definition of switching hysteresis Δp
The pressure difference between the upper and lower switching pressures



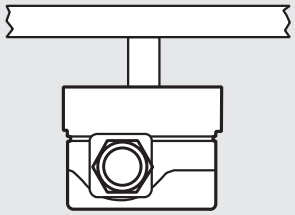
Installation position



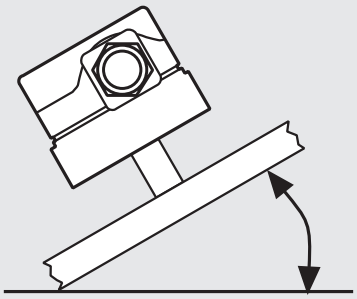
Standard installation position



When installed horizontally, the pressure switch switches at a pressure higher by approximately 0.2 in wc (0.5 mbar).



When installed upside down, the pressure switch switches at a pressure lower by approximately 0.2 in wc (0.5 mbar).



When installed in other position the pressure switch switches at pressure deviating from the set reference value by max. ±0.2 in wc (0.5 mbar).

NOTE: Always calabrate the switch in the desired mounting position

Pressure switch
for gas and air

GAO A4
GMH A4
GML A4

DUNGS®

Technical data

Type	Version	Order No.	Setting range In. W.C.	Switching hysteresis In. W.C. (calibrated at)
GAO A4 pressure switch	GAO A4-4-2	46014-2	0.16 - 1.20“	≤ 0.12“
	GAO A4-4-3	46014-3	0.40 - 4.00“	≤ 0.20“
	GAO A4-4-5	46014-5	2.00 - 20.00“	≤ 0.40“
	GAO A4-4-6	46014-6	12.0 - 60.00“	≤ 1.20“
	GAO A4-4-8	46014-8	40.00 - 200.00“	≤ 4.00“
	GAO A4-4-2 Gold	46014-12	0.16 - 1.20“	≤ 0.12“
	GAO A4-4-3 Gold	46014-13	0.40 - 4.00“	≤ 0.20“
	GAO A4-4-5 Gold	46014-15	2.00 - 20.00“	≤ 0.40“
	GAO A4-4-6 Gold	46014-16	12.0 - 60.00“	≤ 1.20“
	GAO A4-4-8 Gold	46014-18	40.00 - 200.00“	≤ 4.00“
GMH A4 pressure switch	GMH A4-4-4	46015-4	1.00 - 20.00“	--
	GMH A4-4-6	46015-6	12.00 - 60.00“	--
	GMH A4-4-8	46015-8	40.00 - 200.00“	--
	GMH A4-4-4 Gold	46015-14	1.00 - 20.00“	--
	GMH A4-4-6 Gold	46015-16	12.00 - 60.00“	--
GML A4 pressure switch	GML A4-4-4	46016-4	1.00 - 20.00“	--
	GML A4-4-6	46016-6	12.00 - 60.00“	--
	GML A4-4-8	46016-8	40.00 - 200.00“	--
	GML A4-4-4 Gold	46016-14	1.00 - 20.00“	--

We reserve the right to make any changes in the interest of technical progress.

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e-mail info@dungs.com
Internet http://www.dungs.com

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.

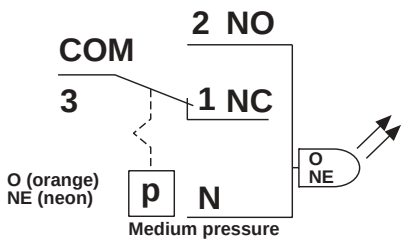
GMH-A2… SPDT pressure switch requires no auxiliary power. The GMH-A2… is suitable for making and/or breaking a circuit when the set point is exceeded. A tripped switch is indicated by a neon light after set point is exceeded. **Manual reset** is required to reset the switch.

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.

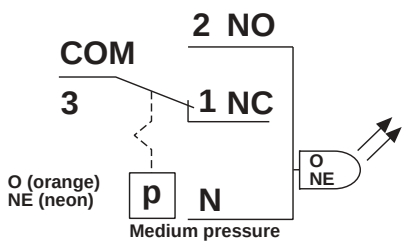
Specifications

Max. operating pressure	GAO-A2-4-2,3,5,6	7 PSI (500mbar)
	GMH- and GML-A2-4-4,6	7 PSI (500mbar)
	GAO-, GMH- and GML-A2-4-8	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	-40 °F to +140 °F (-40 °C to +60 °C)
	Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C)
GAO-, GMH- and GML-A2-4-8	Ambient temperature	-22 °F to +140 °F (-30 °C to +60 °C)
	Medium temperature	-22 °F to +140 °F (-30 °C to +60 °C)
Materials	Housing	Aluminium
	Switch	Polycarbonate
	Diaphragm	NBR-based rubber
	Switching contact	Silver or Gold
Electrical ratings	AC eff.	min. 24 V max. 240 V
	DC	min. 24 V max. 48 V
Nominal current	Silver (Ag) contact ratings	Gold (Au) contact ratings
	AC 10A resistive @ 120 VAC	
	AC 8A inductive @ 120 VAC	
	DC min. 20 mA @ 24 VDC	DC max. 5m A @ 5 VDC
	DC max. 1 A @ 48 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.	

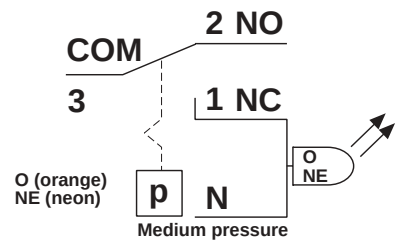
GAO switching function (upper)
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



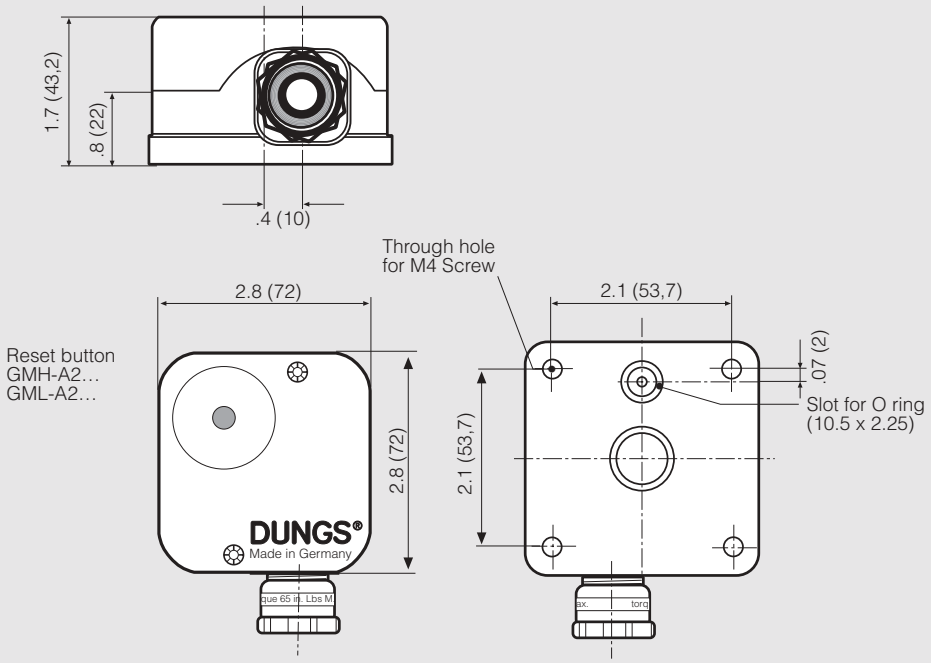
GMH switching function
As pressure rises
2 NO closes, 1 NC opens
Neon light ON, tripped.



GML switching function
shown in Operating state.
As pressure falls
2 NO opens, 1 NC closes
Neon light ON, tripped.

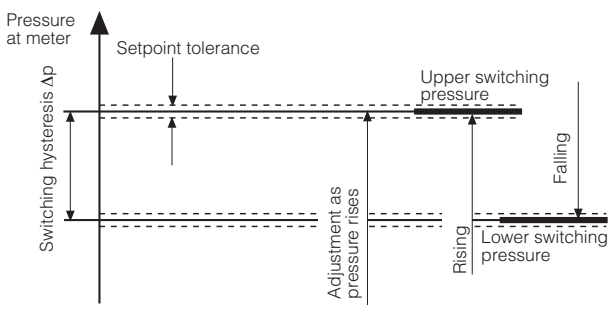


Dimensions inch (mm)
GAO-, GMH-, GML-A2…



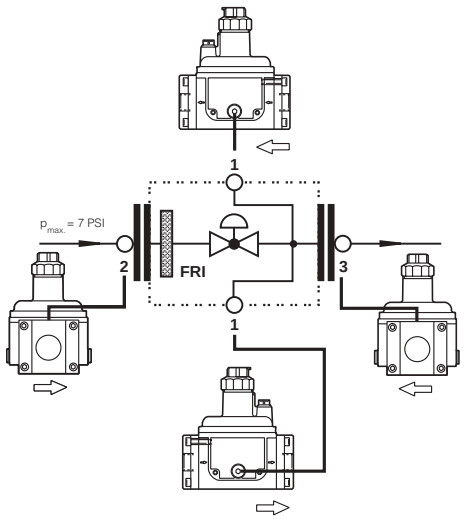
Adapters / replacement parts / Accessories	Order No.	For equipment	Notes
A2 Mounting kit (included)	D226 188	GAO, GMH, GML	M4 Screws, 10.5 x 2.25 O-ring
DMV Port 3 adapter (DMV side mount for high pressure switch)	D214 975	DMV-D(LE) 701 - 703	NPT 1/2“ - NPT 2“
Replacement conduit adapter	46000-14	GAO, 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



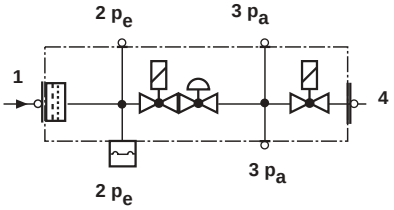
A2 mounting options
FRI gas pressure regulator

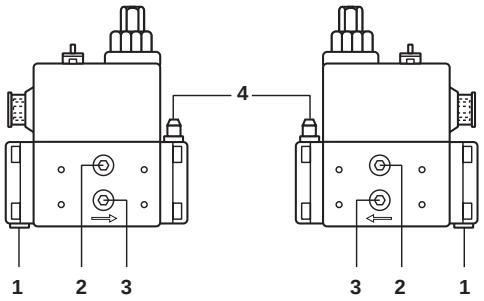
Pressure tap	mounting possible…
1	yes
2	yes
3	yes



A2 mounting options
MB 053-403 GasMultiBloc

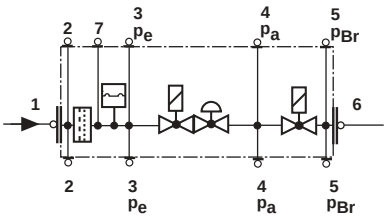
Pressure tap	mounting possible…
1	yes, with #D221630
2	yes
3	yes
4	yes, with #D221630

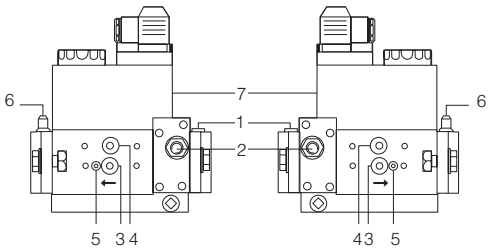


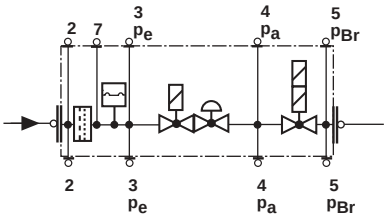


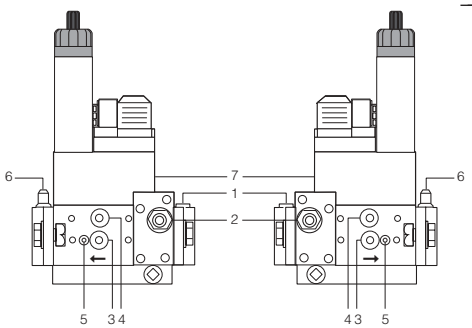
A2 mounting options
MB-D GasMultiBloc; MB-Z 405-412

Pressure tap	mounting possible…
1	alternativ to 7
2	no
3	yes
4	yes
5	yes, with #D214975
6	yes, with #D221630
7	yes



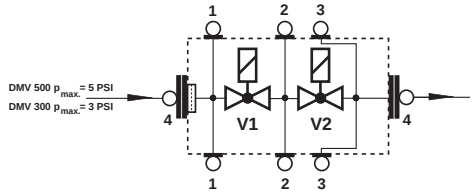


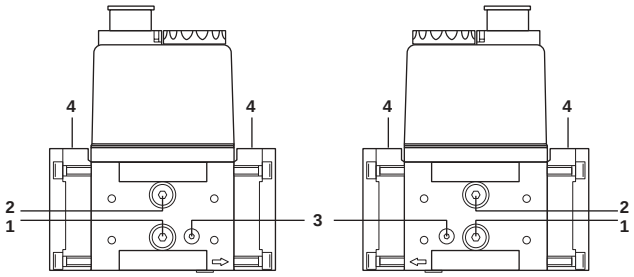




A2 mounting options
DMV 300/500 Dual modular valve

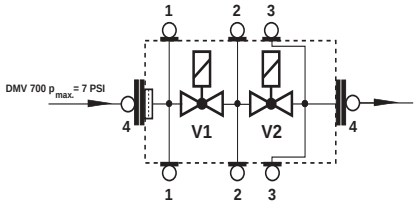
Pressure tap	mounting possible…
1	yes
2	yes
3	yes, with # D214 975
4	yes, horizontal yes, with # D221 630

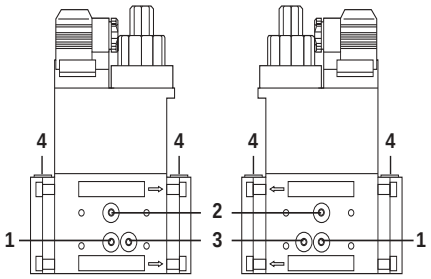




A2 mounting options
DMV 701-703 Dual modular valve

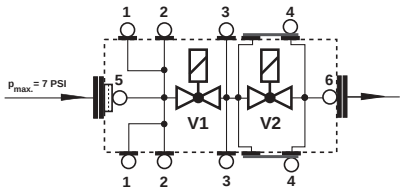
Pressure tap	mounting possible…
1	yes
2	yes
3	yes, with # D214 975
4	yes, horizontal yes, with # D221 630

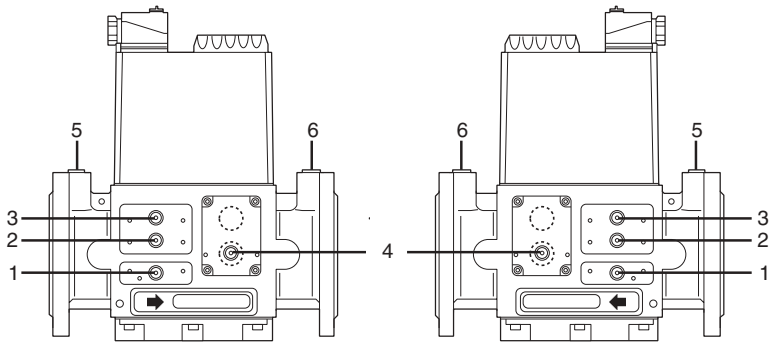




A2 mounting options
DMV 525,5040-5125/11 Dual modular valve

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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Eclipse Combustion

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

		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

	ºF	ºC
Maximum Chamber Temperature (Alloy & SIC Tubes) *Note: For higher temperatures, contact Eclipse.*	1500	820
Flame Detection	Flame rod or UV scanner	
Fuel	Natural gas, Propane, or Butane. *For any other mixed gas, contact Eclipse Combustion for orifice sizing*	

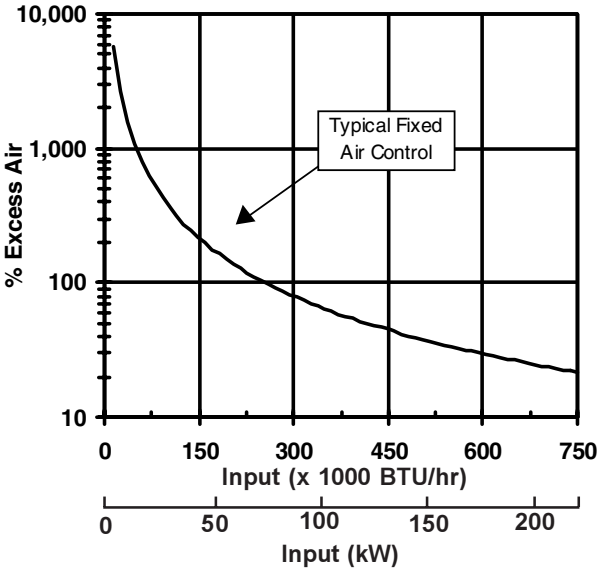
- All information is based on laboratory testing in neutral (0.0"w.c.) chamber with standard combustor design. Different chamber conditions and/or combustor design will affect the data.
- Maximum inputs are given for the standard combustion air blower without an air filter.
- All inputs based upon gross 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™ Innovative Thermal Solutions

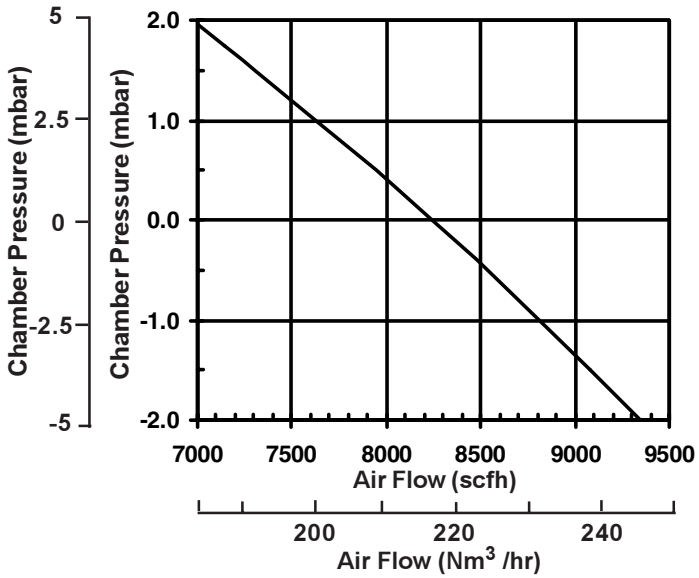
Performance Graphs

ThermAir TA075

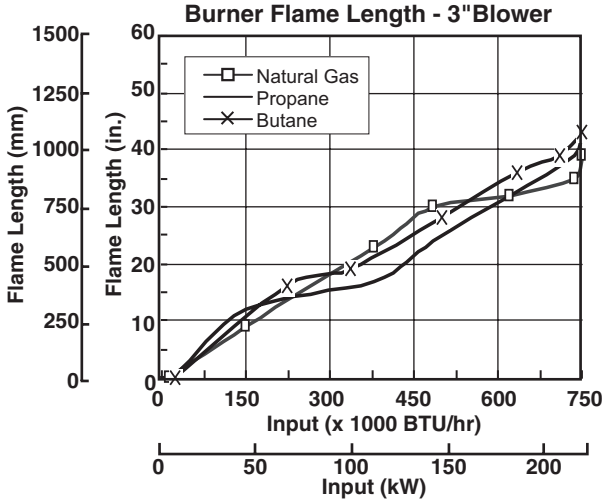
Control & Operation Zone



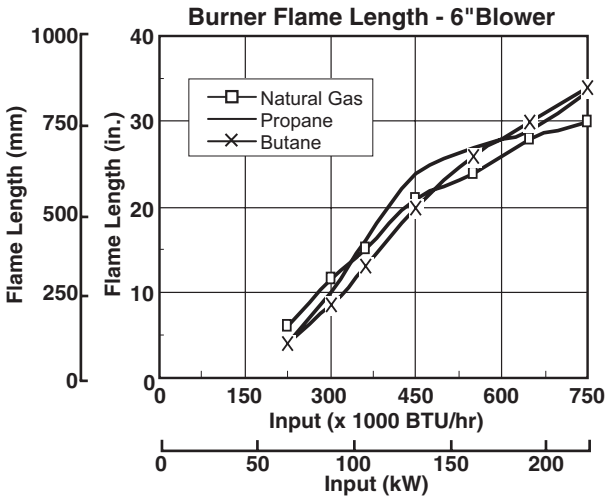
Air Flow vs. Chamber Pressure



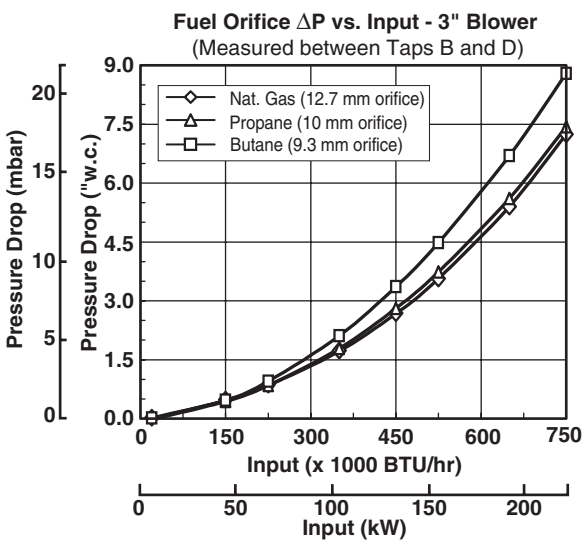
Burner Flame Length - 3"Blower



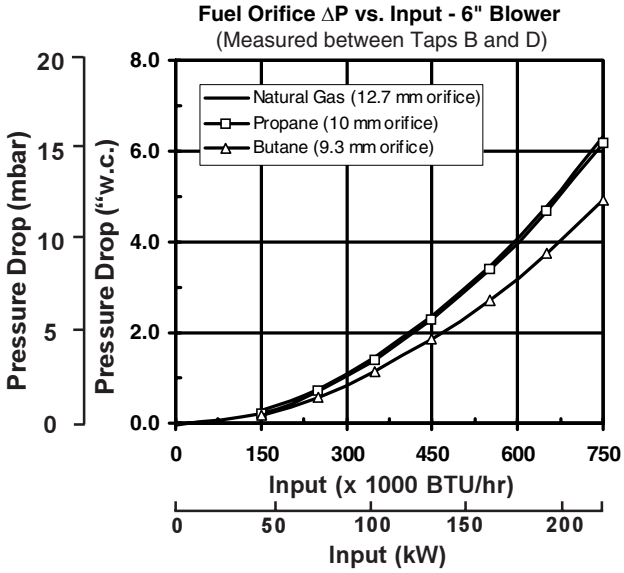
Burner Flame Length - 6"Blower



Fuel Orifice ΔP vs. Input - 3" Blower
(Measured between Taps B and D)

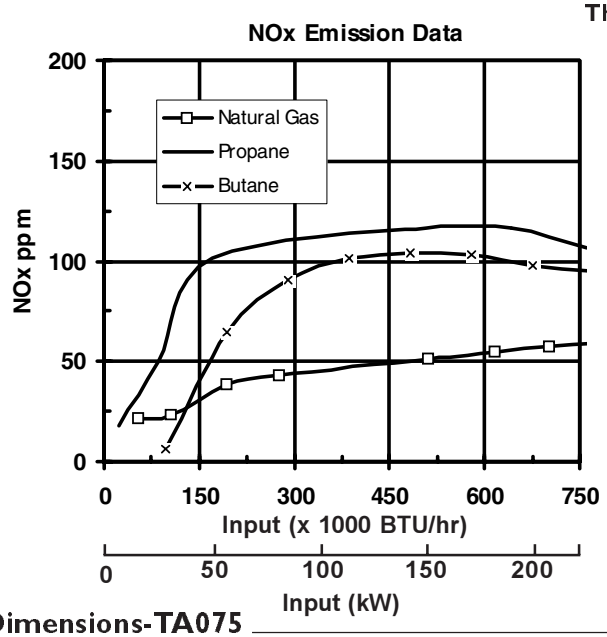


Fuel Orifice ΔP vs. Input - 6" Blower
(Measured between Taps B and D)



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

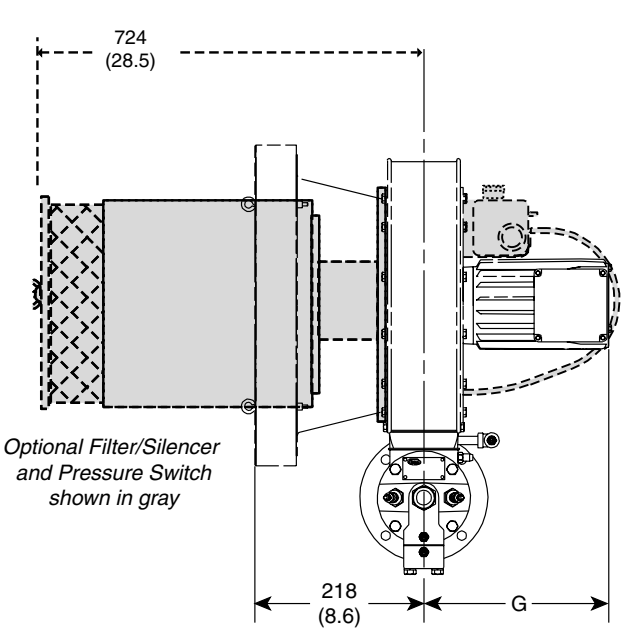
Emissions are influenced by:

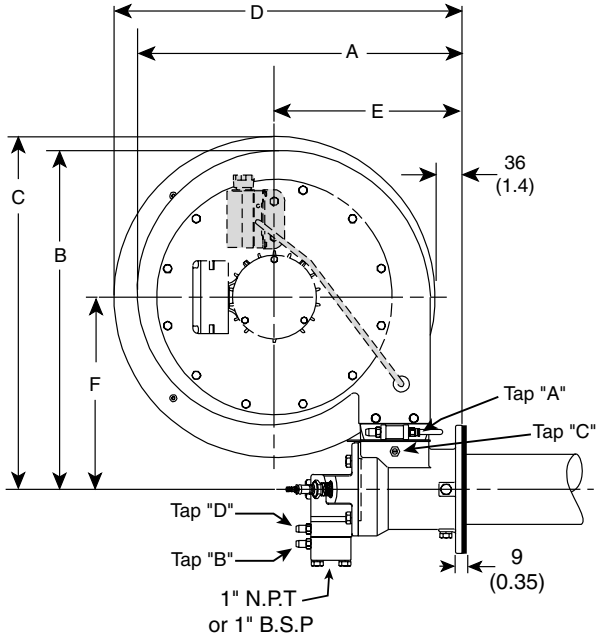
- Chamber conditions
- Fuel type
- Firing rate
- Combustion air temperature

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)

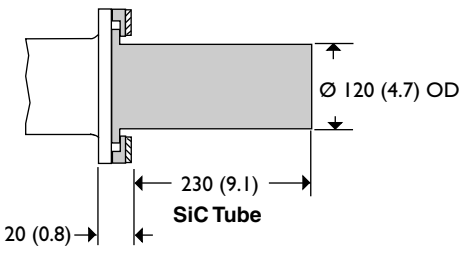


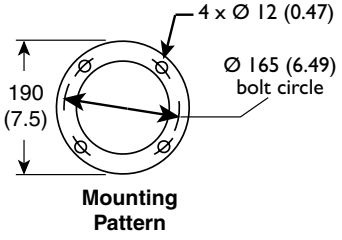


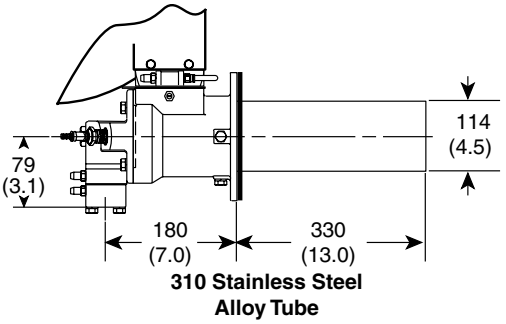
Port Connection	
Sparkplug	14mm
Flamerod or scanner	0.5" N.P.T.
Peepsight	0.75" N.P.T.

