Model “SRN and HRN” Atmospheric Steam Boiler

Operating and Maintenance Manual

Designed and Manufactured in Accordance with ASME Code Section I (SRN) & ASME Code Section IV (HRN) Heating Boilers

Photo shown may vary from actual model.

E.T.L. Compliance

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AJAX BOILER INC.

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Operating and Installation Instructions (Model SRN & HRN)

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

The Ajax steam boiler is of rugged construction, yet of simple design. The boiler is of the incline water tube type, consisting of two water headers with interconnecting, 2" O.D., straight inclined tubes. Normally, steel tubes are supplied on “closed” systems where the amount of make-up water is negligible. Copper tubes should be used on “raw” water applications, where a total or a high percentage of water make up takes place, or where water with high corrosive properties is encountered.

The tubes are rolled and flared into tube sheets with a minimum 1/2" thick, P.V. quality steel plate. The boiler is equipped with removable head plates, front and rear, giving easy access to the straight tubes for inspection, cleaning or replacing.

The combustion chamber and flue passages are designed to give maximum efficiency and serviceability. The best grade of castable refractory is used. Expansion joints are provided to allow for normal contraction and expansion of the refractory. The refractory is backed up with 3” of rockwool insulation. The boiler is enclosed in a casing of 18 gauge-galvanized steel.

The boiler serial number is stamped on the front header plate and on the boiler nameplate, generally mounted on the right hand side of the boiler. All boilers furnished with copper tubes will have a decal applied on the front and rear head plates and will have sacrificial anodes fixed in the water box section of the head plates.

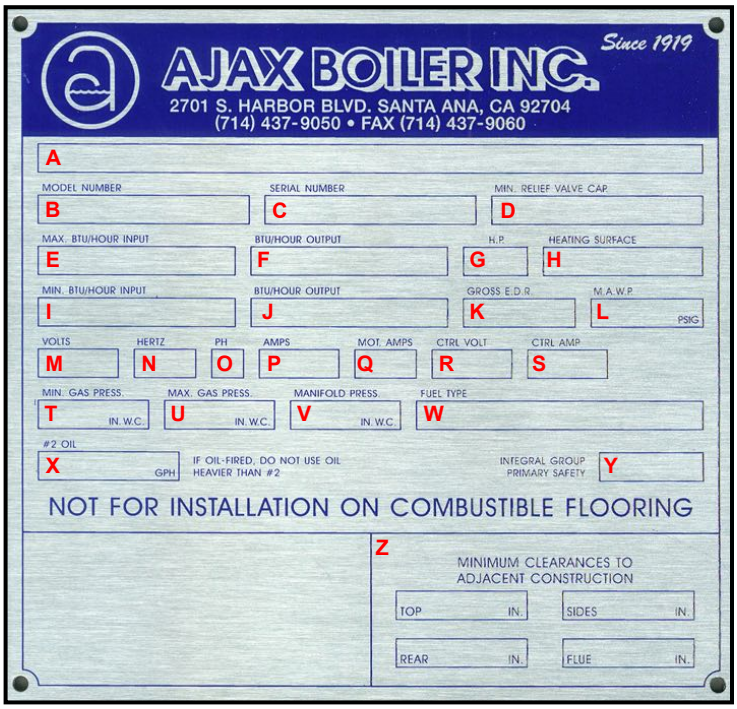
Experience in the field has proven that the Ajax Boilers, if properly applied and maintained, will give many years of efficient, dependable and economical service.

The Boiler Nameplate And Model Number

The Boiler Name Plate

The following illustration is an accurate depiction of the nameplate found on the right hand side of the boiler. You will also find an ASME nameplate on the front head plate with some of the same information.

A. Boiler description
B. Model number
C. Serial number
D. Minimum relief valve capacity
E. Maximum Btu/Hr fuel input
F. Maximum Btu/Hr output**
G. Boiler horsepower
H. Square feet of heating surface
I. Minimum Btu/Hr fuel input*
J. Minimum Btu/Hr output***
K. Gross E.D.R.
L. Max. allowable working press.***
M. Supply voltage
N. Electrical supply Hertz
O. Electrical supply Phase
P. Required Amperage
Q. Motor amp draw****
R. Control voltage****
S. Control amp draw****
T. Min. Gas pressure*****
U. Max. Gas pressure*****
V. Manifold gas pressure*****
W. Fuel type (See model #)
X. Gallons per hour oil****
Y. Int. Group Prim Safety****
Z. Minimum distances btw. boiler and adjacent construction.



* Minimum Btu/Hr ratings apply to high-low and modulating type boilers only.
** Boiler output ratings are based on factory tests under appropriate conditions. Field results may vary.
*** Maximum allowable working pressure for boiler only. Relief valve set pressure should not exceed the lowest MAWP of any component in your system.
**** Applies to forced draft type burners only
***** Minimum and maximum gas pressure values are measured at the point of connection to the boiler gas train. Manifold gas pressures are measured after the gas train.

The Boiler Model Number

S R N G 50 W

Type of boiler:
W = 125 PSIG MAWP Hot Water
DR = 150 PSIG MAWP Hot Water
HR = 15 PSIG MAWP Low Pressure Steam
SR = 150 PSIG MAWP High Pressure Steam

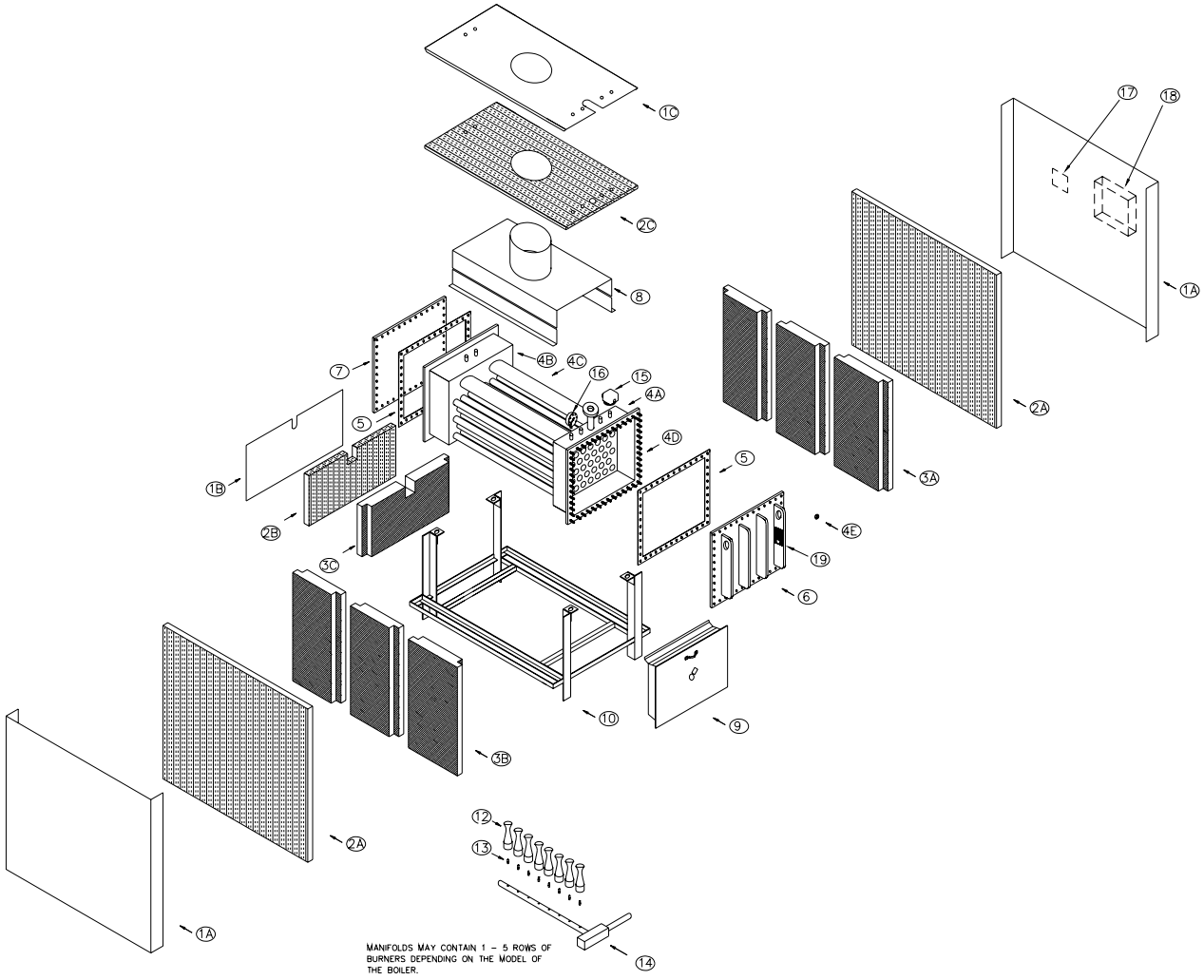
Type of burner:
N = Atmospheric (H-Burner)
F = Forced Draft
E = High Efficiency Forced Draft
P = Premix Low NOx
R = Atmospheric (Round Burner)

Firing Rate:
150 = 150,000 Btu/Hr.
(On high pressure steam, # represents HP)

Fuel Type:
G = Natural Gas
P = Propane
C = Combination #2 Oil/Natural Gas
W = Outdoor
O = #2 Oil
D = Dual Gas (Natural Gas/Propane)

The Parts of the Boiler

Exploded Boiler View



Parts

1a	Outer sheet metal jacket-RT	6,7	Head plates
1b	Outer sheet metal jacket-LFT	8	Inner top flue collector
1c	Rear jacket panel	9	Front door
1d	Top sheet metal jacketing	10	Stand frame
2a,b,c,d	Rockwool insulation	12	Burner head
3a,b,c	High temp refractory	13	Orifice
4a	Front box header	14	Manifold
4b	Rear box header	15	Low water probes
4c	Boiler tubes and steam drum	16	Pressure-temperature gauge
4d	Welded stud bolts	17	Boiler name plate
4e	Head plate nuts	18	Electrical panel
5	Gasket	19	ASME data plate

See manufacturer's cut-sheets enclosed with the boiler for complete information on the various parts.

Receiving your boiler And Installation

Receiving your boiler

Check Equipment Received: Inspect the boiler for any shipping damage. Make sure you have received all loose parts, such as draft hoods or controls packaged separately, which are listed on the packing slip. Note any damages or shortages on the bill of lading prior to signing it. *If a boiler is received damaged or missing parts, it is your responsibility to notify the shipping company and file a freight claim*. Ajax Boiler cannot send replacement parts for freight damaged or missing equipment as warranty items. Consignee must file claims for shortages and damages with the carrier. Permission to return goods must be received from the factory prior to shipping. Goods returned without a Returned Goods Authorization number will not be accepted. Purchased parts are subject to replacement only under the manufacturer's warranty. The warranty does not include the cost of labor, removal, or installation of the warranted part.

Installation

Code Requirements: It is very important that your installation comply with all federal, state and local codes (NFGC, NEC, NFPA, CSD-1) as well as meet good industry practices as shown in publications issued by ASME, AGA, UL, ASHRAE, ABMA, ANSI etc.

Boiler Placement: The boiler should be placed on a solid foundation, preferably a concrete pad, adequately sized for your boiler. Ajax Boilers are not suitable for installation on combustible surfaces. Electrical conduit **should not** be imbedded in the concrete directly under the boiler without first consulting with the engineer of the approved boiler pad. Provide adequate clearance for normal inspection and maintenance purposes and allow proper clearances for combustion air. Also, allow tube pull length clearance in the front or rear of the boiler for servicing (see boiler dimensions page for tube lengths). The minimum clearances to combustible surfaces are listed under the UL-795 clearance guidelines and on the boiler nameplate. Make sure the boiler is level, from side to side and front to back. Use metal shims if necessary.

Combustion Air: Adequate combustion air is one of the most important requirements for an atmospheric fired boiler. A lack of proper airflow can result in poor combustion, sooting and premature failure to the boiler. Sizing combustion air intakes according to the National Fuel Gas Code or NFPA 54 is acceptable. Ventilation openings should be provided per the National Fuel Gas Code. The boiler room should have two permanent openings. One opening shall be within two feet of the ceiling and one more within two feet of the floor. Each opening should have a free area of not less than 1 square inch per 1,000 BTU/HR of the total input of every combustion product in the boiler room. The openings should not be obstructed from the outside and air conditioning or exhaust fans should not interfere with proper airflow and ventilation of the boiler room. Consideration should always be given to the blocking effect of louvers in determining total free area. Always leave adequate clearance around the base of the boiler to allow the combustion air to freely enter the combustion chamber. The combustion air entering the boiler must be free of hazardous and flammable vapor fumes. This includes such fumes as perchlorethylene, chlorine, etc.

Venting: This boiler operates with a negative vent static pressure and is approved for use with "B" vent. The boiler must be vented as directly as possible and protected from excessive wind and/or down draft conditions. The stack must be equipped with an appropriate weather cap of the correct size. and protected from excessive wind and or down draft conditions. Draft hoods or barometric dampers should be installed directly above the boiler. The stack must be the same diameter as the boiler vent or the combined area of multiple boiler vents. The recommended upward slope of the horizontal breaching is 1" per linear foot. In other words, the stack should rise 1" vertically for each foot horizontally. The stack should reach at least 3 feet above the highest obstruction of the roof to insure proper venting. At no time should the boiler support the stack weight. (Refer to the latest version of the National Fuel Gas Code for additional installation requirements).

When a draft inducer is required, a draft proving switch must be wired to the boiler to prevent the boiler from firing unless the draft is proven.

Relief Valve: The relief valve discharge must be piped to a floor drain to eliminate the potential of scalding burns. The drain line must be the same size as the relief valve outlet and have a downward slope to insure proper drainage. The drain line termination should be visible to see discharge. Check the relief valve nameplate. The boiler operating pressure cannot exceed that listed on the relief valve. Also, confirm the boiler does not exceed the maximum Btu rating on the relief valve.

Stud Nuts on Boiler Headers: During shipment, the head plate nuts may loosen. Tighten these if required to the torques specified later in this manual. After the boiler has been in operation for a few days, check and retighten the head plate nuts. Ajax recommends using an anti-seize compound when reinstalling head plate nuts. Refer to *Quick Reference Guide*.

Water Connections: See typical piping diagram as shown in the installation instructions (page 9).

Gas Connections: Check supply gas pressure and select gas line pipe size for adequate capacity at boiler firing rate. Install a condensate trap in the gas line ahead of the boiler gas valve regulator. Do not use Teflon tape on the gas line pipe threads. Use a pipe compound rated for use with gas. All gas piping must be leak tested after installation as components may work loose during shipment. Do not check for gas leaks with an open flame. Use a bubble test. Do not test the boiler gas piping at a pressure higher than the boiler maximum gas pressure rating as this can damage the gas train components. Support the gas piping with hangers, not by the boiler or its accessories.

Manual Main Gas Shutoff Valve: This valve is located on the upstream of the main gas pressure regulator and is normally located on the lower right side of the boiler. The gas supply is to be connected to this valve. Boilers with a minimum input rating are set for the specified rating at the factory. The minimum input rating is not adjustable in the field.

Electrical: The boiler is wired for 120volts 60hz 1phase and 12 amps, unless otherwise noted on the boiler nameplate. Verify the electrical supply using a voltmeter. he voltage tie-in leads are indicated on the wiring diagram. *For your safety, turn off electrical power supply at the service entrance before making any electrical connections.* This boiler contains sensitive control components and should be protected by a suitable commercial grade surge protection device and properly grounded. The boiler must be installed in accordance with the National Electric Code and in accordance with all state and local codes.

Pump Selection: An appropriate sized pump will need to be installed, to pump water through the boiler at its appropriate flow rate. Ajax recommends using a delta T of 20° to 40°F through the boiler. The boiler circulation pump must interlock with the boiler, so the pump will operate under normal boiler operation.

Expansion Tank: A properly sized expansion tank is required on the boiler-piping loop.

Indoor Boilers: Protect all electrical components from moisture. The venting must be completely sealed to prevent spent flue gas into the boiler room. The draft diverter must be installed on top of metal screws in the boiler vent(s) per U.L. requirement. ***Note:*** Boilers are not designed to support stack weight.

Outdoor Boilers: The Ajax atmospheric outdoor boiler design is UL and ETL certified for outdoor installation. Outdoor boilers have been tested to light off in 40 MPH and operate in 10 MPH wind conditions. Boiler must be protected from excessive wind and or down draft conditions (see venting). The boiler must not be installed under any overhang that is less than 6 feet from the top of the boiler. Three sides must be open in the area under the overhang. All roof water drainage must be diverted away from the boiler. Outdoor boilers are self-venting when supplied with the factory supplied rain cap and require no additional vent piping, however, the vent must not be exposed to down draft conditions.

Size of Piping to Gas Boilers

In determining the size of gas pipe, the following factors should be considered:

a.) Length of pipe and number of fittings.
b.) Maximum gas consumption to be provided for (including possible future expansion).
c.) Allowable loss in pressure from meter outlet to boiler.

The volume to be used (in cubic feet per hour) shall be determined, whenever possible, directly from BTU ratings of the boiler which will be installed and the heating value of the gas to be used. To obtain the cubic feet per hour, divide the total BTU input of the boiler by the BTU heating value per cubic foot of gas.

PIPE DELIVERY SCHEDULE

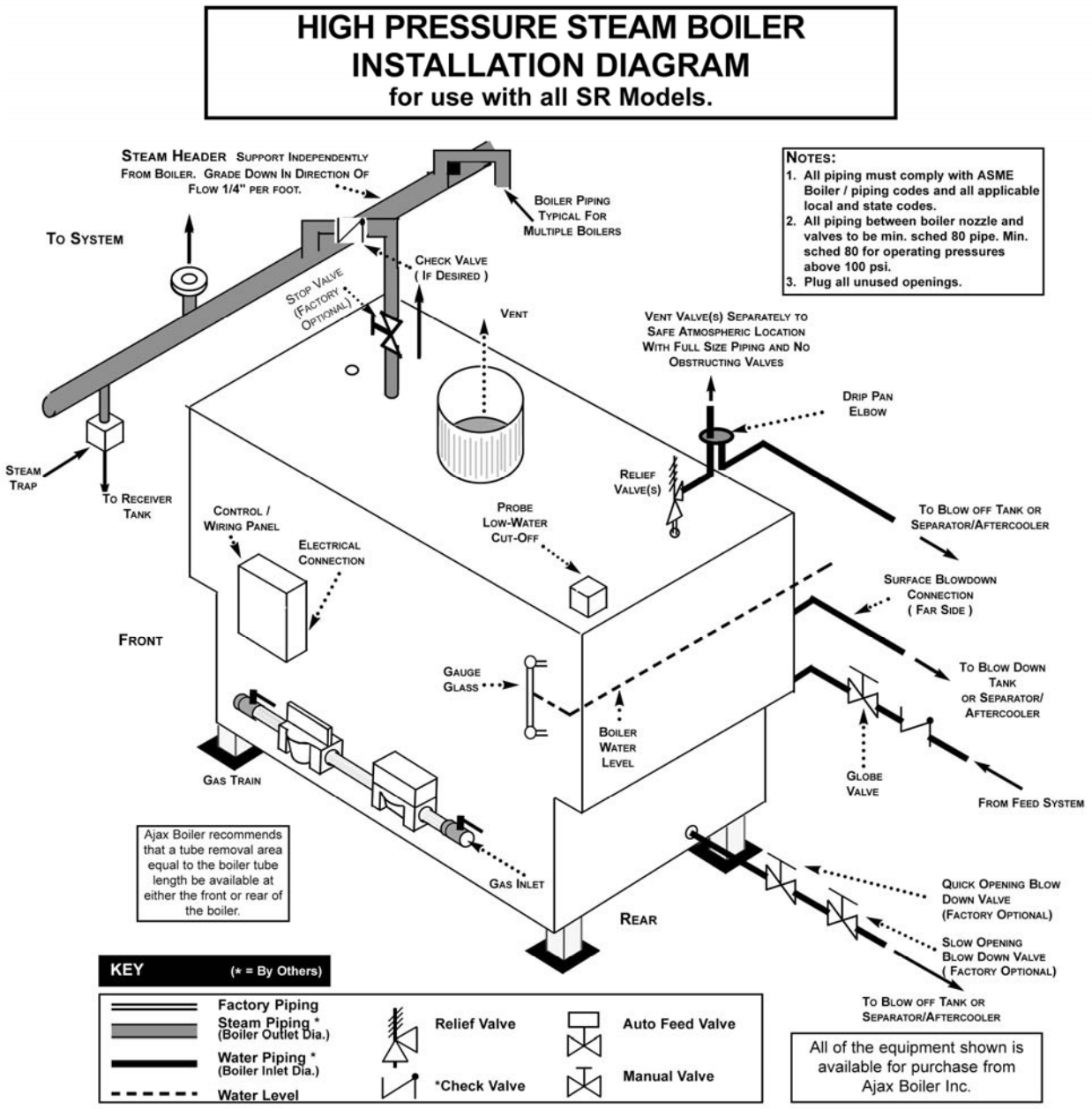
Length of Pipe in Feet	1”	1-1/4”	1-1/2”	2”	2-1/2”	3”	4”	6”
10	520	1,050	1,600	3,050	4,800	8,500	17,500	44,000
20	350	730	1,100	2,100	3,300	5,900	12,000	31,000
30	285	590	890	1,650	2,700	4,700	9,700	25,000
40	245	500	760	1,450	2,300	4,100	8,300	22,000
50	215	440	670	1,270	2,000	3,600	7,400	19,000
75	175	360	545	1,020	1,650	2,900	6,000	16,000
100	150	305	460	870	1,400	2,500	5,100	14,000
150	120	250	380	710	1,130	2,000	4,100	11,600

* Capacity of Pipes in Cubic Feet of Gas per Hour
** Pipe sizes in the table are based on a pressure drop of 0.3 inches water column and a specific gravity of 0.60.

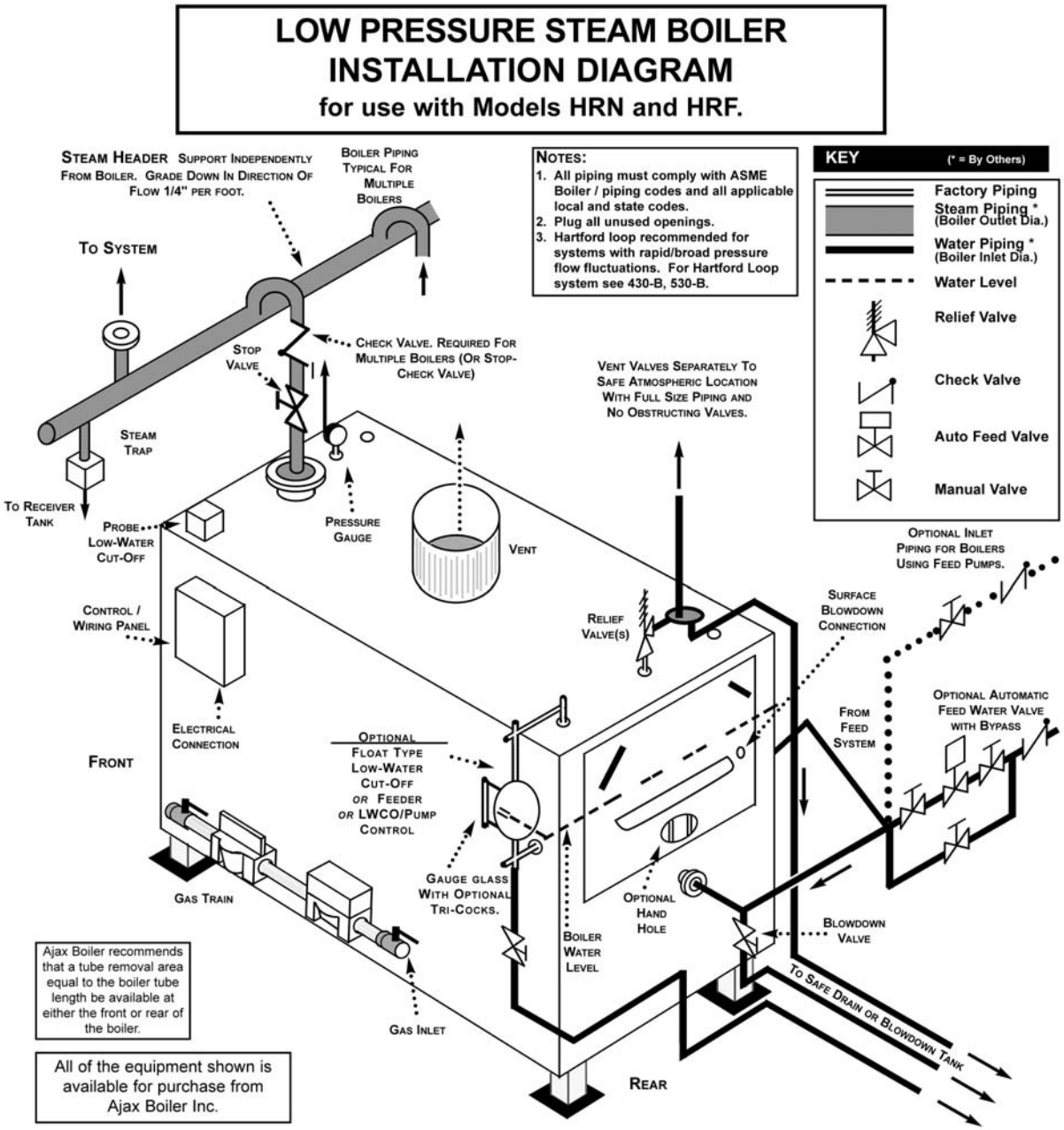
ADDITIONAL LENGTH OF PIPE TO BE ADDED FOR EACH ELBOW OR TEE BEND IN THE LINE

Pipe Size Inches	Elbow	Tee
1	2.62 ft.	5.24 ft.
1-1/4	3.45 ft.	6.90 ft.
1-1/2	4.02 ft.	8.04 ft.
2	5.17 ft.	10.3 ft
3	7.67 ft.	15.3 ft.
4 Fl.	5.37 ft.	15.1 ft.
6 Fl.	8.09 ft.	22.8 ft.