Weights	lb	kg
Burner, w/ blower	78	35
Burner, less blower	31	14
Filter/Silencer	41	19

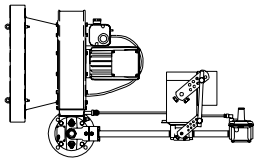
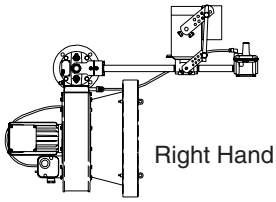
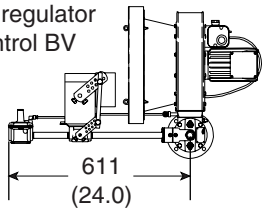
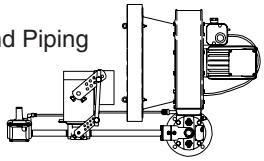
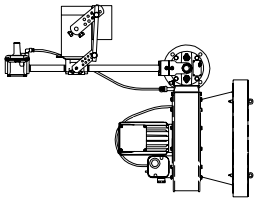
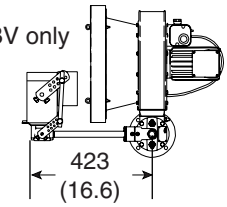
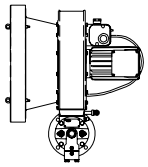
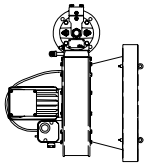
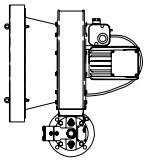
	A		B		C		D		E		F		G	
Blower 6" w.c.														
Hz	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	484	19.0	532	20.9	N/A	N/A	N/A	N/A	272	10.7	309	12.2	291	11.5
60	424	16.7	473	18.6	482	19.0	447	17.6	243	9.5	279	11.0	291	11.5
Blower 3" w.c.														
60	338	13.3	393	15.5	N/A	N/A	N/A	N/A	202	7.9	234	9.2	192	7.6







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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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 2,000,000 1,871,000	-1.0 0.0 1.0	607 586 548	-2,5 0,0 2,5
		50 Hz packaged blower	2,235,000 2,066,000 2,028,000	-1.0 0.0 1.0	655 605 594	-2,5 0,0 2,5
Minimum input Natural Gas, Propane or Butane			BTU/hr 66,000		kW 19,4	
Main gas inlet pressure • *fuel pressure at gas inlet (Tap "B")*	Natural Gas Propane Butane		"w.c. 9.4 9.8 9.8		mbar 23 24 24	
High fire flame length • *measured from the outlet end of combustor*	Natural Gas Propane Butane		inches 54 54 53		mm 1370 1370 1345	
Maximum Chamber Temperature (Alloy & SIC Tubes) *Note: For higher temperatures, contact Eclipse.*			°F 1500		°C 815	
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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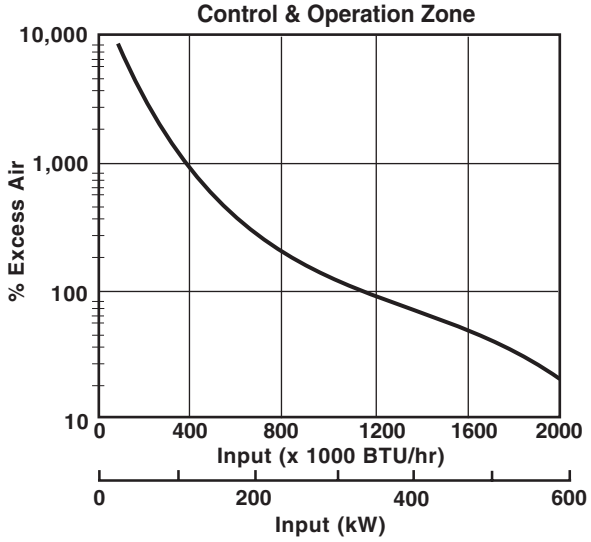
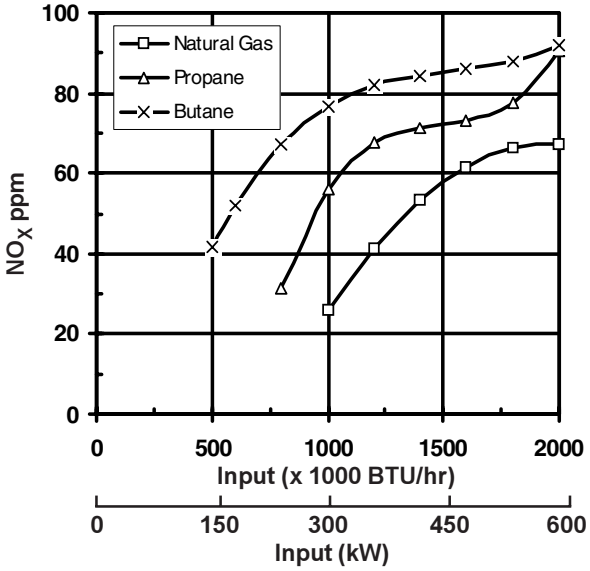
Performance Graphs

ThermAir TA200

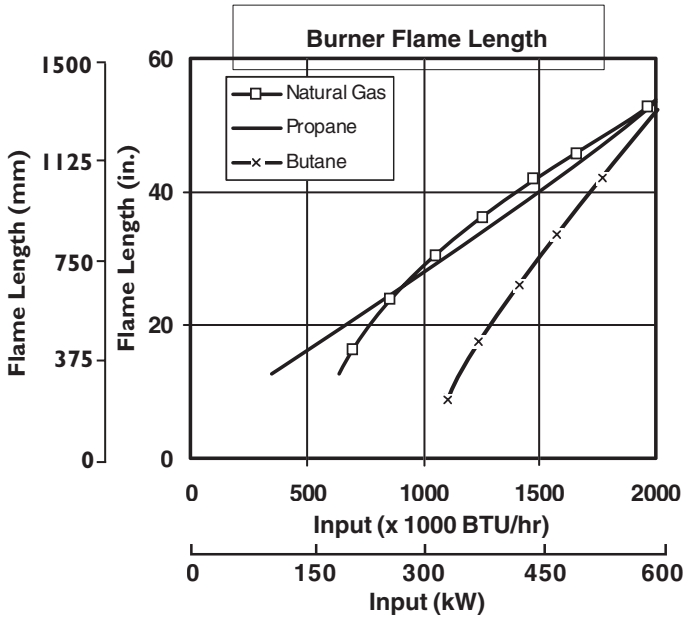
Control & Operation Zone



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

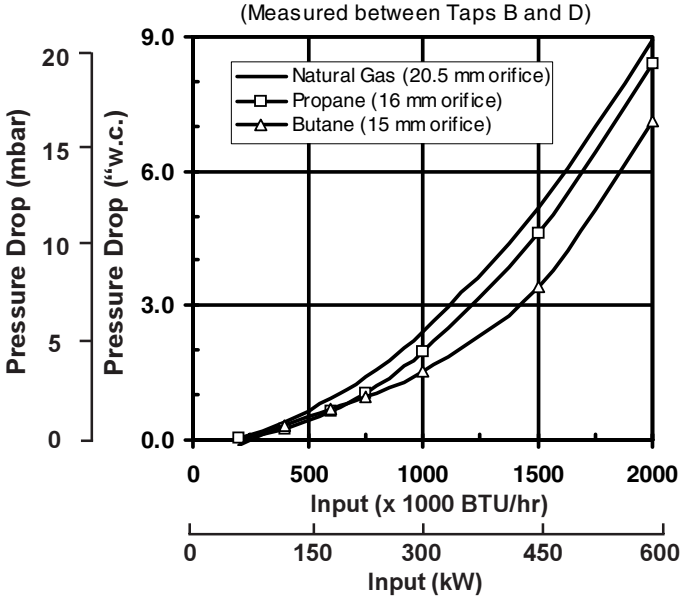
Emissions are influenced by:

- Chamber conditions
- Fuel type
- Firing rate
- Combustion air temperature

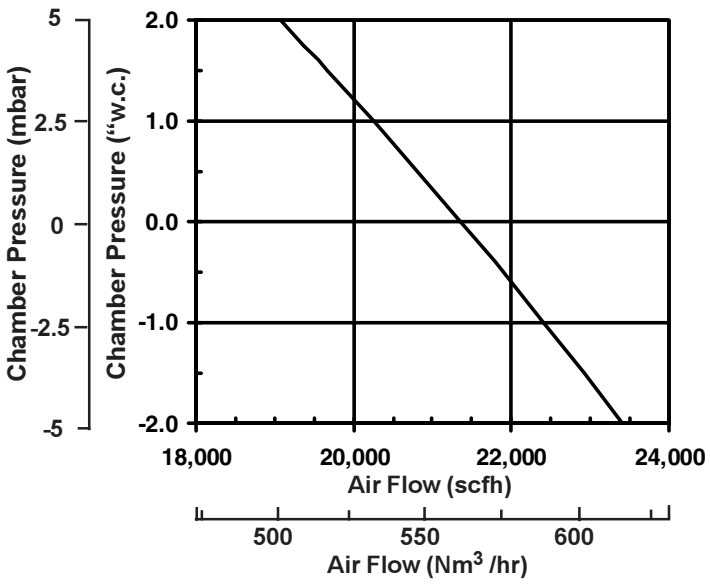
CO emission is largely influenced by chamber conditions. Contact your local Eclipse Combustion representative for an estimate of CO emission on your application.

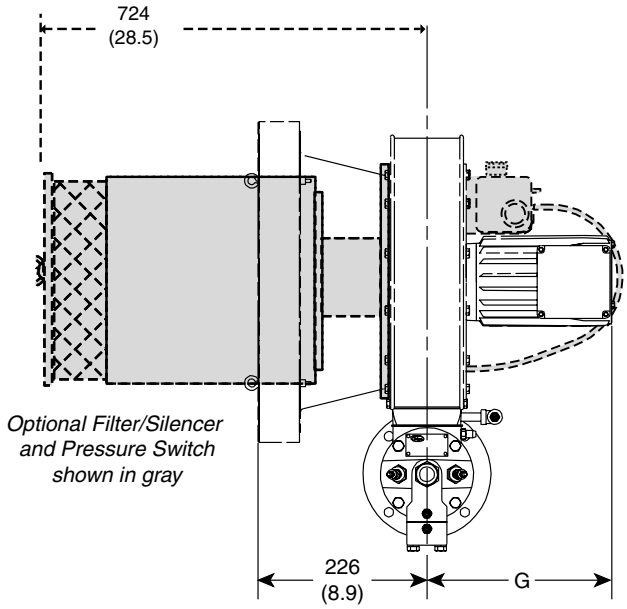
Fuel Orifice ΔP vs. Input

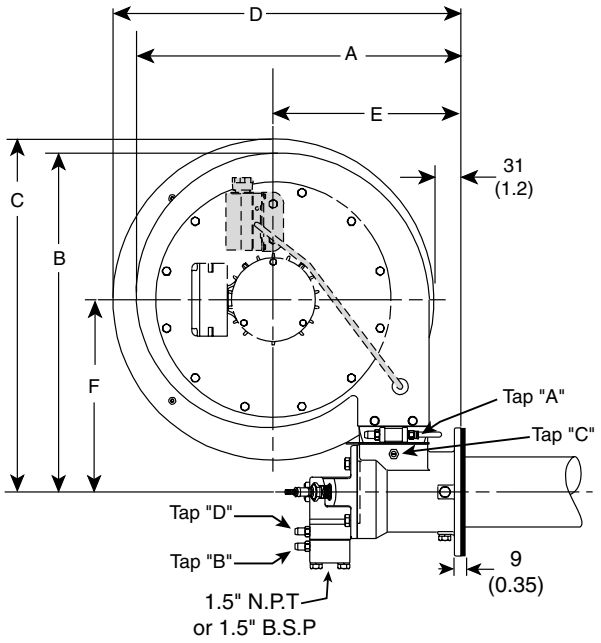
(Measured between Taps B and D)



Air Flow vs. Chamber Pressure



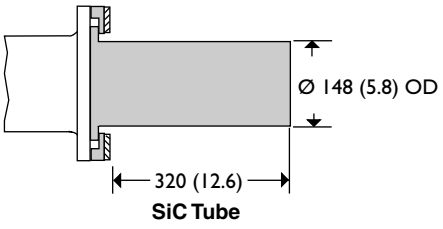


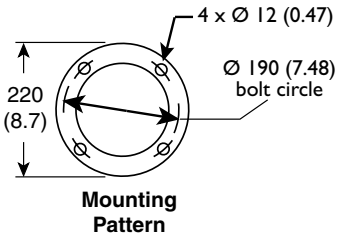


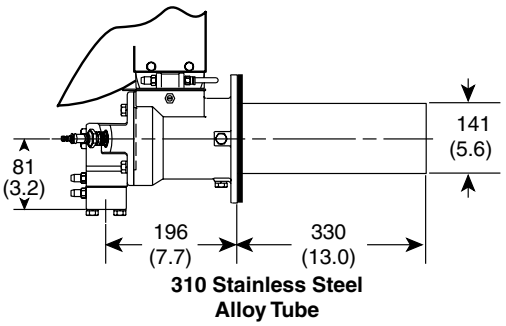
Port Connection	
Sparkplug	14mm
Flamerod or scanner	0.5" N.P.T.
Peepsight	0.75" N.P.T.

Weights	lb	kg
Burner, w/ blower	99	45
Burner, less blower	46	21
Filter/Silencer	41	19

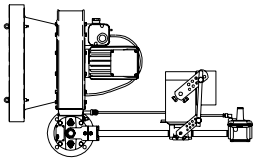
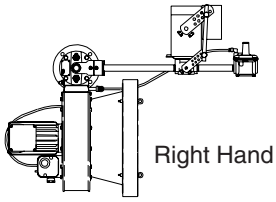
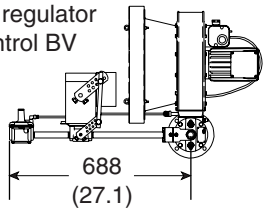
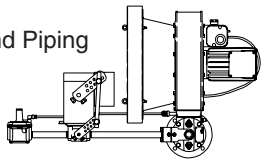
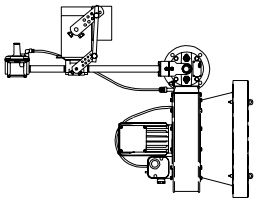
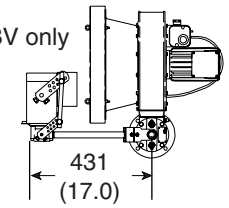
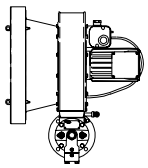
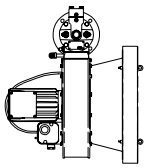
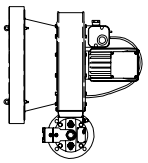
Blower 10" w.c.														
	A		B		C		D		E		F		G	
Hz	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	586	23.1	669	26.3	N/A	N/A	N/A	N/A	322	12.7	392	15.4	290	11.4
60	503	19.8	577	22.7	608	23.9	565	22.2	283	11.1	342	13.5	298	11.7







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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Installation Guide 114
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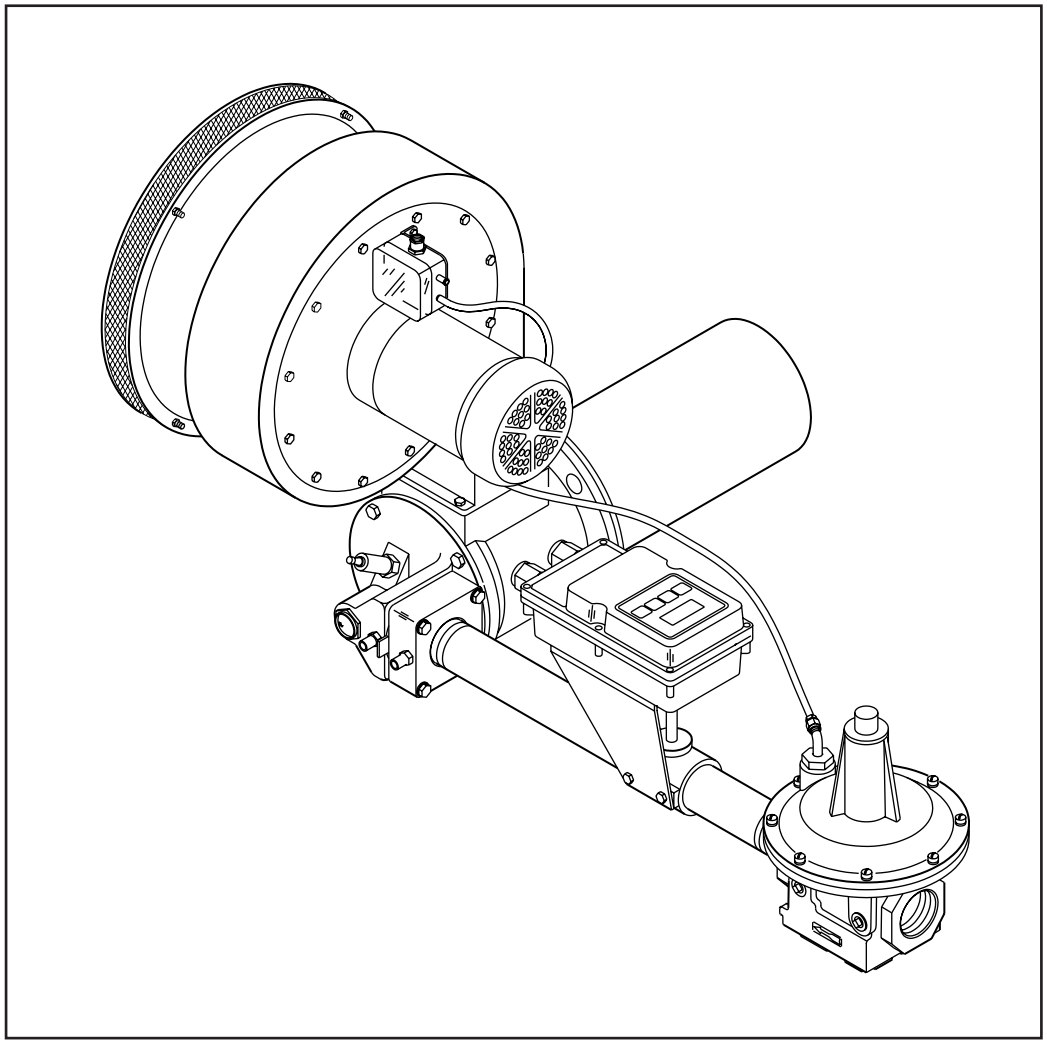
Eclipse Combustion

ThermAir Burners

TA Series

version 1



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Disclaimer Notice

We reserve the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

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, you can contact your local Eclipse representative. A complete listing of Eclipse representatives world wide can be found at www.eclipsenet.com.

You can also contact Eclipse at:
1665 Elmwood Rd.
Rockford, IL 61103
815-877-3031

Table of contents

Introduction

1

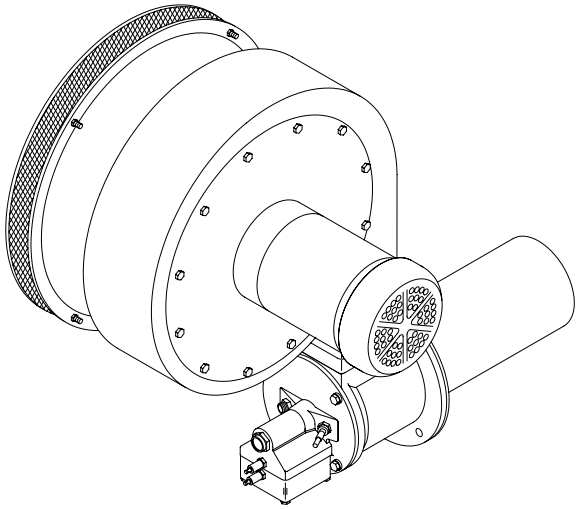
Product Description

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

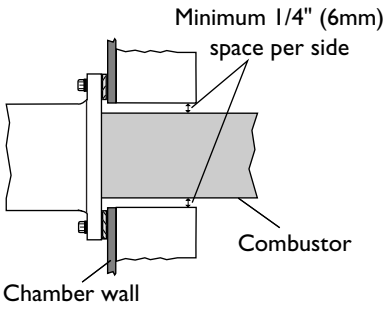
Install the burner so it may be easily accessed for inspection and maintenance.

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.

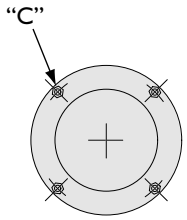
Burner



Chamber Opening

Provide an opening in the chamber wall at least ½" (12mm) larger in diameter than the outside diameter of the combustor.

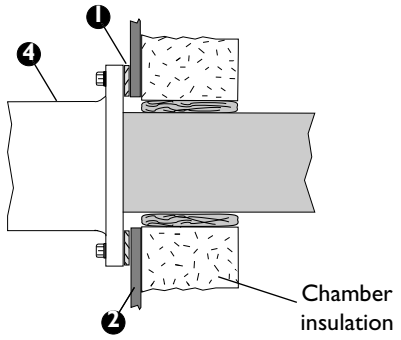
Provide an accessible pressure tap on the chamber wall to measure the pressure inside the firing chamber. The pressure tap should be located near the burner.



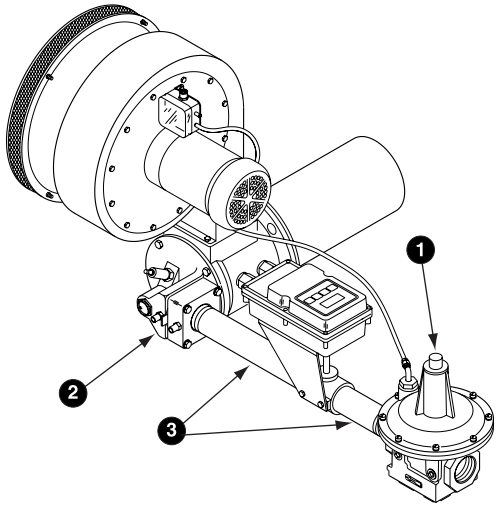
Mounting Pattern

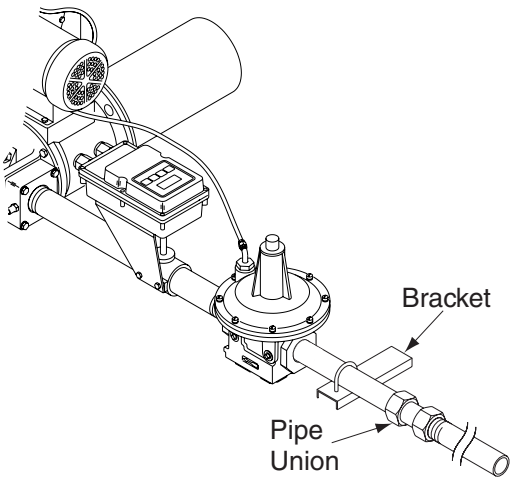
Attach four mounting bolts to the chamber wall. Position these bolts to match the clearance holes (C) on the burner mounting flange. Refer to the appropriate ThermAir data sheet.

Installation (continued)



Gas Piping





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.