Installation Diagram (High Pressure)



Installation Diagram (Low Pressure)



Water Treatment

We, the manufacturer of your boiler, wish to call to your attention to the necessity for a sound approach to the broad problem of boiler feed water treatment.

Boilers used for space heating purposes only, operate with a closed system of piping in which all of the boiler water is brought back to the boiler. Under these conditions, very little raw makeup water is added to the system. Unless there are system leaks, only a small amount of makeup is required and there is little need for attention to the problem of feed water treatment. Heating boilers are subject to idle periods during the warmer months of a year. Protection of such idle boilers to prevent corrosion should be considered. Such protection can be provided in several ways and can be recommended by a qualified feed water treatment service or chemical supply company in your area.

Makeup water continuously introduces contaminants; scale forming solids, corrosive minerals and oxygen, which is the primary cause of corrosion, in both water and steam boilers. The application of your boiler system, the condition of your boiler system and its operation should be carefully considered. For example, during initial operating periods of a new or a remodeled boiler system, all or a large amount of the water may be wasted. There are other reasons for water losses such as piping leaks, a faulty relief valve, blow down, summer drainage, etc. Whenever appreciable amounts of raw makeup water are continuously added to your system, we recommend that the problem be brought to the attention of a qualified water consultant.

Boiler water treatment means more than just scale prevention. It actually includes:

1. The kind and control of the chemical treatment.
2. A suitable method of regulating the preheating and pretreatment of raw water.
3. Regulating and the method of blow down of the boiler water in amounts proportionate to the raw water makeup.

The treatment program maintains the boiler water concentration within safe and acceptable limits for longer boiler life and reduced maintenance.

The feed water treatment is dependent upon the make-up water conditions. We, the manufacturer, offer the following general guidelines for water treatment. Refer to *Quick Reference Guide*.

The analysis for and the supervision of this treatment and control can only be handled by a qualified operator, of your own or an outside chemical service that specializes in the field.

Particular care is exercised in handling the water problems in large utility central station plants. Modern industrial boilers deserve comparable attention. All modern boilers, including the smaller industrial types, are designed with lower water storage content than was used many years ago. They operate at ratings above those employed on the boilers of yesterday. This is one of the reasons we draw your attention to the importance of the proper handling of the water problem.

Water treatment is a specialized subject that we, as boiler manufacturers, are not qualified to carry on a water treatment service. We, therefore, recommend that a qualified feed water treatment service company be used to supervise all phases of the water problem that may be encountered in your installation. This service should be picked most carefully as the prevention of trouble costs far less than the cost of repairs to equipment that has been neglected.

Final proof of any feed water treatment program is in the continued observation of its effectiveness on the waterside surfaces of the boiler. Regular internal inspection of the boiler, therefore, should become part of the maintenance program.

Before Start-up

1. **Check the burners:** Remove the front door to get access to the boiler firebox. Remove shipping tie down wire from the burner heads. The wire is used to hold the burners intact during shipping.

If not removed, the wire may cause failure of the controls and/or cause improper combustion.

Examine each burner to make sure that the burner heads and venturi tubes are straight and securely in place. Make sure that the burner heads are lined up properly and have not been misaligned in shipping. Also, examine the pilot, sensor and spark electrode to make sure that they have not become misaligned.

2. **Clean system:** The boiler and the entire system should be cleaned and flushed prior to filling the boiler in accordance with ASME recommendations.

3. **Fill the boiler:**

   a.) After cleaning, fill the system with a treated water mixture according to a water treatment specialist's recommendation and to the correct system pressure. Further information can be found at www.H2Ochem.com.

   b.) After filling the system, inspect all piping throughout the system for leaks. If found, make necessary repairs.

4. **Additional controls:** Boilers are pre-wired at the factory. If additional controls are to be installed, care should be taken not to disturb the continuity of the existing circuit. Refer to the boiler wiring diagram and control manufacturer's instructions supplied with the boiler.

5. **Check factory assembled joints and head bolts:** Although the boiler pressure vessel and the gas train are pressure tested prior to shipping, often times during shipment, items may work loose. These items may include head plate nuts, relief valves and gas train assemblies. These items should be checked prior to operating the boiler and tightened. Refer to *Quick Reference Guide*.

Important! The boiler gas piping and all connections should be tested for leaks before starting up the boiler. *Do not use a flame test*. It is important that you check the boiler gas train as some components may shift during transport. The boiler has been furnished completely assembled at the factory and all burner heads, venturi tubes and orifices have been furnished to deliver rated capacity, for the type of gas specified, as designated on the boiler nameplate. The manifold pressure must be set between 3.5" to 4" Water Column for natural gas and 11" Water Column for propane (LPG). The supply pressure to the boiler regulator must be set between the minimum and maximum pressures stated on the boiler nameplate.

Start-up Instructions

Boilout Instruction: Cleaning of the water side surfaces of the boiler to remove loose scale, grease and other foreign material prior initial operation is necessary to maintain high quality steam.

Important! When starting up your boiler for the first time, run it at low fire for 30 minutes prior to running it at high fire. The refractory panels may contain moisture from the curing process. Running the boiler at low fire will dry out the panels. If the boiler is immediately operated at high fire, there may be a chance that the refractory will crack. A "cold" boiler should be treated the same way.

1. **Read manual:** Before attempting to start-up the boiler, read this manual in its entirety and be familiar with the details contained within.

2. **Verification:** Locate the boiler nameplate and verify the voltage, type of gas, gas pressure and regulator setting. Ensure free combustion air openings to the boiler room meet the requirements on the boiler nameplate, local codes, gas industry standards and the O&M manual. The venting will include a draft hood or barometric damper (Indoor units only). A wind deflecting vent cap that prevents down drafts, must be securely fastened to the vent outlet. Outdoor units will be provided with a rain cap as standard.

3. **Inspect:** Turn off all electric power and open the main gas valve. Smell for gas, especially around the floor. **If you smell gas, shut the main gas valve to the boiler immediately and check for piping leaks!** If you do not smell gas, go on to the next step.

4. **Operating controller:** Set the operating pressure controller to its lowest setting and the hi-limit 10psi above the operating pressure control. (Figure 1.4)

Figure 1.4

5. **Verify pilot and ignition:** Before attempting to fire the boilers main burners, verify the operation of the ignition and pilot. Disable the main burners by closing the manual gas valves (closest to the burner manifold) on each burner stage. (If this is an on-off staged boiler, it will have only one valve).

6. **Turn on main power:** Open the pilot and main manual gas valve and turn the ON-OFF switch on the boiler control panel to the ON position. The pilot should light after attempting its trial for ignition. If the pilot does not light, check all the manual resets on the boiler (gas pressure switches, high limit). It may take several tries to purge the air from the pilot lines.

7. **Open main valve(s):** Once the pilot has been established, open the manual valves on the gas train to half open. The main burners should light. Let the boiler run at this low input rate for 30 minutes. This will evaporate the moisture in the refractory panels.

8. **Low fire run time:** After running the boiler at low fire for 30 minutes, open the manual gas valves fully. Make sure the boiler operating pressure control is set at the desired output pressure.

9. **Full fire:** The boiler will continue to operate at full fire until it satisfies its set operating pressure. Once satisfied, the boiler will shut down or go to low fire if equipped.

10. **Testing:** While the boiler is running, test all interlocks and safeties. Once the boiler has reached at least 150°F, test the high limit by turning the pressure dial to its lowest setting. The boiler should shut down and lock out. To put the boiler back in operation, turn the high limit pressure setting to 10psi higher than the operating pressure setting and press the reset button on the high limit. The boiler will now resume.

11. **Testing low water cut-off:** To check the low water cut-off, push the test button located on the boiler control panel, labeled LWCO. Hold it for 5 seconds. This will produce a simulated low water shutdown. Upon release of the button, the boiler will remain locked out. The boiler will remain locked out until the low water cut-off reset button, located on the control panel, is depressed.

12. **Draft:** Stack Draft Requirements (ATM), -0.02" to -0.04" Water Column.

13. **System Piping Temperature:** In steam applications, if the boiler has been shut off for a prolonged periods of time, the system piping temperature is usually at ambient temperature. Low system piping temperature at start-up may cause condensation and a vacuum condition can occur in the system piping. This vacuum condition can draw steam away from the boiler, which will result in a low water boiler shut down. To prevent this condition, at start-up the system must be gradually brought to the desired temperature.

After Start-up Check List

- ☐ Has air been purged from the system?
- ☐ Has the gas line piping been checked for gas leaks?
- ☐ Have the operating and high limit pressure controls been set?
- ☐ Is the boiler inlet water temperature above 140°F?
- ☐ **Flue gas spillage and soot:** Check for spillage at the draft hood. Check for soot around the sheet metal joints. Use the smoke from a match to detect flue gas spillage. If spillage is present, determine the cause of the problem and correct it.
- ☐ **Leaks:** Look for water on the floor. Check for water leaks from any part of the boiler, valves or piping.
- ☐ **Supports:** Check for proper supports on the water piping and gas lines.
- ☐ **Caution:** Keep flammable materials away from the boiler. In the event of the boiler overheating – shut the boiler down by (1) turning off the manual gas valve located in the gas controls manifold adjacent to the boiler and (2) turn off the electricity to the boiler.

Shutting Down the Boiler

1. **Operating controller:** Set the operating pressure controller to its lowest setting.
2. **Power:** Turn off the boiler by switching the toggle switch on the control panel into the OFF position.
3. **Gas valves:** Close the boilers main gas valve.

Maintenance Instructions

1. **Keep tubes clean:** In order to maintain high boiler efficiency and boiler life, the boiler tubes should be cleaned periodically, both inside and outside. The frequency of cleaning the inside of the boiler tubes depends on the characteristics of the water and the type of installation. When a large amount of makeup water is used, it is good practice to inspect and clean, if necessary, the inside of the tubes after 30 days. The accumulation of lime and other solids within this time will establish the criterion for how often the boiler tubes should be cleaned. On closed systems, where only a small amount of makeup water is used, the insides the boiler tubes should be examined and if necessary, cleaned at the end of the heating season. When makeup water is negligible, such as boilers connected to unit heaters or radiators, the boiler should be flushed at the end of each heating season. All water and steam boiler should have a tee installed at the boiler inlet for draining the boiler. Steam boilers should have a properly sized blowdown valve piped to a blowdown tank and/or suitable drain per local codes. Steam boiler installations that consume steam and therefore use makeup water should be blown down daily. Clean tubes will not only ensure higher boiler efficiency but will also prevent possible damage to the boiler. The boiler should never be fired unless it is full of water.

2. **Gaskets:** Tighten gaskets during start up and periodically thereafter. Leaky gaskets will cause the use of excessive makeup water and could cause corrosion of the stud bolts. It is good practice to use a new gasket; however, if the gasket is not damaged, it may be reused. Use a soft gasket compound on both sides of the gasket. Specify boiler model number and the height and width of the boiler head plate when ordering new gaskets.

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

   Should, for any reason, a stud bolt on a boiler head be broken, it can be replaced as follows: without removing the heat plate, use a slow speed drill to drill out the remaining portion of the stud. Re-drill the header and tap using a standard thread tap. Spare studs may be obtained from the factory.

4. **Controls:** Under normal conditions, controls furnished with the Ajax Boiler require very little service. It is important, however, that the controls be protected from moisture and dirt. All controls should be checked frequently to make sure that they are working properly. Turn both the operating controls and the safety controls up and down to verify that they will operate satisfactorily. The high limit control furnished with the boiler should only be used as a safety control.

5. **Safety pilots:** Keep pilot, igniter and sensor clean and properly adjusted. Dirty pilot orifices may cause unwarranted shutdowns. The pilot flame should be in contact with the sensor rod and the spark electrode must be located directly in front of the pilot orifice. Test per the manufacture's cut-sheet instructions.

6. **Gas burner:** The burner heads and orifices must be kept free from foreign matter. The burner heads should be brushed periodically with a steel brush to remove carbon build-up.

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

8. **Low water cut-off:** A low water cutoff is furnished to protect the boiler against damage by preventing it from operating without water. This is particularly important when the boiler is installed above the water level, i.e., on a roof. Low water level cutoffs should be checked periodically by lowering the water level in the boiler and verifying that the safety circuit opens. Float type low water cutoffs should be flushed at least once a week on "open" systems and once a month on "closed" systems (if applicable). If neglected, accumulation of sediment within the low water cutoff casing may render the control inoperative and thereby become a safety hazard. Probe low water cutoffs may accumulate deposits on the grounding element. These should be carefully cleaned.

9. **Operating control:** The operating pressure control sets the desired boiler water pressure output. To adjust the water pressure, insert a small straight screwdriver into the slotted screw hole at the front of the controller. This controller has an adjustable differential wheel under its casing.

10. **High limit manual reset:** The boiler is equipped with a manual reset high limit pressure safety designed to shut down the boiler in the event the boiler water pressure exceeds the high limit set point. The high limit should be set 10psi above the operating pressure controller.

11. **Gas pressure switches (Optional, where applicable):** The low gas pressure switch is designed to shut down the boiler if the gas supply drops below its set point. The high gas pressure switch is designed to shut the boiler down if the gas pressure exceeds its set point. Both switches will lock out and must be manually reset if tripped.

12. **Anodes:** Magnesium anodes are standard on all copper tube boilers. They will extend the life of the boiler, and must be replaced periodically. The replacement frequency can vary from six months to several years. Higher temperatures and/or higher total dissolved solid contents in the boiler water will speed electrolysis and decrease the life of the anodes. Normally, two anodes in each header are adequate for header protection. Under adverse conditions, it may be necessary to install as many as three or four anodes in each header. New anodes may be purchased from your Ajax Boiler representative.

13. **Venting system (indoor boilers):** Examine the venting system externally at least once a year for:
    a.) Tightness of all joints and connections including the draft hood to the boiler and the vent connection from the draft hood to the stack.
    b.) Corrosion of metal in the vent ducting.

14. **Flue gas passageways:** Inspect and clean, if necessary, at least once every five years.
    a.) Shut off gas and turn off electric power to boiler.
    b.) Disconnect vent pipe and remove draft hood(s) or vent cap on outdoor boilers.
    c.) Examine flue gas passageways and the inside of the venting system for soot and corrosion.
    d.) If cleaning is needed, open front door, remove main burners, and cover burner orifices and pilot burner with a waterproof covering.
    e.) Protect controls, electrical, etc. with waterproof covering.
    f.) Clean tube bundle through vent opening(s) at top of boiler using a water or steam hose. Clean out and reassemble boiler after cleaning.

Note: If any parts need tightening or replacement, consult a qualified serviceman.

It is highly recommended that an operator's log be kept as a record of boiler readings as a way of tracking operational changes that may affect warranty and/or boiler reliability.

Maintenance Intervals

Daily Maintenance

1. **Check water level:** An unstable water level can indicate several problems such as excessive solids or water treatment, contamination from oil, overload or control malfunction. Ensure there is water in the gauge glass (if applicable) every time you enter the boiler room.
2. **Blow down the boiler:** Blow down the boiler in accordance with the recommendation of your feed water consultant. A water quality and chemical treatment program will dictate frequency of the boiler blow down.
3. **Blow down water level controls:** Blow down the water level controls to purge the float bowl of possible sediment accumulation (if applicable). Operating conditions will dictate frequency of this check.
4. **Check combustion visually:** Look at the flame to see if anything has changed. Changes may be an indication that a problem is developing.
5. **Treat water according to the established program:** Add chemicals and take tests as outlined by your chemical feed water consultant.
6. **Record boiler operating pressure and temperature:** An excessive steam or water temperature drop will alert you to excessive loading on the boiler.
7. **Record feed water pressure and temperature:** A change in pressure or temperature may indicate a problem is developing with your feed pump(s), deaerator or packaged feed system.
8. **Record stack temperatures:** Changes in stack temperatures could indicate the boiler is sooting, scaling or there is a problem with baffles or refractory.
9. **Record gas pressure:** Changes in pressure could have an effect on combustion in the boiler and indicate a problem in the gas delivery system.
10. **Check with general boiler/burner operation personnel:** Has anything changed from the day before? If so, why?
11. **Record boiler water supply and return temperatures:** On hot water boilers, record these temperatures to assist in detecting system changes. Return temperatures below 140ºF will cause the boiler to condense.
12. **Record makeup water usage:** Excessive makeup water could be an indication of system problems (leaks) in both steam and hot water systems.
13. **Check auxiliary equipment:** There is a vast difference between "is it running" and "is it running properly." Take nothing for granted, as auxiliary equipment can shut down your operation.

Weekly Maintenance

1. **Check for tight closing fuel valves:** Check to ensure fuel does not flow through the fuel valve(s) when the burner is shut off.
2. **Check indicating lights and alarms:** Check for burned out or loose light bulbs. In addition, check to ensure the alarm bell sounds on the appropriate shut down condition.
3. **Check operation of water level controls:** Stop the boiler feed pump and allow the control to stop the boiler under normal low fire conditions.
4. **Check for leaks, noise, vibration, unusual conditions, etc.:** Checking for these items, is a cost-effective way to detect system operational changes. Small problems can be corrected before they become large problems.
5. **Check operation of all motors:** By developing a routine, any change in operation or bearing temperature will usually be caught in time to avoid a failure.
6. **Check the flame scanner assembly (if applicable):** Using the appropriate meter, check the flame signal strength at the program relay flame amplifier. Ensure the scanner assembly is clean and dry.
7. **Check gauge glass:** Ensure there are no scratches or etching in the glass or leakage around the package.

Monthly Maintenance

1. **Inspect burner operation:** Do a visual inspection of the pilot flame and main burner flame throughout the firing range.
2. **Analyze combustion:** Take the flue gas analysis over the entire firing range, comparing the combustion analysis and stack temperature reading with the pervious month.
3. **Check for flue gas leaks:** Ensure something hasn't changed in the breaching, stack or overall system that allows flue gas to be drawn into the boiler room.
4. **Check boiler blow down:** Review boiler blow down to determine that a waste of treated water is not occurring. Check water treatment and testing procedures with your feed water consultant.
5. **Check all combustion air supply inlets:** Ensure sufficient combustion air is being supplied to the boiler room and burner.
6. **Check the fuel system:** Make sure certain strainers, vacuum gauges, pressure gauges and pumps are properly cared for.
7. **Check lubrication:** Verify lubrication requirements of all bearing supported equipment. Do not over-lubricate electric motors.

Semi-Annual Maintenance

1. **Clean low water cut-off(s):** Remove the head assembly or probes, inspect and clean out any sediment or contamination in the column or piping. Determine why sediment or contamination condition exists.
2. **Repair refractory:** Repair all cracks and fill in gaps.
3. **Reset combustion:** The entire combustion process should be carefully checked, O_2 readings taken and necessary burner adjustments made. Make certain readings are recorded and used as a basis of comparison for future tests. Combustion adjustments should only be made by those thoroughly familiar with all aspects of burner adjustments and combustion.

Annual Maintenance

1. **Clean fireside surfaces:** Clean fireside surfaces by brush or use a powerful vacuum cleaner to remove soot. After the cleaning process, and if the boiler is to be left open, it is advisable to spray all fireside surfaces with some type of corrosion preventative.
2. **Clean breaching:** Inspect breaching, stack, and remove any soot build-up.
3. **Clean waterside surfaces:** Remove all head plates and inspect tubes. Inspect water columns, tee's and float assemblies from water columns. Thoroughly wash all waterside surfaces.
4. **Check gauge glass for possible replacement:** If internal erosion at water level is noted, replace with new glass and gaskets.
5. **Remove and recondition safety valves:** Have them reconditioned by an authorized safety valve facility. The safety valve is an important device yet possibly receives less attention than any other device.
6. **Boiler feed pumps:** Strainers should be reconditioned. Feed pump elements wear and must be replaced. Sometimes a review of the condensate return system and chemical feed arrangement will reveal causes of short pump life.
7. **Chemical feed systems:** Chemical feed systems should be completely emptied, flushed and reconditioned. Metering valves or pumps should be reconditioned at this time.
8. **Tighten all electrical terminals:** All terminals should be checked for tightness, particularly on starters and moveable relays.

Trouble Shooting Guide

The following is a list of items that can cause boiler performance problems if not installed correctly.

Available combustion air: Normal Conditions: 1 sq. in. open area per 1000 Btu/hr. Note: This must be open area between louvers.
Stack draft: Normal Conditions: Atmospheric: -0.02 to -0.04 in. WC.
Fuel pressure: Normal Conditions: Atm.: 4"WC natural gas manifold pressure and 11"WC propane manifold pressure.
Inlet water treatment, flow, and/or temperature: Minimum inlet water temperature without boiler recirculator line = 140°F

The following are common problems with possible causes and solutions.

1. **Nuisance flame failures:**
   a.) The flame safeguard is not sensing an adequate flame signal. If your boiler contains a Fireye Micro M controller, measure the flame signal across its two ports (See *Fireye manual*). Voltage signal should measure between 14 and 18 volts DC. If your boiler uses a Honeywell S8610, consult the Honeywell S8610 trouble-shooting guide included in this manual.
   b.) The flame rod is dirty or sooted.
   c.) The copper lead is grounding on the boiler between the junction box and the pilot.
   d.) The flame rod on the pilot is not directly in the flame. If the flame is pulling away from the flame rod, the gas pressure may be too low or the stack draft too high.
   e.) Check all connections on the flame rod, pilot, and the flame safeguard controller and make sure the pilot is grounded.

2. **Burners have yellow flame:** Some yellow tipping is normal with atmospheric boilers. However, the best way to insure appropriate burner flame is the use of a combustion analyzer. Check the percentage of combustibles against the standard list included in this manual. Also, check the stack draft, inlet and outlet water temperatures at high fire and the combustion air openings in the boiler room.

3. **Boiler not putting out enough heat:** The main reason a boiler will not put out enough heat is usually due to there not being enough gas reaching the burners. Check the following:
   a.) Have you been able to accurately measure the gas flow rate at the meter
   b.) What is the gas pressure at the burner manifold, after the gas train, before the burners
   c.) What is the inlet gas pressure, while the burner is firing? This number will be lower than when the burner is not firing.
   d.) Review combustion report, if the boiler is under fired, there should be too much Oxygen in the stack gases.
   e.) Is the boiler at altitude? If yes, has it been derated?

4. **Boiler is sooting up:**
   a.) If the gas pressure is too low, the burners will overheat and soot up the boilers. For instance, if they have propane gas and the boiler has natural gas orifices, the manifold pressure will be too low and the boiler will soot. Running a boiler at less than 2" water column (WC) may cause sooting.
   b.) Running the boiler in a condensing mode with inlet water temperatures below 140°F. When this happens, it will "rain" down on the burners and appear to be leaking. The boiler will subsequently soot up.
   c.) If the boiler uses propane gas "candling" may be a problem. Propane is heavier than air. When a propane burner shuts off, the gas remaining in the manifold pipe continues to burn at the top of the orifice, below the burner and venturi tube. It takes about 15-45 seconds to burn

the remaining propane. If the burner comes on before the propane is completely burned, the "candle" on the top of the orifice lights the burner and the flame burns inside the venturi and burner casting. This will soot up the boiler quickly. The solution is to eliminate the short cycling. This can be done with a "delay on break" time delay relay powered off the main valve.

d.) Insufficient combustion air/draft may cause sooting. The only way to tell if this is the cause is by obtaining answers to the following:
   1.) Start-up or Combustion report.
   2.) Open a door to the boiler room. Any improvement? If so, there is not enough combustion air in the boiler room.
   3.) Check for flame rollout. In extreme cases, flame rollout will light the gas at the orifice and produce a situation similar to the candling propane burners.
   4.) Is the room pressurized? Is there other equipment in the room? Is there an extractor fan in the room?

5. **My boiler is leaking:** Sometimes boilers appear to be leaking when they are actually operating in a condensing mode. To prevent condensing, inlet water temperature should be 140°F or higher.

Condensation

During startup conditions, when the boiler water temperature is below 140°F, condensation will occur. Condensation will stop when the return boiler water temperature exceeds 140°F. *Water tube boilers, including the Ajax Boiler, should not be operated at water inlet temperatures below 140°F*. ***Prolonged operation of the boiler under condensation conditions will cause damage to the boiler*.** If the boiler application requires inlet water temperatures below 140°F, a boiler recirculation system must be installed so that the cold inlet water is mixed with hot boiler water in a ratio to ensure that condensation does not occur.

Cold Start-ups

Too many cold startups will be evidenced by rust stains on the refractory inside the boiler and around the boiler doors. If condensation occurs regularly, eventually the boiler tubes and firebox area may rust apart and collapse. Frequent shutdowns of the heating system can endanger the boiler life expectancy. With a water boiler, maintain at least the minimum inlet water temperature recommended (140°F). If an outdoor reset control is used, the controls must be arranged so that the boiler never falls below the recommended water temperature.

Soot

No matter what kind of fuel is used (gas, LPG), soot and scale deposits will accumulate on the outside of the boiler tubes. If the tubes aren't cleaned regularly, boiler efficiency will be sacrificed and fuel will be wasted. Soot has excellent insulating properties, which can result in a tremendous heat loss and increased fuel consumption.

CAUTION:

1. Check daily to be sure that boiler area is free and clear of combustible materials, gasoline, solvents, and other flammable vapors, liquids or materials.
2. Check daily to be sure that the flow of combustion and ventilating air to the boiler is not obstructed.
3. If the boiler overheats, shut it down immediately by (1) turning off the manual gas valve located on the boiler and (2) turning off the electric power to the boiler.

Burner Flames

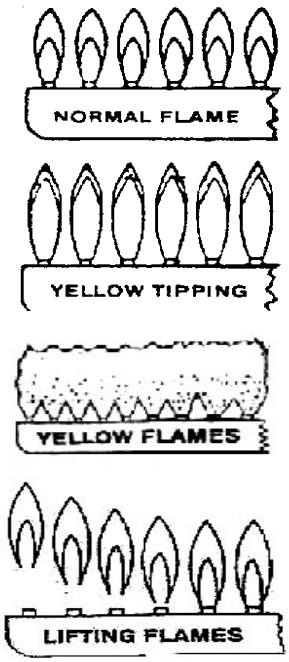
The gas manifold and control assembly provided on Ajax boilers have been tested and met safe lighting and other performance criteria specified by Underwriters Laboratories UL-795 and American National Standard ANSI Z221.13.-1982. The main burner and pilot burner flames should be visually checked at each start up and at least once a month during regular operation. The following is a description of various flames:

1. **Normal Flame:** A normal flame is blue-white with a well-defined blue inner cone. The flame should not have yellow tips and should not be lifting.

2. **Yellow Tipping:** Caused by a lack of primary air to the burners. Check air opening to boiler room and air access to boiler, soot and carbon monoxide may form. Dust may cause orange-yellow streaks in the flames but will have little effect on combustion.

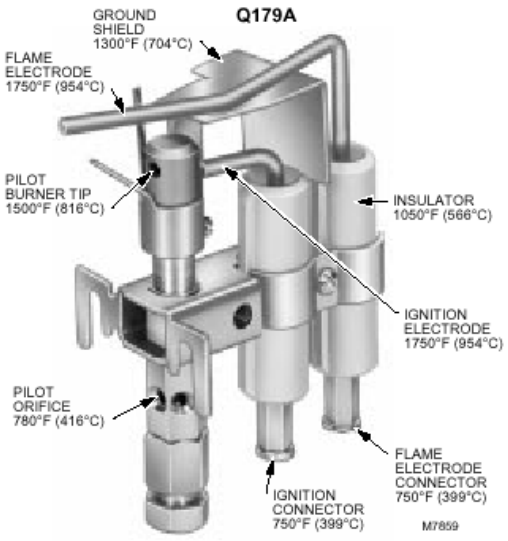
3. **Yellow Flames:** Caused by severe lack of primary air to boiler, burner heads/venturi tubes not properly in place or excessive gas input to boiler. This condition must be corrected immediately.

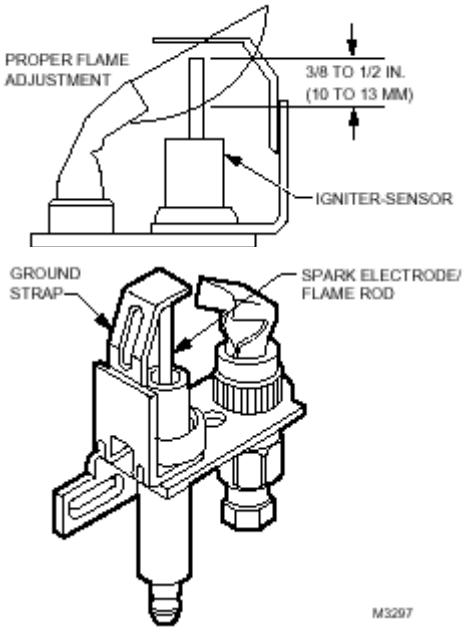
4. **Lifting Flame:** Caused by high gas pressure at the burner or an up draft condition. Slight lifting from a cold burner is acceptable if the flame settles back down to the port as the burner heats up.



Pilot Burners

The Q345A and Q179A are combination pilot burners and rectifying flame rod detectors (sensors) with an ignition electrode intermittent or interrupted ignition pilot system. The Q345A is used with the S8610H controller, and the Q179A is used with the Fireye controller. The pilot flame should envelop the tip of the flame rod detector/sensor. See illustrations below.





For other trouble shooting issues, please reference the specific control sheets included in this manual.

Quick Reference Guide

Head Plate Torque Requirement

(Model "SRN")		(Model "HRN")	
1/2" bolts	78 ft.lbs	5/8" studs	90 ft.lbs.
5/8" bolts	156 ft.lbs.	3/4" studs	150ft.lbs
3/4" bolts	260 ft.lbs	7/8" studs	240ft.lbs

Stack Draft Requirements (ATM)	-0.02” to -0.04” Water Column
Manifold gas pressure (Nat. Gas)	3.5” to 4” Water Column
Manifold gas pressure (LPG)	11” Water Column
Minimum Inlet Water Temperature	140º F
Water Treatment	
Hardness	Less than 0.3 ppm
PH Value	7.2 to 9.5
Suspended solids	Less than 10 ppm
Dissolved solids	Less than 3000 ppm
Oxygen before scavenger addition	Less than 0.2 ppm
Oxygen after scavenger addition	Less than 0.007 ppm
Total alkalinity	Less than 350 ppm

Replacement Parts

Ajax Boilers have been manufactured since 1924. In the course of these years, many improvements have been incorporated in the design of our boilers. Information on the Ajax Boiler is subject to change without notice as design improvements continue. Ajax Boiler maintains a complete equipment list for each boiler filed by boiler serial number. In order for us to give prompt service and to ensure that correct parts are supplied, please be sure and supply the boiler model and serial number.

1. **Head Plate Gaskets:** Specify the height and width of the boiler head plate with the model and serial number when ordering.
2. **Anodes:** Give boiler model and serial number when ordering.
3. **Burners:** When ordering burners and burner orifices advise boiler model, serial number, altitude and the type of gas (natural or LPG).
4. **Boiler Tubes:** All Ajax Boilers are equipped with 2” O.D. steel or copper tubes. These tubes are rolled and flared into a tube sheet with a minimum thickness of 1/2”. Furnish overall boiler length, taken at the top of the jacket, with the model and serial numbers when ordering boiler tubes.
5. **Studs:** If a stud on a boiler header should break, see stud replacement in the service instructions.
6. **Control and Pilot Burners:** To order replacement controls or pilot burners, refer to the attached “Equipment List” and the control manufacturer’s bulletins included with these instructions.

Material Safety Data Sheets

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

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

ⓐ Ajax Boiler Inc.
2701 S. Harbor Blvd.
Santa Ana, CA 92704
Parts: 714.437.9050
www.ajaxboiler.com
email: info@ajaxboiler.com

AJAX BOILER INC.

AJAX Series • ACE Series • ATLAS Series

AJAX BOILER INC. - ACE BOILER INC.

FACTORY LIMITED WARRANTY POLICY

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

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

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

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

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

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

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

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

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

The following is a review from the terms and conditions of sale. Also included in paragraph two, below, is the Ajax Boiler Inc. non-conformance policy.

1. Ajax Boiler Inc. warrants its products against defective material and/or workmanship only. The warranty does not apply to operational failures, electrical failures, gasket leaks, and/or other malfunctions caused by improper application, installation and/or maintenance.

2. It is the buyer's responsibility to inspect and accept the product, when received, as conforming to their purchase order, specifications and approved drawings. All claims for non-conformance, errors, shortages, etc. must be made within 10 days after receipt of the shipment.

3. Ajax Boiler Inc. do not provide a warranty or guarantee, express or implied, in any manner, form, usage of trade, merchant -ability or fitness which extend beyond the product description and quotation.

4. Ajax Boiler Inc. liability is limited to the factory repair or replacement of warranty failures, or non-conformance, upon the return of the product to the factory.

5. Ajax Boiler Inc. is not liable for any direct or consequential damages.

6. The Ajax Boiler Inc. warranty is based upon section 23161(2) of the uniform commercial code and is printed in the terms and conditions of sale which is referenced in every quotation, on the back of sales order acknowledgements and invoices. It is legally correct and is an industry standard policy.

AJAX BOILER INC. - ACE BOILER INC.

WARRANTY

LIMITED
THERMAL SHOCK

In addition to our standard one (1) year warranty against defective parts and workmanship, Ajax Boiler Inc. provides the following guarantee with all commercial hot water, forced circulation, space heating boilers:

Ajax Boiler Inc. guarantees this new boiler pressure vessel for twenty (20) years after date of installation from damage due to thermal shock. Thermal shock occurs when cold makeup water, up to 150ºF less than the boiler water outlet temperature, is added directly into the boiler while the boiler is operating within the normal temperature range from 140ºF to 250ºF with a temperature rise from 20ºF to 40ºF. This guarantee shall cover damage to the boiler tubes, tube headers, and tube sheets when such damage is attributed to unequal expansion, poor circulation and/or other causes quite often described as "thermal shock". This guarantee does not cover damage or failures that can be attributed to corrosion, condensation, scale, boiler treatment chemicals, dirt accumulation, low water conditions, or any other abnormal operating conditions.

The liability of Ajax Boiler Inc. is limited solely to the replacement of the complete pressure vessel, with tubes, if found by our inspection to be damaged by thermal shock. In no event shall Ajax Boiler Inc. be held liable for replacement labor charges or for freight or handling charges.

AJAX BOILER INC.
AJAX Series • ACE Series • ATLAS Series

2701 South Harbor Blvd.
Santa Ana, California 92704
United States
Tel. (714) 437-9050
Fax (714) 437-9060
http://www.ajaxboiler.com
mail@ajaxboiler.com

June-2010

AJAX BOILER INC. - ACE BOILER INC.

LIMITED

WARRANTY

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

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

Boiler Pressure Vessels: One year.
Carbon Steel Tank and Heat Exchanger Pressure Vessels: One year.
Stainless Steel Tanks: Three years.
Boiler Copper Fin Coils: Three years.
Single-wall or Double-wall Tank/Exchanger Coils: One year.
Single-wall or Double-wall Mini-Packs™: One year.
Atlas Series Condensing Boiler: One year.
Linings: (Pro-rated Warranty)
In Section VIII Tanks: Glass 30" dia. and above (Five years).
Glass 24" dia. and under (One year).
Cement (Five years).
Pre-Krete (Ten years).
In Section IV Tanks: Glass (One year).
Controls: Components manufactured by other than Ajax Boiler Inc. such as controls, instruments, forced draft burner, etc., provided with the boilers and packaged products are not covered by the Ajax Boiler Inc. Warranty. However, Ajax Boiler Inc. extends to the customer the same warranty provided by the manufacturer to Ajax Boiler Inc. The customer shall receive the full benefits of adjustments made to Ajax Boiler Inc. by the manufacturer.

Any claim for adjustment under this limited warranty must be made within the warranty period. Ajax Boiler Inc.'s liability shall be limited to factory repair or, at Ajax Boiler Inc.'s option, replacement of all parts which, upon test and examination by Ajax Boiler Inc., prove to be defective material and/or workmanship and within the above limited warranty. If required by Ajax Boiler Inc., parts which are claimed to be defective must be promptly delivered to the Ajax Boiler Inc. facility, transportation charges prepaid. This warranty does not cover the cost of labor, removal, or installation of the warranted item during the limited period.

This warranty is limited to the above and applies only for the period set forth. Ajax Boiler Inc. will not be liable for any loss damage, direct, incidental or consequential damages of any kind, whether based upon warranty, contract, negligence or strict liability and arising in connection with the sale, use or repair of the products. Ajax Boiler Inc.'s maximum liability shall exceed the contract price for the product's merchantability or fitness for any particular purpose and in no event shall be held responsible for any consequential damages.

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

Ajax Boiler Inc., also doing business as Ace Boiler Inc., is referred to herein as Ajax Boiler Inc.

AJAX BOILER INC.
AJAX Series • ACE Series • ATLAS Series

2701 South Harbor Blvd.
Santa Ana, California 92704
United States
Tel. (714) 437-9050
Fax (714) 437-9060
http://www.ajaxboiler.com
mail@ajaxboiler.com

AJAX BOILER INC. - ACE BOILER INC.

WARNING

PRODUCT SAFETY NOTICE

AJAX BOILER AND WATER HEATER PRODUCTS OPERATE AT HIGH TEMPERATURE AND PRESSURES AND NOT FOR INSTALLATION ON COMBUSTIBLE FLOORING.

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

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

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Santa Ana, California 92704
United States
Tel. (714) 437-9050
Fax (714) 437-9060
http://www.ajaxboiler.com
mail@ajaxboiler.com

Effective: November-2008

FIREYE MODULAR MicroM

FLAME SAFEGUARD CONTROLS

c UL US LISTED FM APPROVED

Year 2000 Compliant in accordance with BSI document DISC PD2000-I:1998

WARNING: Selection of this control for a particular application should be made by a competent professional, licensed by a state or other government. Inappropriate application of this product could result in an unsafe condition hazardous to life and property.

DESCRIPTION

The Fireye MicroM Series Flame Safeguard Control is a compact, microprocessor based, modular burner management system designed to provide automatic ignition and continuous flame monitoring for commercial sizes of heating and process equipment firing any type of fuel.

The MicroM is designed to be backward compatible with existing M-Series controls. The advantages of the MicroM are zero dependence on discrete components previously used for timing functions. The MicroM, through the use of micro-controller technology, incorporates smart diagnostic LED's, smart reset function, optional alpha-numeric display output (ED510), and serial communications via a Modbus or E500 Communication Interface. The MicroM system also provides additional amplifier selections. Along with the standard UV and Flame Rod/Photocell amplifiers are UV self-check, Infrared and Cadmium Sulfide. All amplifiers are available with flame failure response times of 0.8 seconds or 3 seconds nominal (4 second maximum) and each provide a set of test jacks with a uniform range of 0-10 VDC for the measurement of flame signal intensity.

A complete MicroM system includes the appropriate flame detector, plug-in amplifier and programmer modules which connect into a standard chassis and wiring base. Interchangeable programmer and amplifier modules allow for complete versatility in selection of control function, timing and flame scanning means. Functions such as relight, two stage capability, non-recycle air flow, proof of air flow open at start, purge timing and pilot cutoff are determined by the appropriate programmer module. Type of flame scanner (UV, Repetitive UV Self-Check, Flame Rod, Photocell, IR or Cadmium Sulfide) and the flame failure response time (FFRT) are determined by the amplifier module. Optional plug-in boards provide additional features such as remote reset, alpha-numeric display and serial communications.

The MicroM programmers are micro-controller based modules that control the sequence of operation and also interface with plug-in amplifiers, meter boards, display drivers and external communication devices. The programmers are available in an assortment of configurations necessary to resolve the application requirement. Current families of programmers include the MEP100, MEP 200 and MEP500 series.

Some programmer modules are equipped with a series of dipswitches to select Purge Timing, Pilot Trial for Ignition (PTFI) timing, Proof of Air flow open at start, Post Purge, Recycle and Non-Recycle operation. LED indicators on the programmer modules indicate the current operating status of the control and during a lockout condition displays the fault as a coded sequence, simplifying the troubleshooting of a shutdown.

In the event of pilot ignition failure, or following a safety shutdown, the control locks out, activating an alarm circuit and displays the cause of lockout on the integrated LED's and on the optional ED510 display. Manual reset is required. Remote reset is available on the MEC120R, MEC120RC and MEC230 chassis. A detailed description of the various programmer, amplifier and chassis modules is found later in this document. A "run-check" switch is provided on the MEP560, MEP561, MEP562 and MEP536 programmer modules to assist in testing size, position and stabilization of the pilot.

Modular MicroM controls incorporate a safety checking circuit that is operative on each start. If flame (real or simulated) is detected prior to a start or during purge, the fuel valves will not be energized and the unit will lock out.

The modular MicroM controls use the same wiring base as the Fireye UVM, TFM and M-Series II controls and are designed to be interchangeable with most models with little or no rewiring. See INSTALLATION OF CONTROL, SCANNERS AND FLAME DETECTORS (page 7) for temperature and wiring requirements.

NOTE: The individual MicroM modules, i.e. MEC chassis, MEP programmers and amplifiers are not interchangeable with M-Series II modules, i.e. MC chassis, MP programmers and amplifiers.

SPECIFICATIONS

Supply: 120 VAC (min. 102, max. 132) 50/60 Hz. (MEC120, MEC120R, MEC120C, MEC120RC, MEC120D), (MEC120RD)
230 VAC (min. 196, max. 253) 50/60 Hz. (MEC230)

Power Consumption: 12 VA (Operating)

Shipping Weight (Approx): 3 lbs (1.4 kg)

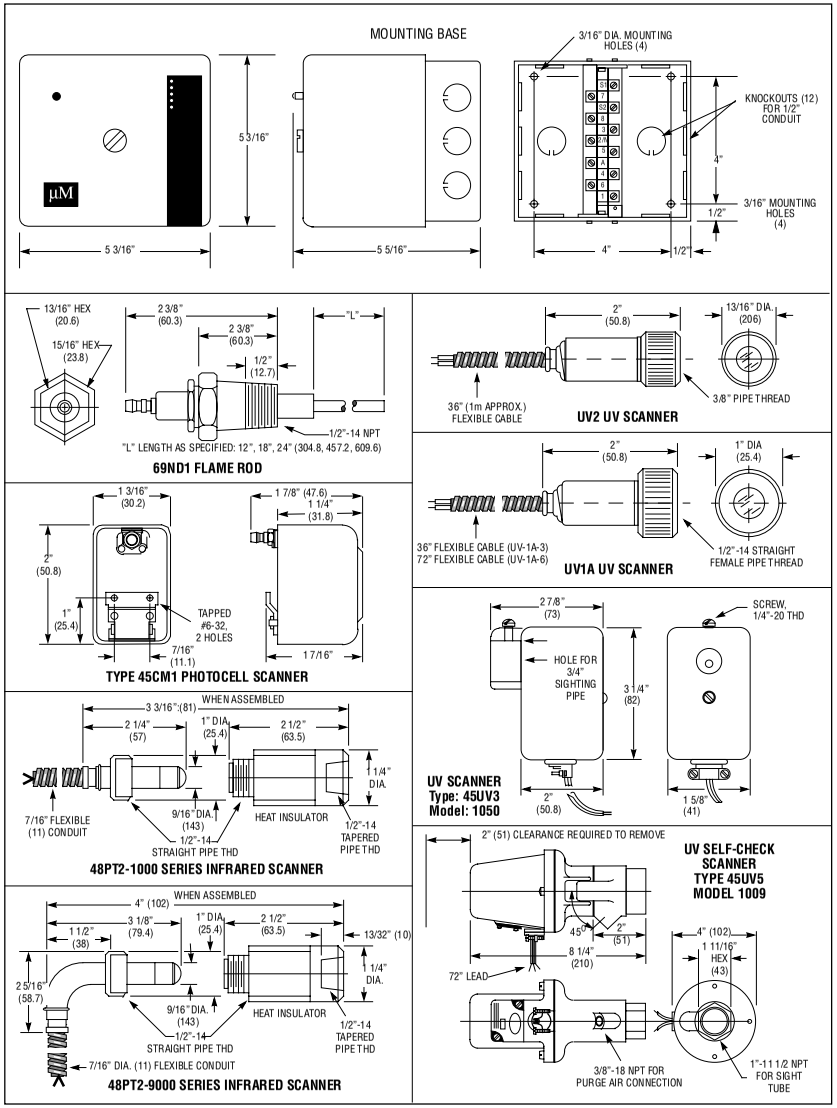
Operating Temperature: -40°F (-40°C) to 140°F (60°C)

Table 1: AMBIENT TEMPERATURE LIMITS

	MAXIMUM		MINIMUM	
Control	140°F	60°C	- 40°F	- 40°C
Scanner UV1A, UV2, UV8A, 45UV3	200°F	93°C	- 40°F	- 40°C
45UV5-1007, 45UV5-1009	200°F	93°C	- 40°F	- 40°C
Photocell 45CM1	165°F	74°C	- 40°F	- 40°C
Flame Rod (Tip 2460 F)	1500°F	816°C	- 40°F	- 40°C
48PT2	125°F	52°C	-40°F	-40°C
CSIA5	140°F	60°C	-40°F	-40°C

Table 2: LOAD RATINGS

Fireye Terminal	Typical Load	Maximum Rating @120V 60 Hz
3 or 4 Individual or combined	Pilot valve(s) Solenoid valve Ignition Transformer	125 VA pilot duty (solenoid valve) plus 250 VA (Transformer)
5	Main Fuel Valve(s)	125 VA pilot duty (solenoid) or 25 VA pilot duty (solenoid) and 400 VA (opening) motorized, 250 VA hold
8	Motor or contactor	Terminal 8 rated to energize and de-energize 9.8 FLA, 58.8 LRA on safety lockout.
A	Alarm	125 VA, pilot duty
Minimum load requirement = 100mA		



All dimensions in inches (millimeters in parentheses).

WARNING: This equipment is a Class B digital apparatus which complies with the Radio Interference Regulations, CRC c.1374.

CAUTION: Published load ratings assume that no control be required to handle inrush current more often than once in 15 seconds. The use of control switches, solenoids, relays, etc. which chatter will lead to premature failure. It is important to run through a test operation (with fuel shut off) following the tripping of a circuit breaker, a blown fuse, or any instance of chattering of any external current consuming devices.

APPROVALS

Underwriters Laboratories Inc.
Listed Guide MCCZ - File MP1537

Factory Mutual System (FM) Approved

Underwriters Laboratories Inc.
Recognized Components Guide MCCZ2
File MP1537

Canadian Standards Association
Guide 300-1-0.2 Class 2642 Oil File LR7989
Guide 140-A-2 Class 2632 Gas File LR7989

UL and CSA approval does not apply to 230VAC operations.

WARNING: Selection of programer and amplifier type for a particular application should be made by a competent professional, such as a Boiler/Burner technician licensed by a state or government agency, engineering personnel of the burner, boiler or furnace manufacturer (OEM) or in the performance of duties based on the information from the OEM.

WARNING: This equipment generates and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be equipped to take whatever measures that may be required to correct the problem

In order for the MicroM to gather and retain statistical and historic data such as burner hours, burner cycles, system hours and average flame signal, it is necessary that Terminal 1 be powered at all times. Removing power from Terminal 1 at the end of the firing cycle causes all data gathered during the previous 16 hours or lockout occurrence will be lost. For conversions or upgrades from older TFM or M-Series II controls that use MART1 amplifiers, it is that Terminal 1 be directly powered with 120 VAC.

ORDERING INFORMATION

MicroM Chassis Types (Common for all controls, includes dust cover):	
MEC120	120 VAC input with standard plug-in board.
MEC120R	120 VAC input with remote reset capability.
MEC120D	120 VAC input with alpha-numeric display interface to ED510.
MEC120RD	120 VAC input with alpha-numeric display interface to ED510 and remote reset capability.
MEC120C	120 VAC input with interface to E500 Communication Interface and Modbus capability.
MEC120RC	120 VAC input with remote reset capability, alpha-numeric display interface to ED510, interface to E500 Communication Interface and Modbus capability.
MEC230	230 VAC input with standard plug-in board.
MEC230RC	230 VAC input with remote reset capability, alpha-numeric display interface to ED510, interface to E500 Communication Interface and Modbus capability.