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

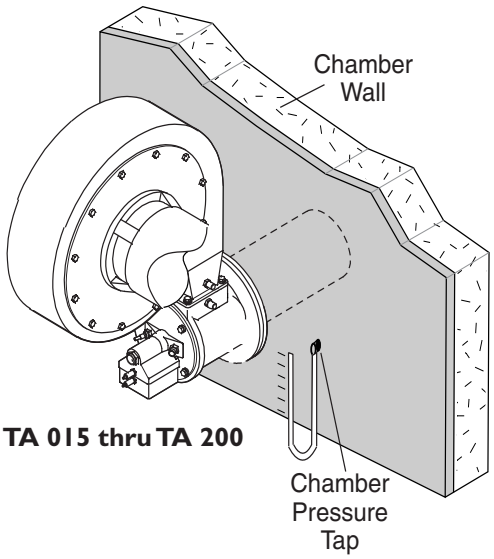
If you are adjusting a ThermAir burner equipped with a ratio-regulator for the first time, you must follow these steps:

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

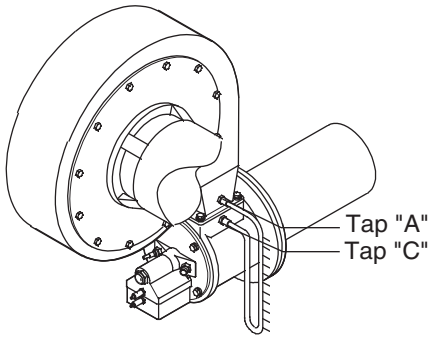
Step 1: Reset the system

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 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.

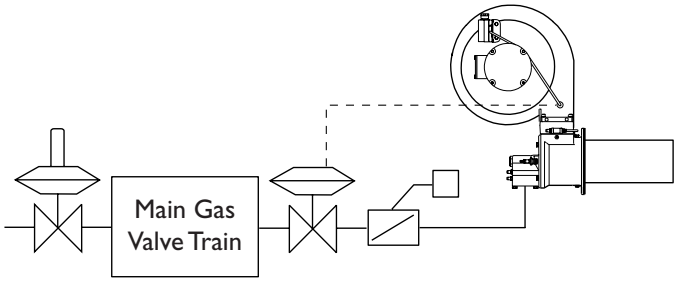
There are two separate ignition procedures which depend upon whether or not bypass start gas is installed on the burner. Each procedure is unique and both are outlined below.

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:

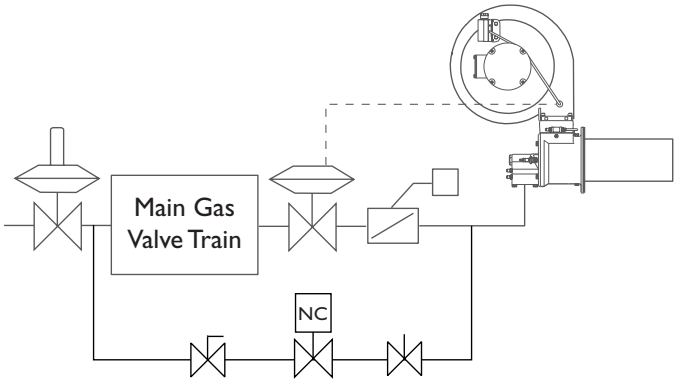
   a) Try to ignite again to purge the air out of the gas piping.

   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 a 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.

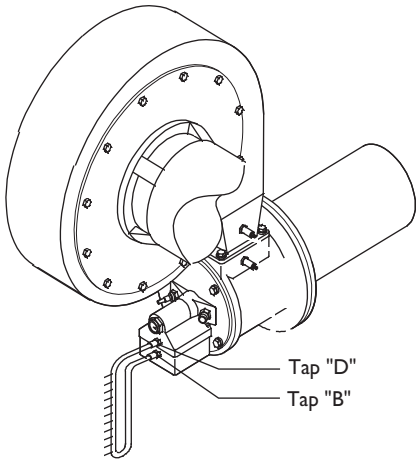
   b) If the burner does not ignite after one or two additional ignition attempts, see the Trouble shooting Guide contained in the Maintenance & Troubleshooting section of this guide.

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.

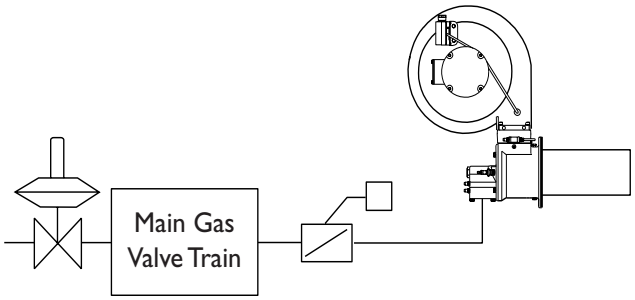
Note:
It is very difficult to measure the very low gas pressures experienced at low fire, and it may be necessary to rely on visual inspection of the flame. This is especially true when gas turndowns in excess of 10 to 1 are being used. The main intent is to provide a stable flame with good flame signal 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

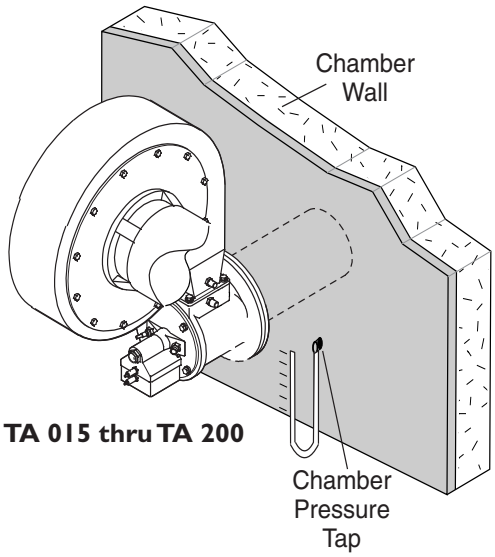
6. Verify gas settings

Step 1: Reset the system

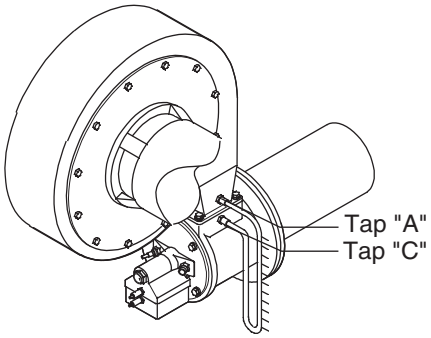
1. Close these valves
- the automatic gas valves
- the manual gas cocks

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

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

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

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:

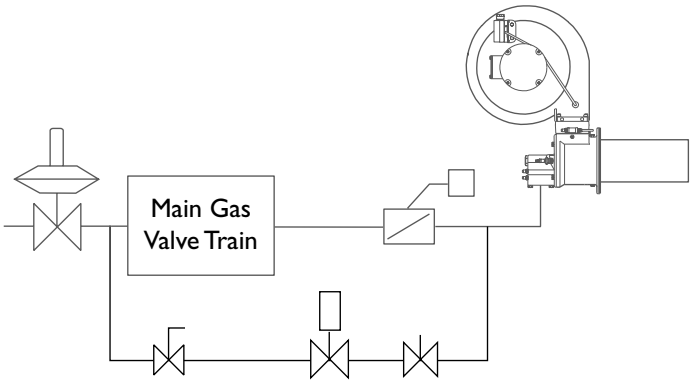
a) Try to ignite again to purge the air out of the gas piping.

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.

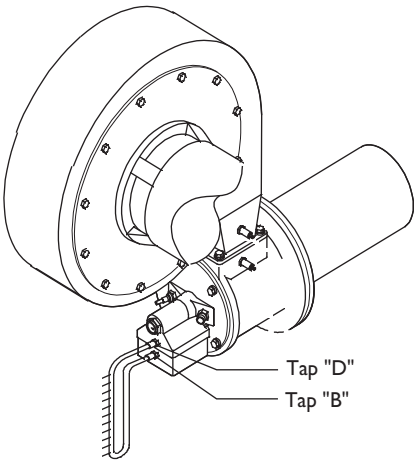
b) If the burner does not ignite after one or two additional ignition attempts, see the Trouble shooting Guide contained in the Maintenance & Troubleshooting section of this guide.

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 250°F (121°C).
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.

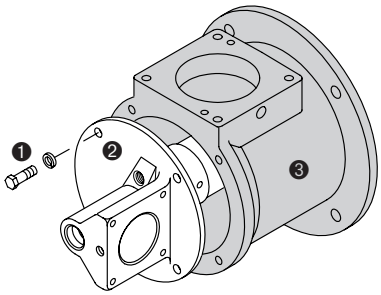
Maintenance

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.

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.

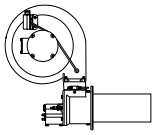
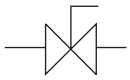
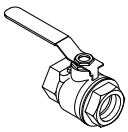
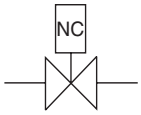
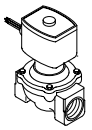
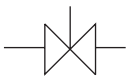
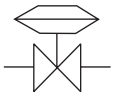
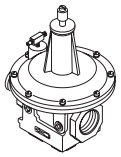
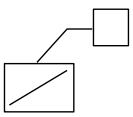
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric.

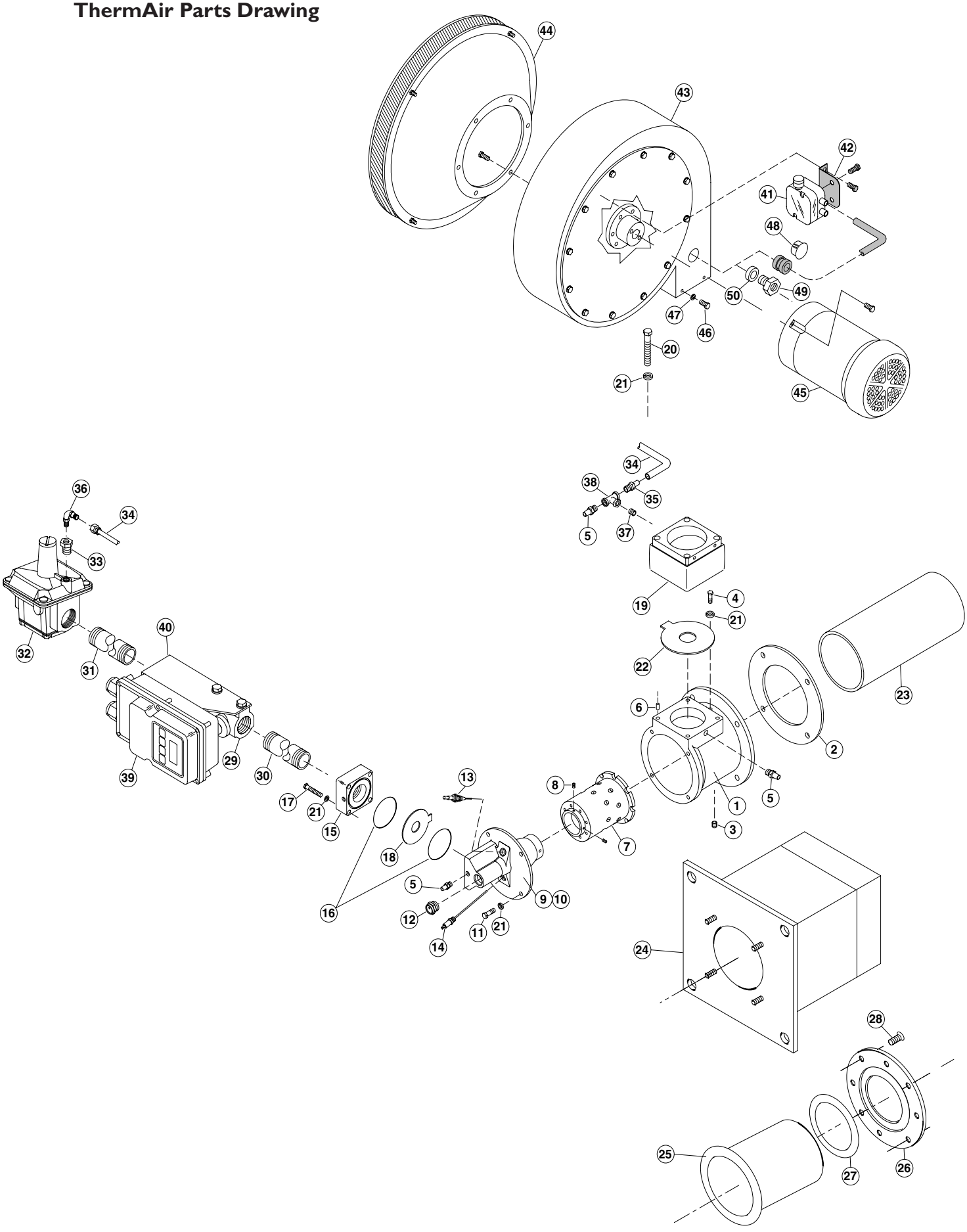
From	To	Multiply By
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F – 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column (“wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
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 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	23045	23045	23045
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	14188-8	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

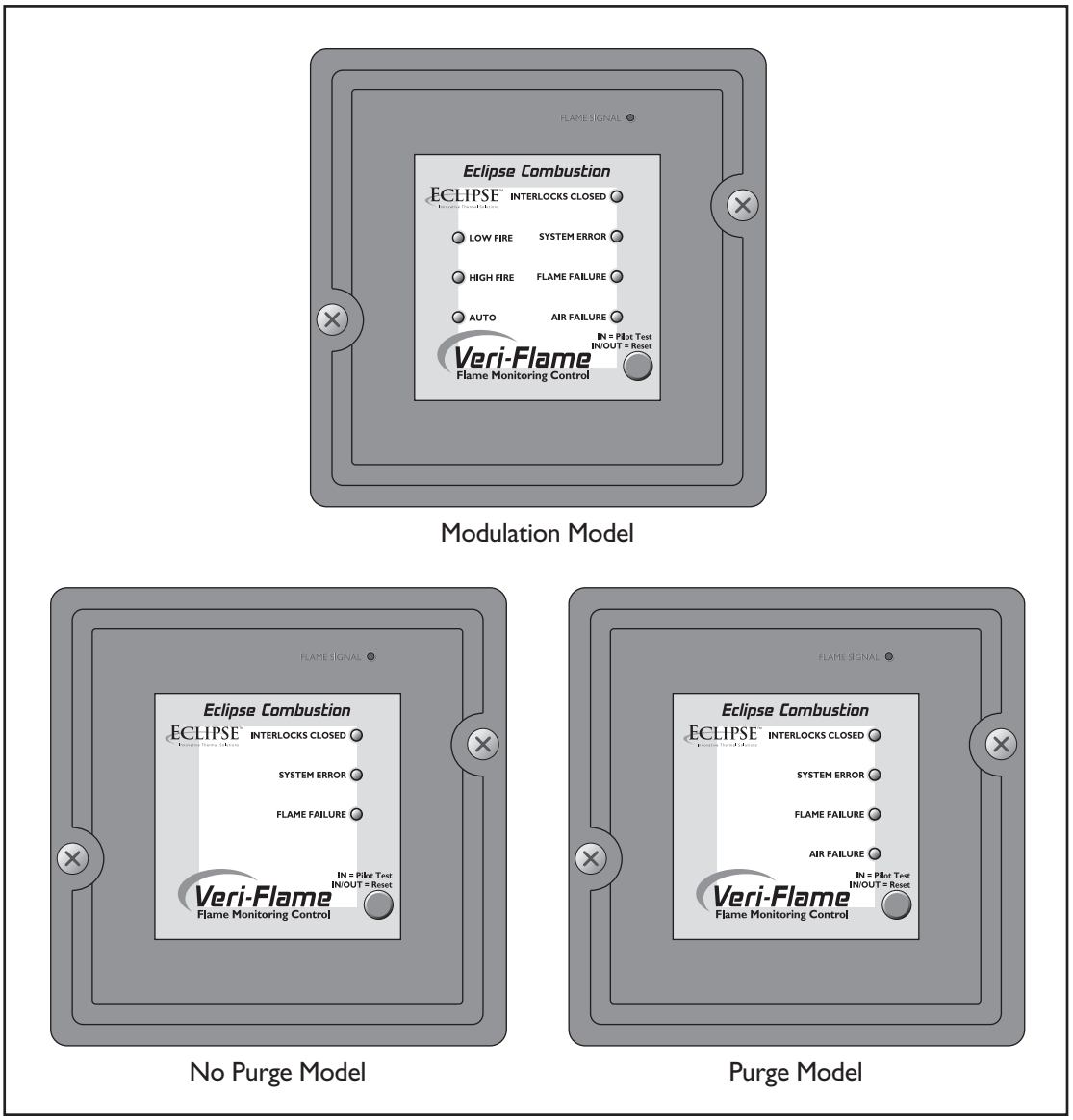
* ACT004A3B1A1AX
** BLOWER-PACKAGED1.1

Instruction Manual 818
6/1/06

Eclipse Combustion

Veri-Flame Single Burner Monitoring System

Model 5600
Version 1.21



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Innovative Thermal Solutions

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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, 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'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 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 products.

Eclipse, 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, solid state UV/IR and flame rod.

Required components are the Veri-Flame, matching wiring base and a flame sensor. Optional components include a remote display and cable, tester, and various scannner accessories.

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 GE GAP acceptable; the 5605 Series is UL listed, FM approved and GE GAP acceptable. The 5603 Series is for 240VAC applications and is FM approved. Please see instruction manual 818-2 for European CE marked versions.

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 GE GAP acceptable. The 5603 Series is for 240VAC and is FM approved.

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

PARAMETER	DESCRIPTION
Supply	• 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).

Temperature Ranges

Unit	Model Nos.	Temperature Range
Veri-Flame	All Models	-40° to +60°C (-40° to +140°F)
90° U.V. Scanner	5600-90A	-20° to +60°C (0° to 140°F)
U.V. Scanner	5600-91	-20° to +125°C (0° to +257°F)
NEMA4 UV Scanner	5600-91N4	-20° to +125°C (0° to +257°F)
UV/IR Scanner	5600-92SC	-20° to +80°C (0° to +176°F)
Self-Check U.V.	5602-91	-20° to +60°C (0° to +140°F)
Remote Display	5602DBP	0° to 50°C (32° to 122°F)

Flame Failure Response	3 seconds ±0.5 seconds.
Trial For Ignition (TFI)	*No Purge & Purge Models:* Series 5602 & 5603: 5 or 10 seconds selectable. Series 5605: 10 or 15 seconds selectable. Modulating Model: 5 or 10 seconds selectable
Pilot Interrupt (if selected)	10 seconds.
Purge Time	Selectable from 0-225 seconds in 15 second increments.

Output Ratings for 120 VAC *(maximum total connected load not to exceed 15 amps)

Function	Terminals	UL, CSA Inductive Load	Relay Contact Rating Resistive Load
Gas Valve	3, 5	175VA, 1/10 HP	10 amps
Ignition	4	375 VA	10 amps
Motor or Contactor	8	470 VA, 1/2 HP	16 amps
Control Signal	A, 10, 11, 12, 13	175VA	10 amps

Output Ratings for 240 VAC *(maximum total connected load not to exceed 15 amps)

Function	Terminals	Relay Contact Rating Resistive Load
Valves, Ignition	3, 4, 5,	5 amps
Motors or Contactor	8	16 amps
Alarm	A	5 amps
Control	10, 11, 12, 13	5 amps

*Resistive loads have inrush currents approximately the same as steady state operation. The inductive inrush current must be less than 10 timesthe rating. The inrush current must not be applied more than once every 15 seconds.

(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 GE GAP acceptable. Series 5603: FM approved. Series 5605: UL listed, FM approved and GE GAP acceptable. • *Modulating Models:* Series 5602: UL recognized (must be mounted in panel), CSA certified, FM approved and GE GAP acceptable. Series 5603: FM Approved.
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, File MP1537

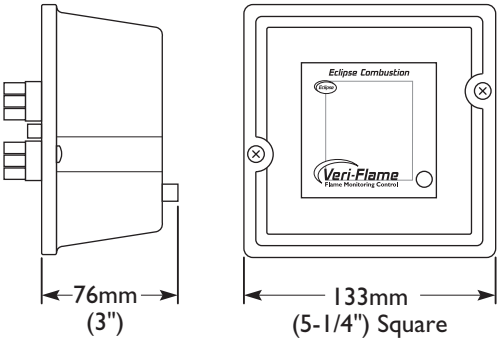
UL Recognized, File MP1537

CSA Certified, File 007989

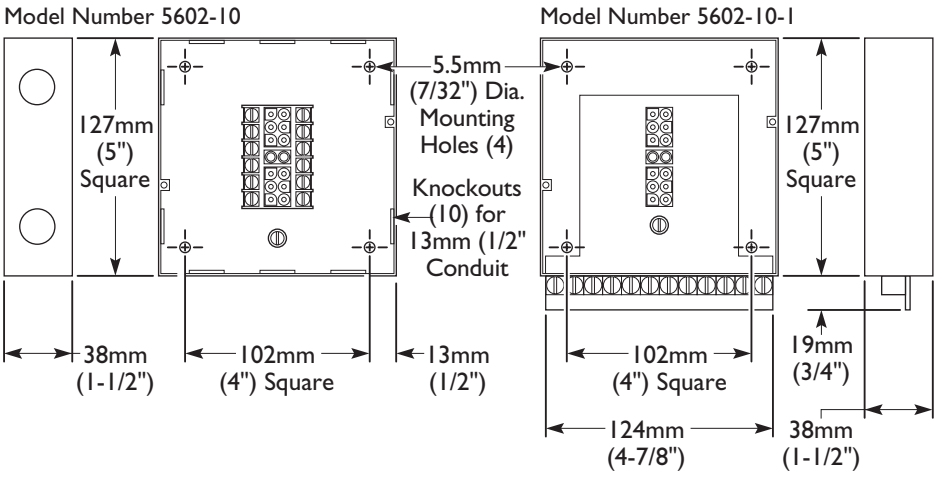
FM Approved, File 3013812

Dimensions

Veri-Flame Unit/All Models

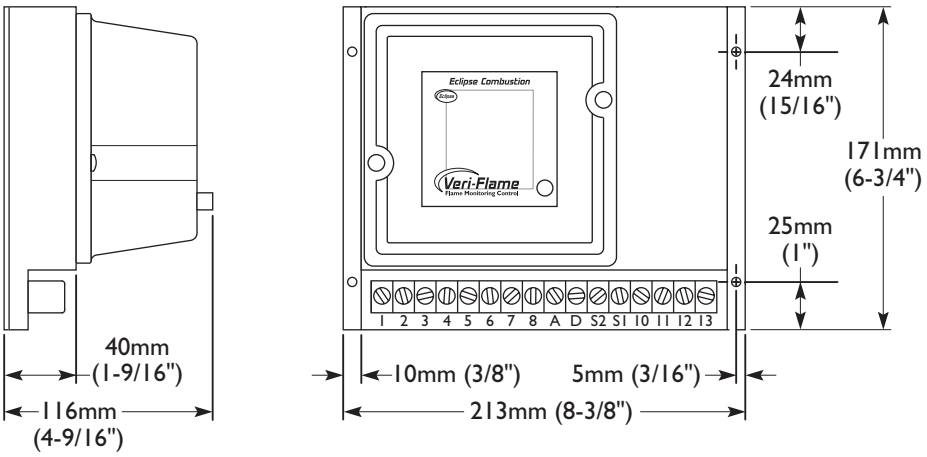


Veri-Flame Bases/Purge & No Purge Models

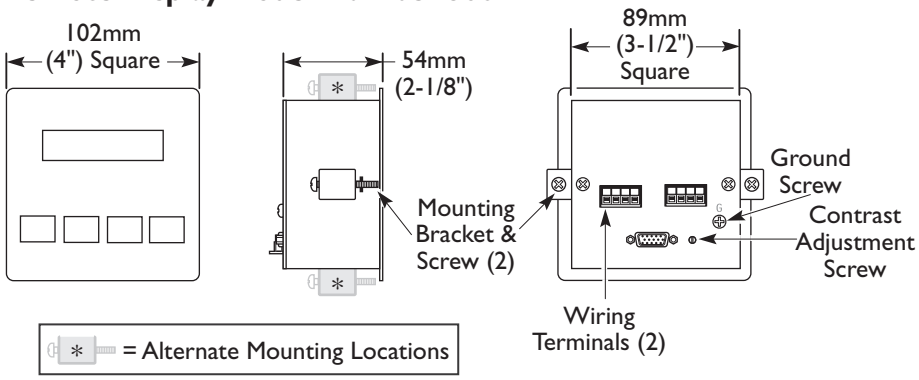


Dimensions *(continued)*

Veri-Flame/Modulating Model with Base Model Number 5602-40



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.

Caution
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)

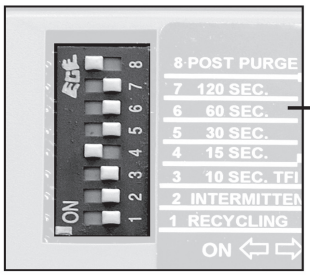
SW2: Pilot selection (On=Intermittent, where pilot remains on during burner cycle; Off = Interrupted, where pilot valve closes after main burner is established).

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. If all are set off, the trial for ignition starts when the air switch input comes on.

SW8: Post purge selection. (On=15 second post purge).

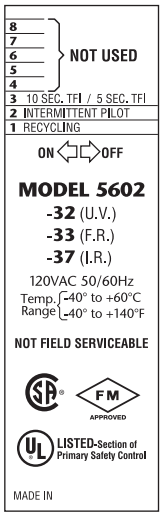
Figure 3.1 DIP Switch Location

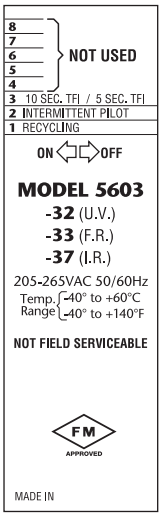


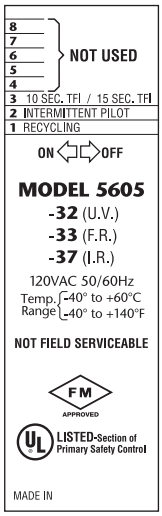
Close-up of DIP switches on back side of all Veri-Flame models.