MicroM Programmer Models:	
MEP100	Relight operation, 10 sec. PTFI.
MEP101	Relight operation, allow flame signal until 60 seconds after interlock circuit closes.
MEP102	Non-recycle on flame fail, 5 second PTFI.
MEP103	Fixed 10 second SISP*, 10 second MTFI, re-try once on igniter failure, fixed 30 second post purge.
MEP104	Non-recycle on flame fail, 10 second PTFI.
MEP105	Non-recycle on flame fail, lockout on air-flow open with flame present, 10 second PTFI.
MEP106	Same as MEP100. 12 second pre-purge, added reset from lockout via line voltage.
MEP107	Same as MEP100. Force 5 minute purge delay after main flame fail.
MEP108	Same as MEP100 with 0 second purge, 15 second PTFI, Non-Recycle on flame fail.
MEP100P	Relight operation, 10 sec PTFI, fixed 15 second post purge.
MEP130	Same as MEP100, 30 second PTFI.
MEP230	Selectable purge timing (7, 30, 60, 90 seconds) 10 sec PTFI timing, recycle/non-recycle, post purge, prove air open at start.
MEP230H	Same as MEP230 with 8 second pilot stabilization.
MEP235	Same as MEP230 with lockout on air flow open 10 seconds after the start of a cycle, selectable recycle/nonrecycle lockout on air flow open after flame is proven and dedicated lockout after loss of flame.
MEP236	Same as MEP230 with additional 6 second igniter on time with main fuel. To be used with intermittent pilot only.
MEP238	Same as MEP230. Ignition de-energized 3 seconds after pilot flame detected. Provides 8 second pilot stabilization period.
MEP290	Same as MEP230 except selectable post purge is 0 or 90 seconds.
MEP560	Same as MEP230H, 10 second main trial for ignition, run-check switch.
MEP561	Same as MEP560 without 8 second pilot stabilization. Selectable purge time on 7, 10, 15, 30.
MEP562	Same as MEP560, lockout on loss of air flow, non-recycle operation only.
MEP536	Same as MEP230, 10 second trial for ignition, run-check switch, will not lockout on air flow open during purge.

*Spark Igniter Sensing Period

MicroM Amplifier Models:	
MEUV1	UV amplifier, 0.8 second FFRT, uses UV1A, UV2, UV8A, UV90 and 45UV3-1050 scanners.
MEUV4	UV amplifier, 3 second FFRT, uses UV1A, UV2, UV8A, UV90 and 45UV3-1050 scanners.
MEUVS1	UV Self-Check amplifier, 0.8 second FFRT, uses 45UV5-1009 scanner.
MEUVS4	UV Self-Check amplifier, 3 second FFRT, uses 45UV5-1009 scanner.
MERT1	Flame Rod / Photocell amplifier, 0.8 second FFRT, uses 69ND1 or 45CM1.

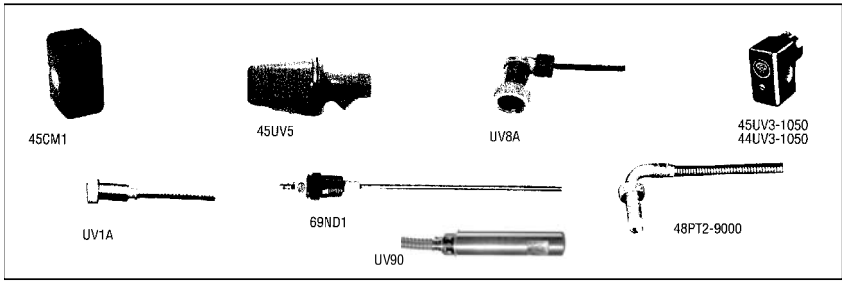
MicroM Amplifier Models:	
MERT4	Flame Rod / Photocell amplifier, 3 second FFRT, uses 69ND1 or 45CM1.
MEIR1	Infrared amplifier, 0.8 second FFRT, uses 48PT2 scanner.
MEIR4	Infrared amplifier, 3 second FFRT, uses 48PT2 scanner.
MECD1	Cadmium sulfide amplifier, 0.8 second FFRT, uses CS1A5 scanner.
MECD4	Cadmium sulfide amplifier, 3 second FFRT, uses CS1A5 scanner.

Optional Plug-In Board Modules:	
Optional Plug-In Board	Description
MED1	Standard local reset switch.
MED2	Same as MED1 with display output.
MED3	Same as MED1 with remote reset.
MED4	Same as MED1 with display output and remote reset.
MED5	Same as MED1 with display output and communications.
MED6	Same as MED1 with display output, remote reset and communications.
MED7	Same as MED1 with communications.

WIRING BASE (COMMON FOR ALL CONTROLS):	
61-3060	Closed wiring base, surface mounting.
61-5042	Open wiring base, cabinet mounting.

Accessories	
ED510	Two line by 16 character, back lit LCD display with keypad.
ED580-2, -4, -8	Remote display cable with RJ45 connection in 2, 4 or 8 foot long lengths. To be used with the appropriate daughter board.
EC485	RS232/RS485 converter with power supply and RJ12 jack.
SMDK-1004	Serviceman's display kit used for diagnosing MicroM system. Consists of ED510 equipped with back plate, MED daughter board and ED580-4.
129-145-1, -2, -3	ED510 remote display mounting kit with 4', 8' or 2' cable respectively.

FLAME SCANNNERS



CAUTION: The UV1, UV2, UV8A, UV90 and 45UV3 ultra-violet flame scanners and associated amplifier modules are non self-checking UV systems and should be applied only to burners that cycle often (e.g.: a minimum of once per 12 hours) in order for the safety checking circuit to be exercised. If component checking is required during burner operation for constantly fired burners, utilize the self-checking ultra-violet flame scanners (45UV5) with associated amplifier module (MEUVS1, MEUVS4) or the infrared flame scanner (48PT2) with associated AutoCheck amplifier (MEIR1, MEIR4).

For a complete system, choose one of each of the following:

- Chassis
- Programmer Module
- Amplifier Module
- Flame Detector
- Wiring Base

WARNING: Installer must be trained and qualified. Follow the burner manufacturers instructions, if supplied. Otherwise, proceed as follows:

INSTALLATION OF CONTROL, SCANNERS AND FLAME DETECTORS

Wiring Base

Mount the wiring base on the burner or on a panel. The location should be free from excessive vibration and within the specified ambient temperature rating. The base may be mounted in any angular position.

All wiring should comply with applicable electrical codes, regulations and local ordinances. Use moisture resistant wire suitable for at least 90 degrees C. Good electrical wiring practice should be followed to ensure an adequate ground system. Refer to Fireye Service Note SN-100 separately and General Grounding Rules later in this document for grounding methods.

A good ground system should be provided to minimize the effects of AC quality problems. A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages will follow the desired path in preference to alternative paths, where extensive damage may occur to equipment.

Circuit recommendations are found on pages 33 through 38. Consult the factory for assistance with non-standard applications.

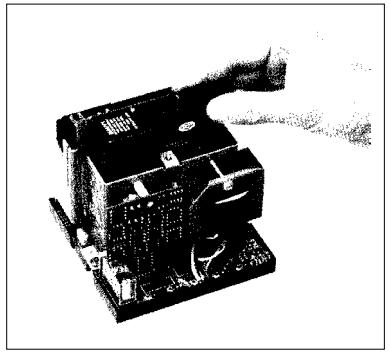
WARNING: Controls require safety limits utilizing isolated mechanical contacts. Electronic limit switches may cause erratic operation and should be avoided.

Care must be taken to NOT route the high energy ignition wire in close proximity to the flame sensor wiring, particularly when using MERT amplifier.

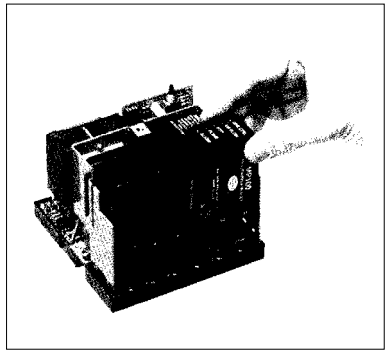
INSTALLING THE PROGRAMMER AND AMPLIFIER MODULES

WARNING: Remove power from the control before proceeding.

FIGURE 1. .



AMPLIFIER



PROGRAMMER

Select the appropriate programmer and amplifier modules for your application. Remove the dust cover from the chassis. Insert the amplifier module into the slot in the corner of the chassis and gently push the module into position. Insert the programmer module into the slot at the right side of the chassis and gently push the module into position.

NOTE: Refer to programmer dipswitch settings on page 10 for the proper setting of the dipswitches for those programmers with this feature.

WARNING: Turn off the power when installing or removing the control.

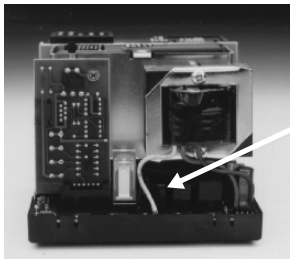
Replaceable Fuse

The chassis modules are designed with a field replaceable fuse. The fuse is located on the printed circuit board below the transformer. In the event the fuse becomes OPEN, the Operating Control, PTFI, and Flame LED's will light. However, KL or KF (Wiring Arrangements section on pages 33 through 38) will not be energized and the control will lock out and indicate Lockout, Check Blown Fuse. The fuse will blow as a result of an overload condition on Terminals 3, 4, or 5. To replace the fuse, remove power from the system and using a small screwdriver or similar tool, install a Fireye replacement fuse (P/N 23-197) or equivalent 10 amp fuse (e.g. Wickman # 19373-071-K).

FOR MEC230, ORDER FIREYE REPLACEMENT FUSE P/N 23-198 OR EQUIVALENT 4 AMP FUSE (E.G. WICKMAN # 19373-062-K).

WARNING: Disconnect power before servicing.

FIGURE 2.



Replaceable
Fuse Location

PROGRAMMER DISPSWITCH SETTINGS

NOTE: *The dipswitch settings become permanently stored within the programmer's eeprom memory after 8 hours of continuous electrical operation.*

The first 8 hours of continuous operation is determined from the value of system hours being accumulated by the MicroM. System hours are stored to memory (eeprom) automatically every 1,000 minutes or at the occurrence of a lockout. Therefore, any lockout that occurs during the first 8 hours will cause the system hour value to become the time when the last lockout occurred. If power is removed and restored, the continuous 8 hours feature will be reduced by the time when the lockout occurred.

This allows sufficient opportunity to make the appropriate selection, test and checkout the system. Once stored, the settings cannot be altered.

The MEP200 and MEP500 series programmers have a series of 6 dipswitches (see Figure 3) which allow the user to program the purge timing, trial for ignition timing, enable post purge, enable proof of air flow open at start and select recycle/non-recycle operation.

MicroM Programmer Dip Switch Configuration

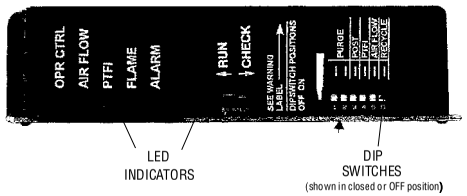
SWITCH						FUNCTION		NOTES
6	5	4	3	2	1			* The MEP561 Programmer module has selectable purge timings of 7, 10, 15 and 30 seconds.
				C	C	7	PURGE* TIME SECONDS	
				C	O	30		
				O	C	60		
				O	O	90		
			C			DISABLED	POST** PURGE	** The MEP290 Programmer module has selectable post purge of 90 seconds.
			O			15 SECONDS		
		C				5	PTFI TIME	
		O				10		
	C					DISABLE	PROVE AIR FLOW OPEN AT START	
	O					ENABLE		
C						RECYCLE		
O						NON-RECYCLE		

Note: *C refers to switch closed position, closed position is when the switch is toward the printed circuit board. O refers to switch open position or when the switch is moved away from the printed circuit board. Indicating arrow on top of programmer cover points toward closed position.*

Once the switches are set, they become permanently stored after 8 hours of continuous operation or they can be manually set through the use of the optional ED510 display. Refer to the section using the optional ED510 display for detailed information.

Where applicable, each MicroM programmer is shipped with dip-switch 6 set to non-recycle on flame fail, dipswitch 4 sset to 5 second PTFI time, and dipswitches 1 & 2 set to the longest purge time.

FIGURE 3.



Dipswitch Definitions

Purge Time: Begins after power is detected on Terminal #7 (limit control) and Terminal #6 (running interlock switch) and no flame (real or simulated) is detected.

Post Purge: If enabled, Terminal #8 (blower motor or contactor) will remain energized for 15 seconds after terminal #7 or Terminal #6 is detected as open.

PTFI Time: The maximum length of time that Terminal #3 and Terminal #4 will be energized after the pre-purge period to detect pilot flame. For all programmers, the MicroM forces a 3 second delay

before advancing to the next logic module (Stabilization, MTFI or Auto) after flame is detected during the PTFI period. This is to allow establishment of a pilot and stabilization of the fuel flow.

Prove Air Flow Open: After power is detected on Terminal #7 (limit control) and before energizing Terminal #8 (blower motor or contactor) no power must be detected on Terminal #6 (running interlock switch). If power is detected on Terminal #6, the MicroM will hold for 60 seconds after which safety lockout will occur. On recycle operation, if this is enabled, Terminal #8 will be de-energized to allow Terminal #6 to open.

Recycle / Non-Recycle: Applies to flame failure during the Run condition. If a flame failure occurs, the control will de-energize Terminals #3 and #5 and if Recycle is selected a new prepurge period will begin. Lockout will occur immediately and the alarm will energize 15 seconds after flame failure if Non-Recycle is selected. Unless otherwise stated (see Programmer Description), the MicroM recycles on all occurrences of air flow failure. The MEP235 and MEP562 will always initiate a lockout on flame failure.

LED INDICATOR LIGHTS

The MEP100, MEP200 and MEP500 Programmer Modules have 5 LED lights to indicate the operating status of the control and also to display the coded sequence under locked out conditions. The function of the lights under a normal operating condition is:

Operating Control: This LED is energized whenever the burner control switch and all other various limit switches are closed and power is applied to Terminal #7.

Interlock or Air Flow: This LED is illuminated whenever power is detected on Terminal #6, indicating the air flow switch or other running interlock is closed. If the operating control is closed and the running interlock switch remains open, this LED will flash at a 1 second rate indefinitely for the MEP100 and MEP200 family. Lockout will occur if the switch remains open for 10 minutes in the MEP500 family. This LED will blink when configured as a flame switch and flame detected.

PTFI: This LED is illuminated only during the pilot trial for ignition period and the stabilization period when so equipped.

Flame: This LED is on whenever a flame signal is detected, and the control is not in a locked out state.

Alarm: This LED flashes when an alarm condition is detected and is used as an address indicator (see communication).

During an alarm condition, the Alarm LED is made to flash at approximately a 1 second rate. The remaining four LEDs are illuminated as a coded sequence identifying the reason for the lockout. For instance, for a LOCKOUT - FLAME FAIL- PTFI, the INTERLOCK, PTFI and FLAME LED's will all be lit steady, with the Alarm LED flashing. This remains true if power is removed and then restored in a locked out condition.

While in the Idle or Off state, the LEDs are made to flash sequentially to show the operational status of the control every minute. The LEDs can be tested by pressing and releasing the Reset push button, while in the Idle or Off state.

LOCKOUT CODES

MSGN		DESCRIPTION	OP CTRL	AIRFLOW INTLCK	PTFI	FLAME	ALARM
DEC	HEX						
6	6	Lockout Line Frequency Noise Detected	●	❍	❍	●	✱
7	7	Lockout Flame Fail - PTFI	❍	●	●	●	✱
15	0F	Lockout Fault Unknown	●	●	●	●	✱
16	10	Lockout Amplifier High Count Fail	❍	❍	❍	❍	✱
19	13	Lockout Flame Fail - MTFI	❍	❍	●	●	✱
20	14	Lockout False Flame - STANDBY	❍	●	❍	❍	✱
21	15	Lockout Intrlck Open	●	●	●	❍	✱
22	16	Lockout intrlck Closed	❍	●	●	❍	✱

MSGN		DESCRIPTION	OP CTRL	AIRFLOW INTLCK	PTFI	FLAME	ALARM
24	18	Lockout Chassis Opto	●	●	❍	●	✱
37	25	Lockout Flame Fail - AUTO	❍	●	❍	●	✱
39	27	Lockout Fuel Valve State Change	❍	❍	❍	●	✱
54	36	Lockout Check Chassis	❍	❍	❍	●	✱
55	37	Lockout Check Programmer	❍	❍	●	❍	✱
56	38	Lockout Check Amplifier	●	❍	❍	❍	✱
58	3A	Lockout Amplifier Auto Check Fail	●	❍	●	❍	✱
59	3B	Lockout Check BLOWN FUSE	●	❍	●	●	✱
76	4C	Lockout Check Scanner	●	●	❍	❍	✱

❍ = NOT LIGHTED
● = LIGHTED
✱ = FLASHING

All MicroM chassis are shipped with a convenient peel off label that can be applied to any surface (inside cover) for future reference.

DIAGNOSTIC MESSAGES - TROUBLESHOOTING GUIDE

	POSSIBLE CAUSE	SOLUTION
Check Programmer	Voltage on Terminal 5 at improper time.	Inspect wiring to main fuel valve
	Welded watchdog relay	Replace MEC Chassis
	Internal diagnostic failure	Replace MEP Programmer
Check Chassis	Voltage on Terminal 3 or 4 at improper time.	Inspect wiring to pilot valve and igniter.
	Welded watchdog relay	Replace MEC Chassis
Chassis Opto	Opto-Coupler(s) short circuited	Replace MEC Chassis
Amplifier High Count Fail	Amplifier signal level high	Replace Amplifier module
Amplifier Auto Check Fail	Flame signal too high	Use orifice in sight pipe
	Internal Amplifier diagnostic fault	Replace Amplifier module
Check Scanner	Defective shutter	Inspect scanner wiring, replace scanner
	UV tube false firing	Replace UV tube or scanner
Check Blown Fuse	No power detected on terminal 3	Inspect defective pilot valve or igniter
	Defective fuse	Replace fuse
Line Frequency Noise Detected	Spikes detected on AC Mains	Check for SCR motors or DC Drives
		Inspect ground system
Fuel Value State Change	Terminal 5 (main fuel) detected on during PTFI	Check external wiring or replace MEC chassis
Check Amplifier	Amplifier not passing diagnostic tests	Replace Amplifier Module

PROGRAMMER DESCRIPTION

For replacement of UVM, TFM and M-II type controls, refer to the cross-reference provided at the end of this section.

MEP100 SERIES

MEP100 and MEP101

These programmers provide relight operation, in the event of a flame failure, pilot trial for ignition is reinitiated. The MEP101 will not lock out if flame signal is present during the Idle or Off cycle. With flame signal present, lockout will occur 60 seconds after the start of a cycle and the air flow switch is closed.

Pilot Ignited Burners

Refer to typical wiring arrangement illustrated on page 33.

Normal Operation

With power applied and the limit operating control circuit (1-7) closed, the Operating Control LED illuminates, the burner motor circuit is energized (Terminal 8).

After the air flow proving switch (7-6) closes, the interlock (air flow) LED is illuminated and a short time delay period (3-5 seconds) begins.

At the expiration of the safe start check period, a 10 second pilot trial for ignition (PTFI) period is initiated, illuminating the PTFI Led. Power is applied to Terminal 3, energizing the pilot gas valve and to Terminal 4, energizing the spark ignition.

At the detection of pilot flame, the FLAME LED is illuminated, and the programmer holds that position for 3 seconds to allow the to pilot stabilize.

Power is then applied to Terminal 5 energizing the main fuel valve and removing power from Terminal 4, turning off the spark igniter.

When the operating control opens, the control de-energizes Terminal 3 and Terminal 5 and the programmer reverts back to an Idle state.

Safety Shutdown

In the event pilot flame is not detected at the end of the 10 second PTFI period, the pilot gas valve and spark ignition are de-energized. A safety lockout occurs which de-energizes the burner motor and energizes the lockout alarm relay circuit, lighting the Alarm LED, 15 seconds after the safety lockout occurs. Manual reset is required.

In the event of a flame failure during a firing period, the main fuel valve is de-energized (Terminal 5) and the spark ignition is re-energized (Terminal 4), the PTFI period begins again as described above under Normal Operation.

In the event of the interlock switch opening, the main fuel valve and pilot valve are de-energized. The control reverts back to the Idle state and begins again a new cycle starting with the safe start check period.

Direct Spark Ignited Burners

Refer to typical wiring arrangement illustrated on page 34.

Normal Operation

With power applied and the limit operating control circuit (1-7) closed, the Operating Control LED illuminates, the burner motor circuit is energized (Terminal 8).

The interlock proving switch (7-6) closes, the INTRLCK LED is illuminated and a short time delay period (3 seconds) begins (safe start check period).

At the expiration of the safe start check period, a 10 second PTFI period is initiated. The PTFI Led is illuminated, power is applied to Terminal 3, energizing the main fuel valve and to Terminal 4, energizing the spark ignition.

At the detection of main flame, the FLAME LED is illuminated, and the programmer holds that position for 3-5 seconds to allow the main flame to stabilize.

Power is then removed from Terminal 4, turning off the spark igniter.

When the operating control opens, the control de-energizes Terminal 3 and Terminal 5 and the programmer reverts back to an Idle state. Terminal 8 is immediately de-energized.

Safety Shutdown

In the event the main flame is not detected at the end of a 10 second PTFI period, the main fuel valve and spark ignition are de-energized. A safety lockout occurs which de-energizes the burner motor and energizes the lockout alarm relay circuit, lighting the Alarm LED, 15 seconds after the safety lockout occurs. Manual reset is required.

In the event of a flame failure during a firing period, the secondary fuel valve (if used) is de-energized and the spark ignition is re-energized, the PTFI period begins again as described above under Normal Operation.

In the event of the interlock switch opening, the main fuel valve and pilot valve are de-energized. The control reverts back to the Idle state and begins again a new cycle starting with the safe start check period.

MEP102 & MEP104

The MEP102 and MEP104 programmers operate the same as the MEP100, except the PTFI time is limited to 5 seconds and 10 seconds respectively, the relight feature is eliminated and instead, the control will enter safety lockout on flame failure. Recycle to the start of safe start check period to begin a new cycle will occur on air flow switch opening.

MEP103

The MEP103 programmer implements a fixed 10 second spark igniter sensing period (SISP) used to detect spark, followed by a 10 second main trial for ignition (MTFI). Safety lockout occurs on flame failure during the main firing period (AUTO). Recycle occurs on air flow switch opening. If spark is not detected during the spark igniter sensing period the control makes one attempt to establish pilot following a post purge of 30 seconds and a safe start check. Failure to ignition spark on the second attempt results in safety lockout.

MEP100P

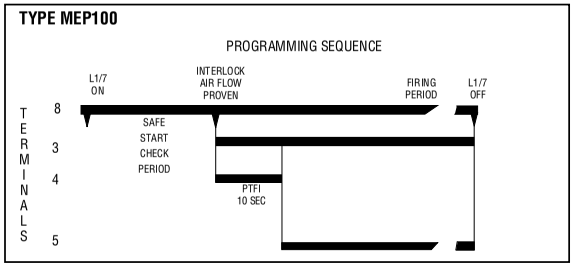
The MEP100P programmers provides a fixed 15 second post purge period upon detection of the operating Control (1-7) or Air Flow switch (7-6) opening.

MEP100 as FLAME SWITCH (refer to Figure 11)

For systems that require flame switch operation, that is, relay KF will toggle on with flame signal and off without flame signal, the MicroM provides this function when equipped with an MEP100 programmer. To operate as a flame switch, Terminals 1 and 6 **MUST** be powered with 120 VAC while Terminal 7 **MUST** be left unpowered. Terminals 3, 4, and 5 will provide an isolated (KL relay not energized) set of contacts with Terminal 3 being the common input, Terminal 4 will be normally closed and Terminal 5 will be normally open. **If Terminal 7 is powered or if Terminal 6 is non-powered and a flame signal is present, the MicroM will lockout after 1 minute and Terminals 4 and 5 will no longer switch with flame signal.** Refer to Figure 11 for configuration wiring. Air Flow LED will blink while flame is detected.

TIMING CHART

TYPE MEP100



Terminal #5 is energized 3 seconds after flame is detected.
Re-ignited PTFI on flame fail after Terminal 5 energized.
Recycle on loss of interlock (air flow) after flame proven.

MEP101

Same as MEP100 but will tolerate flame signal during “Off” cycle.

MEP102

PTFI time limited to 5 seconds, lockout on flame fail.

MEP104

PTFI time limited to 10 seconds, lockout on flame fail.