Figure 3.2 DIP Switch Labels with Selections

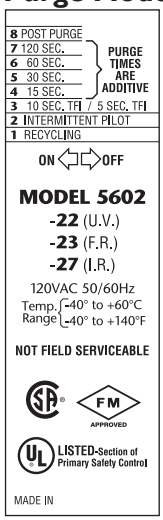
No Purge Models

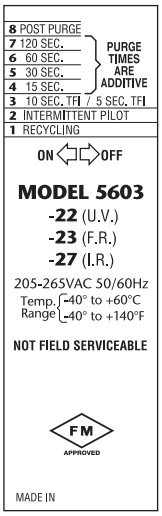


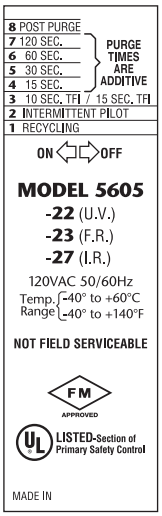




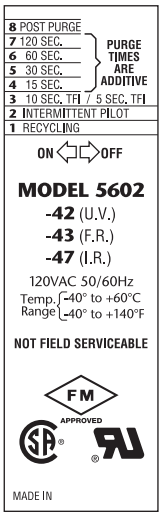
Purge Models

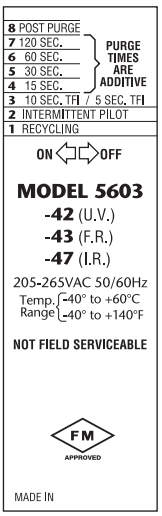






Modulation Models





Function Summary

4

Introduction

This section describes the features of the Veri-Flame. It is divided 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 re-cycle 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, 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 you must 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. If a flame signal is present at the end of the TFI, the pilot output 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" on page 14)
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 12 (Low Fire)
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 purge to high fire sequence does not start until the air switch input is on. 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

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. Do not order this option if the Veri-Flame is mounted inside an enclosure.

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

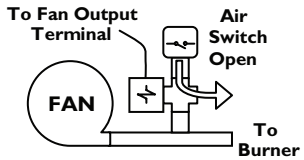
Wire external interlock, control, and limit switches in series to this input. Guard against induced voltage levels to wiring connected to this input. In some extreme wiring runs, reduction of induced voltages may require a load (relay or light) connected to terminal 7 to avoid system error lockouts. 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

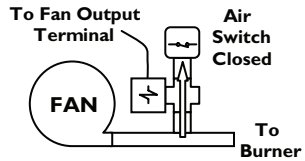
For purge and modulation models: Wire any switches and contacts in series to this terminal for proving air flow function and relating to the air failure light. Power must not be immediately present at terminal 6 when power is first applied to terminals 1 or 7.

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.



3-Way Solenoid Valve De-energized



3-Way Solenoid Valve Energized

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.

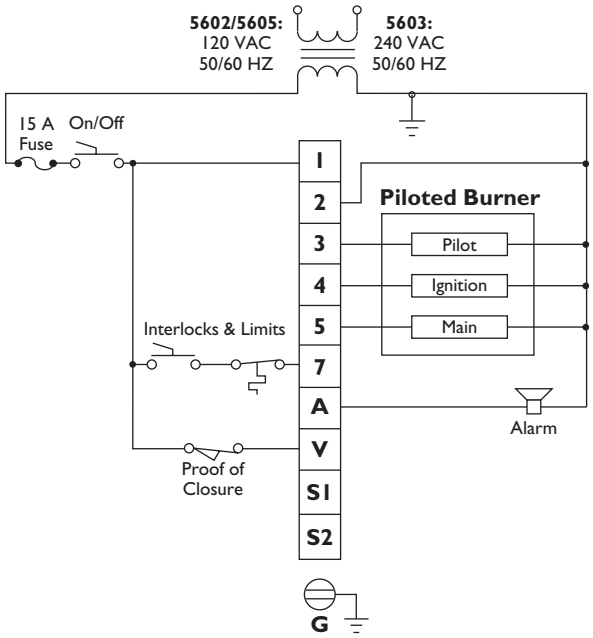
Remote Display & Power Supply

Wire the display 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.

Note:
power for terminal 7 of the VeriFlame should not flow through the R1-R2 contact when load currents exceed 5 amps.

Figure 5.1 No Purge and Purge Wiring Diagrams

No Purge Models



Purge Models

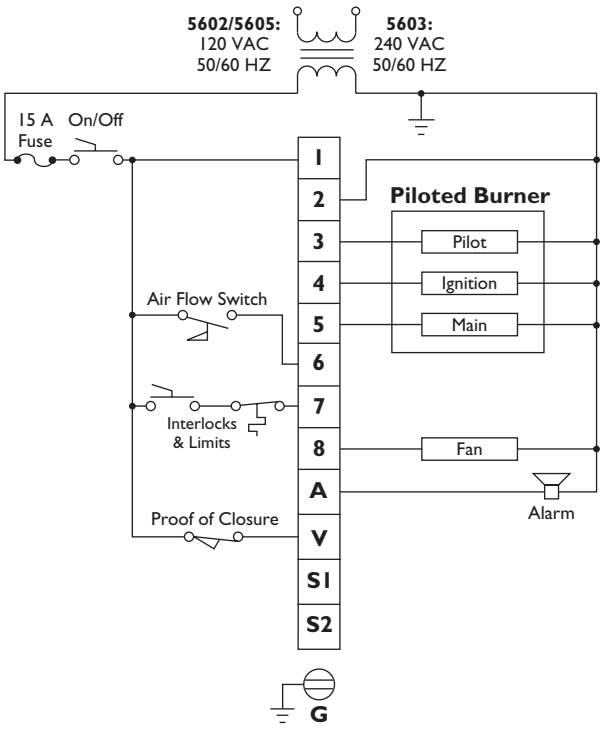


Figure 5.2 Modulation Wiring Diagram

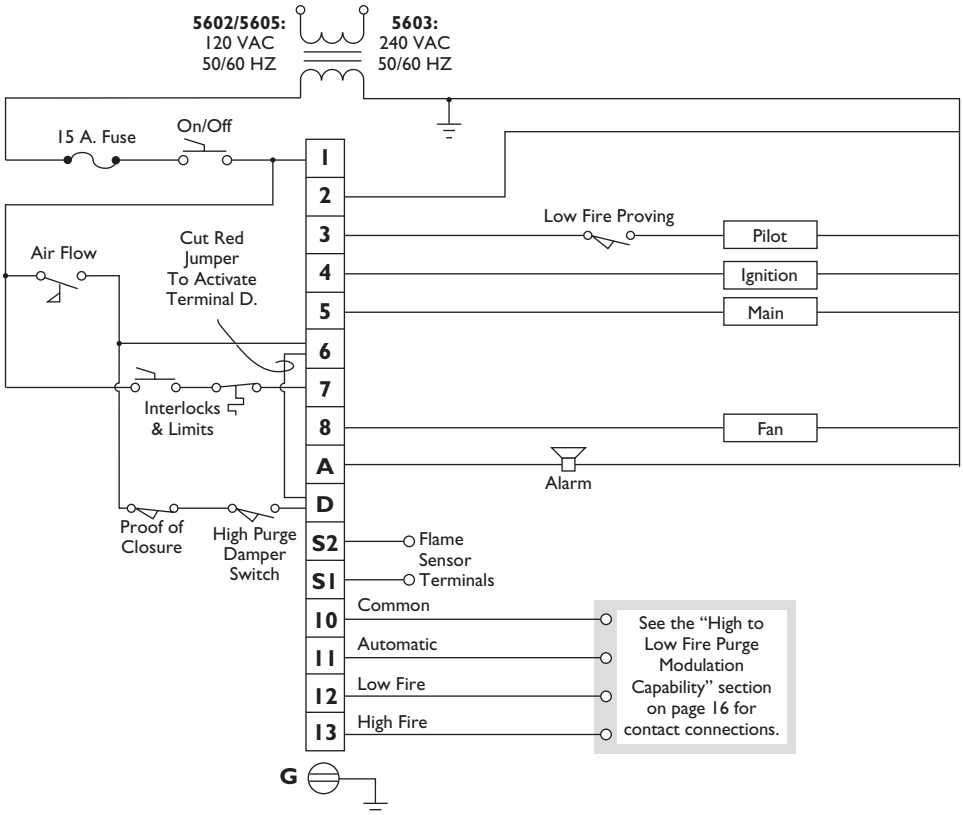
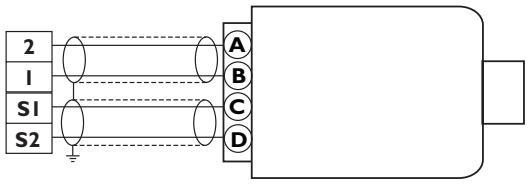
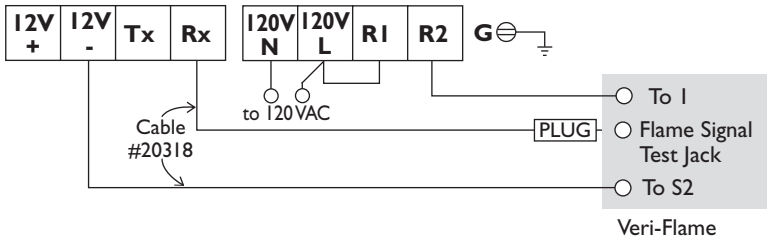


Figure 5.3 Typical Connections For All Models

Self Check U.V. 5602-91
(Requires 5602-91-7 cable)

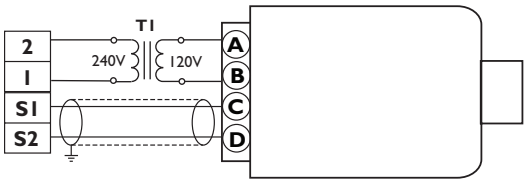


Model 5602 DBP
120 VAC Remote Display



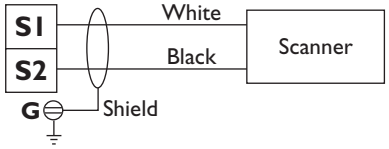
Veri-Flame

Self-Check U.V. 5602-91
(Requires 5602-91-7 cable)
for 240 VAC Veri-Flame

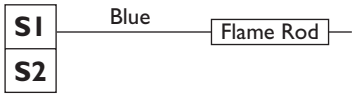


T1 Third party transformer required. Must be at least 25 VA.

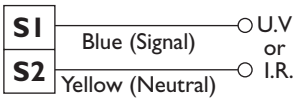
Solid State U.V./I.R.



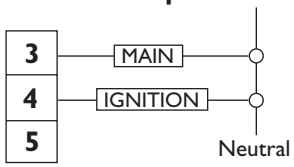
Flame Rod



U.V.

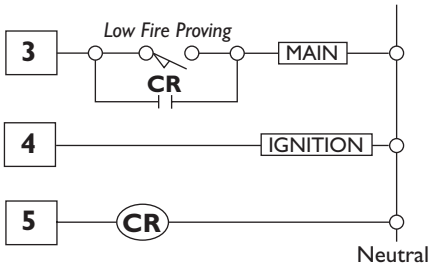


No Purge & Purge
Direct Spark



Note: Intermittent pilot must be selected, DIP-SW2 = ON

Modulation
Direct Spark with
Low Fire Start

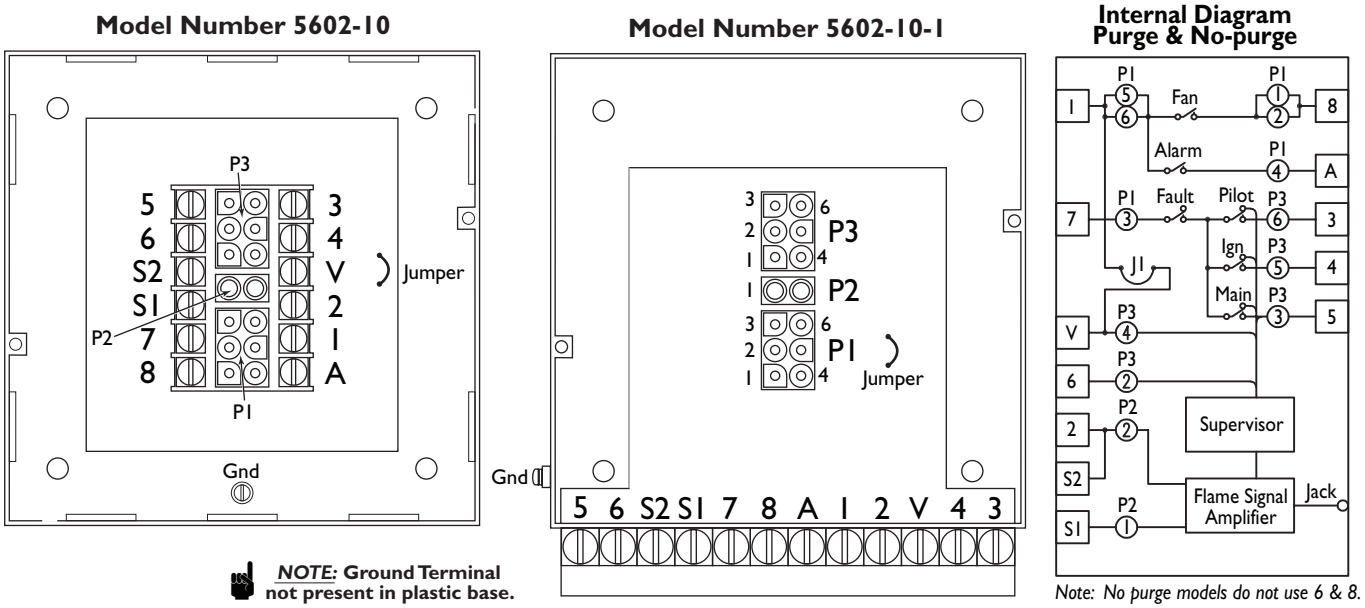


Note: Intermittent pilot must be selected, DIP-SW2 = ON
CR is a control relay used to bypass the low fire switch after the burner is lit.

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 wireway (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 S2 or 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**



Modulating Base

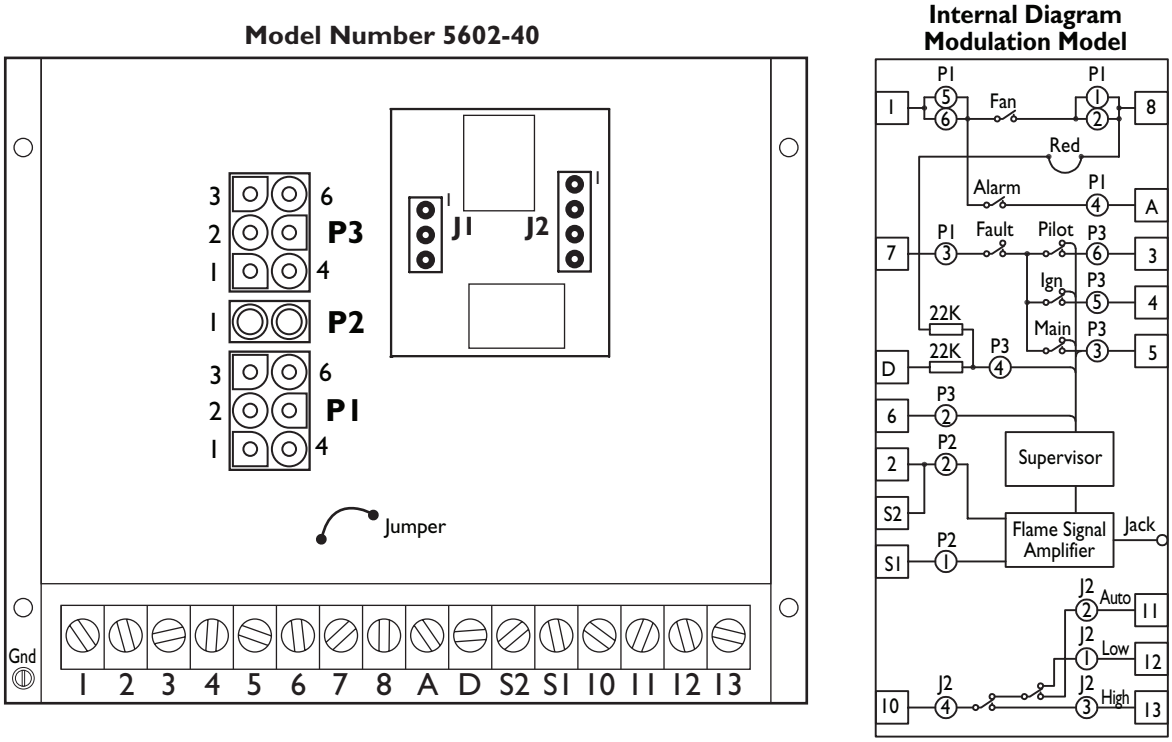
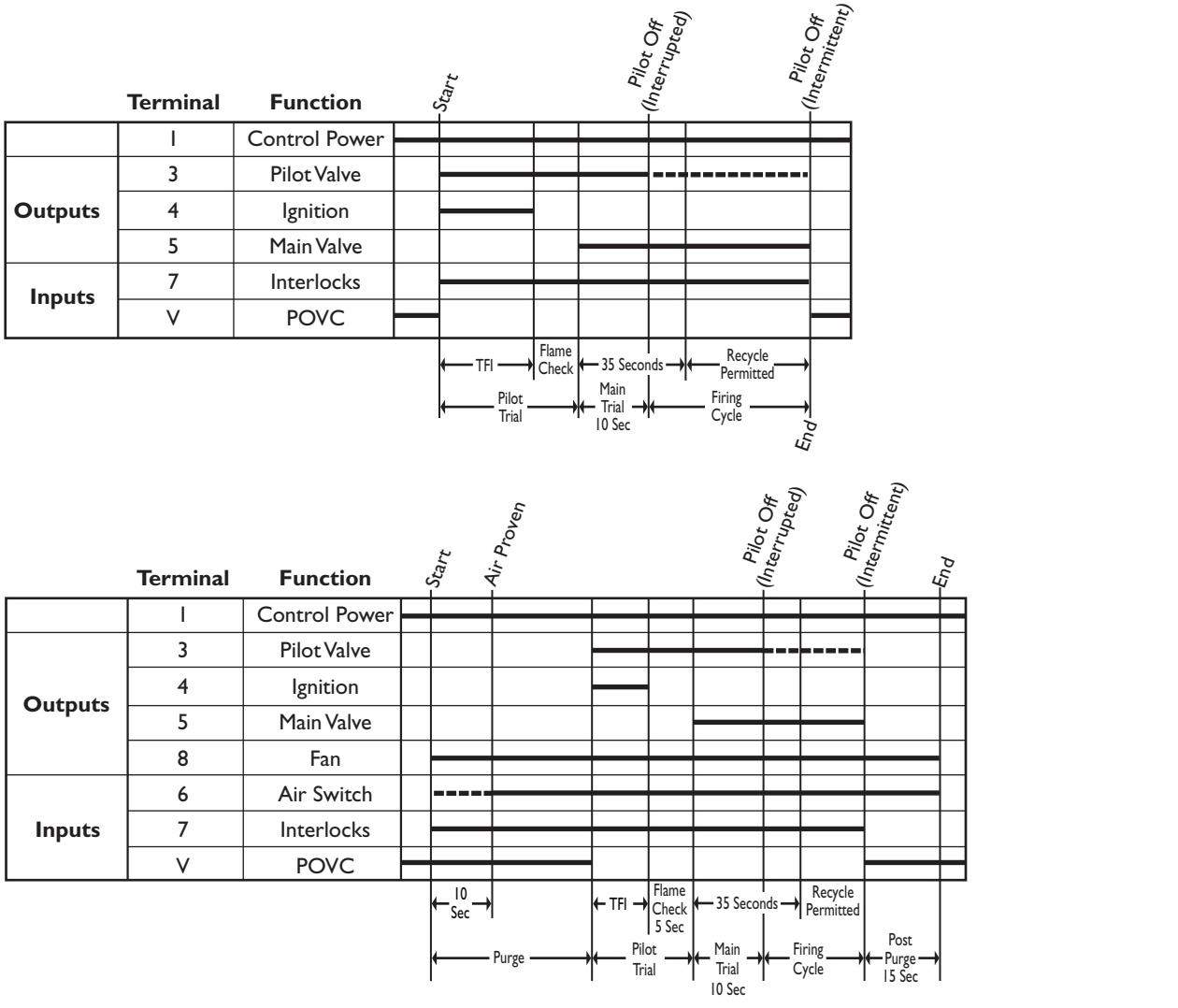


Figure 5.5 Sequence Diagrams



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.

Warning

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).

Note:

Unshielded sensor wiring must not be run in common with other wires; it must be run in separate conduit. Multiple unshielded flame sensor wiring must not be run together for long lengths in a common conduit or wireway. Use #14 to #18 AWG wire suitable for 90°C (194°F) and 600 volt insulation, or a better grade if required by the application. Multiple shielded flame sensor cables can be run in a common conduit.

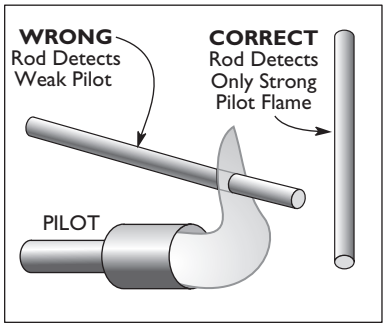
Flame Rods

Flame rods should be used only on gas burners. They accumulate soot from 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:

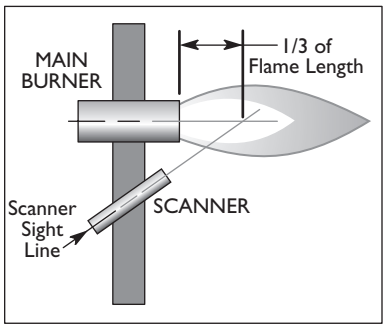
1) Position the scanner within 457 mm (18") of the flame. Consult factory for longer distances.
2) Bushing threads are 1/2 inch F.N.P.T. for all scanner models except 5602-91 which has 1 inch F.N.P.T. bushing threads.
3) The ambient temperature limits of each scanner varies; check the literature for 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

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) If possible, sight the scanner away from the ignition spark. Sighting the spark or its reflections from burner internals may lead to a misdiagnosis of shut-downs 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) Solid State UV/IR scanner model 5600-92SC may better detect oil flames. When used, aim the scanner at the outer oil flame for flicker detection.

Figure 6.2 U.V. Scanner Sighting



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 S2 or 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. It is not necessary to correct a spark sighting condition for a Veri-Flame when the ignition transformer is connected to terminal 4.

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 equip ment with new equipment before resuming operation. Oper ating a system with defective safety equipment can cause ex plosions, injuries, and property damage.

* Indicated by the illuminated red "Flame Failure" LED on the Veri-Flame front cover.