MEP200 SERIES

The MEP200 Series programmers come equipped with a bank of dipswitches that allow user selectable prepurge timing, selectable PTFI timing, selectable post purge, selectable air flow proven open at start, and selectable recycle/non-recycle operation. Refer to PROGRAMMER DIPSWITCH SETTINGS for detailed information.

Recycle operation refers to flame failure during the main (AUTO) firing period. In the event of a main flame failure, power is removed from Terminal 3 and Terminal 5. If selected by the dipswitch, the control will enter a post purge period for 15 seconds and revert back to the Idle state where the pre-purge period begins.

If non-recycle operation is selected, in the event of a main flame failure, power is removed from Terminal 3 and Terminal 5. The control will enter a forced post purge period of 15 seconds, after which the Alarm LED is illuminated and the alarm relay is energized putting power on Terminal A.

The MEP230H programmer operates the same as the MEP230 with the exception of an additional 8 second pilot stabilization. After flame is detected during the trial for ignition period, the powering of Terminal 5 is delayed for eight (8) seconds. Terminal 4 remains powered during the stabilization period. This function is offered primarily for two-stage light oil burners, to assure a specific delay between light off of the first and second stage, and to provide additional ignition timing to improve flame stabilization.

The MEP290 programmer operates the same as the MEP230 with the exception that post purge is selectable from 0 to 90 seconds.

MEP235

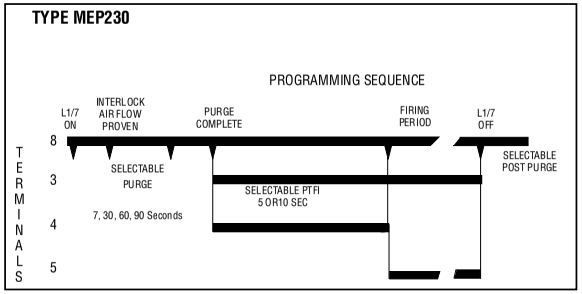
The MEP235 programmer operates the same as the MEP230 except flame failure during the firing period causes lockout. Dipswitch #6 refers to Recycle/Non-Recycle on a loss of air flow (Terminal 6) after flame is proven. The running interlock circuit (Terminal 6) must be proven closed within 10 seconds after start of a cycle.

MEP236

The MEP236 programmer provides a 3 second main flame stabilization period by keeping Terminal #4 (igniter) energized while the main fuel valve (Terminal #5) opens. The MEP236 is to be used on an intermittent pilot only.

TIMING CHARTS

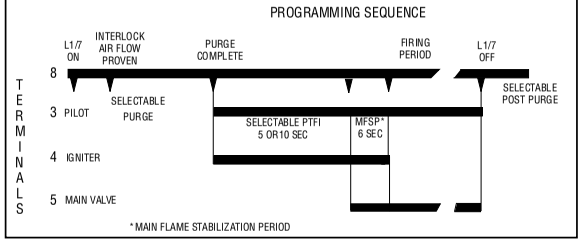
TYPE MEP230



Terminal #5 is energized 3 seconds after flame is detected.
Selectable Recycle/Non-Recycle operation on loss of flame after Terminal 5 energized.
Recycle on loss of interlock (air flow) after flame proven.
Selectable air flow (interlock circuit) proven at start.

Selectable purge times are 7, 30, 60 and 90 seconds.

TYPE MEP236



Terminal #5 is energized 3 seconds after the flame is detected.

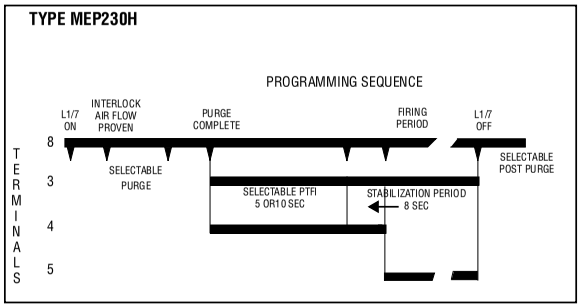
Selectable Recycle/Non-Recycle operation on loss of flame after flame is proven.

Igniter remains on for 6 seconds after main valve opened.

Intermittent pilot only.

For interrupted pilot, use MEP536

TYPE MEP230H



Pilot Stabilization timing begins as soon as flame is proven.

Selectable Recycle/Non-Recycle operation on loss of flame after Terminal 5 is energized.

Selectable air flow (interlock circuit) proven at start.

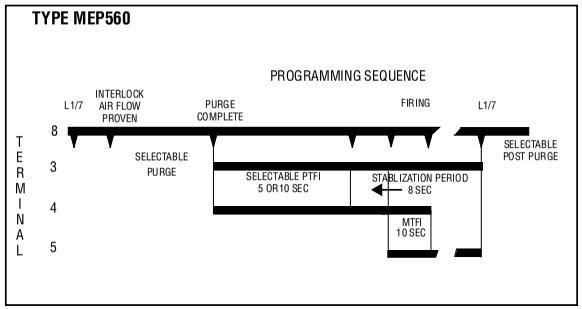
MEP500 SERIES

Refer to typical wiring arrangement illustrated on pages 33 and 38.

The MEP500 Series Programmers provide an additional relay used to control Terminal 4 separately. This allows the implementation of a pilot stabilization period as well as main trial for ignition period. They also come equipped with a bank of dipswitches that allow the user selectable prepurge timing, selectable PTFI timing, selectable post purge, selectable air flow proven open at start, and selectable recycle/non-recycle operation. Refer to PROGRAMMER DIPSWITCH SETTINGS for detailed information.

A “run-check” switch is also provided to assist in testing size, position and stabilization of pilot in conjunction with the flame detector,

For the MEP560 and MEP562, after pilot flame is detected, the control enters an 8 second pilot stabilization period with Terminal 3 and Terminal 4 energized. At the expiration of the stabilization period, Terminal 5 is energized.

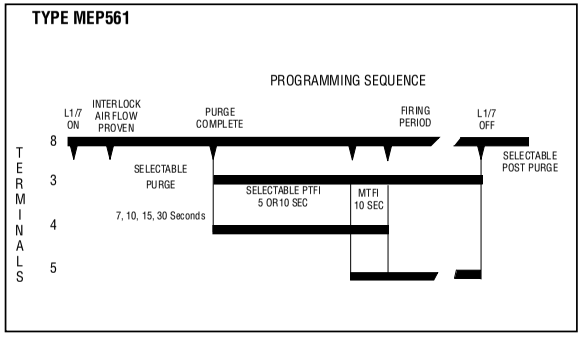


Pilot Stabilization timing begins as soon as flame is proven.

Selectable Recycle/Non-Recycle operation on loss of flame after Terminal 5 is energized.

Selectable air flow (interlock circuit) proven at start.

Recycle on loss of air flow (interlock circuit) after flame is proven.



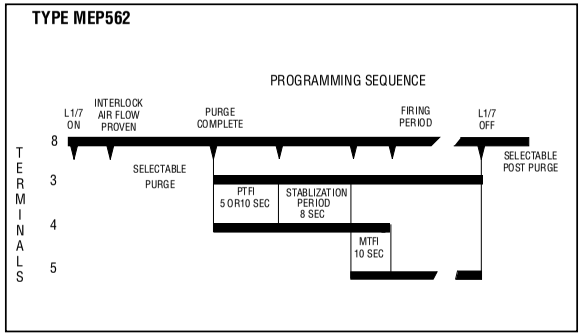
Selectable purge times are 7, 10, 15 and 30 seconds.

10 second timing begins 3 seconds after flame is proven.

Selectable Recycle/Non-Recycle operation on loss of flame after Terminal 5 is energized.

Selectable air flow (interlock circuit) proven at start.

Lockout on loss of air flow (interlock circuit) after flame is proven.



Pilot stabilization timing begins as soon as flame is proven.

Lockout on loss of air flow (interlock circuit) after flame is proven.

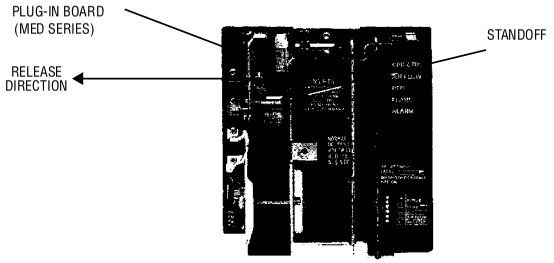
Lockout on flame fail.

OPTIONAL PLUG-IN BOARDS

Description

A family of optional plug-in boards are available separately for the MicroM chassis to provide remote reset, remote alpha-numeric display and serial communications as a stand alone or in combination. Refer to ORDERING INFORMATION for MicroM Chassis types for units that have pre-installed functions.

FIGURE 4. PLUG -IN BOARD LOCATION AND INSTALLATION



Installation

WARNING: Remove power when servicing the control.

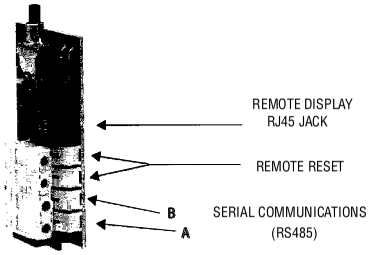
For upgrading standard units or for replacing the installed plug-in board, grasp plug-in board at the top and pull away from the chassis, freeing the unit from the retaining standoff. Lift plug-in board up and away from connector located on chassis board. Guide new plug-in board into the same connector and push onto standoff.

Function

Remote Reset

The MEC120R, MEC120RC, or any chassis type with the appropriate plug-in board installed provides remote reset capabilities in the event of a lockout condition. A remote reset switch consists of a dry contact such as a remote momentary push-button wired to the two (2) terminals located on the plug-in board as shown in Figure 5. The reset switch will also force the MicroM to recycle if depressed and released during the purge or run period.

FIGURE 5. REMOTE RESET



CAUTION: Remote reset is recommended only on a control solely for proved ignition programming (pilot ignited burner) or a control for use only with applications in which unburned fuel cannot accumulate and that is intended for installation in inaccessible locations such as open-flame, ceiling-suspended gas heaters. The remote reset location must be within sight and sound of the fired equipment.

ADVANCED RESET FUNCTIONS

Multiple functions have been integrated into the reset push button located on the MicroM and provided by way of the remote reset terminals. Among these are reset/recycle, reset from lockout only, recycle only and set unit address. **The functions of the switch is determined by the length of time the push button is depressed and released.**

The MicroM allows the connection of the remote resets to be connected together, usually in a multi-burner system where multiple MicroM's are mounted in a common panel. The reset push button located on the MicroM daughter board is in parallel with the remote reset terminals when provided by the other MED daughter boards.

Normal Operation
If the push button is depressed and released for greater than 1/2 second but less than 3 seconds, the MicroM will either reset if in lockout, or shutdown and revert back to the start of the cycle. If the MicroM is in the Idle state, this action will cause the LED's to sequence from the bottom to top and serves as a LED test.

Smart Reset
If the push button is depressed and released greater than 3 seconds but less than 5 seconds, the MicroM will reset from the lockout state only. This is especially useful where, through the use of remote reset daughter boards, all reset inputs can be connected together to a common reset pushbutton or intelligent device (PLC). If the push button is depressed as described above it will only cause the unit that is in lockout to reset and not effect any other units.

Smart Recycle
If the push button is depressed and released greater than 5 seconds but less than 7 seconds, all connected MicroM units will recycle back to the beginning of purge. All units that are in lockout will remain in lockout.

Address Mode
If the unit is in the Idle or Standby mode and the push button is depressed and released for greater than 10 seconds, the unit address of the MicroM will be displayed on the LED's in a binary format. The range of the address is 0 to 31 and is used for Modbus or E500 communications. Because the default address is 0 and since address 0 would mean no LED's would be lit; the ALARM LED is made to flash when the address is 0. The OP CTRL LED is the least significant bit while the FLAME relay is the most significant bit. The ALARM LED is used to indicate if the address is greater than or less than 16. If the ALARM LED is flashing, the address is less than 16 and conversely if the ALARM LED is solid, the unit address is greater than 16. This only applies to the address. To increment the address on the control, depress and release the RESET push button and observe the LED pattern. If the RESET switch is untouched for 30 seconds, the current address displayed will be stored to memory and the MicroM will automatically exit the address mode.

	LED	BINARY VALVE
OP CNTRL	❍	1
INTRLCK	❍	2
PTFI	❍	4
FLAME	❍	8
ALARM	❍	16
The ALARM LED flashes for addresses less than 16.		
The ALARM LED is solid for addresses greater than 15.		

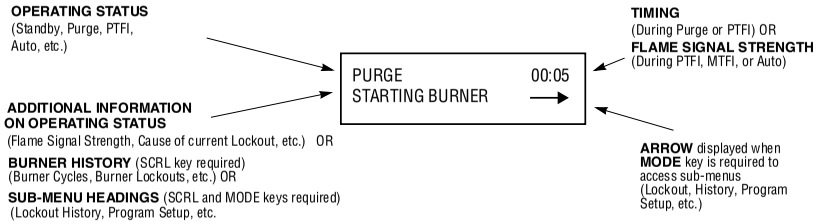
REMOTE DISPLAY

The MicroM provides an interface to the optional ED510 display module. The ED510 connects to the MicroM through the plug-in board using a ED580 cable. The ED580 cable is available in 2, 4, or 8 foot lengths. Part number 129-145 -1 (4 ft.), -2 (8 ft.), -3 (2 ft.) is available for remote mounting the ED510 Display Module.

The ED510 Display Module is a backlit, 2 line by 16 character LCD display with keypad to provide both current operation and historical information of the MicroM. The ED510 contains a keypad consisting of three push keys, SCRL, RESET and MODE. Remote reset is available through the ED510 Keypad.

The ED510 displays current burner status, first out annunciation in the event of a lockout condition, historical burner information, detailed lockout information of the last six (6) lockout conditions and programmer configuration information. Through the display the ability to program the unit address for communications, as well as resetting the stored information (cycles, hours, and lockouts) to zero is provided.

Depending on the information being displayed, data is displayed on the ED510 screen in the following locations:



At any time the MicroM is powered, the SCRL key is used to scroll through and display the total number burner hours, burner cycles, burner lockouts and system hours on the bottom line of the ED510 display. The top line will continue to show the current run mode of the control (e.g. PURGE, AUTO, etc.) Following the historical information, the SCRL key will display three (3) sub-menus providing the following information and/or functions:

— Lockout History (with burner cycle and burner hour time stamp).

— Program Setup (to display programmer type, purge timing, switch configuration, etc.)

— System Information (values of average pilot and main flame signal, and reset burner history).

The system sub-menus require the MODE key to gain access to the information associated with each sub-menu. An arrow is displayed in the lower right hand corner of the display to indicate a system sub-menu is available. Once within the sub-menu, pressing the SCRL key displays the next item within the sub-menu, and pressing the MODE key will exit the sub-menu and return the display to the top of the main menu.

AUTO 40 BNR HOURS 673	Number of burner operating hours. (Terminal #5 energized).
AUTO 40 BNR CYCLES 2784	Number of burner cycles.
AUTO 40 BNR LOCKOUTS 21	Number of burner lockouts.
AUTO 40 SYS HOURS 1386	Number of hours the control has been powered.
AUTO 40 LOCKOUT HISTORY →	Sub-menu to display the cause of the last 6 lockouts. The MODE key is required to display the actual lockouts.
AUTO 40 PROGRAM SETUP →	Sub-menu to display various operating parameters of the programmer and amplifier. The MODE key is required to enter the sub-menu.
AUTO 40 SYSTEM INFO →	Sub-menu to display information pertaining to the operation of the control. The MODE key is required to enter the sub-menu

LOCKOUT HISTORY

The sub-menu "LOCKOUT HISTORY" will display the last six (6) lockouts, along with the burner cycle and burner hour when the lockout occurred. When the MODE key is pressed, the screen will display the most recent lockout condition and the number of that lockout (e.g. LO #127 represents the 127th lockout of that control). The SCRL key will display the Burner Hour, followed by the Burner Cycle when the lockout occurred. The SCRL key will advance to the next lockout, and repeat the sequence listed above. The MODE key will exit the sub-menu.

PRESS	SCREEN DISPLAYS	DESCRIPTION
SCRL	AUTO 45 LOCKOUT HISTORY	Scrolling through the historical information.
MODE	LO #127 PTFI FLAME FAIL	The latest (most recent) lockout condition. This is the 127th lockout of the control. History indicates the lockout occurred during PTFI.
SCRL	LO #127 PTFI @ BNR HOURS 136	The last lockout occurred after 136 hours of burner operation.
SCRL	LO #127 PTFI @ BNR CYCLE 744	The last lockout occurred at burner cycle 744.
SCRL	LO #126 PURGE AIR FLOW OPEN	The second latest lockout condition. This is the 126th lockout of the control. History indicates the lockout occurred during purge.
MODE	AUTO 45 FLAME SIGNAL	Screen has returned to the normal run message.

PROGRAM SETUP

The sub-menu "PROGRAM SETUP" allows the user to review the various operational settings of the programmer module (e.g. programmer type, purge timing, etc.). The MODE key is used to enter the "PROGRAM SETUP" sub-menu, and the SCRL key is used to advance through the sub-menu.

MODE	AUTO 45 PROGRAMR MEP230	Programmer Type is an MEP230.
SCRL	AUTO 45 ENGR CODE NO. 5	Software Engineering code of the programmer module is code 5.
SCRL	AUTO 45 AMP. TYPE= MEUV	Amplifier module is an EUV1 or an ERT1.
SCRL	AUTO 45 FLAME FAIL TIME = 3s	Flame Failure Response Time (FFRT) is 3 seconds.
SCRL	AUTO 45 PURGE TIME = 7s	Purge timing (selected by the dipswitches) is 7 seconds.
SCRL	AUTO 45 PROVE 7-6 OPEN = N	Prove 7-6 open to start is disabled (selected by dipswitches).
SCRL	AUTO 45 POST PURGE = 0s	Post purge time is 0 seconds (selected by dipswitches).
SCRL	AUTO 45 TYPE RECYCLE	Control recycles on flame fail (selected by dipswitches).

SCRL	AUTO UNIT ADDRESS 00	Unit Address is 00. Refer to section on communications.
SCRL	PRESS RESET TO ACCEPT SETTINGS	Force storage of dipswitch settings before 8 hours time-out.
MODE	AUTO 45	Mode key returns to normal run message.

SYSTEM INFO

The sub-menu "SYSTEM INFO" allows the user to review information pertaining to the operation of the control (e.g. average main flame signal strength, status of the high fire and low fire end switches, etc.). The MODE key is used to enter the "SYSTEM INFO" sub-menu, and the SCRL key is used to advance.

Press	Screen Displays	Description
SCRL	AUTO 45 SYSTEM INFO >	SCRL key advances through the historical information until "System Info" is displayed. Pressing and releasing the MODE Key enters the sub-menu.
MODE	AUTO 45 AVG. PILOT FLM 22	The average flame signal strength of the pilot flame = 22
SCRL	AUTO 45 AVG. MAIN FLM 40	The average flame signal strength of the main flame = 40.
SCRL	PRESS RESET TO CLEAR HISTORY	Historical data will be cleared to 0. Must be done while terminal I-7 is open.
MODE	AUTO 45 FLAME SIGNAL	Mode key returns to run message.

COMMUNICATIONS

The protocol to be used is Modbus RTU. This is implemented by the master (PC, PLC, etc.) issuing a poll to the slave (MicroM) and the slave responding with the appropriate message.

A typical format of a poll request is as follows:

DST	FNC	ADR HI	ADR LO	DAT HI	DAT LO	CRC LO	CRC HI

DST refers to the logical address of the slave.

FNC is the function being requested. FNC 03 is a read request.

ADR is the message number or register number of the data being requested. In Modbus, register addresses begin at 40001 but is interpreted as address 00.

DAT is the number of words being requested. A word is an integer consisting of 2 bytes.

The normal response from a slave is as follows:

DST	FNC	DBC	DATA…. Hi/Lo	CRC LO	CRC HI

DBC is the data byte count being returned. It must be two times the DAT number from the poll request.

DATA is the data returned and is always a series of 2 byte integers. If 4 words were requested then DBC would be 8 and there would be 8 data bytes or 4 data words containing the requested data.

The format of the data is 4800,N,8,1 meaning 4800 baud, no parity, and 1 stop bit.

Below is a table of currently available messages provided by the MicroM programmers, followed by a description where necessary.

MESSAGE ADDRESS		WORD REQUESTED	RESPONSE	VALUE
DEC	HEX			
00	00	1-6	STATUS	83 (053H) = RUN; 202 (0CAH) = LOCKOUT
01	01	1	MSGN	Current message being displayed (see Table 3)
02	02	1	GSTAT	Defines Timer Type
03	03	1	TIMER	Time, Flame, Address
04	04	1	FLAME	Flame Signal
05	05	1-3	LOGSTAT	Current logic module, PURGE, PTFI, AUTO (See Table 1)
06	06	1	INPUTS	Input limits state
07	07	1	OUTPUTS	Output relays state
08	08	2	SYSMINS	System on minutes
10	OAH	2	BNRMINS	Burner on minutes
12	OCH	2	CYCLES	Completed Burner Cycles
14	OEH	1	LOCKOUT COUNT	Stored Lockout Count
15	OFH	1-6	LOCKOUT HISTORY	Last 6 Lockouts, first word is most current lockout
21	15H	1-2	DEVTYP	Programmer device type, 5=EP, 6=EPD, 7=MicroM
22	16H	1	AMPTYP	Amplifier Type; MECD=080H; MEUV=090H; MEIR=0A0H; MERT=0B0H; MEUVS=0C0H
23	17H	1	PROGTYP	Programmer Type (See Table 2)
24	18H	2	FLAME SIGNAL AVERAGES	PTFI and Auto Flame Signal Averages

Message 00, message 05, message 15 and message 21 are unique in that a limited number of successive registers can be combined with these requests. For example, a request to message 00 can contain up to 6 data words. The response to this would contain STATUS, MSGN, GSTAT, TIMER, FLAME and LOGSTAT. If the requested data word count (DAT) were to be 2 then the response would contain STATUS and MSGN only. Message 15, last 6 lockouts, can return data ranging from 1 to 6, with 1 referring to the most recent lockout.

The MSGN being transmitted is a numerical value and must be interpreted by the communicating device, which actually is an advantage since this can be made to be whatever message text the end user wants. In other words, it allows for programming custom messages without actually changing the message in the programmer.

The MicroM stores its burner on time (Terminal 5 powered) and system on time (L1 powered) in minutes. Internally, the programmer converts this to hours for display purposes, however the result is rounded down. The information being supplied by Modbus will be the actual time in minutes and it is

up to the communicating device to do the conversion. Since the maximum value stored in the MicroM is 9,999,999 minutes, the maximum value in hex therefore, is 98967FH and comprises of two data words. The maximum cycle count is 999,999 decimal or 0F423FH, still two data words.

All returned values are represented in a HEX or base 16 format.

GSTAT determines the type of value TIMER represents. TIMER can be a running timer such as is used in purge, a flame signal or meaningless. Only the lower nibble of GSTAT has any value. If this value is 0 then the TIMER value has no meaning. The value in TIMER is a background minute timer in the MicroM and should be ignored. If GSTAT is between 4 and 7, the TIMER represents the current value flame signal. If GSTAT is a 1, 2, or 3 then TIMER represents a running timer value.

The baud rate of the MicroM is fixed at 4800 bits per second. The format of the data is 8 data bits, no parity and 1 stop bit. Due to the RS485 format, the communication format is considered half-duplex. That is, only one user is permitted on the communication lines at a time.

The information contained in INPUTS and OUTPUTS represents the status of the interlocks and relays respectively. For the INPUTS, a 1 in the interlock position defines the interlock as being on or energize where the 1 in any bit position in the OUTPUT register signifies the relay as being energized.

INPUTS

			Term 5	Term 3	Term 6	Term 7	
Reset	Scrl	Mode	RF	Pilot	Intrlck	OpCntrl	Ref

Reset, Scrl and Mode represent the keypad located on the ED510 display. A'0' in any of these positions indicates the switch is depressed. A '1' in the opto-coupler position indicates the opto-coupler is on or interlock closed.

OUTPUTS

			Term 8	Term A	Term 3	Term 5	Term 4
N/A	N/A	N/A	Blower	Alarm	Pilot	Main Fuel	MTFI (MEP56x)

A '1' in any terminal position indicates the relay is energized. Term 4 indicates the state of K1 relay, located in the MEP500 series programmers.

It is suggested that repeated polling interval not be less than 200 mSec per request. Requesting data such as burner minutes, system minutes and burner cycles be kept at a minimum due to the amount of processing time required to gather that data.