Maintenance & Troubleshoot-

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 need to 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

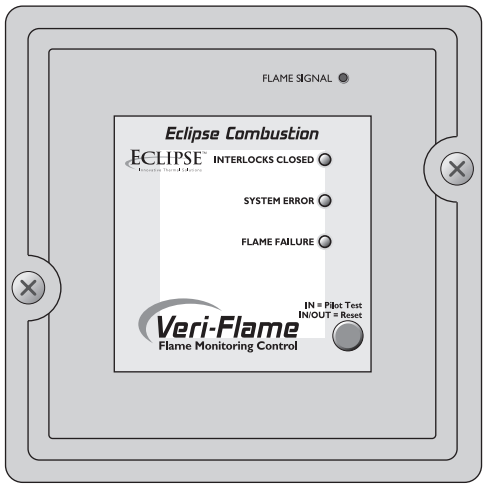
PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate start sequence	Main valve is not closed.	Check main valve closed switch. No voltage on V (or D).
	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower. 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**

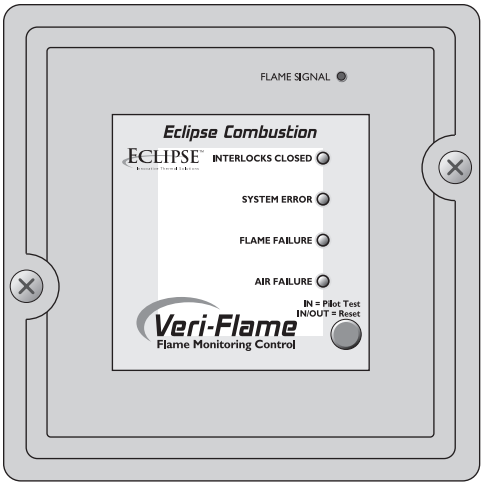
LED(s) Lit	Possible Causes
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway," flame signal light is on. 3) Inductance is detected on sensor wires, flame signal 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**

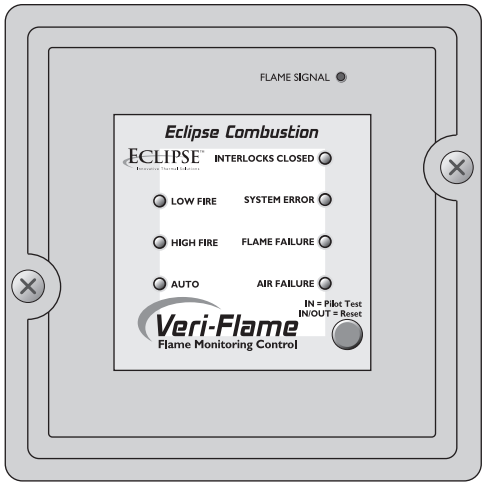
LED(s) Lit	Possible Causes
INTERLOCKS CLOSED	1) The interlocks are closed (normal operation), power on terminal 7.
SYSTEM ERROR	1) The flame detected is out of sequence, flame signal light is on. 2) The sensor is "runaway", flame signal light is on. 3) Inductance is detected on sensor wires, flame signal 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

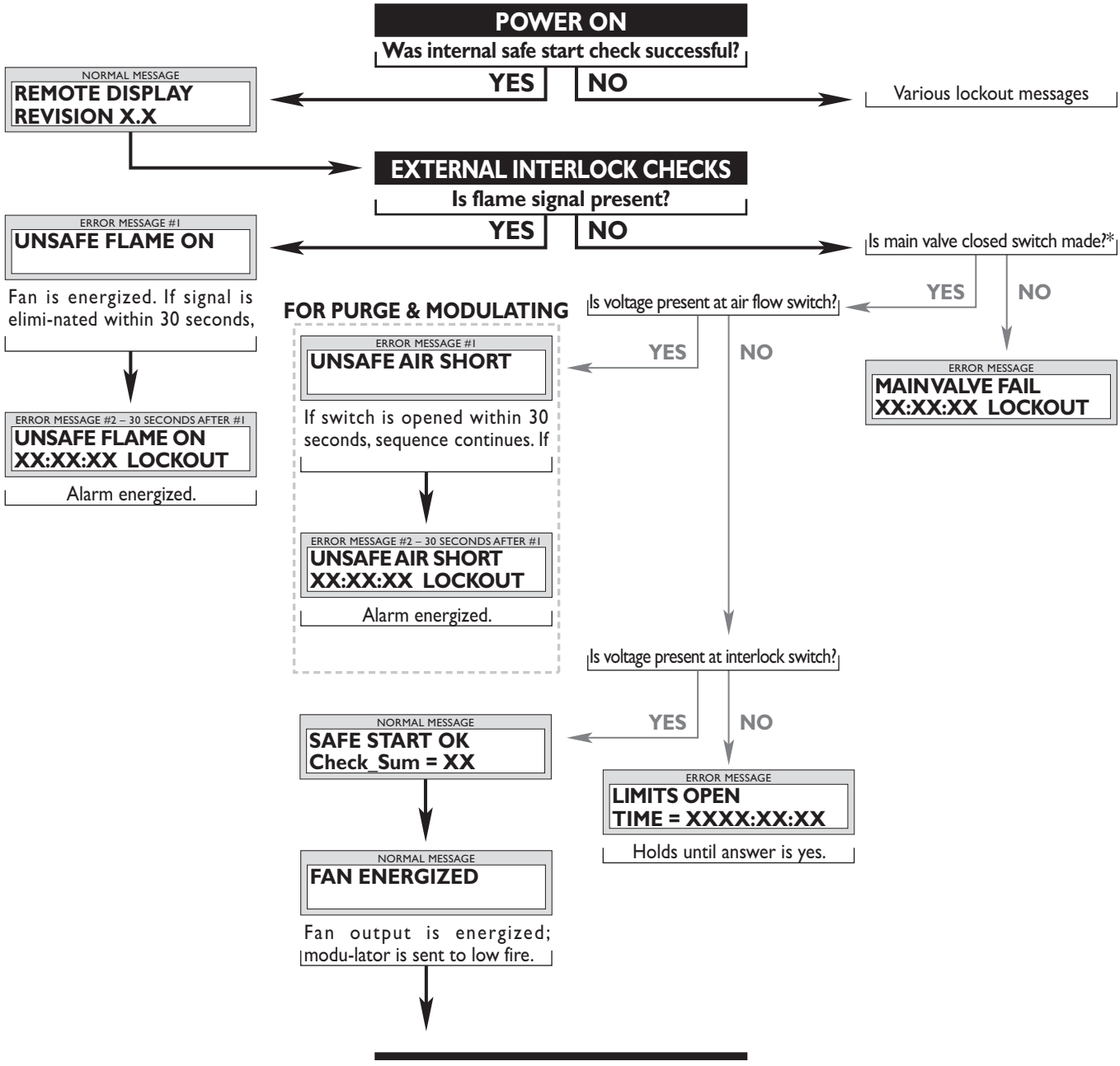
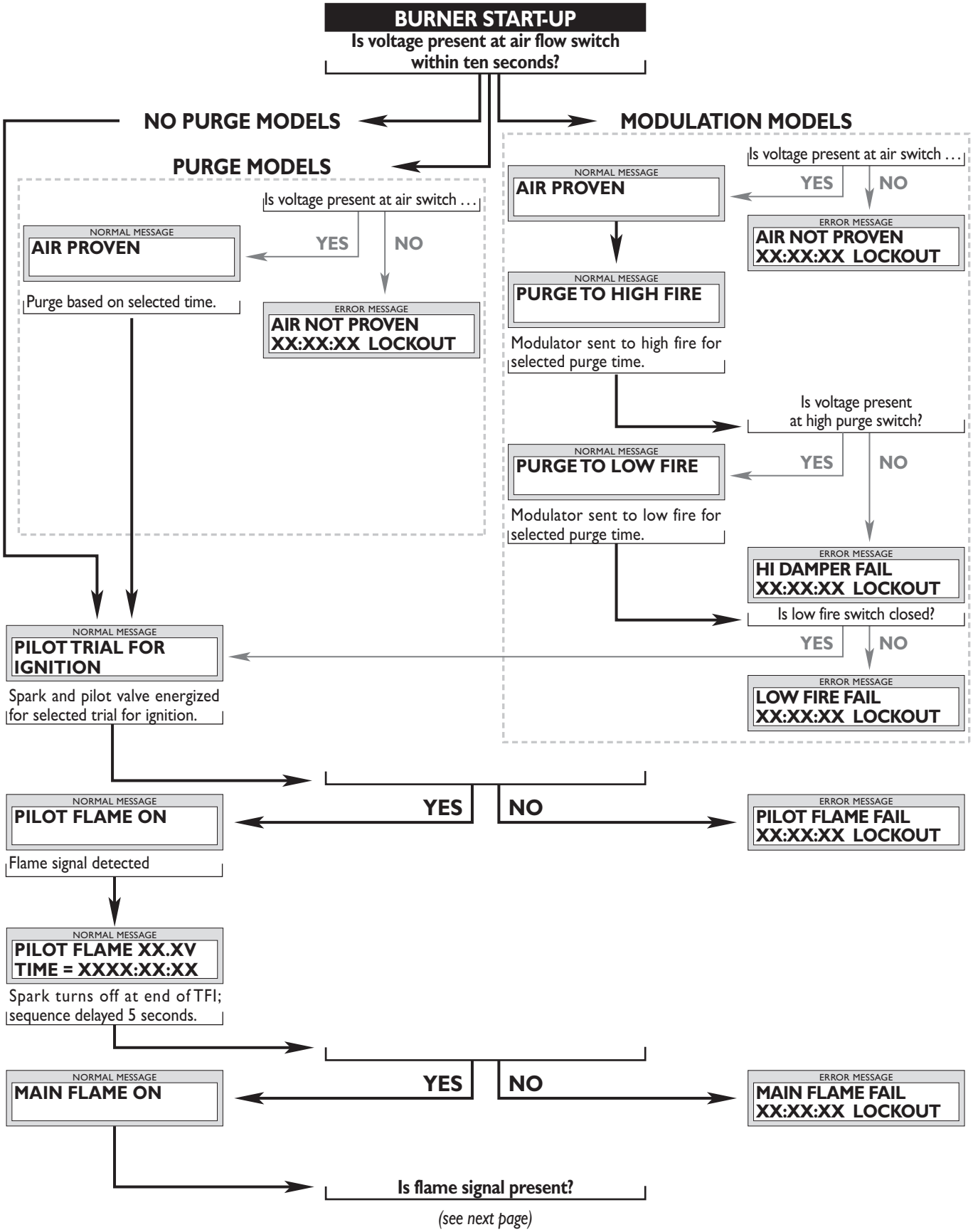


Table 9.1 **Veri-Flame Operating Sequence** (continued)



(see next page)

Table 9.1 **Veri-Flame Operating Sequence** (continued)

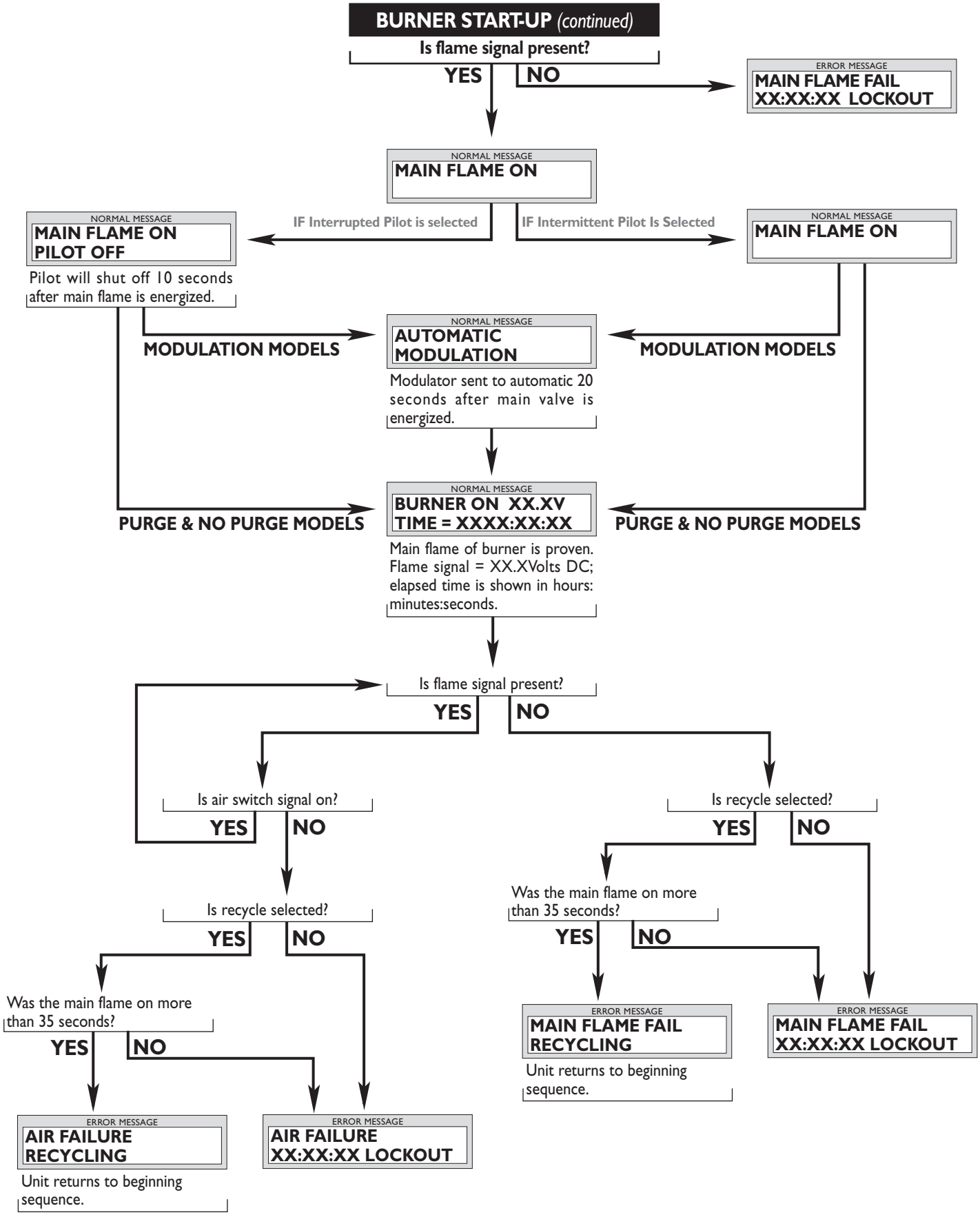
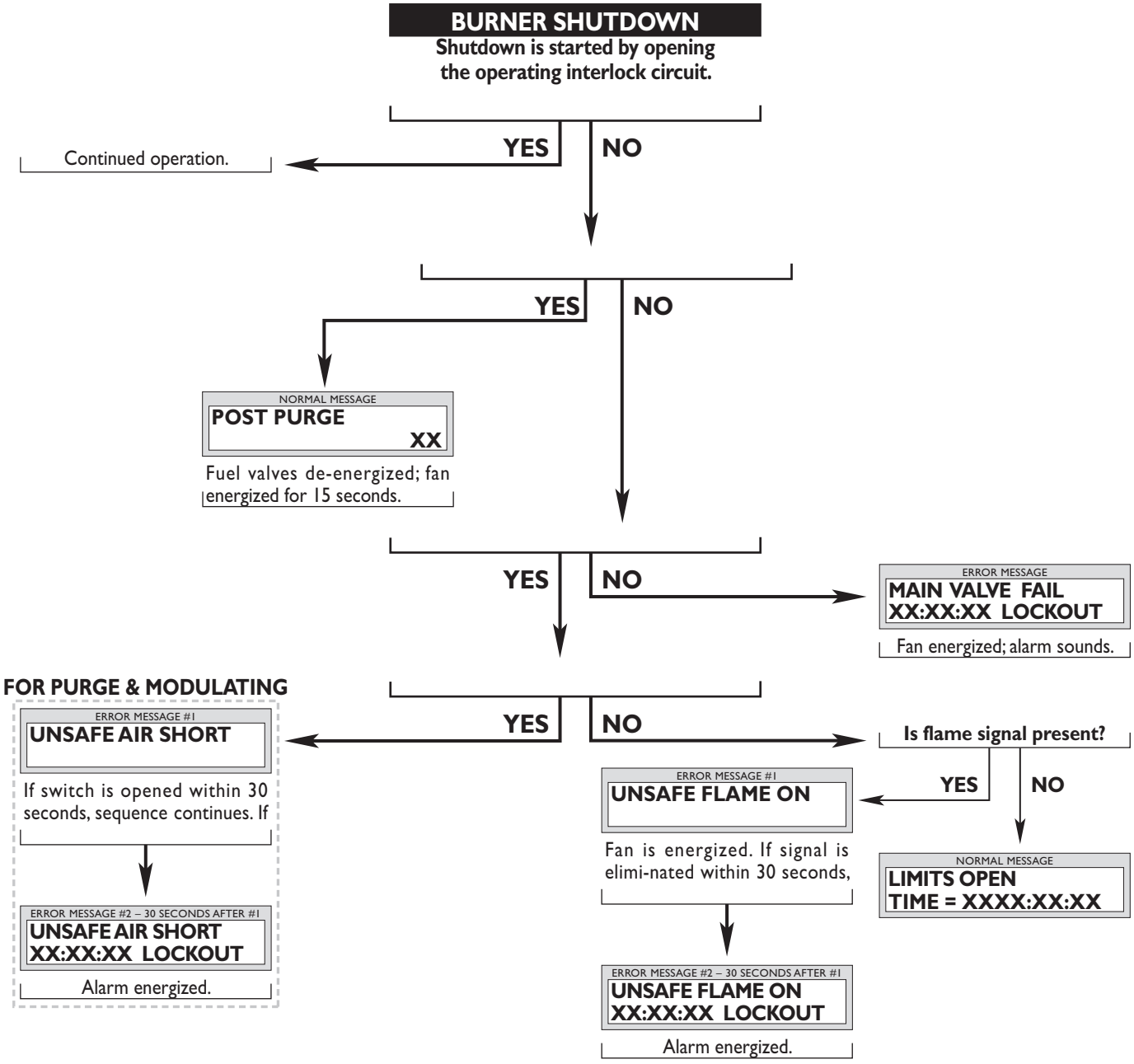


Table 9.1 **Veri-Flame Operating Sequence** (continued)



* 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}

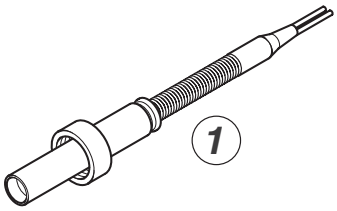
Metric to Metric.

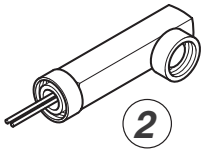
From	To	Multiply by
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

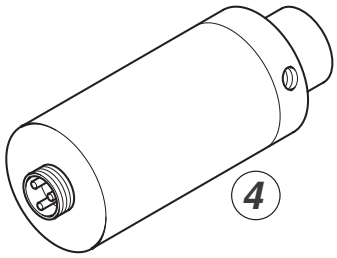
English to Metric.

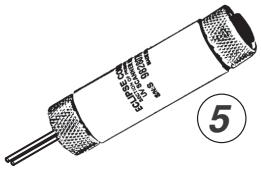
From	To	Multiply by
Btu/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F – 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column (“wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95

Illustrated Parts List



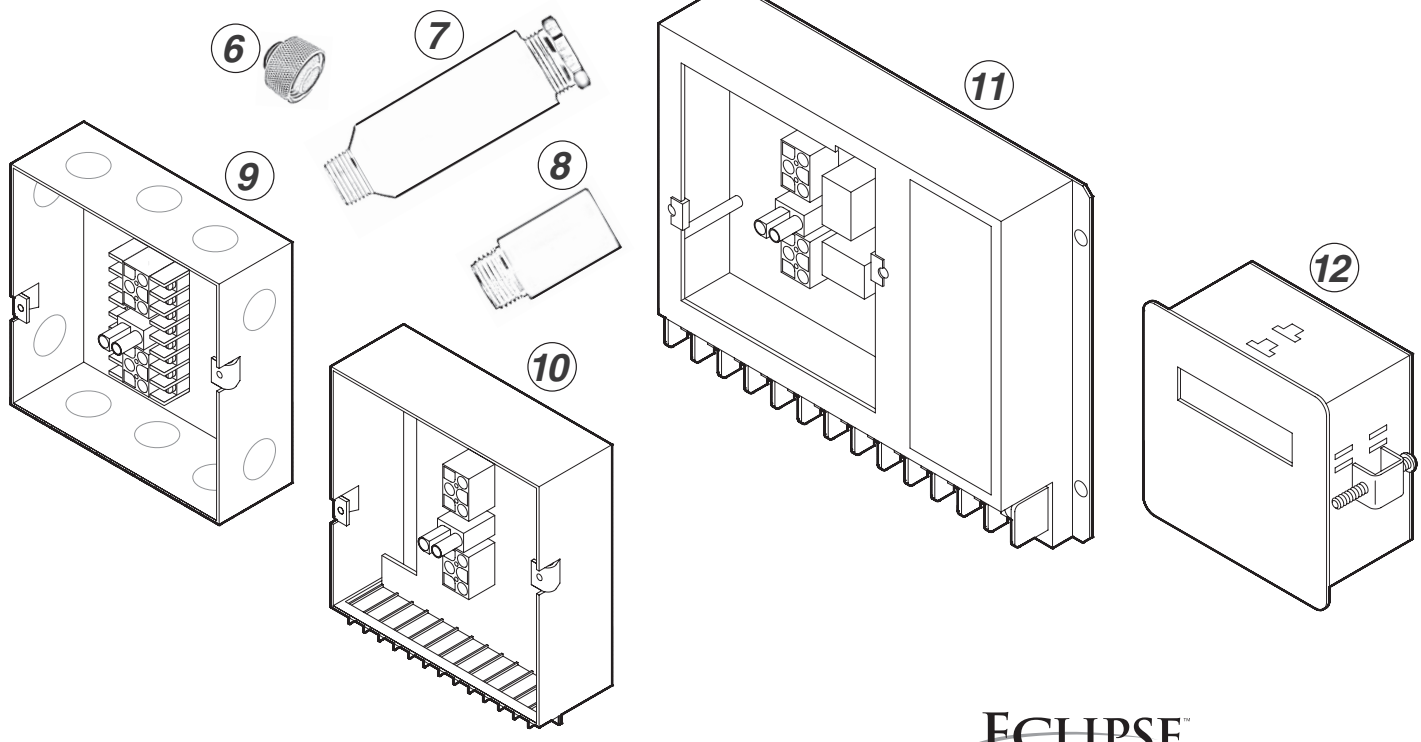






Category	Pos. No.	Description	Model Number	Part Number
Sensors	1	Straight U.V. scanner	5600-91	49600-91
	——	NEMA 4 U.V. scanner	5600-91N4	20898
	2	90° U.V. scanner	5600-90A	49600-90
	4	Self-check scanner	5602-91	49602-91
	5	Solid-state U.V./I.R. scanner	5600-92SC	21349
	——	10-foot cable for self-check scanner	5602-91-7	49602-91-7
	6	Scanner support (1)	5600-90A SS	20722
	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
	——	Heat block seal	23HBS	4400011
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
	——	Exposed terminal base, plastic	5602-10-1P	22195
	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	——	Remote display, 120VAC with keypad	5602 DBP	20896
	——	Cable for remote display		20318

(1) For 90º U.V. scanner (Model No. 5600-90A), NEMA 4 U.V. scanner (5600-91N4) and solid state U.V./I.R. scanner (5600-92SC)
(2) For magnifying lens assembly (Model No. 5600-98), self-check scanner (5602-91), and heat block seal (23HBS)
(3) Used to test modulation controls on tester (Model No 5602) above.



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Fisher Controls

Instruction Manual

"H" Series Relief Valves

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.

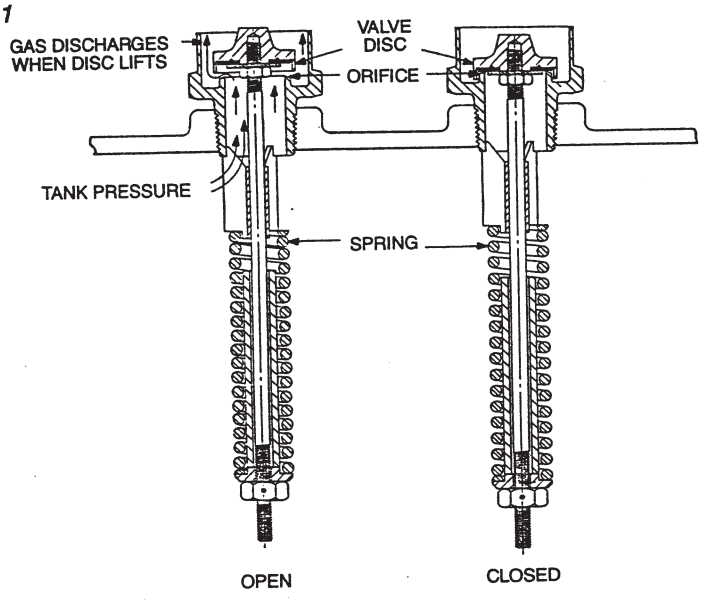
Raincaps are required on all valves. The raincap should be kept in place; an out-of-place raincap indicates the valve may have opened to relieve overpressure. Most relief valves have a drain hole in the body which must remain open at all times.

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.

Type R352 & S102KL Second Stage LP Gas Regulators

⚠ 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.

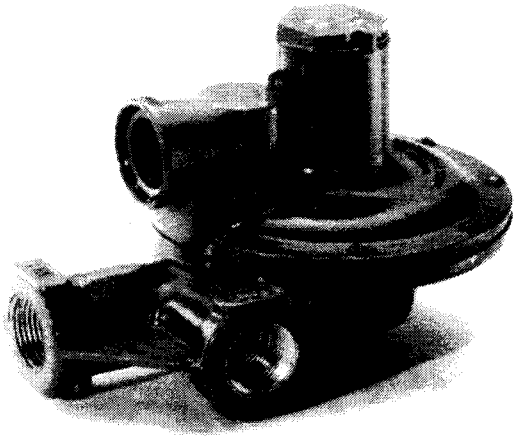


Figure 1 Type R352 Regulator (S102KL not shown)

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 can be 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 Type R352 & S102KL second state regulators.

These second stage regulators have an integral internal relief valve.

Description

The Type R352 & S102KL regulators are designed for low pressure (inches of water column) vapor service and are not to be used for liquid service. Their outlet pressure setting is usually 11 inches wc and the regulator is painted palm green.

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 or air.

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Type R352 & S102KL Second Stage LP Gas Regulators

Table 1. Specifications

TYPE NUMBER	SIZE, INCH FNPT		VENT CONNECTION SCREENED	OUTLET PRESSURE SETTING (INCHES WC)	MAXIMUM INLET PRESSURE	VAPOR CAPACITY, BTU/HR PROPANE*
	INLET CONNECTION	OUTLET CONNECTION				
R352	3/4	3/4	3/4 NPT	NOMINAL 11 ADJUSTABLE 8-15	10 PSIG	1,250,000
S102KL	3/4-1	3/4-1	3/4 NPT	NOMINAL 11 ADJUSTABLE 8-15	10 PSIG	2,400,000

STANDARD VENT POSITION – Over inlet. Contact factory for non-standard vent positions.

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.

On horizontally mounted installations, a hood or protective cover must be used to protect the regulator's vent opening from the elements.

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.

Never use a first stage high pressure (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. 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 the 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. Remove any dirt or foreign matter which may have accumulated in the regulator body or the pipeline. Apply pipe compound to the male threads of the pipe.

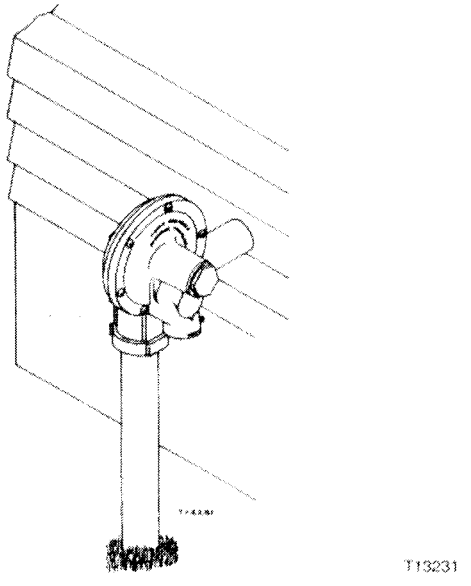

Figure 2. Point Vent Down on Outdoor Installations

Some installations, such as in areas with heavy snow fall, may require a hood or enclosure to protect the regulator. **Horizontally mounted regulators 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 elements.

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 size. 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.

The R352 and S102KL are typically not installed in underground applications. For information on installing a regulator in an underground system, call Fisher Controls.

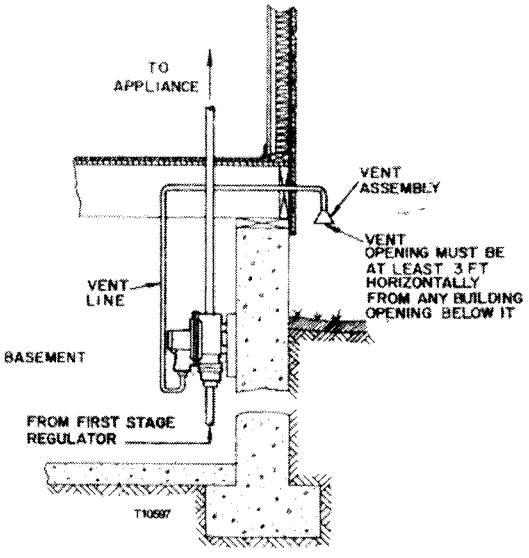

Figure 3. Typical Indoor Installation With Vent Line and Vent Assembly

Adjustment

Each regulator is individually factory set to deliver 11 inches wc. If it becomes necessary to increase the outlet pressure, remove the closing cap and turn the adjusting screw clockwise. Turn the adjusting screw counterclockwise to decrease the outlet pressure. Install a water manometer or pressure gauge in the outlet piping to determine the regulator's outlet setting during adjustment. (Actual pressure at the appliance may be less due to line loss.) After setting, replace the closing cap.

Overpressure Protection

⚠ WARNING

Personal injury or system damage may result if these regulators are installed without appropriate 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 any damage that may have occurred.

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.

These 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 of foreign material on the orifice. The internal relief valve limits downstream pressure to 2 psig as long as inlet pressure does not exceed 15 psig and the vent is unobstructed.

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.

Maintenance

⚠ WARNING

To avoid personal injury or equipment damage, do not attempt any maintenance 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 replacement 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 the 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. 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 extension 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. Closely examine regulators directly connected to the container valve by means of a solid POL adapter (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.

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 for the repair of Fisher regulators. Be sure to give the complete type number of the regulator when corresponding with the factory.

For information, contact Fisher Controls:
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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.

D4500727012

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.

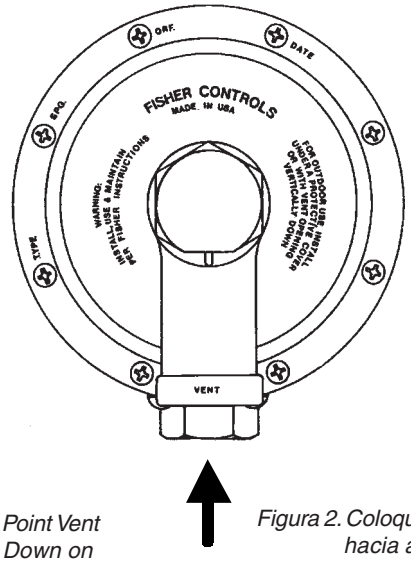

Figure 2. Point Vent Down on Outdoor Installations

Figura 2. Coloque la Ventila hacia abajo en Instalaciones Exteriores

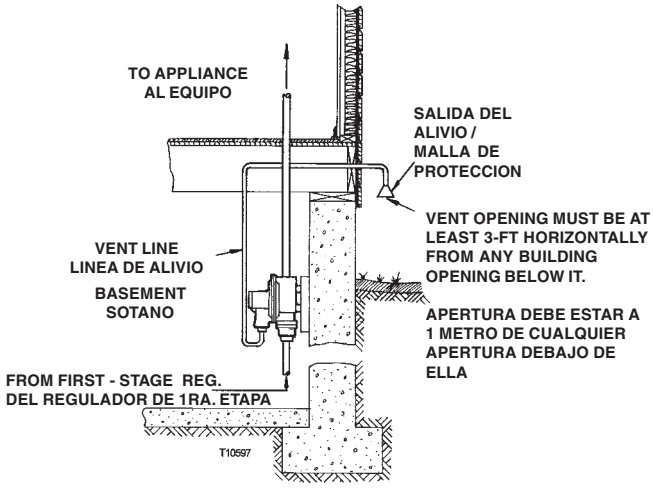

Figure 3. Typical Indoor Installation With Vent line and Vent Assembly

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.

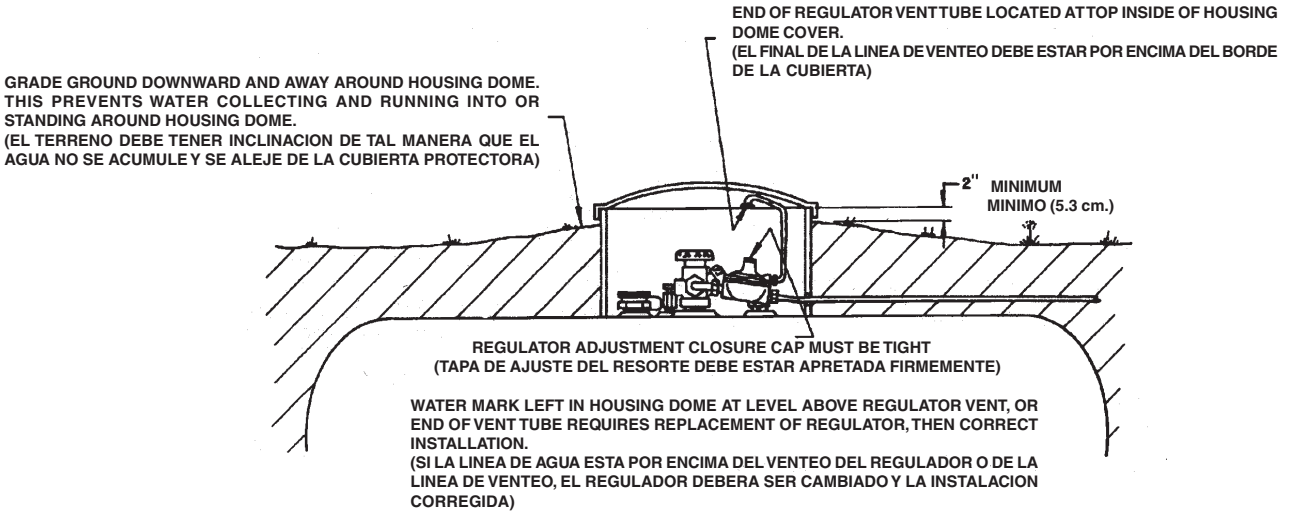

Figure 4. Regulators Installed on Underground Installations Require a Vent Tube

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
McKinney, Texas 75069, USA
DIRECCION EN EL INTERNET: www.fisherregulators.com/lp

Fisher Controls

Installation Manual

Type R522 and R522H Pressure Reducing Regulators

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.

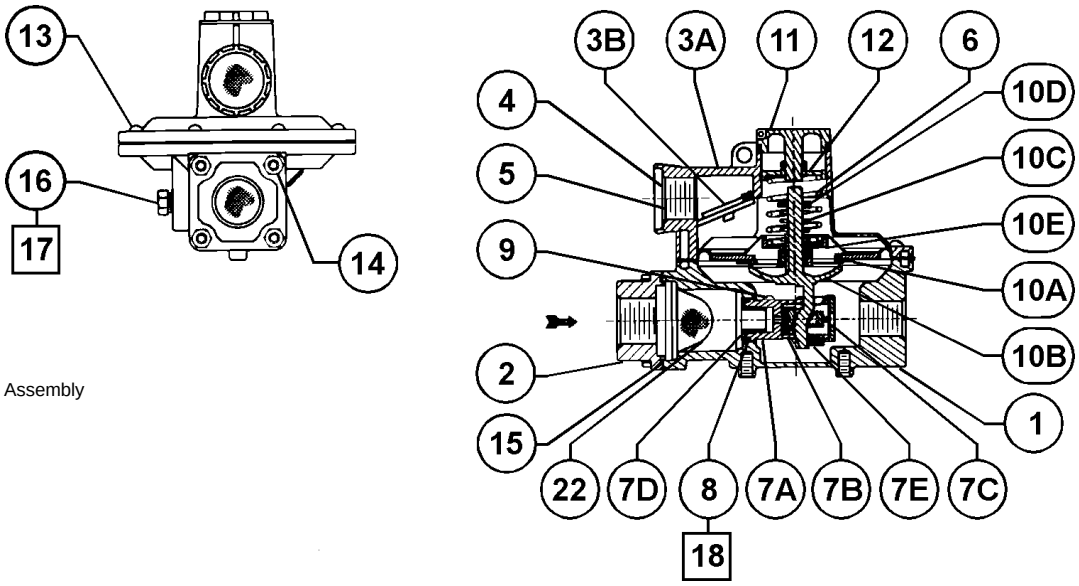

Figure 1. Type R522 Regulator Assembly

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.

R600 Series Instruction Manual

⚠ 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. Show the customer the vent or vent assembly or vent tube. Stress that this opening must remain unobstructed at all times. Tell the customer 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 Type R600 Series regulators, which includes first stage, second stage, integral and 2 psi service regulators used on LP-Gas vapor service applications. **They are not to be used on liquid service**.

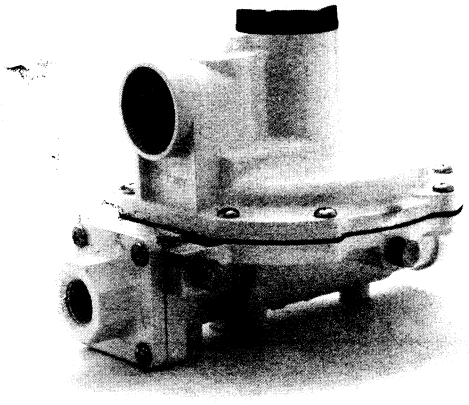

Figure 1. Type R622E

Description

2nd Stage Low Pressure Regulators

The R622 and R652 regulators provide low pressure, inches of water column, delivery pressures. They are normally set at 11 inches water column pressure. They have high capacity internal relief valve construction. The regulators are normally painted PALM GREEN. The units differ in construction and capacity rating.

Integral 2 Stage Regulator

The Type R632 integral 2 stage regulator contains a non-adjustable first stage regulator on the inlet. The second stage provides 11 inches water column outlet pressure. The 2nd stage portion has a high capacity internal relief valve construction. The first stage does not have an internal relief valve. The regulators are normally painted GRAY.

R600 Series LP-Gas Regulators

Table 1. Specifications

TYPE	BODY SIZE, INLET AND OUTLET CONNECTIONS		3/4 NPT VENT (SCREENED) STANDARD LOCATION
2nd Stage Service	**Inlet**	**Outlet**	
R622	1/2-inch & 3/4-inch NPT	1/2-inch & 3/4-inch NPT	Over Inlet
R652	1/2-inch & 3/4-inch NPT	3/4-inch NPT	Over Inlet
Integral Regulator			
R632	1/4-inch NPT, or POL	1/2-inch & 3/4-inch NPT	2nd Stage: Over Outlet 1st Stage: Down
1st Stage Service			
R622H	1/2-inch & 3/4-inch NPT POL	1/2-inch & 3/4-inch NPT	Over Outlet
2 PSI Service			
R622E	1/2-inch & 3/4-inch NPT	1/2-inch & 3/4-inch NPT	Over Inlet
R652E	1/2-inch & 3/4-inch NPT	3/4-inch NPT	Over Inlet

Pressure Taps Size Restriction	1/8 NPT: #54 (0.055 in.) Drill on outlet and inlet
Orifice Sizes, Inches (mm)	7/32 (5,55)
Wide Open C_g for Relief Sizing	38
Maximum Allowable Inlet Pressure, psig (bar)	**R622H, R632**: 250 (17,24) **R622E, R652E**: 10 (0,69) **R622**: 10 (0,69)
Maximum Emergency Inlet Pressure, psig (bar)	**R622H, R632**: 250 (17,24) **R622E, R652E**: 15 (1,03) **R622**: 15 (1,03)
Outlet Pressure Standard Set Point	**R622, R652**: 11 in w.c. (27 mbar) **R632**: 1st Stage - approx. 10 psi (0,69 bar) / 2nd Stage - 11 in w.c. (27 mbar) **R622E, R652E**: 2 psi (0,14 bar) **R622H**: 10 psi (0,69 bar), 5 psi (0,35 bar)
Outlet Pressure Spring Range	**R622, R652**: 7.5-9.5 in w.c., 9-13 in w.c., 13-20 in w.c., 16-40 in w.c. **R632**: 1st Stage - non-adjustable / 2nd Stage - 9-13 in w.c. **R622E, R652E**: 1-2.2 psi **R622H**: 8-12 psi, 4-6 psi
Temperature Capabilities	-20°F to 160°F (-29°C to 71°C)
Pressure Registration	Internal
Approximate Weight	R622H and R632 with POL Inlet: 1.7 lbs (765 grams) All Others: 1.4 lbs (627 grams)

Table 2. Relief Valve Specifications

TYPE	TYPICAL SET POINT	NOMINAL RELIEF VALVE START TO DISCHARGE	MAXIMUM INLET PRESSURE TO NOT EXCEED OUTLET PRESSURE WITH DISC REMOVED	
			INLET PRESSURE, psig (bar)	MAXIMUM OUTLET PRESSURE, psig (bar)
R622	11 inches w.c.	1 psi	50 (3,4)	2 (0,14)
R652				
R632			250 (17,2)	
R622E	2 psi	3.5 psi	50 (3,4)	5 (0,34)
R652E				
R622H	10 psi	20 psi	Not Applicable	

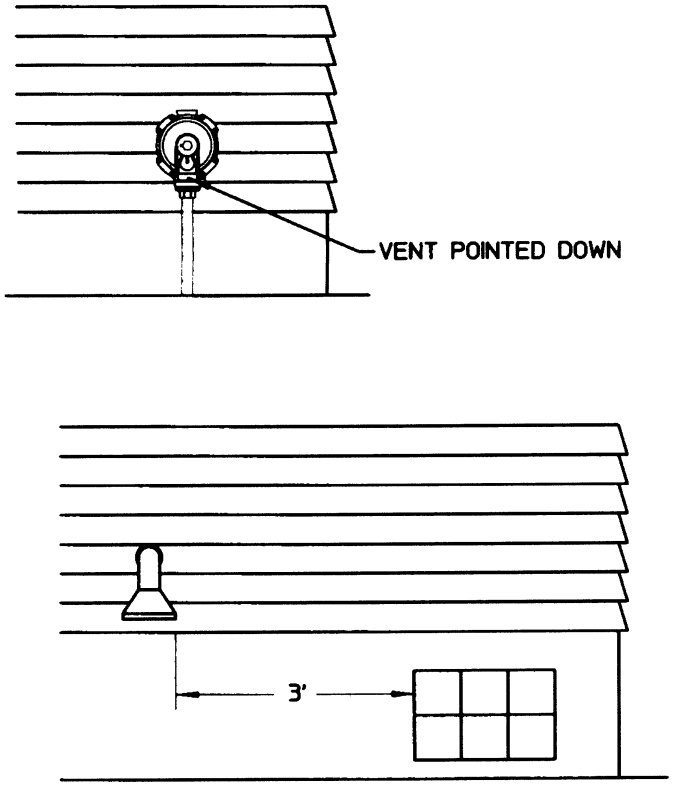

Figure 2. Regulator with Vent Pointed Down

First Stage and 2 PSI Service Regulators

The Type R622H, R622E and R652E regulators are designed for high pressure (pounds per square inch) vapor service. These regulators have high capacity internal relief valves.

When used on first-stage service, the R622H regulator reduces container pressure to 10 psig for a second-stage regulator. On final stage service the regulator reduces container pressure for a high pressure burner. The regulator is normally painted RED.

The R622E or R652E standard outlet pressure setting is 2 psig. The regulator is painted PALM GREEN with a WHITE CAP. It is an intermediate stage regulator that reduces 10 psig first-stage pressure to 2 psig. They are used on 2-psig pressures systems. **The R622E and R652E are not suitable for first-stage service.**

Specifications

Tables 1 and 2 lists the specifications for these regulators. Contact the factory if the regulator is to be used on any service other than LP-gas, natural gas, or air. The following information is located on the spring case: Type number, orifice size, spring range, and date of manufacture.

Installation

⚠ WARNING

All vents should be kept open to permit free flow of air into and out of the regulator. Protect vent openings 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 hazard-

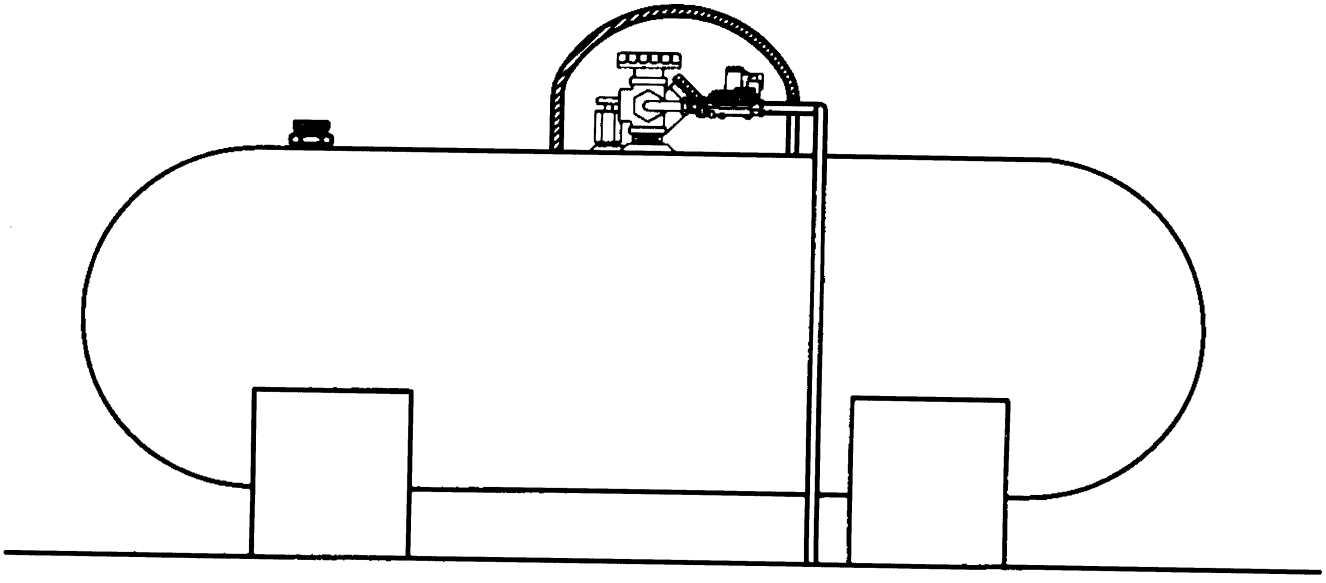

Figure 3. Tank Installation

ous accumulation of gas which could result in personal injury or property damage.

Never use a R622H, R622E or R652E (pounds to pounds) regulator on low pressure (inches of water column) service because personal injury or property damage could occur. The R622E and R652E are not suitable for use as a "first-stage" regulator.

General Installation Instructions

Before installing the regulator,

- Check for damage, which might have occurred in shipment.
- Check for and remove any dirt or foreign material, which may have accumulated in the regulator body.
- Replace old pigtails. Blow out any debris, dirt or copper sulfate in the copper tubing and the pipeline.
- Apply pipe compound to the male threads of the pipe before installing the regulator.
- 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.

Installation Location

- The installed regulator should be adequately protected from vehicular traffic and damage from other external sources.
- **Install the regulator with the vent pointed vertically down, see Figure 2**. If the vent cannot be installed in a vertically down position, the regulator must be installed under a separate protective cover. Installing the regulator with the vent down allows condensation to drain, minimizes the entry of water or other debris from entering the vent, and minimizes vent blockage from freezing precipitation.
- **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. Evan a protective hood may not provide adequate protection in these instances.
- 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.

Regulators subjected to Heavy Snow Conditions

Some installations, such as in areas with heavy snowfall, may require a hood or enclosure to protect the regulator from snow load and vent freeze over.

Horizontally Installed Regulators

Horizontally mounted regulators, such as found in single cylinder installations and ASME tanks, must be installed beneath a protective cover or under the ASME tank dome, refer to Figure 3. If possible, slope or turn the vent down sufficiently to allow any condensation to drain out of the spring case. Be careful

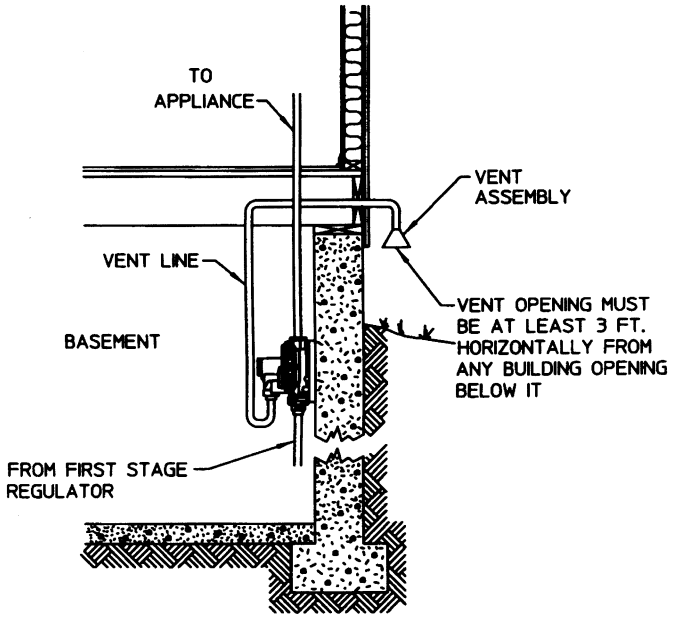

Figure 4. Basement Installation

that the slot in the tank dome or protective cover for the regulator's outlet piping does not expose the vent to the elements. The 1st stage vent on the R632 should be pointed down.

Indoor Installations

By code, regulators installed indoors have limited inlet pressure, and they **require** a vent line to the outside of the building, see Figure 4. A vent assembly, such as Fisher Y602 series, should be used on the end of the vent line. The same installation precautions, previously discussed throughout this manual for the regulator vent, apply to the end of the vent tube assembly. Vent lines must not restrict the gas flow from the regulator's internal relief valve. Vent lines should be at least 3/4" NPT pipe or 3/4" npt size, Gray PVC Schedule 40 Rigid Non-metallic Electrical Conduit for above Ground Service, per UL 651. To install the vent line, remove the vent screen and apply a good grade of pipe dope to the male threads of the line. Vent lines should be as straight as possible with a minimum number of bends.

Underground Installations

CAUTION

Type R632 integral regulators require 2 vent tubes, one on the 1st stage vent and one on the 2nd stage vent, when installed on underground tanks. Failure to use 2 separate vent tubes can result in early regulator failure and/or over pressuring the 2nd stage that could result in fires or personal injury.

Regulators installed in the dome of an underground container require a vent tube to prevent water from entering the regulator spring case, see Figure 5.

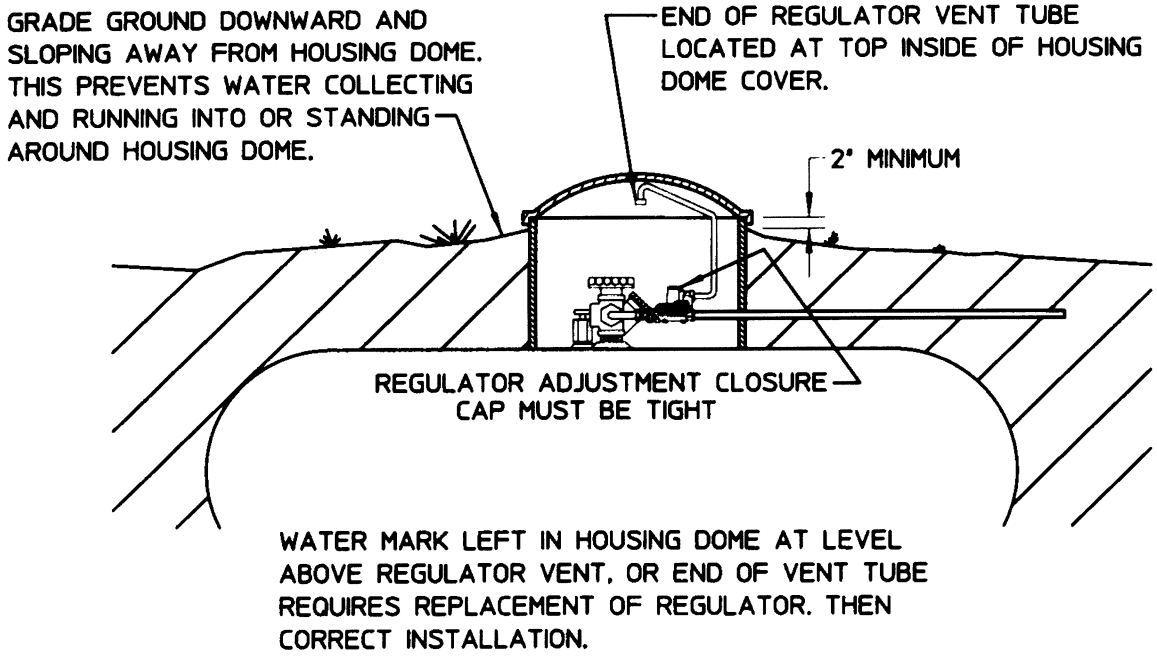

Figure 5. Underground Installation

Note: Type R632 integral regulators installed on underground tanks require the use of 2 vent tubes, one for the 1st stage vent and the other for the 2nd stage vent of the regulator. 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. Make sure the regulator's closing cap is on tightly, and maintain drainage away from the dome at all times. For further information on underground installations, contact Aero Fulfillment Services at phone number 866-840-1075 and ask for Item number 000412 "Installation of Underground LP-Gas Systems: Suggested Installation, Inspection,".

Adjustment

Each regulator is factory set. 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 first stage portion of the R632 integral regulator is non-adjustable**. The outlet pressure plug may be removed using a 7/16" hexagon wrench. The pressure tap is restricted, so the plug can be removed with pressure on the outlet of the regulator. Install a pressure gauge to determine the regulator's outlet setting during adjustment, (Actual pressure at the 2nd stage regulator 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 pressure tap is restricted, so the plug can be removed with pressure on the inlet of the regulator.

Overpressure Protection

WARNING

Some type of overpressure protection is needed if actual inlet pressure can exceed the outlet pressure rating. Overpressuring any portion of this equipment above the limits shown in the Specifications Table 1 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 any portion of the regulator is exposed to an overpressure condition that exceeds the limits in the Specification Table 1, it must be inspected for damage that may have occurred.

Large volumes of gas may discharge through the regulator vent during internal relief valve operation, which can, if not controlled, result in fire or explosion from accumulated gas.

The R600 series regulators, **except for the 1st stage of the type R632**, contain internal relief valves. The internal relief valve in all units will give overpressure protection against excessive build-up resulting from seat leakage due to worn parts or chips or foreign material on the orifice. The amount of internal relief protection provided varies with the regulator type and the cause for the overpressure relief valve operation. When the internal relief valve opens, gas escapes to the atmosphere through the regulator's vent.

Some type of additional external overpressure protection must be provided if the outlet pressure in an overpressure condition exceeds the inlet pressure rating of the gas system or downstream equipment. Common methods of external overpressure protection include relief valves, monitoring regulators, shutoff devices, and series regulation.