Table 1: Logic Dispatch

LOGIC DISPATCHER		
VALUE (hex)		MicroM
45H		MPOSTIDLE
46H		MPREPURGE1
47H		MPURGE
48H		MTFI
49H		MSTABLE
4AH		MTFMF
4BH		MAUTO
4CH		MSHTDWN1
4DH		MSHTDWN2
4EH		MIDLE

Logstat represents the current software module the Flame-Monitor is currently executing. They are named as close to the logic module the actual burner sequence is in. For instance, in the Flame-Monitor, MPURGE represents High Fire Purge where MPOSTPURGE represents low fire start purge. MSHUTDWN1 represents the post purge period after a complete cycle or the cool down period after a lockout.

MIDLE or STANDBY is the period of time where the operating control is open or the control is in lockout waiting for reset. On instances of false flame during the purge period, the control algorithm forces the control back to STANDBY until false flame ceases or lockout occurs.

MPREPURGE1 is the period of time prior to PURGE where the control checks the status of the air flow interlocks or in the case of the Flame-Monitor, high fire proving switch (D-8). If found open, the control will remain in this state until the respective switch closes or lockout occurs.

MTFI represents the pilot ignition stage of a burner sequence. MTFMF represents the main trial for ignition period where main fuel is introduced along with pilot.

MAUTO is the run period of the burner sequence.

MPOSTIDLE and MSHTDWN2 are small periods of time where certain internal tests are conducted and general cleanup before and after a cycle is performed.

PROGTYP is represented by 1 data word. The upper byte identifies the family and the lower byte represents the programmer type within the family. The data represented by PROGTYP can be used to guard against the wrong programmer being installed in a system.

Table 2: Programmer Module Identification

Programmer Module	Identifier
MEP100	0H, 1H
MEP101	0H, 2H
MEP102	0H, 3H
MEP103	0H, 4H
MEP100P	0H, 5H
MEP130	0, 8H
MEP104	0H, 9H
MEP105	0H, 0AH
MEP106	0, 0BH
MEP107	0, 0CH
MEP108	0, 0DH
MEP230	1H, 1H
MEP230H	1H, 2H
MEP235	1H, 4H
MEP236	1H, 5H
MEP238	1H, 7H
MEP290	1H, 6H
MEP536	2H, 4H
MEP560	2H, 1H
MEP561	2H, 2H
MEP562	2H, 3H

Message Table Description

Table 3: Message Description

DEC	HEX		MicroM Message
1	1		L1-7 OPEN
2	2		FALSE FLAME
3	3		STARTING BURNER
4	4		
5	5		INTRLCK OPEN
6	6		LOCKOUT LINE FREQUENCY NOISE DETECTED
7	7		LOCKOUT FLAME FAIL - PTFI
8	8		UNIT ADDRESS
9	9		MTFI
10	0AH		IGNITION TIMING
11	0BH		
12	0CH		FLAME SIGNAL
13	0DH		CYCLE COMPLETE
14	0EH		OFF
16	10H		LOCKOUT AMPLIFIER HIGH COUNT FAIL
19	13H		LOCKOUT FLAME FAIL – MTFI
20	14H		LOCKOUT FALSE FLAME – STANDBY
21	15H		LOCKOUT INTRLCK OPEN
22	16H		LOCKOUT INTRLCK CLOSED
23	17H		INTRLCK CLOSED (PROVING AIR FLOW OPEN AT START)
24	18H		LOCKOUT OPTO FAILURE
30	1EH		FALSE FLAME
37	25H		LOCKOUT FLAME FAIL - AUTO
39	27H		FUEL VALVE STATE CHANGE
40	28H		AIR FLOW CLOSED
49	31H		LOCKOUT FLAME FAIL - PTFI
54	36H		LOCKOUT CHECK CHASSIS
55	37H		LOCKOUT CHECK PROGRAMMER
56	38H		LOCKOUT CHECK AMPLIFIER
58	3AH		LOCKOUT AMPLIFIER AUTO CHECK FAIL
59	3BH		LOCKOUT CHECK BLOWN FUSE
76	4CH		LOCKOUT CHECK SCANNER

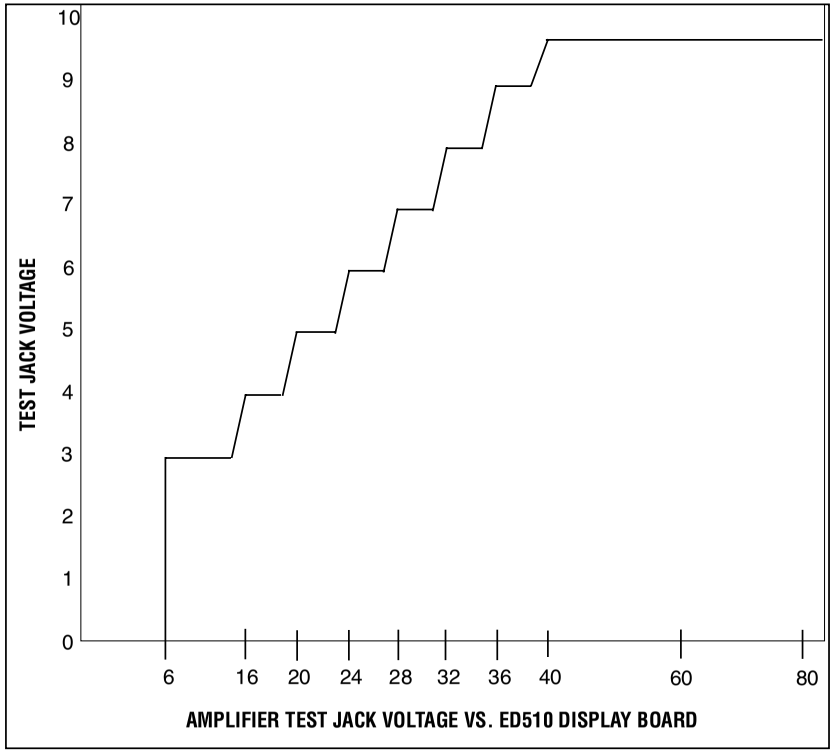
Addressing Modes

For communication in a multi-burner or multi-control environment, each MicroM must have a unique address. The range of address allowed within the MicroM is 0 to 31 allowing for a possible 32 units to be connected in a single multi-drop node. As shipped the default address is 0. The address of the MicroM may be set using two methods. Using the ED510 display, it is necessary is SCRL to the PROGRAM SETUP menu and enter that submenu with the MODE key. SCRL down until the display indicates UNIT ADDRESS with the actual address of the MicroM being displayed on the top line of the display. Pressing and releasing the RESET key will cause the address to increment. The

address after 31 is 0. The second method is to use the local reset located on the plug-in board. It is first necessary to open the operating control (L1-7) to have the MicroM in the IDLE or STANDBY position. Depressing the reset switch for greater than 10 seconds will cause the address of the MicroM to be displayed in a binary format on the LEDs located on the programmer board. Because the default is address 0, and since address 0 would mean no LEDs would be lit; the ALARM LED is made to flash when the address is 0. The OP CTRL LED is the least significant bit while the ALARM relay is the most significant bit. To increment the address counter, depress and release the RESET push button and observe the LED pattern. If the RESET switch is untouched for 30 seconds the current address displayed will be stored to memory and the MicroM will automatically exit the address mode.

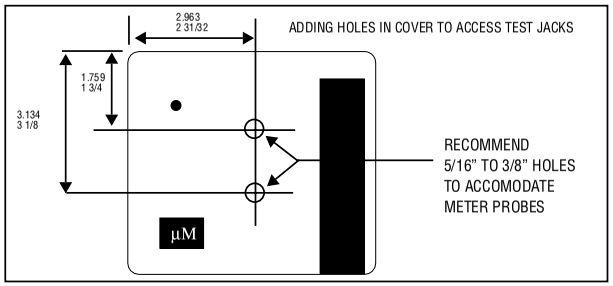
TEST JACK VOLTAGE

For all amplifiers, the MicroM provides a uniform 0-10 volt signal to represent the flame signal strength. A signal reading greater than 4 volts is considered sufficient to provide reliable operation. This same signal is also available in a numerical format on the ED510 display. The chart below correlates the test jack voltage to the numerical value. The signal clamps at 10 volts at a numerical value greater than 42 and the numerical value clamps at 80.



EXTERNAL METER CONNECTIONS

The test jacks are located on the amplifier card. If external access is desired for a panel meter the shown below will assist you in locating the position to drill through on the front cover. The hole sizes should be large enough to accommodate the body of the meter probes. The tests accept meter probes up to .080" or 2mm diameter.



INSTALLATION TESTING

Use of Test Meter (All Controls)

Testing the Fireye MicroM Controls requires the use of a test AC/DC multimeter, with a minimum 1000 ohm/volt AC scale and 20,000 ohm/volt DC scale.

With the test meter on the DC scale, and the test meter leads inserted into the test jacks on the amplifier (Red for positive (+) polarity, Black for minus (-) polarity), a DC voltage reading of 4.0 to 10 volts for all amplifier types should be obtained when the control is detecting flame and 0 volts when no flame is present. Wildly fluctuating readings are an indication of an unstable flame or flame sensor requiring maintenance. Inadequate flame signal may be improved by:

1. Assuring that the flame detector and wiring installations have followed the instructions on pages 3 and 4.
2. Assuring that the flame detector is clean and within the ambient temperature limits.
3. Assuring that the flame is sufficiently large to detect.
4. Assuring that the flame quality (fuel to air ratio, combustion air velocity) is satisfactory.
5. Trying a shorter sight pipe or increasing the sight pipe diameter. **(The burner manufacturer should be consulted before mechanical changes are made).**

When using a flame rectification amplifier, a micro-ammeter may be connected in series with the wire to Terminal S2. Normal flame will produce a meter reading between 4 and 10 micro-amps.

With the test meter on the AC scale, line and load voltages may be measured at the identified test points on the chassis.

WARNING: Before making a pilot flame test, manually shut off the fuel supply to the main burner.

Normal Pilot Flame Test (MEP560, MEP561, MEP562 Programmers Only)

1. At pilot trial for ignition (PTFI) place the Run/Check switch in the Check position.
2. During the pilot flame test and adjustment period, if flame is not detected within 30 seconds, the control will lock out and require manual reset to initiate another cycle.

3. Observe the pilot flame signal on the test meter or the ED510 display. If the flame signal is below 4.0 volts DC or a reading of 10 on a remote display, re-adjust the pilot flame or realign the flame detector.

WARNING: DO NOT TOUCH a flame rectification rod with power applied.

4. When using UV detection, a test is required to verify that UV radiation from the ignition spark is not being detected. To accomplish this, manually shut off both the pilot and main fuels. Initiate a normal start-up. Observe the test meter which should read no more than 1/2 volt DC. If higher levels are observed, realign the UV scanner, and/or shield the spark from the scanner's view.
5. Move the Run/Check switch to the Run position, check pilot flame response time by manually shutting off the pilot fuel and initiate a normal start-up. With no pilot flame present, the control will de-energize the pilot assembly at the end of the trial for ignition interval (selectable by dipswitch #4) and go into safety shutdown.

WARNING: The minimum pilot test must be accomplished by a trained and qualified burner technician.

Minimum Pilot Test

This test assures that the flame detector will not sense a pilot flame too small to light a the main flame reliably. It must be made on every new installation as well as following the repositioning or replacement of the flame detector. This procedure should not be used on a direct spark burner.

1. Manually shut off the fuel to the main burner.
2. Place the Run/Check switch in the Check position. (MEP500 Series Programmers only).
3. Connect a test meter to the test jacks on the Amplifier Module or observe the reading on the ED510 display.
4. Initiate a normal start-up.
5. Reduce the fuel to the pilot until the DC voltmeter reads 4.0 volts. This is the minimum pilot. For flame rectification the flame signal for minimum pilot varies depending on the application. See WARNING below.
6. Return the Run/Check switch to the Run position (MEP500 Series Programmers only).
7. Slowly turn on the main fuel and insure the main flame lights off promptly and normally.

WARNING: If light off is delayed, shut off the power to the installation. Realign the flame detector so a larger pilot flame is required before flame is detected. Repeat this test until the main flame lights reliably with minimum pilot.

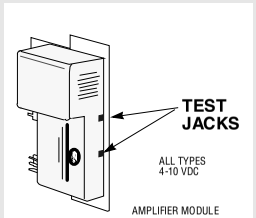
Flame Failure Test

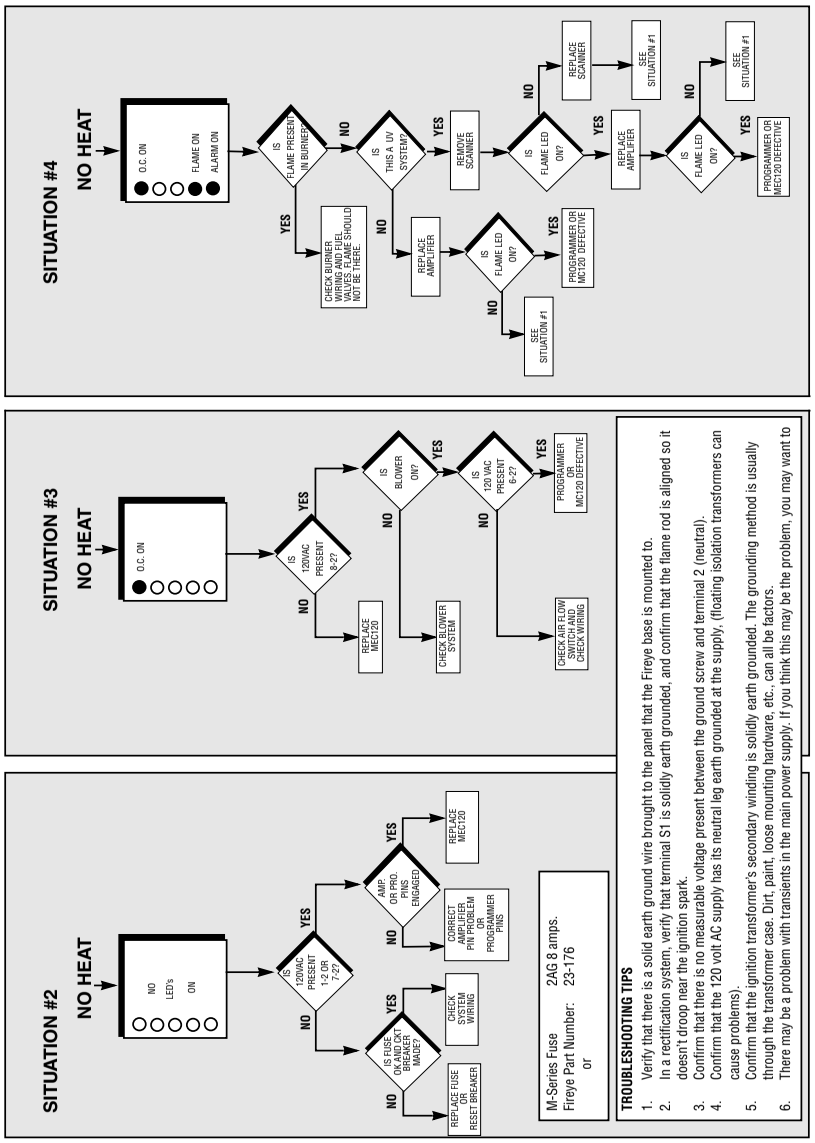
1. Temporarily connect spark ignition and pilot to Terminal #3.
2. Initiate a normal start-up.
3. Manually shut off all fuel and observe the loss of flame signal on the test meter.
4. If flame signal does not reduce to zero within the flame failure response time of the control (FFRT determined by the selection of the amplifier), verify the UV flame detector is not actuated by the ignition spark. If spark is detected, a metallic shield or relocation of the UV detector is required.

5. **IMPORTANT: When the test is completed, reconnect the spark ignition to Terminal #4.**

MicroM SERVICE GUIDE

SITUATION #1 NORMAL LOCKOUT





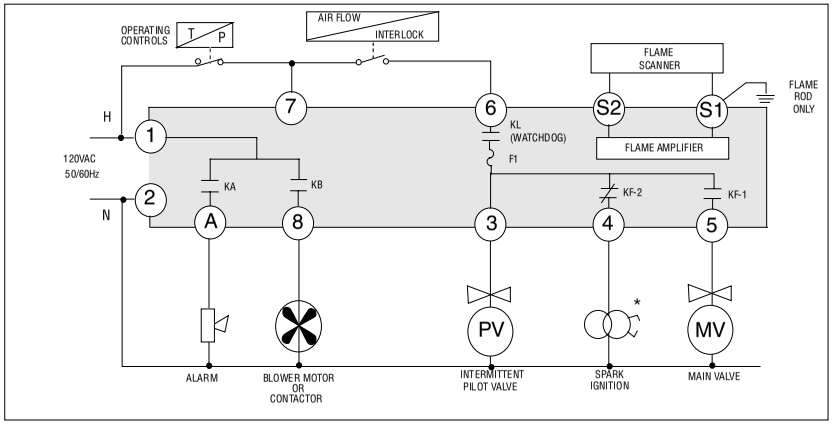
Wiring Arrangements

IMPORTANT: Use moisture resistant wire rated 90°C minimum.

CAUTION: When powered, 560 VAC across S1, S2 with MEUV4, MEUV1, MEUVS4 and MEUVS1; 260 VAC across S1, S2 with MERT4 and MERT1.

CAUTION: Control wiring procedures which deviate from those shown in the diagrams may bypass safety functions designed in the control. Check with the Fireye Representative before deviating from the recommended wiring diagrams.

FIGURE 6. WIRING ARRANGEMENT FOR PILOT IGNITED BURNERS USING MEP100 AND MEP200 SERIES PROGRAMMERS



*For intermittent ignition, connect to terminal 3

FIGURE 7. WIRING ARRANGEMENT FOR PILOT IGNITED BURNERS AND PROVISION FOR MAIN FLAME STABILIZATION USING MEP236 SERIES PROGRAMMERS

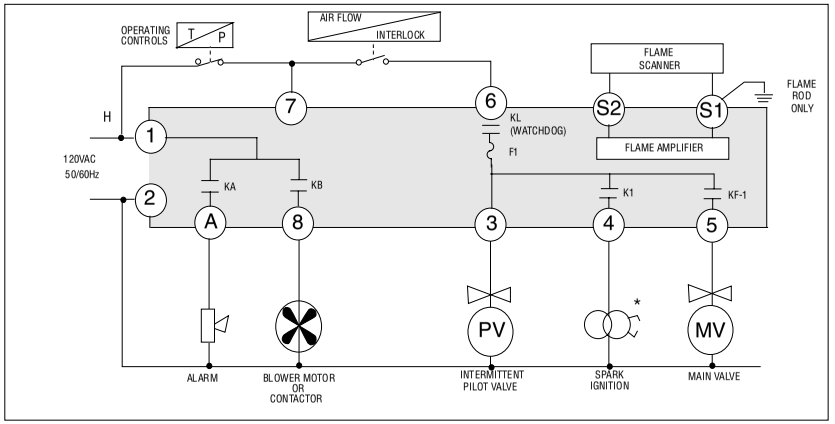
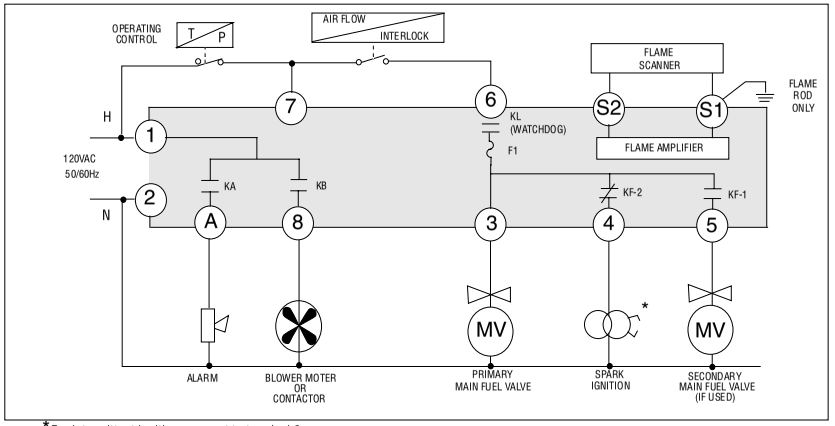


FIGURE 8. WIRING ARANGEMENT FOR DIRECT SPARK IGNITED BURNER, TWO STAGE OPERATION USING MEP100 AND MEP200 SERIES PROGRAMMERS



*For intermittent ignition, connect to terminal 3

FIGURE 9. WIRING ARRANGEMENT FOR PILOT IGNITED BURNER AND INTERRUPTED PILOT USING MEP500 SERIES PROGRAMMERS.

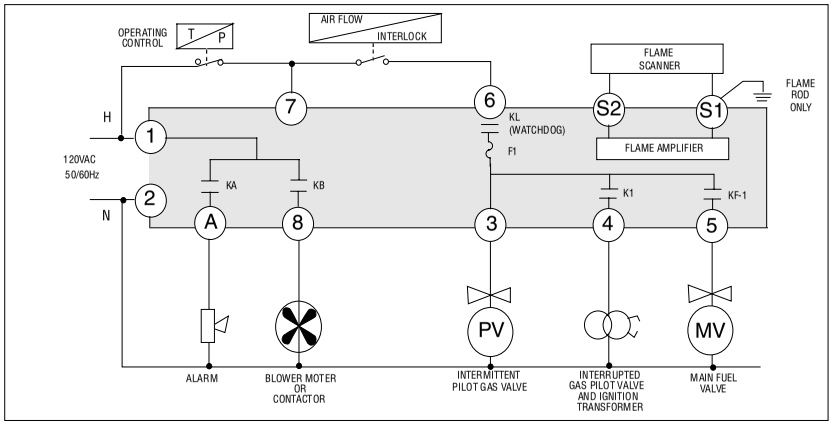
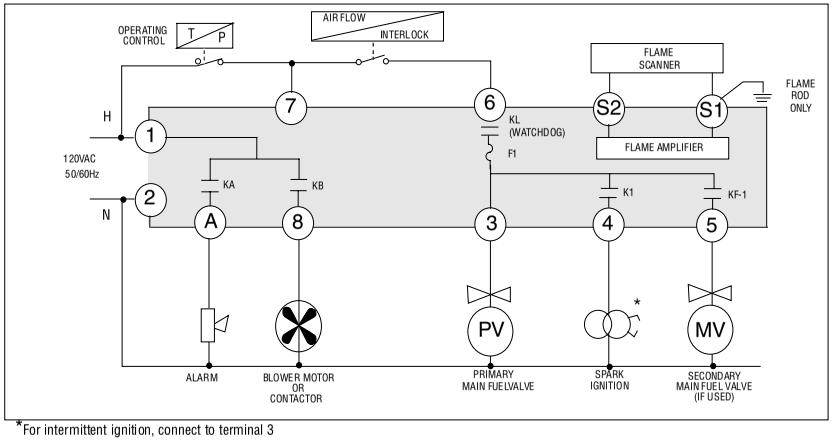
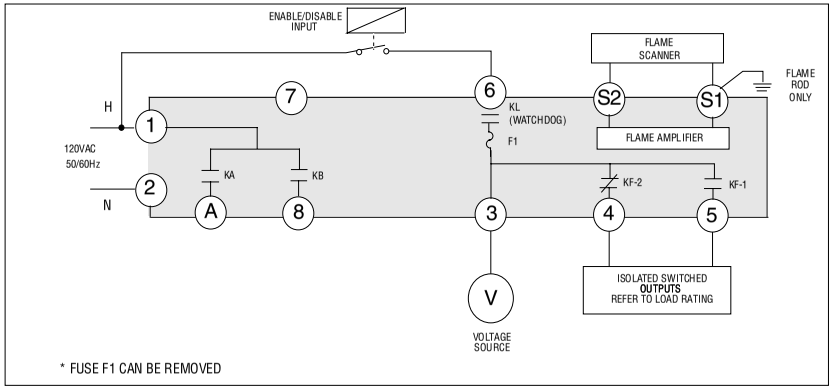


FIGURE 10. WIRING ARRANGEMENT FOR DIRECT SPARK IGNITED BURNERS AND INTERRUPTED IGNITION USING MEP500 SERIES PROGRAMMERS



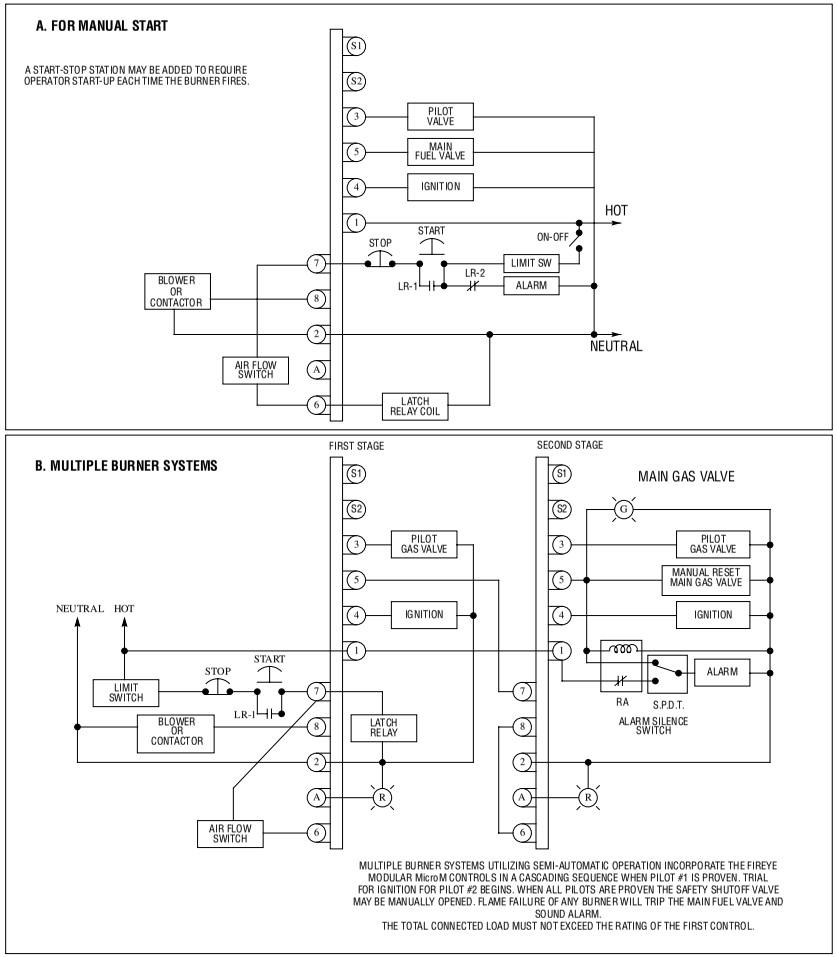
*For intermittent ignition, connect to terminal 3

FIGURE 11. WIRING ARANGEMENT FOR FLAME SWITCH USING MEP100 PROGRAMMER



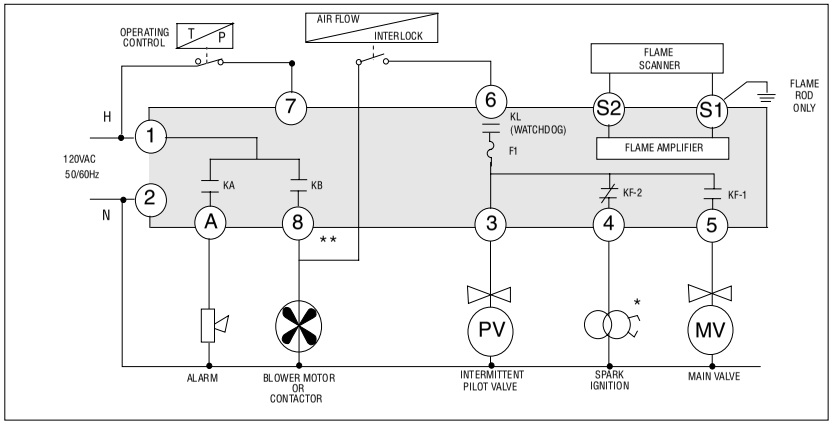
***NOTE:** Air Flow LED will blink while flame is detected and KF relay is energized.*

FIGURE 12. ALTERNATE WIRING ARRANGMENT FOR MEP CONTROLS



IMPORTANT: Use moisture resistant wire rated 90°C minimum.