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 replacement 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 20 years from date of manufacture or sooner should inspection reveal the need.

Visually inspect the regulator each time a gas delivery is made for:

- Improper installation, vent not pointed vertically down or under a cover; no vent tube on underground systems.
- Plugged or frozen vent.
- Wrong regulator or no regulator in the system.
- Internal or external corrosion.
- Flooded Regulator; water in spring case; regulator submersed on underground tanks
- Regulator age.
- Any other condition that could cause the uncontrolled escape of gas.

Failure to do the above could result in personal injury or property damage.

Vent Opening

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.

Water inside Regulators from Floods, Weather or Water Table on Underground Systems

Replace any regulator that has been flooded or has been submersed below the water table of an underground tank, have had water in their spring case or show evidence of external or internal corrosion. Checking for internal corrosion can be done by removing the closing cap and with the aid of a flashlight observing the condition of the relief valve spring, main spring, and internal spring barrel area. A more detailed examination will require shutting down of the gas system and the complete removal of the adjusting screw. Closely examine regulators installed with their vent horizontal for signs of corrosion. Correct any improper installations.

Regulator Replacement

Older regulators are more likely to catastrophically fail because of worn or corroded parts. Replace R600 Series regulators over 20 years of age. Other service or environmental conditions may dictate replacement of the regulator before it becomes 20 years old. Regulators that are installed on underground systems and in areas that are subject to sea salt (coastal) atmospheres should be inspected annually for external and internal corrosion and may require replacement sooner. Refer to Fisher Bulletin LP-32 for additional information.

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.

The type number, orifice size, and spring range are on a label attached to the spring barrel. The date of manufacture is stamped on the regulator. Always provide this information in any correspondence with your Fisher Distributor regarding replacement parts or technical assistance. **If construction changes are made in the field, be sure that the regulator marking is also changed to reflect the most recent construction**.

Instruction Manual
MCK-2141
03/03

R600 Series LP-Gas Regulators

Emerson Process Management

Fisher Controls International, LLC
P.O. Box 8004
McKinney, Texas 75070, USA
Telephone: 1-800-432-8711
Telephone: 1-972-542-5512

www.FISHERregulators.com/lp

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

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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.

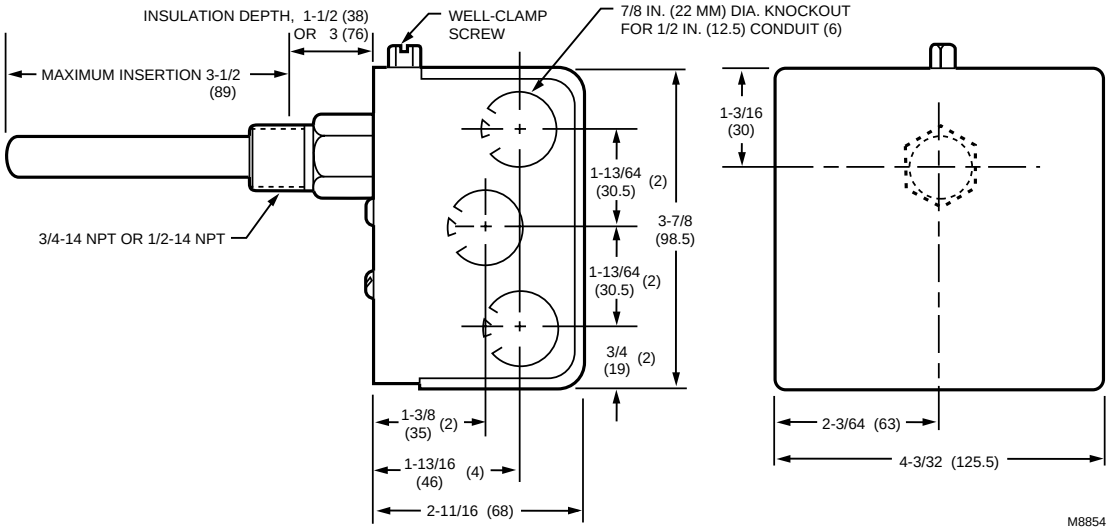
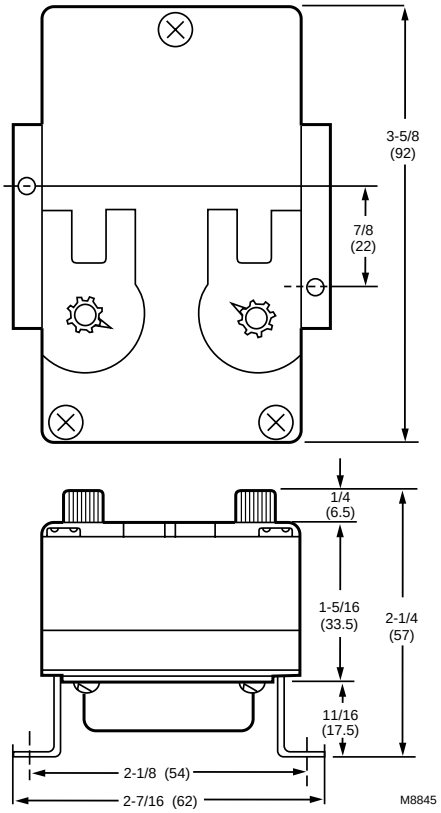


Fig. 2—L6081C mounting dimensions in in. (mm).



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:

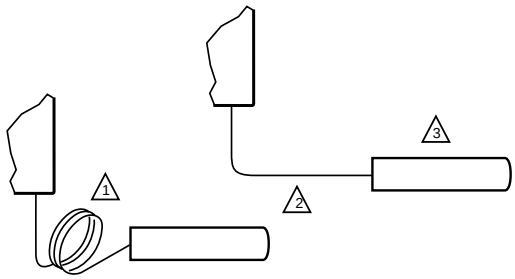
1. Drain the boiler if system is filled with water.
2. Place front of controller down on a horizontal surface and gently raise the sensing bulb until it is at a right angle with the back of the case and centered with the large hole in the case. This requires bending the capillary tube, but be sure to 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.

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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.

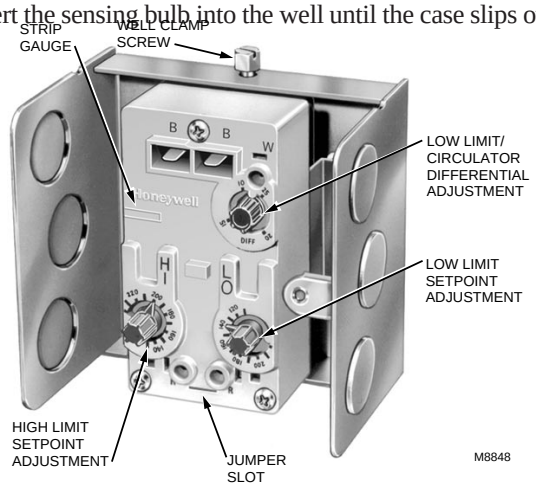
5. Apply pipe dope sparingly to the threads of the well; then screw the well tightly into the boiler tapping.

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.

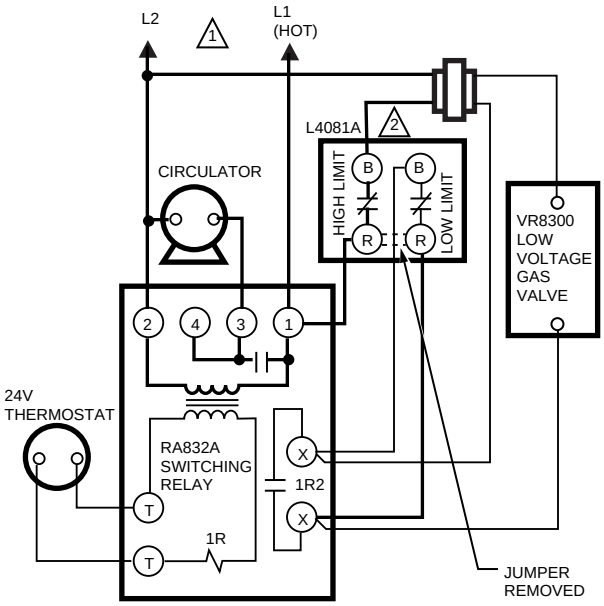
Use the following procedure when connecting wires to the B tab terminals (Fig. 4):

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).

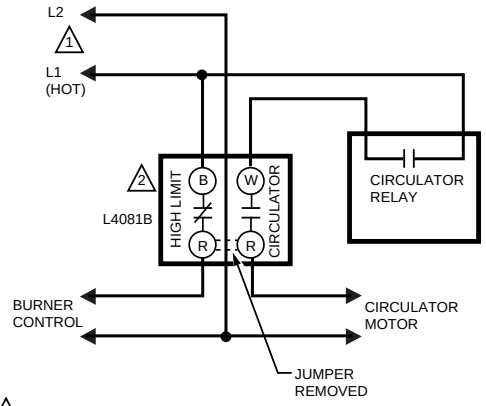


1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 B TERMINALS ARE TAB TERMINALS.

M8846

Fig. 6—L4081B used to prevent circulator operation with boiler water temperature below low limit setting.

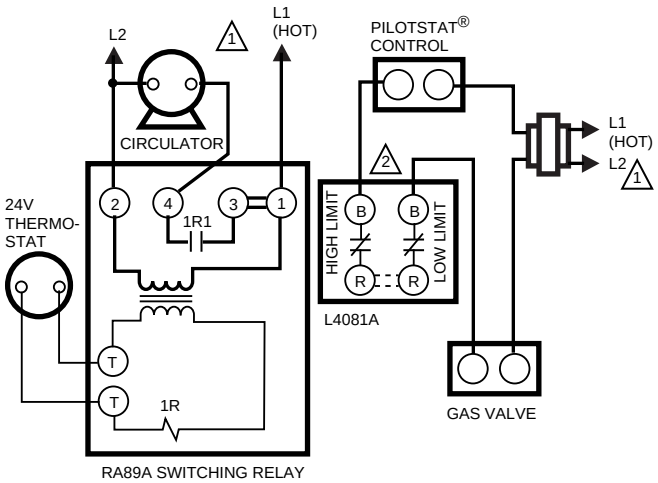


1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

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.

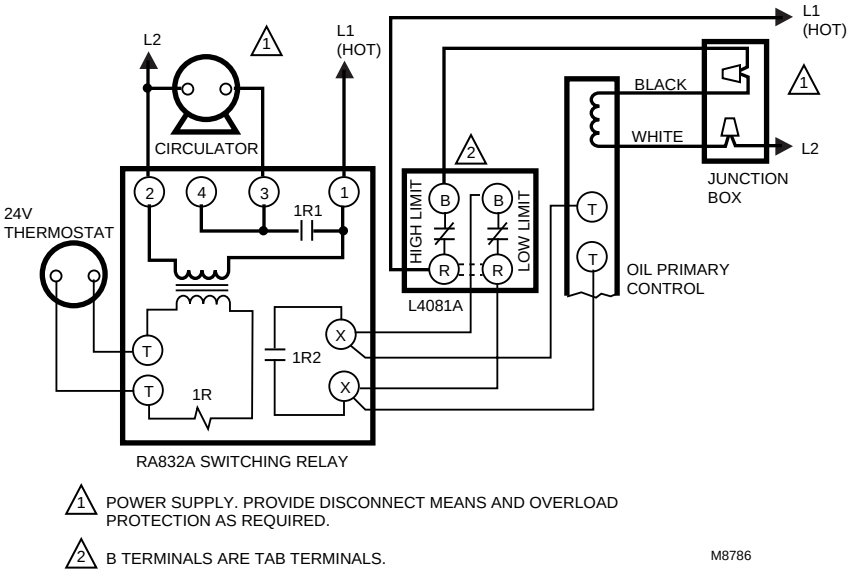
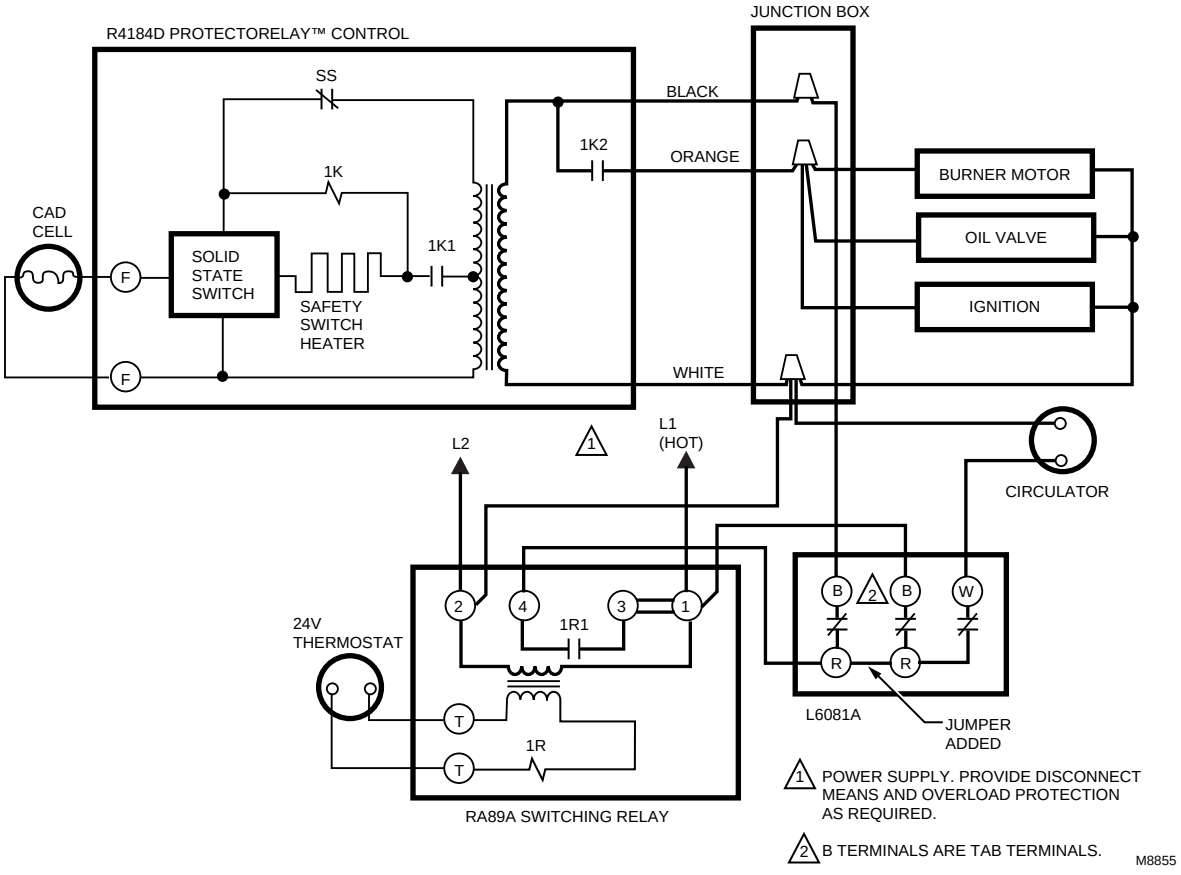


Fig. 9—L6081A used with oil burner.



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.

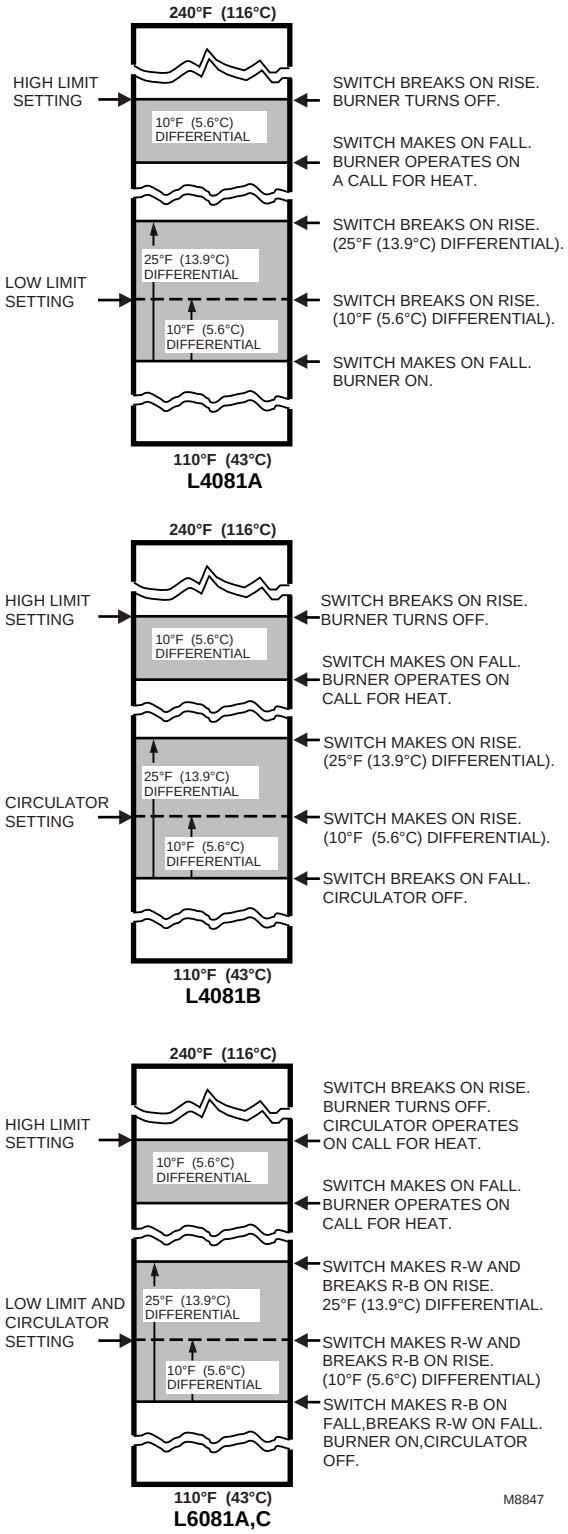
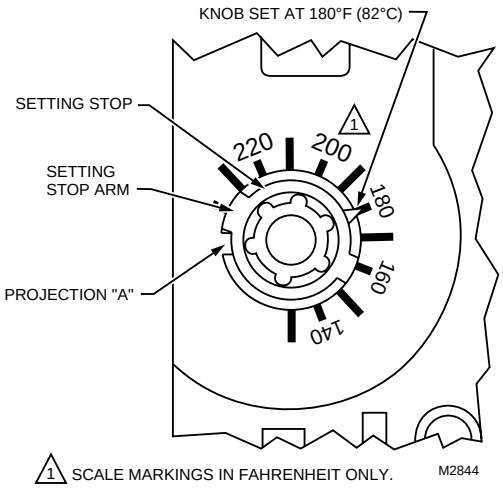


Fig. 11—Setting stop shown in position to limit high limit setting to 180°F (82°C).



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

Prepared by PACE, Incorporated, Minneapolis, MN

NA - Not Applicable NE - Not Established UN - Unavailable PACE MBH039

Material Safety Data Sheet (MSDS) for heat-conductive compound, which is included with the TRADELINE® Aquastat Relay models.

SECTION V - HEALTH HAZARD INFORMATION

DS 9021

ACUTE EFFECTS/SYMPTOMS
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 ☒	IARC yes ☐ no ☒	OSHA yes ☐ no ☒	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.

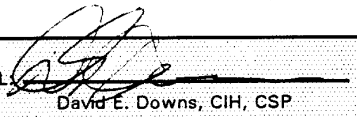
WASTE DISPOSAL METHOD
Dispose of in accordance with Local, State and Federal regulations.

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 2 13 92 DATE

MBH039

Honeywell

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1985 Douglas Drive North
Golden Valley, MN 55422

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Honeywell Limited—Honeywell Limitée
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Scarborough, Ontario
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L6006 and L6007 Aquastat® Controllers

Installation Instructions for the Trained Service Technician.

Application

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

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

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

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

ELECTRICAL RATINGS (A):

	l20 Vac	240 Vac
Full Load	8	5.1
Locked Rotor	48	30.6
Inductive Current	0.25 at 1/4 to 12 Vdc	

Installation

WHEN INSTALLING THIS PRODUCT...

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

WARNING

CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

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

CAUTION

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

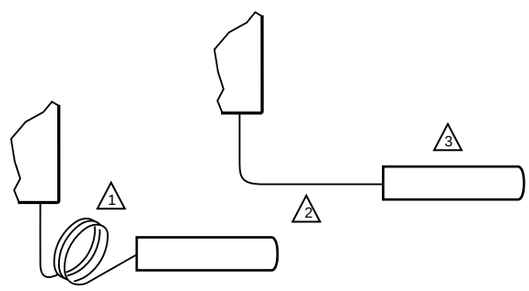
IMPORTANT: *Controller can be used with or without immersion well. If used, well must snugly fit sensing bulb for good thermal response. Bulb should be inserted until it rests against bottom of well, and then held there while the tubing clamp is tightened.*

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. 1.

The manufacturer usually provides a tapping for insertion of the controller sensing element. This tapping is located at a point where typical water temperature can be measured. Depending on model, the element is inserted in an immersion well or directly immersed through a capsule compression fitting.

Follow the instructions furnished by the system manufacturer, if available; otherwise, refer to the appropriate following procedure.

Fig. 1—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

INSTALLING IMMERSION WELL MODELS (L6006A, L6007A)

On existing installation, shut off the power and remove the old control. If the old immersion well appears suitable, and the adapter clamp on the Aquastat® Controller fits the old well spud, do not replace.

1. If the system is filled, drain system to a point below the boiler tapping.

2. Remove plug (or old well) from boiler tapping.

3. Install the immersion well included with the controller. If boiler tapping is greater than 1/2 in., use a reduction fitting to adapt the boiler opening to the 1 in. threads that are standard with the well or fitting. Fittings with 3/4 in. threads are also available.

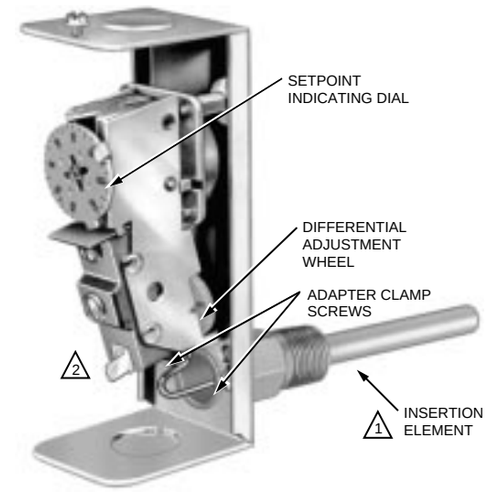
4. Fill the system. Make sure that the well is screwed in tightly enough to prevent leakage. Do *not* tighten after controller is secured to well because of possible excessive force on the case.

5. Loosen screw (at top of case, above scale setting), and remove cover. Loosen two screws that secure adapter clamp. See Fig. 2.

6. Insert the sensing element into the immersion well.

7. Fasten the case of the Aquastat® Controller to the well with the adapter clamp. Make certain that the clamp is properly positioned over the groove of the well spud. Also, be sure the flange at the opening of the well fits snugly into the opening of the case. The sensing element bulb must bottom in the well.

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



1 WITH VERTICAL MOUNTING OF IMMERSION WELL, ELEMENT IS ATTACHED TO BOTTOM OF THE CASE.

2 SELECT MODELS HAVE SCREW TERMINAL, NOT TAB TERMINAL.

M8806

INSTALLING DIRECT IMMERSION MODELS (L6006B)

Install fitting in boiler tapping as follows:

1. Be sure sealing washer is in place as shown in Fig. 3. Make sure that spud of capsule compression fitting is screwed in tightly enough to prevent leaking.

2. Insert immersion bulb (sensing element) through capsule compression fitting. Adjust the adapter clamp so that it fits over the groove at the opening of the capsule compression fitting.

3. Tighten adapter clamp screws so the Aquastat® Controller is firmly attached to the capsule compression fitting.

INSTALLING SURFACE-MOUNTED MODEL (L6006C)

CAUTION

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

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

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

WIRING

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

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

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

Operation

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

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

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

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

Switching action is as follows:

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

Adjustment

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

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

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

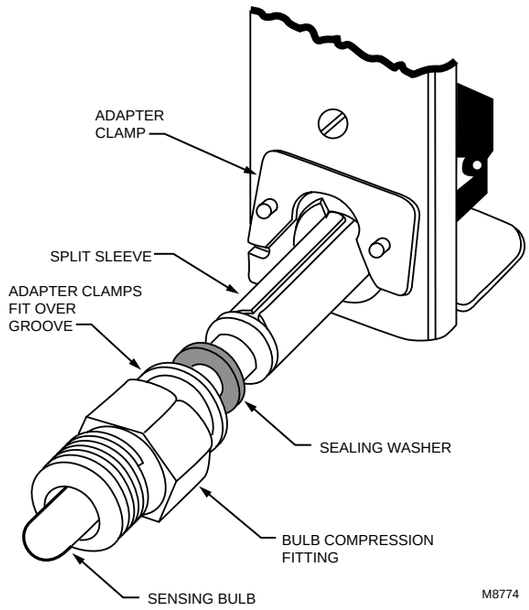


Fig. 4—Mounting L6006C on pipe or tank.

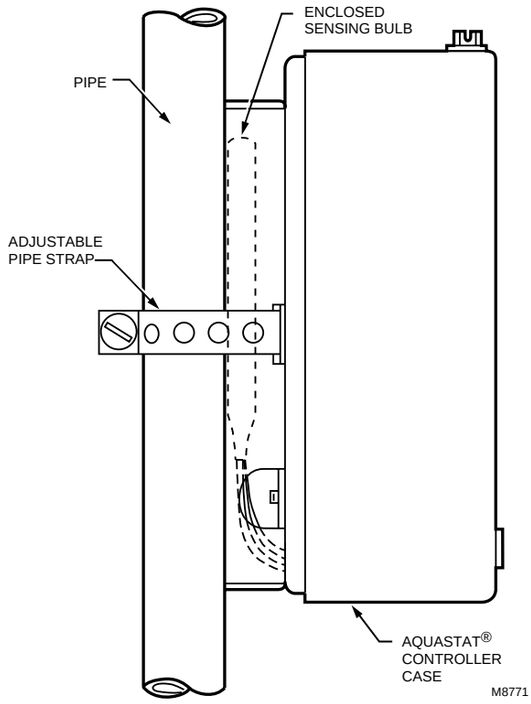


Fig. 5—Typical wiring hookup using the L6006 or L6007 for low limit and circulator control in oil-fired hydronic system.

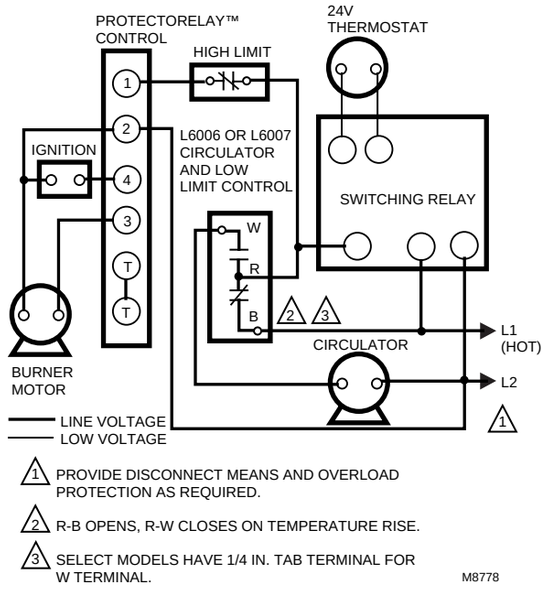
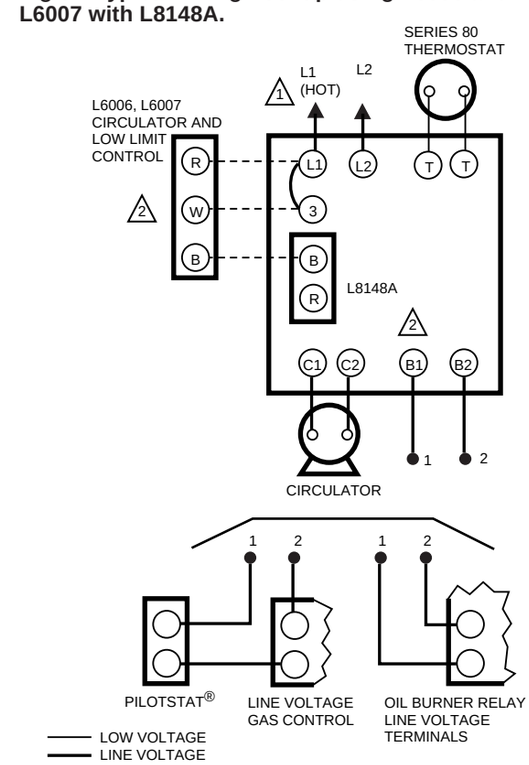


Fig.6—Typical wiring hookup using L6006 and L6007 with L8148A.



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 SELECT MODELS HAVE 1/4 IN. TAB TERMINAL FOR W OR B1 TERMINAL.

M8779

Checkout

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

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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.

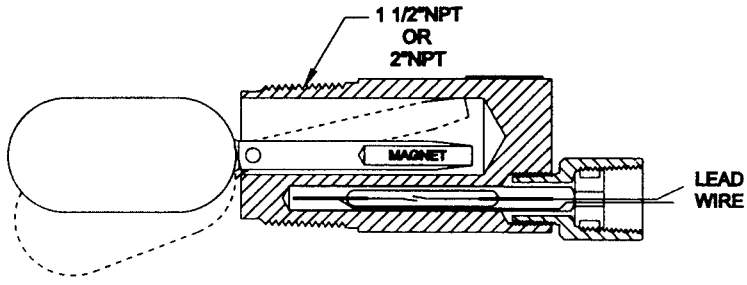

Figure 1

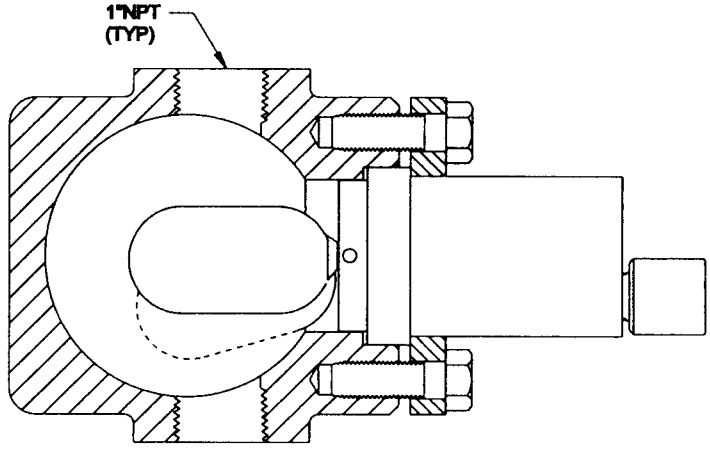

Figure 2

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.

Caution: *Do not exceed switch ratings.*

LINC-L471, LINC-L471SC: *SPST, 100 VA AC with 3 AMP inrush capability, maximum 250 volts.*

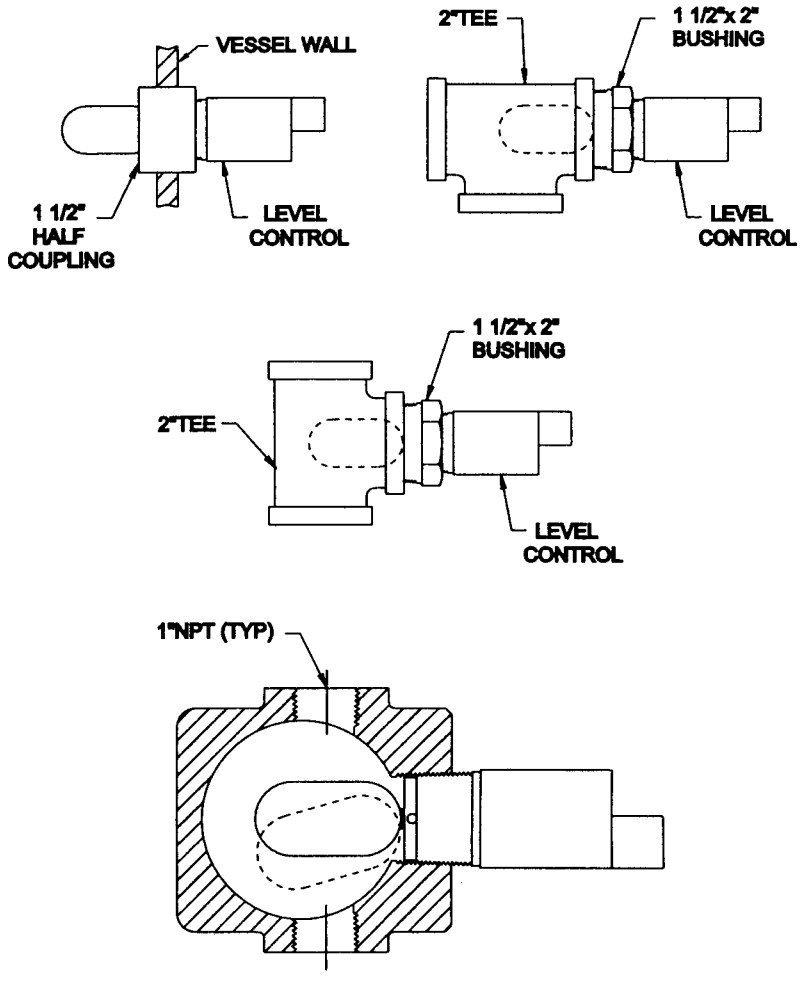

Figure 3

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

ELECTRIC LEVEL CONTROLS

MAINTENANCE

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

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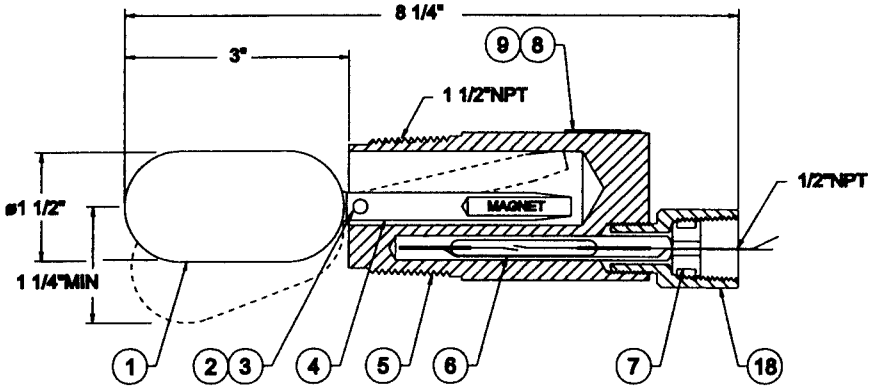
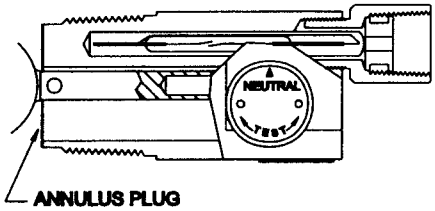
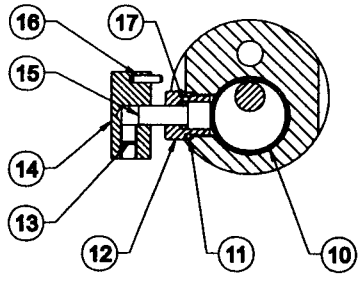


Model LINC-L471-01





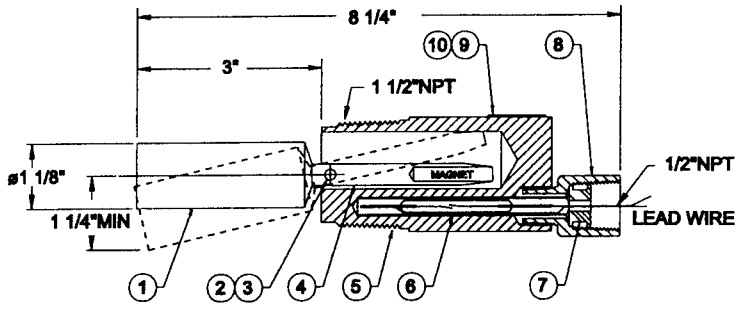
MANUAL OVERRIDE, STANDARD BODY
Body Style -2, -4

Model	L471-01	L471-21			
Item	Part #	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

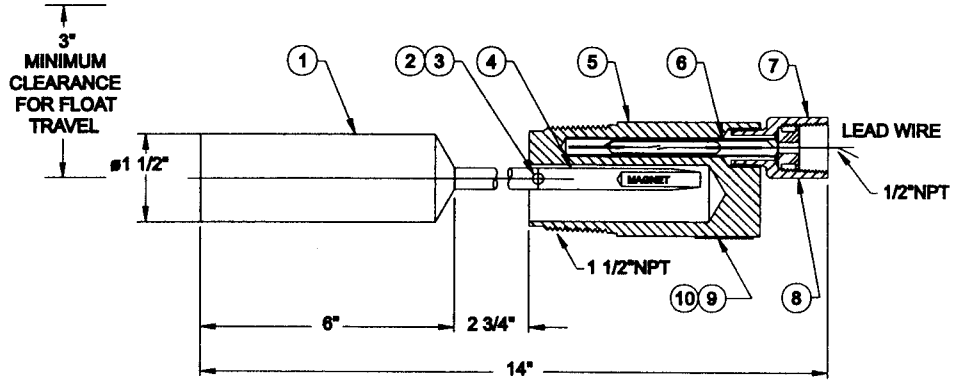
*Recommended spare

ELECTRIC LEVEL CONTROLS

LINC-L471-02 & LINC-L471-03



Model LINC-L471-02



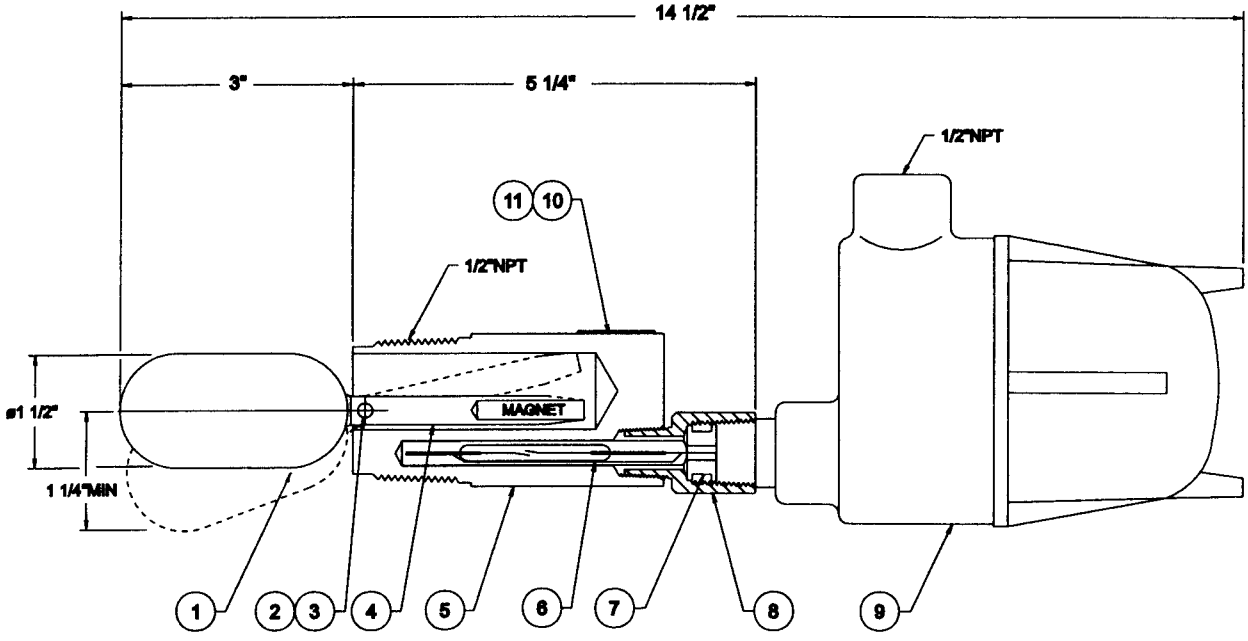
Model LINC-L471-03

Model	L471-02	L471-03			
Item	Part #	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®

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Southfield, MI 48037-2230 U.S.A.
248.356.1400 • Fax 248.356.0829

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.

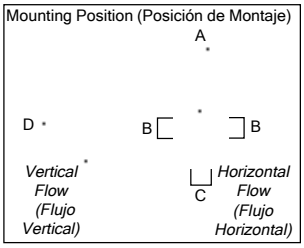
9. **Un regulador MAXITROL deberá usarse** dentro del rango de temperatura y no deberá excederse la presión máxima de entrada que se muestra en la tabla siguiente y deberá estar en la posición indicada de montaje. Los reguladores MAXITROL pueden usarse con todo tipo de gases combustibles.

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] (Posicióndе 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.



LITHO IN U.S.A. 110MMP

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

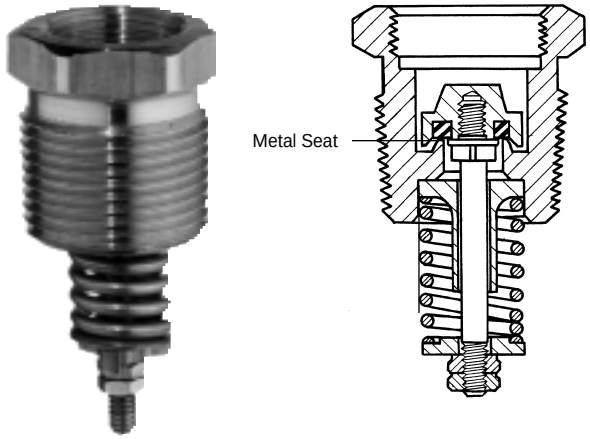
When ordering RegO® Pressure Relief Valves, be sure you are certain that it will sufficiently protect the container as specified in the forewording information, NFPA Pamphlet #58 and any other applicable standards or specifications.

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

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.**

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 0psi 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.

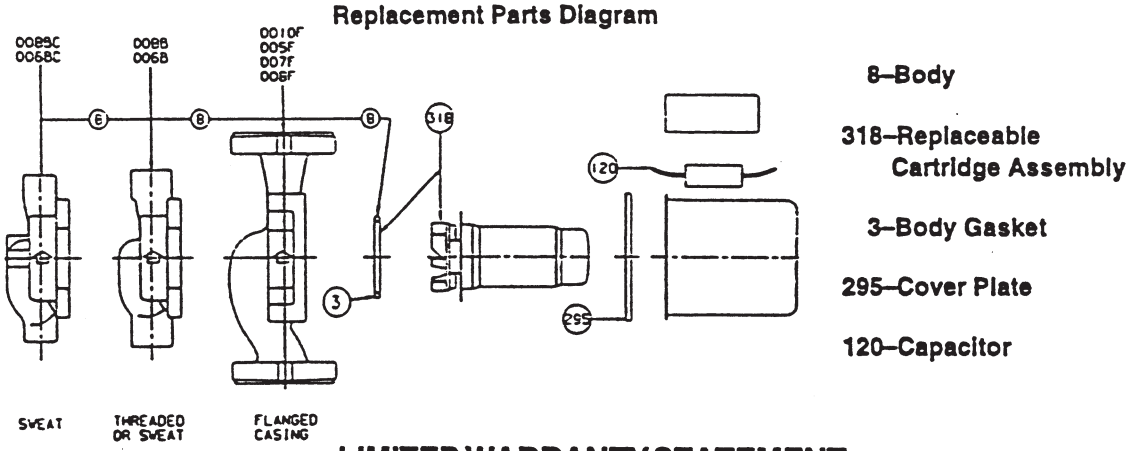
Circulator Product No.	Replacement Cartridge Part Number	
	Cast Iron Units	Bronze Units
005-1,2	005-019RP	005-020RP
006-3,4	N/A	005-020RP
*007-3,4	007-039RP	006-027RP
008-5	008-040RP	008-041RP
009-4	009-001RP	009-007RP
0010-1	0010-001RP	0010-005RP

*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



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.

COMPARE. YOU'LL TAKE TACO.

Taco, Inc., 1160 Cranston Street, Cranston, RI 02920. Telephone: 401/942-8000. FAX: 401/942-2360.
Taco (Canada), Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W1B2. Telephone: 416/625-2160. FAX: 416/625-8616.

Q640V / 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.

Taco 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.

COMPARE. YOU'LL TAKE TACO.

TACO, Inc., 1160 Cranston St., Cranston, RI 02920 (401) 942-8000 Telex: 92-7627
TACO, (Canada) Ltd., 1310 Aimco Blvd., Mississauga, Ontario L4W 1B2 (416) 625-2160 Telex: 06-961179

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 into 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.

APPENDIX B

TECHNICAL INFORMATION

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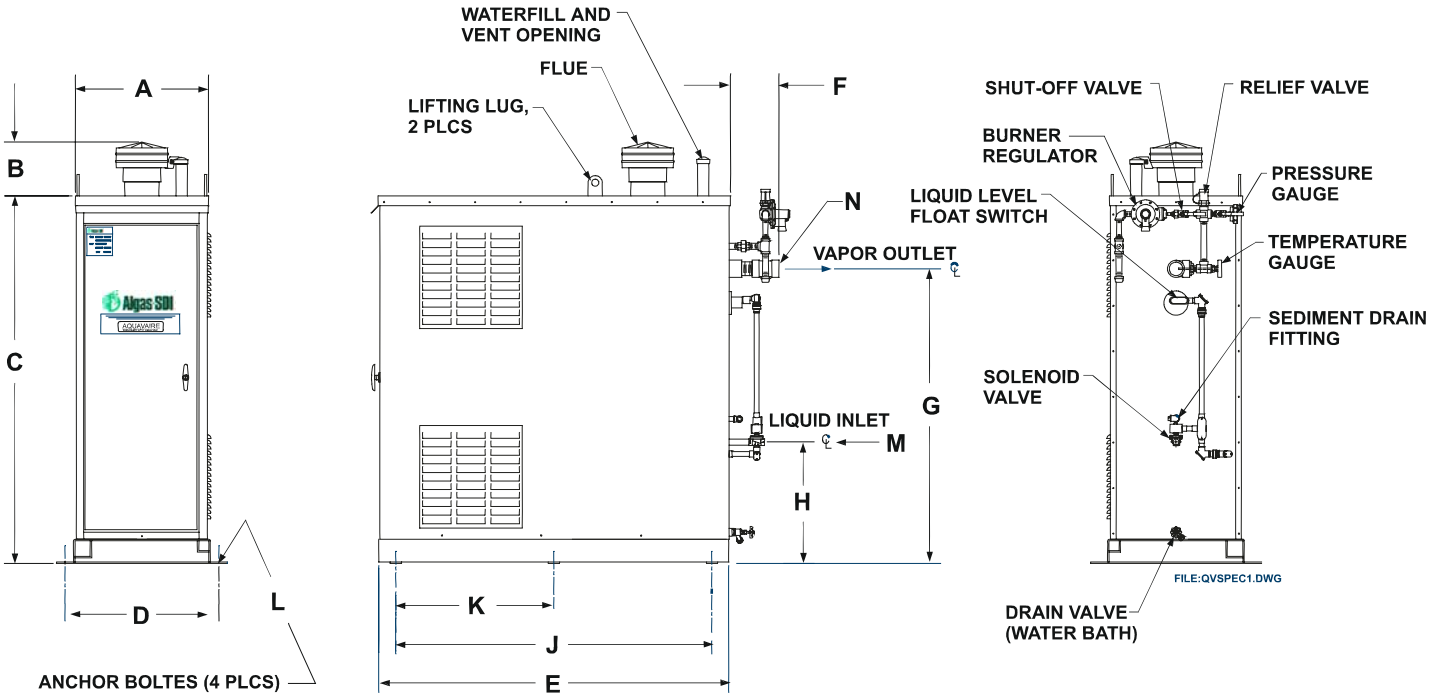
AQUAVAIRE DIMENSIONAL INFORMATION.

Figure 15 – *Aquavaire Dimensional drawing*



MODEL	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	*M*	*N*
Q320V	2'-0" 24" 610mm	0'-10" 10" 254mm	5'-4 1/2" 64 1/2" 1632mm	2'-3" 27" 686mm	5'-1 1/2" 61 1/2" 1562mm	0'-7" 7" 178mm	4'-3 3/4" 51 3/4" 1315mm	1'-9 3/8" 21 3/8" 543mm	4'-7 1/2" 55 1/2" 1410mm	N/A	5/8"	3/4" FNPT	2" FNPT
Q480V	2'-0" 24" 610mm	1'-4 1/4" 16 1/4" 412mm	6'-1 3/4" 73 3/4" 1873mm	2'-3" 27" 686mm	5'-1 1/2" 61 1/2" 1562mm	0'-7" 7" 178mm	5'-1 3/8" 61 3/8" 1559mm	1'-9 1/2" 21 1/2" 546mm	4'-7 1/2" 55 1/2" 1410mm	N/A	5/8"	3/4" FNPT	2" FNPT
Q640V	3'-0" 36" 914mm	1'-5 3/4" 17 3/4" 450mm	5'-5 1/4" 65 1/4" 1657mm	3'-3" 39" 991mm	6'-6 1/4" 78 1/4" 1988mm	0'-7" 7" 178mm	4'-7 3/4" 55 3/4" 1416mm	1'-11 1/8" 23 1/8" 587mm	6'-1/4" 72 1/4" 1835mm	N/A	5/8"	3/4" FNPT	2" FNPT
Q800V	3'-0" 36" 914mm	1'-6" 18" 457mm	6'-6 1/4" 78 1/4" 1988mm	3'-3" 39" 991mm	6'-6 1/4" 78 1/4" 1988mm	0'-7" 7" 178mm	5'-9" 69" 1753mm	1'-11 13/16" 23 13/16" 605mm	6'-1/4" 72 1/4" 1835mm	N/A	5/8"	1" FNPT	2" FNPT
Q960V	3'-0" 36" 914mm	1'-6" 18" 457mm	6'-6 1/4" 78 1/4" 1988mm	3'-3" 39" 991mm	6'-6 1/4" 78 1/4" 1988mm	0'-7" 7" 178mm	5'-9" 69" 1753mm	1'-11 13/16" 23 13/16" 605mm	6'-1/4" 72 1/4" 1835mm	N/A	5/8"	1" FNPT	2" FNPT
Q1120V	4'-3 5/8" 51 5/8" 1311mm	1'-7" 19" 482mm	6'-61/2" 73 1/2" 1867mm	4'-6 1/2" 54 1/2" 1384mm	7'-2 5/8" 86 5/8" 2200mm	0'-7" 7" 178mm	4'-11" 59" 1499mm	2'-8 7/8" 32 7/8" 835mm	6'-8 5/8" 80 5/8" 2048mm	3'-4 5/16" 40 5/16" 1024mm	5/8"	1" FNPT	2" FNPT
Q1375V	4'-3 5/8" 51 5/8" 1311mm	1'-7" 19" 482mm	6'-61/2" 73 1/2" 1867mm	4'-6 1/2" 54 1/2" 1384mm	7'-2 5/8" 86 5/8" 2200mm	0'-7" 7" 178mm	4'-11" 59" 1499mm	2'-8 7/8" 32 7/8" 835mm	6'-8 5/8" 80 5/8" 2048mm	3'-4 5/16" 40 5/16" 1024mm	5/8"	1" FNPT	2" FNPT
Q1650V	4'-3 5/8" 51 5/8" 1311mm	1'-7" 19" 482mm	6'-61/2" 73 1/2" 1867mm	4'-6 1/2" 54 1/2" 1384mm	7'-2 5/8" 86 5/8" 2200mm	0'-7" 7" 178mm	4'-11" 59" 1499mm	2'-8 7/8" 32 7/8" 835mm	6'-8 5/8" 80 5/8" 2048mm	3'-4 5/16" 40 5/16" 1024mm	5/8"	1" FNPT	2" FNPT

QV Drawing Index

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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