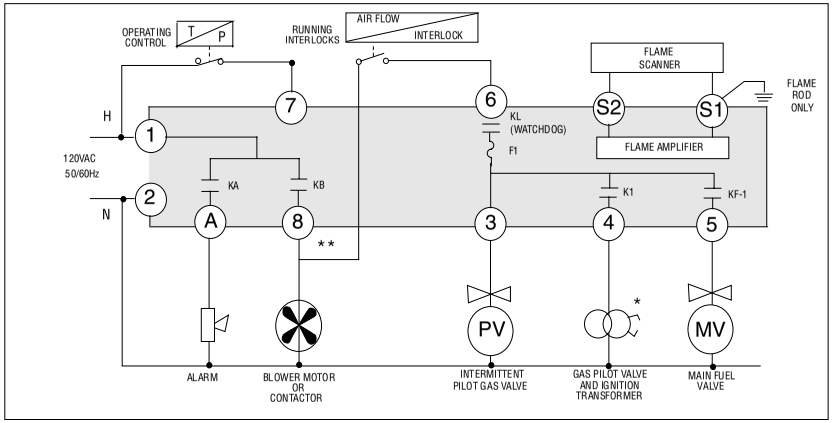
FIGURE 13. BACKWARD COMPATIBLE WIRING USING MEP100 AND MEP200 SERIES PROGRAMMERS(PILOT IGNITED BURNERS).



* For intermittent ignition, connect to terminal 3

* * Combined current from Terminal 8 must not exceed 9.8 Amps

FIGURE 14. BACKWARD COMPATIBLE WIRING USING MEP500 SERIES PROGRAMMERS (PILOT IGNITED BURNERS)



* For intermittent ignition, connect to terminal 3

* * Combined current from Terminal 8 must not exceed 9.8 Amps

SUGGESTED GROUNDING RULES

The MicroM system, being microprocessor based, requires a ground system that provides a zero-voltage reference. The voltage measured from L2 to all other terminals except L1 should be 0 volts.

1. The most effective ground is to run the ground wire in the same raceway as the hot and neutral from the main distribution service panel (not intermediate sub-panels) to the burner control panel and insure that this ground wire is well bonded to the control panel.
2. The wiring base of the MicroM must have earth ground providing a connection between the sub-base and the control panel or the burner.
3. The earth ground wire must be capable of conducting the current to blow the 20A fuse in event of an internal short circuit. A number 14 AWG copper conductor is adequate, wide straps or brackets are preferred rather than lead wires.
4. The ground path needs to be low impedance (less than 1 ohm) to the equipment frame which in turn needs a low impedance to earth ground. For a ground path to be low impedance at RF frequencies, the connection must be made with minimum length conductors having maximum surface areas.
5. All connections should be free of nonconductive coatings and protected against rust.
6. Utilizing conduit as a means of providing a ground must be avoided.
7. Installing ground rods at the burner control panel defeats the purpose of a single point ground as described above and could also present a safety hazard.

INSTALLATION

Do not run high voltage ignition transformer wires in the same conduit with flame detection wiring.

Do not run scanner wires in a conduit with line voltage circuits.

Ensure the frame of the ignition transformer is securely connected to control panel frame or preferably the burner frame.

The MicroM chassis (MEC120) contains a transient suppressing device connected internally across hot and neutral and then to the internal bracket. For this to be effective the chassis must be screwed securely into the wiring subbase.

REMOTE DISPLAY

When the ED510 is to be remotely mounted on the front of the control panel, the ED580 cable must contain a ferrite core, currently supplied by Fireye with the cable. The cable end with the ferrite core must be mounted at the control end. High frequency currents flow more to the surface of the conductor. The 60 Hz ground system, properly designed, has sufficient low-impedance at 60 Hz to maintain all metal surfaces at the same ground reference. But, this same system is unable to provide this at higher frequencies, because of the increased impedance caused by the 'skin effect'. The purpose of the ferrite core is to provide a low-impedance at these higher frequencies and absorb this unwanted energy.

Care must be taken not to route the ED580 cable in close proximity to any starter motor contactors located in the control panel or across any high voltage ignition wires. Refer to Fireye bulletin E8002 for proper installation.

COMMUNICATIONS

When interfacing Fireye controls to a communication system, be it an E500, PLC or other microprocessor based device, ferrite cores should also be utilized. Proper twisted shielded pair cable must be utilized. In a multi-drop system, the shields should be tied together within a cabinet and not to any ground point. The shield at the source end of the cable of the multi-drop connection can then be terminated to ground. Source end is defined as the originating end of the communication system

Care must be taken not to route communication cables in close proximity to any starter motor contactors located in the control panel or across any high voltage ignition wires. Refer to Fireye bulletin E8002 for proper installation.

SCANNERS

The armored cable supplied with the Ultra-Violet and Infrared scanners should be connected to equipment by means of a good mechanical connection such as a conduit fitting. It may be necessary to utilize heat insulator (P/N 35-69) to isolate the sensing end of the scanner from boiler ground. Care must be taken not to route the scanner cable across the high voltage ignition cable. The high energy ignition cable should be checked periodically for cracking, connections and aging.

In applications using flame rod units and the MERT amplifier, it may be beneficial to route a separate return wire from the S1 terminal to the flame rod assembly. This will minimize the effects of transient currents flowing into the MicroM.

In all cases, scanner wires should be routed in separate conduit and not joined with any high voltage AC or ignition cables.

MAINTENANCE

Periodically, the spark electrode should be inspected for proper gapping and cracked ceramics. At ignition time, the high energy from the ignition transformer will attempt to conduct to the point of least resistance and with an improper spark gap, where the conduction takes place will no longer be controlled.

The VA rating of the control transformer must be sized to handle the inrush currents of the pilot solenoid and ignition transformer at PTFI and then the inrush currents of the main fuel valve assembly at MTFI time.

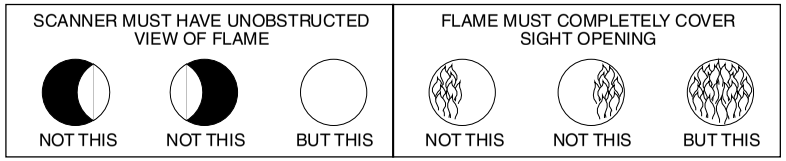
Inspect neatness of wiring in junction boxes and cabinets. It is best to have connections short and direct and also not having wires bunched up and tied off. Also, connections should be periodically inspected for tightness and corrosion.

INSTALLATION - UV SCANNERS

Where possible, obtain the burner manufacturer's instructions for mounting the scanner. This information is available for most standard burners. The scanner mounting should comply with the following general instructions:

1. Position the UV1, UV2 scanner within 30 inches of the flame to be monitored; the 45UV5 within 72 inches, closer if possible.
2. Select a scanner location that will remain within the ambient temperature limits of the UV Scanner. If cooling is required, use an insulating coupling (Fireye P/N 35-69 for UV1, UV2 Scanners, P/N 35-127-1 for 45UV5) to reduce conducted heat.
3. The UV1, UV2, 45UV5 Scanners are designed to seal off the sight pipe up to 1 PSI pressure. Higher furnace pressures should be sealed off. To seal off positive furnace pressure up to 100 PSI for UV1, UV2 Scanners, install a quartz window coupling (#60-1257) For 45UV5 Scanners, use #60-1100 coupling. Add cooling air to reduce the scanner sight pipe temperature.
4. Install the scanner on a standard NPT pipe (UV1: 1/2", UV2: 3/8", 45UV5: 1") whose position is rigidly fixed. If the scanner mounting pipe sights through the refractory, do not extend it more than halfway through. Swivel flanges are available if desired (#60-302 for UV1, UV2 Scanners,

#60-1664-3 for 45UV5). The sight pipe must permit an unobstructed view of the pilot and/or main flame, and both pilot and main flames must completely cover the scanner field of view.

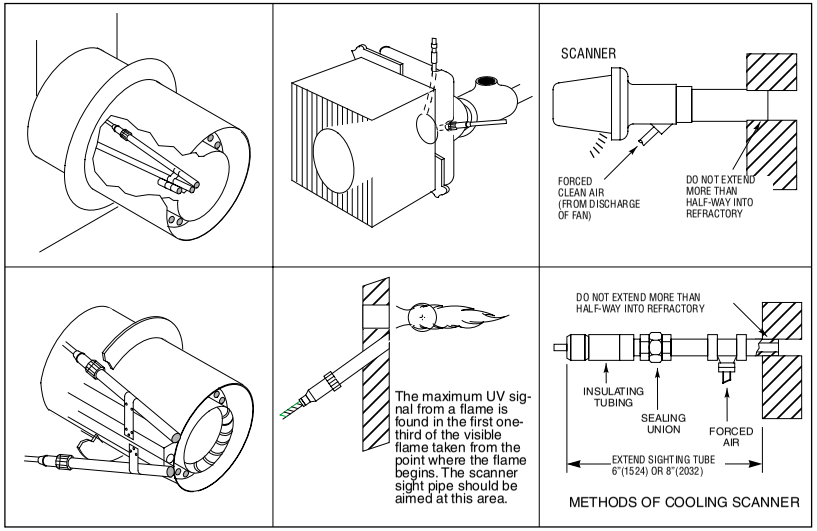


5. Smoke or unburned combustion gases absorb ultraviolet energy. On installations with negative pressure combustion chambers, a small hole drilled in the UV 1, UV2 sight pipe will assist in keeping the pipe clean and free from smoke. For positive pressure furnaces, provide clean air to pressurize the sight pipe, if necessary.
6. Two UV1 or UV2 Scanners may be installed on the burner if it is necessary to view two areas to obtain reliable detection of the flame. They should be wired in parallel. Only one repetitive self-checking 45UV5 Scanner may be installed on a burner.

To increase scanner sensitivity with UV1, UV2 Scanners, a quartz lens permits location of the scanner at twice the normal distance. Use 1/2" x 1 1/2" pipe nipple between UV1 Scanner and the coupling. Use 3/8" pipe nipple and a 1/2" x 3/8" bushing on UV2 installations.

7. Request the assistance of any Fireye field office for recommendations of a proper scanner installation on a non-standard application.

TYPICAL SCANNER INSTALLATIONS



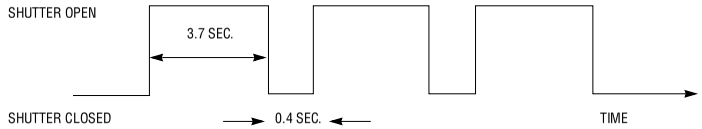
OPERATION — 45UV5 SELF-CHECKING UV SCANNER

Self-checking ultraviolet scanners should be used in applications where burner firing operation is continuous or where the burner is on for long periods of time without recycling. In addition, ultraviolet self-checking systems are mandatory in some locations.

The operation of this type of system consists of maintaining the flame scanning capability at all times while also proving that the ultraviolet tube is firing properly. This is done periodically by mechanically closing off the sight of the UV tube and checking to make sure that the flame signal goes away. A shutter assembly in the 45UV5 scanner performs this function. The diagram below explains the process further.

If the shutter assembly in the scanner fails, the tube is faulty, or there is insufficient power to the scanner, the MicroM will LOCKOUT and display the following message LOCKOUT CHECK SCANNER. The ultraviolet tube is replaceable (P/N 4-314-1).

A lockout will result if a minimum signal is detected for three consecutive shutter closed periods.



WIRING - UV SCANNERS

To connect the scanner to the control, the UV1 Scanner is supplied with 36" or 72" of flexible cable.

The 45UV5 is supplied with four 72 inch lead wires. Install them in a suitable length of flexible armor cable and connect it to the control. A conduit connector is supplied with the scanner. Connect black wires (shutter) to terminals L1, L2; red wires (UV tube) to terminals S1, S2.

If it is necessary to extend the scanner wiring, the following instructions apply:

Scanner wires should be installed in a separate conduit. The wires from several scanners may be installed in a common conduit.

1. Selection of Wire
   a. Wiring: For extended scanner wiring up to 500 feet, and for shorter lengths to reduce signal loss, use a shielded wire (Belden 8254-RG62 coaxial cable, or equal) for **each scanner wire** of UV1, UV2 and **each red wire** of the 45UV5. **The ends of the shielding must be taped and not grounded.**
   b. Asbestos insulated wire should be avoided.
   c. Multiconductor cable is not recommended without prior factory approval.
2. High voltage ignition wiring should not be installed in the same conduit with flame detector wires.

INSTALLATION—INFRARED SCANNER TYPE 48PT2

Where possible, obtain the burner manufacturer's instructions for mounting the scanner, otherwise proceed as follows:

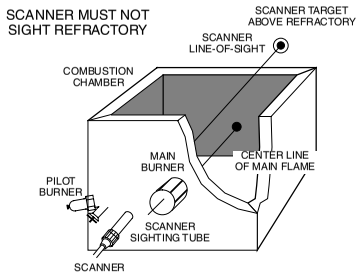
A single scanner is used to detect both pilot and main flames. The sight pipe on which the scanner mounts must be aimed so that the scanner sights a point at the intersection of main and pilot flames.

Proper scanner positioning must assure the following:

1. Reliable pilot flame signal.
2. Reliable main flame signal.
3. A pilot flame too short or in the wrong position to ignite the main flame reliably, must not be detected.
4. Scanner must have an unobstructed view of flame being monitored.
5. Flame being monitored must completely cover the scanner field of view.
6. To avoid nuisance shutdowns, it is important to avoid sighting hot refractory and to keep scanner temperature low (below 125° F) (50°C).

When the proper position has been established, drill a hole through the furnace wall and install a 4" to 8" length of threaded 1/2" black iron pipe on which to mount the 48PT2 scanner.

7. When satisfactory sighting position has been confirmed by operating tests, the sight tube should be firmly welded in place.



Wiring

Attach the cable supplied with the scanner to a junction box. Splice the cable wires to a pair of wires not smaller than #l8. Install the complete run in a separate conduit to the control. **Continuous conduit bonding between scanner and the control is mandatory!** Scanner may be located up to 100 feet from control. Do not pass scanner wiring through any junction box containing other wires. Do not run other wires through scanner conduit. Asbestos insulated wire should be avoided.

Keeping the Scanner Cool

The Infrared Scanner (Temperature Limit 125° F) should never get too hot to grasp comfortably in the hand. Keep the scanner cool by one or more of the following methods.

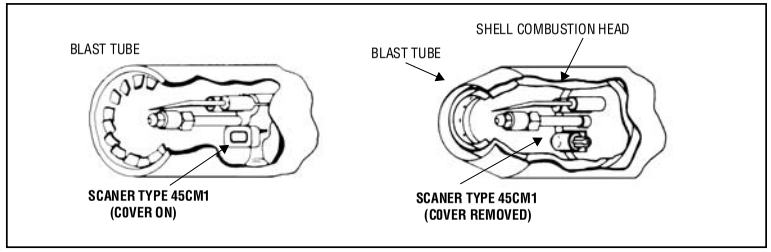
1. Use 6" to 8" length of pipe between scanner and hot furnace front plate.
2. Use insulating tube (Part No. 35-69) on the end of the iron pipe.
3. Force air into sighting tube. Use Fireye Sealing Union (Part No. 60-801).
4. Make sure sighting tube does not extend more than halfway into refractory wall.

INSTALLATION - 45CM1 PHOTOCELL MOUNT

Test for Incandescent Refractory Hold-In with Photocell Detector

Type 45CM1 Photocell Scanners are actuated by light energy. To assure that the flame failure response time is not extended by radiation from incandescent refractory, the following test is recommended:

1. Operate the burner, following the burner manufacturer's instructions, until the refractory is at maximum operating temperature.
2. Turn off the main fuel supply manually.
3. Observe the display flame signal which must drop below 10 within 4 seconds.
4. If the flame failure response time exceed 4 seconds, reduce the amount of light at the Photocell with a screen, an orifice, or a filter lens, until the normal flame failure response is obtained.



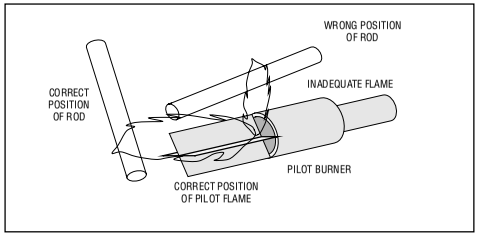
INSTALLATION - 69NDI FLAME ROD

The 69NDI flame rod proves a gas pilot flame and/or main gas flame. It is a spark plug type unit consisting of 1/2" NPT mount, a KANTHAL flame rod, a glazed porcelain insulating rod holder and a spark plug connector for making electrical connections. The 69ND1 is available in 12," 18" or 24" lengths.

The flame rod may be located to monitor only the gas pilot flame or both the gas pilot and main gas flames. It is mounted on a 1/2" NPT coupling.

The following instructions should be observed:

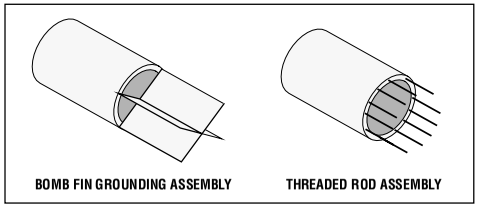
1. Keep flame rod as short as possible.
2. Keep flame rod at least 1/2'' from any refractory.
3. Flame rod should enter the pilot flame from the side so as to safely prove an adequate pilot flame under all draft conditions.
4. If the flame is nonluminous (air and gas mixed before burning), the electrode tip should extend at least 1/2" into the flame, but not more than halfway through.



5. If the flame is partly luminous, the electrode tip should extend only to the edge of the flame. It is not necessary to maintain absolutely uninterrupted contact with the flame.
6. It is preferable to angle the rod downward to minimize the effect of sagging and to prevent it from coming in contact with any object.
7. An adequate grounding surface for the flame must be provided. The grounding surface in actual contact with the flame must be at least four times greater than the area of the portion of the flame rod in contact with the flame. It is essential to adjust the flame rod and ground area ratio to provide a maximum signal reading.

NOTE: Interference from the ignition spark can alter the true signal reading by adding to, or subtracting from it. This trend sometimes may be reversed by interchanging the primary wires (line voltage) to the ignition transformer. This interference can also be reduced by the addition of grounded shielding between the flame rod and ignition spark.

8. Proven types of flame grounding adapters, as shown below, may be used to provide adequate grounding surface. High temperature stainless steel should be used to minimized the effect of metal oxidation. This assembly may be welded directly over the pilot or main burner nozzle.



MAINTENANCE

Type 48PT2 Infrared and Type UV1, UV2, 45UV5 Ultraviolet an~ 45CM1 Photoelectric Scanners

The viewing area of the scanner must be kept clean. Even a small amount of contamination will reduce the flame signal reaching the detector by a measurable amount. Wipe the viewing area routinely using a soft cloth dampened with concentrated detergent.

— Type 48PT2 Scanners include a replaceable #4-263-1 Firetron cell.
— Type 45CM1 Scanners include a replaceable #4-230 Phototube #922.
— Type 45UV5 Scanners include a replaceable #4-314-1 UV tube.

Type 69ND1 Flame Rod

The flame rod and its insulator should be kept clean by washing routinely with soap and water. Rods should be routinely replaced as they oxidize.

Flame Signal Strength

Routine observation of the flame signal strength will forewarn any deterioration in the capability of the flame detector or its application.

Contacts

There are no accessible contacts in the MicroM. Where contacts are used, their design assures long trouble-free life when the load circuits are maintained within the published load ratings.

Humidity

In areas of high humidity, the control chassis should be removed and placed in a dry atmosphere when the system is expected to be out of service for an extended period.

Periodic Safety Check

It is recommended that a procedure be established to test the complete flame safeguard system at least once a month,. This test should verify the proper operation of all limit switches and safety interlocks as well as flame failure protection and fuel safety shutoff valve tightness.

Rotation

It is recommended that control and scanner units purchased as spares be installed periodically to ensure proper operation.

FIGURE 15. Mounting 45UV5 Scanner

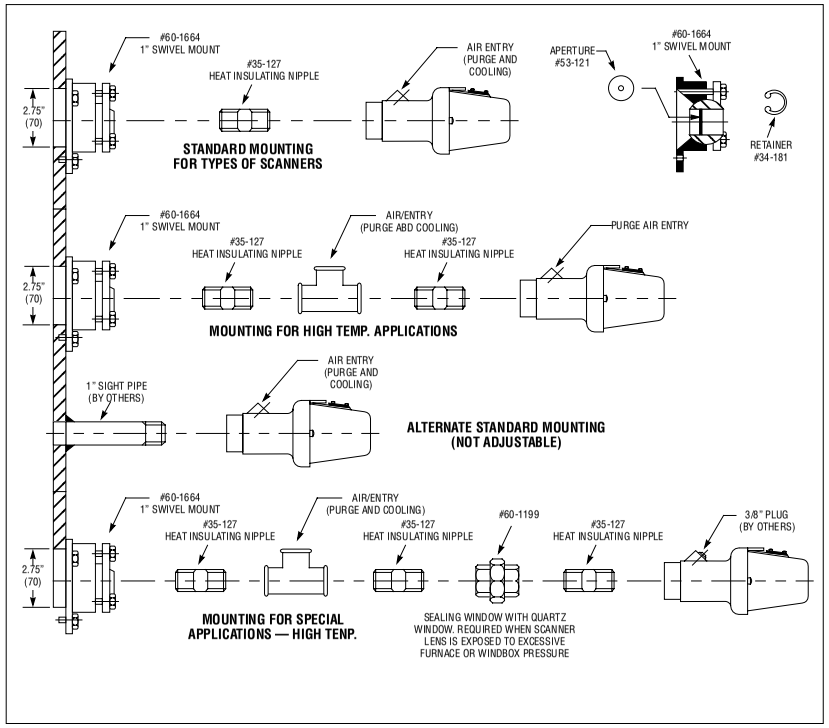
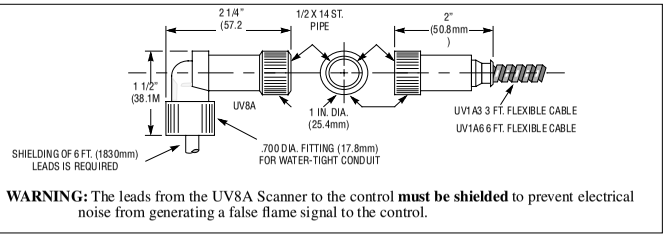
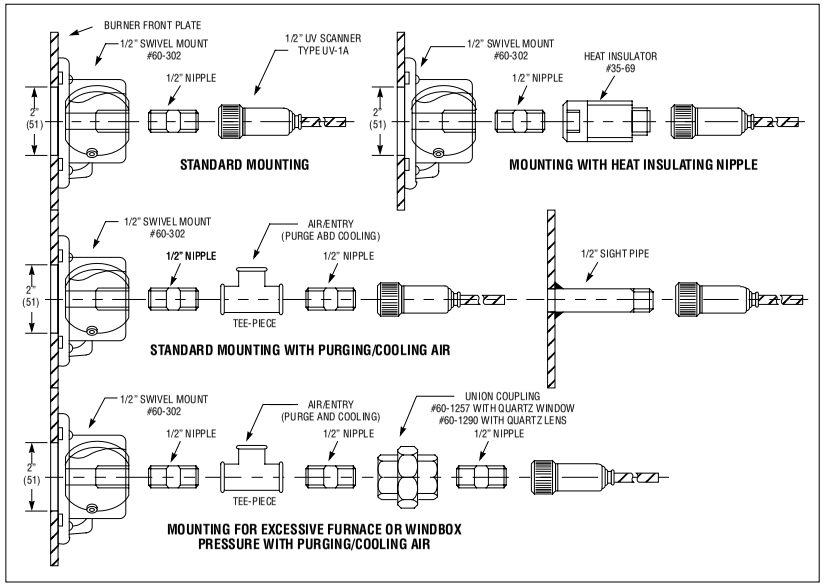


FIGURE 16. UV8A Scanner



WARNING: The leads from the UV8A Scanner to the control **must be shielded** to prevent electrical noise from generating a false flame signal to the control.

FIGURE 17. Mounting UV1A/UV1B Scanners



M-SERIES TO M-SERIES II TO MICROM CROSS REFERENCE LISTING

M-SERIES	M-SERIES II REPLACEMENT MODULES				MicroM REPLACEMENT MODULES			
Part Number	Chassis	Amplifier	Programmer	Programmer Dipswitch #8	Chassis	Amplifier	Programmer	Programmer Dipswitch #6
UVM1D	MC120	MAUV1T	MP100	N/A	MEC120	MEUV1	MEP100	N/A
UVM1F	MC120	MAUVI	MP100	N/A	MEC120	MEUV4	MEP100	N/A
TFM1D	MC120	MART1T	MP100	See Note #1	MEC120	MERT1	MEP100	N/A
TFM1F	MC120	MART1	MP100	See Note #1	MEC120	MERT4	MEP100	N/A
UVM2	MC120	MAUV1	MP230	OFF	MEC120	MEUV4	MEP230	C
TFM2	MC120	MART1	MP230	OFF	MEC120	MERT4	MEP230	C
UVM3	MC120	MAUV1	MP230	ON	MEC120	MEUV4	MEP230	O
TFM3	MC120	MART1	MP230	ON	MEC120	MERT4	MEP230	O
UVM3H	MC120	MAUV1	MP230H	ON	MEC120	MEUV4	MEP230H	O
TFM3H	MC120	MART1	MP230H	ON	MEC120	MERT4	MEP230H	O
UVM5	MC120	MAUV1	MP560	ON	MEC120	MEUV4	MEP560	O
UVM6	MC120	MAUV1	MP560	See Note #2	MEC120	MEUV4	MEP560	C

- N/A — Not Applicable
- Programmer Dipswitches apply to MP230H, and MP560 only.
- Dipswitch #8 sets Recycle / Non-Recycle Operation.
- MP560 Programmer Module has “Check-Run” Switch.
- Note #1: For Standing Pilot, clip out red jumper on MP100.
- Note #2: Dipswitch #8 ON when red jumper of UVM6 is clipped.

- N/A — Not Applicable
- Programmer Dipswitches apply to MEP200, and MEP500 Series Programmers
- Dipswitch #6 sets Recycle / Non-Recycle Operation. (O = Non-Recycle, C = Recycle)
- MEP500 Series Programmer Module has “Check-Run” Switch

PURGE	PTFI	M-Series II PROGRAMMER DIPSWITCH SETTINGS							MicroM PROGRAMMER DIPSWITCH SETTINGS			
TIME	TIME	#1	#2	#3	#4	#5	#6	#7	#1	#2	#4	#6
7	5	ON	OFF	OFF	OFF	OFF	ON	OFF	C	C	C	C
7	5	OFF	ON	OFF	OFF	OFF	ON	OFF	C	C	C	C
30	5	OFF	OFF	ON	OFF	OFF	ON	OFF	O	C	C	C
7	10	OFF	ON	OFF	OFF	OFF	OFF	ON	C	C	0	O
90	5	OFF	OFF	ON	ON	OFF	ON	OFF	O	O	C	C
30	10	OFF	OFF	ON	OFF	OFF	OFF	ON	O	C	O	O
60	10	OFF	OFF	OFF	ON	OFF	OFF	ON	C	O	O	O
90	10	OFF	OFF	ON	ON	OFF	OFF	ON	O	O	O	O

- Dipswitches #1 through #5 set Purge Timing
- Dipswitches #6 and #7 set TFI Timing

- Dipswitches #1 through #2 set Purge Timing
- Dipswitch #4 sets TFI Timing
- Dipswitch #6 set Recycle/Non-Recycle

M-SERIES TIMING CARDS	PURGE TIME	PTFI TIME
MT55	5	5
MT74	7	4
MT304	30	4
MT710	7	10
MT904	90	4
MT3010	30	10
MT6010	60	10
MT9010	90	10

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

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3 Manchester Road
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MC-5000
DECEMBER 2002
Supersedes June 2002

A Kidde Company

Honeywell

VR8104, VR8204, and VR8304 Intermittent Pilot Combination Gas Controls

INSTALLATION INSTRUCTIONS

APPLICATION

These intermittent pilot gas controls are used in gas-fired appliances with up to 415 ft3/hr capacity at 1 in. wc pressure drop (8.5 m3/hr at 0.25 kPa) on natural gas. They include safety shutoff, a manual valve, two automatic operators, a pressure regulator and a pilot adjustment.

These gas controls are available in a range of valve capacities, see Table 1. (Table 2 provides gas capacity conversion factors.) The suffix letter indicates temperature range and regulator type, see Table 3.

For CE-approved models, the relevant sections of these instructions and Table 4 are applicable.

Table 1. Valve Capacity[a]

Model	Size Inlet-Outlet (in.)	AGA Certified Capacity for Natural Gas		AGA Certified Minimum Regulation for Natural Gas		AGA Certified Maximum Regulation for Natural Gas	
		ft^3/hr	m^3/hr	ft^3/hr	m^3/hr	ft^3/hr	m^3/hr
VR8104	1/2 x 1/2	85	2.3	10[d]	0.4	120	3.4
VR8204		150	4.2	20[e]	0.6	200	5.7
VR8304[b,c]		240	6.8	30[f]	0.8	340	9.6
VR8304[b,c]	1/2 x 3/4	270	7.6			370	1.05
VR8304[b,c]	3/4 x 3/4	300	8.5			415	11.8

[a] Capacity based on 1000 Btu/ft^3, 0.64 sp gr natural gas at 1 in. wc pressure drop (37.3 MJ/m^3, 0.64 sp gr natural gas at 0.25 kPa pressure drop).

[b] Capacity is reduced by 5 percent when using an outlet screen.

[c] Valves are guaranteed at only 77 percent of the rating.

[d] Minimum regulation for LP gas is 15,000 Btuh.

[e] Minimum regulation for LP gas is 40,000 Btuh.

[f] Minimum regulation for LP gas is 50,000 Btuh.

Table 2. Gas Capacity Conversion Factor.

Gas	Specific Gravity	Multiply Listed Capacity By
Manufactured	0.60	0.516
Mixed	0.70	0.765
Propane	1.53	1.62

CE-Only Models

These gas controls are used in appliances up to 121kW or 415 kBTUH on natural gas and approved on EN126, which consists of one automatic safety shutoff valve, Class B or C, one servo-operated shutoff valve, Class D, pressure governor, Class C, manually-operated valve, with or without pilot outlet. Only the A, H and U models are available CE-approved.

Table 4 shows the additional specifications for the CE-only models.

CE

69-1225-4

Table 3. Model Number Suffix Letter Designation.

Model No. Suffix Letter	Ambient Temperature Range	Pressure Regulator Type
A	0°F to 175°F (-18°C to +79°C)	Standard
C		Step-opening
H		Slow-opening
U[a]		Nonregulating (on-off)
K	-40°F to +175°F (-40°C to +79°C)	Slow-opening
M		Standard
P		Step-opening
Q		Two-Stage
R		Convertible

[a] Available only on CE VR8204 models.

Table 4. VR8204A,H/VR8304A,H,U CE.

Specifications	VR8204A,H (CE Model Only)	VR8304A,H (CE Model Only)
Main valve connections (If NPT, the valves must be serviced by the appliance manufacturer.	1/2 in. ISO, 7/1 internal thread (BSP, NPT.	1/2 in., 3/4 in. ISO, 7/1 internal thread (BSP, PL) or 1/2 in., 3/4 in. NPT.
Valve Classification	B + D	C + D
Capacity (1kW = 3.41BTUH)	29 kW at 2.5 mBar 43 kW at 5.0 mBar	for 1/2 in., 70 kW at 2.5 mBar 99 kW at 5.0 mBar. For 3/4 in., 87 kW at 2.5 mBar: 121 kW at 5.0 mBar.
Supply Voltage	24 Vac, 50/60 Hz.	
Flanges	None.	
Closing time	Less than 1 second.	
Opening Time	Standard opening (A): less than 2 seconds. Slow opening (H): less than 6 seconds. Special fast opening (U): less than 1 second.	
Suited for gas families	2H, 2L, and 3.	
Outlet Press Range (Except unregulated models)	Natural gas: 7.5 to 12.5 mBar (3 to 5 in. wc). Natural gas: 12.5 to 17.5 mBar (5 to 7 in. wc). LP gas: 20 to 30 mBar (8 to 12 in. wc).	
Manually operated valve operations	10,000 cycles for manual valves; 200,000 cycles for automatic valves.	
Ambient temperature range	-20°C to +70°C (-4°F to +158°F).	
Maximum inlet pressure	60 mBar (24 in. wc).	
Screen	Fine mesh on inlet.	
Pilot connection[a]	M11 x 1 for 6 mm outside diameter tube.	
Ground terminal[a]	6.3 mm.	
Pressure taps[a]	9 mm OD for both inlet and outlet.	
Approval	CE-0063AU1215.	

a The VR8204U uses standard U.S. construction. Inlet and outlet ports are 1/2 in. NPT, and the pilot connection is the standard 7/16 in. thread for a 1/4 in. pilot tube. European-style inlet and outlet pressure taps are available.

⚠ CAUTION

Equipment Damage Hazard.
Improper use can damage equipment.
Read the instructions before use. This control must be installed in accordance with the rules in force.

SPECIFICATIONS

Body Pattern: Straight through; see Table 1 for inlet and outlet size.

Electrical Ratings:
Voltage and Frequency: 24 Vac, 60 Hz.
Current Draw: 0.5A with both operators energized.

Capacity: See Table 1.

Conversion: Use conversion factors in Table 2 to convert capacities for other gases.

Regulation Range: See Table 1.

Natural-LP Gas Conversion Kits: See Table 5.

Table 5. Natural-LP Gas Conversion Kits.

Model No. Suffix Letter	Kit to Convert Natural Gas to LP	Kit to Convert LP to Natural Gas
H, K, M	393691	394588
P	Not field convertible.	Not field convertible.
Q	396021	396025
R	Not required, convertible valve.	Not required, convertible valve.

Pipe Adapters:
Angle and straight adapters available for 3/8-, 1/2- and 3/4-in. pipe. See Table 6. Flange kits include one flange with attached O-ring, four mounting screws, a 9/64 in. hex wrench and instructions.

Approvals:
American Gas Association Design Certificate: L2025006.
Canadian Gas Association Design Certificate: L2025006.
Australian Gas Association Design Certificate: 4214.
Approved for Delta C applications.
European Community (CE) Certificate: Pending.

PLANNING THE INSTALLATION

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury, or death.
Follow these warnings exactly:
1. Plan the installation as outlined below.
2. Plan for frequent maintenance as described in the Maintenance section.

Table 6. Flange Adapter Part Numbers.

Inlet/Outlet Pipe Size (in. NPT)	Flange Type	Part Number[a,b]	
		Without Hex Wrench	With Hex Wrench
3/8	Straight	393690-1	393690-11
3/8	Elbow	393690-2	393690-12
1/2	Straight	393690-6	393690-16
1/2	Elbow	393690-3	393690-13
3/4	Straight	393690-4	393690-14
3/4	Elbow	393690-5	393690-15

[a] Flange kits include one flange, one O-ring and four mounting screws.

[b] Do not use flanges on control models with 3/4 in. inlet and 3/4 in. outlet. On models with 1/2 in. inlet and 3/4 in. outlet, use flanges only on the 1/2 in. inlet side.

Heavy demands are made on the controls when intermittent pilot systems are used on central heating equipment in barns, greenhouses, and commercial properties and on heating appliances such as commercial cookers, agricultural equipment, industrial heating equipment and pool heaters.

Special steps may be required to prevent nuisance shutdowns and control failure due to frequent cycling, severe environmental conditions related to moisture, corrosive chemicals, dust or excessive heat. These applications require Honeywell Home and Building Control Engineering review; contact your Honeywell Sales Representative for assistance.

Review the following conditions that can apply to your specific installation and follow the precautions suggested.

Frequent Cycling

This control is designed for use on appliances that typically cycle three to four times an hour only during the heating season. In year-around applications with greater cycling rates, the control can wear out more quickly. Perform a monthly checkout.

Water or Steam Cleaning

If a control gets wet, replace it. If the appliance is likely to be cleaned with water or steam, protect (cover) the control and wiring from water or steam flow. Mount the control high enough above the bottom of the cabinet so it does not get wet during normal cleaning procedures.

High Humidity or Dripping Water

Dripping water can cause the control to fail. Never install an appliance where water can drip on the control. In addition, high ambient humidity can cause the control to corrode and fail. If the appliance is in a humid atmosphere, make sure air circulation around the control is adequate to prevent condensation. Also, regularly check out the system.

Corrosive Chemicals

Corrosive chemicals can attack the control, eventually causing a failure. If chemicals are used for routine cleaning, avoid contact with the control. Where chemicals are suspended in air, as in some industrial or agricultural applications, protect the control with an enclosure.

Dust or Grease Accumulation

Heavy accumulations of dust or grease can cause the control to malfunction. Where dust or grease can be a problem, provide covers for the control to limit contamination.

Heat

Excessively high temperatures can damage the control. Make sure the maximum ambient temperature at the control does not exceed the rating of the control. If the appliance operates at very high temperatures, use insulation, shielding, and air circulation, as necessary, to protect the control. Proper insulation or shielding should be provided by the appliance manufacturer; verify proper air circulation is maintained when the appliance is installed.

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

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
Follow these warnings exactly:
1. Disconnect power supply before wiring to prevent electrical shock or equipment damage.
2. To avoid dangerous accumulation of fuel gas, turn off the gas supply at the appliance service valve before starting installation, and perform Gas Leak Test after installation is complete.
3. Do not bend pilot tubing at gas control or pilot burner after compression fitting is tightened, or gas leakage at the connection can result.
4. Always install a sediment trap in the gas supply line to prevent contamination of the gas control.
5. Do not force the gas control knob. Use only your hand to turn the gas control knob. Never use any tools. If the gas control knob will not operate by hand, the gas control should be replaced by a qualified service technician. Force or attempted repair may result in fire or explosion.

⚠ CAUTION

Equipment Damage.
Can burn out valve coil terminals.
Never apply a jumper across (or short) the valve coil terminals, even temporarily.

Follow the appliance manufacturers instructions if available; otherwise, use these instructions as a guide.

IMPORTANT

These gas controls are shipped with protective seals over the inlet and outlet tappings. Do not remove the seals until ready to install adapters or connect the piping.

Converting Gas Control from Natural Gas to LP Gas (or LP Gas to Natural Gas)

⚠ WARNING

Fire Or Explosion Hazard.
Can cause property damage, severe injury or death.
1. Do not attempt to convert step-opening models (suffix letter P).
2. Always change the main and pilot burner orifices when converting from natural to LP gas or from LP to natural gas. Carefully follow appliance manufacturer specifications and instructions to assure proper appliance conversion.
3. Gas controls are factory-set for natural (and manufactured) or LP gas. Do not attempt to use a gas control set for natural (manufactured) gas on LP gas, or a gas control set for LP gas on natural (manufactured) gas.

Controls with standard, slow-opening, and two-stage regulators (model numbers with suffix H, K, M, or Q) can be converted from one gas to the other with a conversion kit (ordered separately). See Table 4 for the correct conversion kit.

Convertible Pressure Regulators

Controls with suffix letter R are convertible pressure regulator models. They can be converted from natural gas to LP gas or from LP gas to natural gas without a conversion kit.

Before converting the control from one gas to another, check the control label and the appliance manufacturer's rating plate to determine if the pressure regulator setting (factory set) will meet the appliance manifold requirements after conversion.

NOTE: Convertible pressure regulator models (suffix letter R) do not have field-adjustable regulators.

If the factory pressure regulator setting meets the appliance manifold requirement, convert the control as follows:
1. Remove the pressure regulator cap, Fig. 1.
2. Invert the cap so that the letters appear that represent the gas type appropriate for the appliance. NAT for natural manufactured gas, LP for liquid petroleum gas.
3. Replace the cap and tighten firmly.

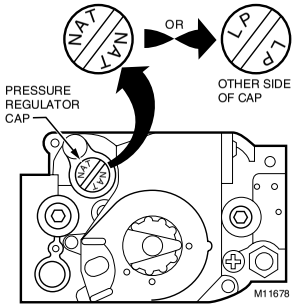

Fig. 1. Top view of convertible pressure regulator cap.

Install Adapters To Control

If adapters are being installed on the control, mount them as follows:

Flanges

1. Choose the appropriate flange for your application.
2. Remove the seal over the gas control inlet or outlet.
3. Make sure that the O-ring is fitted in the groove of the flange. If the O-ring is not attached or is missing, do not use the flange.
4. With the O-ring facing the control, align the screw holes on the gas control with the holes in the flange. Insert and tighten the screws provided with the flange. See Fig. 2. Tighten the screws to 25 inch-pounds of torque to provide a gas-tight seal.

Bushings

1. Remove the seal over the control inlet or outlet.
2. Apply a moderate amount of good quality pipe compound to the bushing, leaving two end threads bare. On an LP installation, use compound that is resistant to LP gas. Do not use Teflon tape.
3. Insert the bushing in the control and carefully thread the pipe into the bushing until tight.

Complete the instructions below for installing the piping, installing the control, connecting the pilot gas tubing and the wiring. Make sure the leak test you perform on the control after completing the installation includes leak testing the adapters and screws. If you use a wrench on the valve after the flanges are installed, use the wrench only on the flange, not on the control. See Fig. 5.

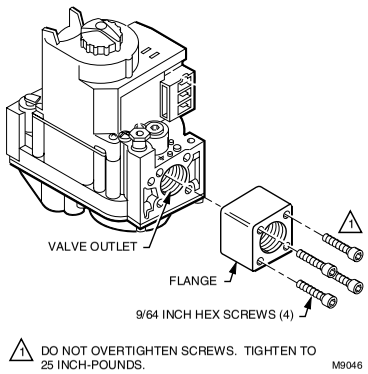

Fig. 2. Firmly fasten flange to valve, but do not overtighten screws.

Location

The combination gas control is mounted in the appliance vestibule on the gas manifold. If this is a replacement application, mount the gas control in the same location as the old control.

Locate the combination gas control where it cannot be affected by steam cleaning, high humidity, or dripping water, corrosive chemicals, dust or grease accumulation or excessive heat. To assure proper operation, follow these guidelines:

- Locate gas control in a well-ventilated area.
- Mount gas control high enough above cabinet bottom to avoid exposure to flooding or splashing water.
- Assure the ambient temperature does not exceed the ambient temperature ratings for each component.
- Cover gas control if appliance is cleaned with water, steam, or chemicals or to avoid dust and grease accumulation.
- Avoid locating gas control where exposure to corrosive chemical fumes or dripping water are likely.

Install Piping to Control

All piping must comply with local codes and ordinances or with the National Fuel Gas Code (ANSI Z223.1, NFPA No. 54), whichever applies. Tubing installation must comply with approved standards and practices.

1. Use new, properly reamed pipe that is free from chips. If tubing is used, make sure the ends are square, deburred and clean. All tubing bends must be smooth and without deformation.
2. Run pipe or tubing to the control. If tubing is used, obtain a tube-to-pipe coupling to connect the tubing to the control.
3. Install a sediment trap in the supply line to the control. See Fig. 3.

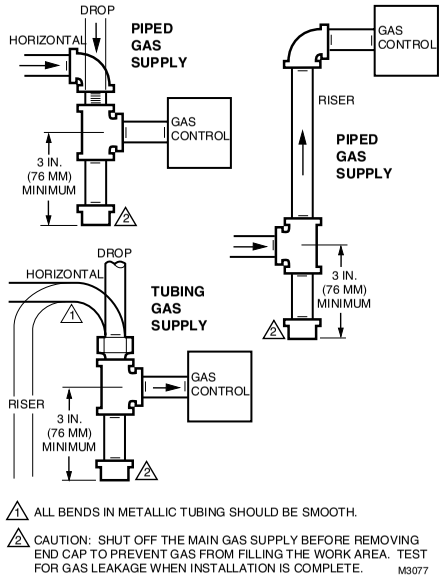

Fig. 3. Sediment trap installation.

Install Control

1. Mounted 0 to 90 degrees in any direction, including vertically, from the upright position of the gas control knob.
2. Mount so the gas flow is in the direction of the arrow on the bottom of the control.
3. Thread the pipe the amount shown in Table 7 for insertion into control or adapters. Do not thread pipe too far. Valve distortion or malfunction can result if the pipe is inserted too deeply.

Table 7. NPT Pipe Thread Length (in.).

Pipe Size	Thread Pipe this Amount	Maximum Depth Pipe can be Inserted into Control
3/8	9/16	3/8
1/2	3/4	1/2
3/4	13/16	3/4

4. Apply a moderate amount of good quality pipe compound (do not use Teflon tape) only to the pipe, leaving two end threads bare. On LP installations, use a compound resistant to LP gas. See Fig. 4.
5. Remove the seals over the control inlet and outlet if necessary.
6. Connect the pipe to the control inlet and outlet. Use a wrench on the square ends of the control. If a flange is used, place the wrench on the flange rather than on the gas control. Refer to Fig. 5 and 6.

Connect Pilot Gas Tubing

1. Cut tubing to the desired length and bend as necessary for routing to the pilot burner. Do not make sharp bends or deform the tubing. Do not bend the tubing at the gas control after the compression nut is tightened, because this can result in gas leakage at the connection.
2. Square off and remove burrs from the end of the tubing.
3. Unscrew the brass compression fitting from the pilot outlet (Fig. 6). Slip the fitting over the tubing and slide out of the way. See Fig. 7.

NOTE: When replacing a control, cut off the old compression fitting and replace with the compression fitting provided on the combination gas control. Never use the old compression fitting because it may not provide a gas-tight seal.

4. Push the tubing into the pilot gas tapping on the outlet end of the control until it bottoms. While holding the tubing all the way in, slide the fitting into place and engage the threads; then turn until finger tight. Tighten one more turn with a wrench, but do not overtighten.
5. Connect the other end of the tubing to the pilot burner according to the pilot burner manufacturer's instructions.

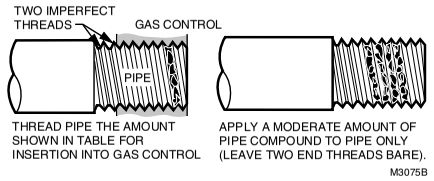

Fig. 4. Use moderate amount of pipe compound.

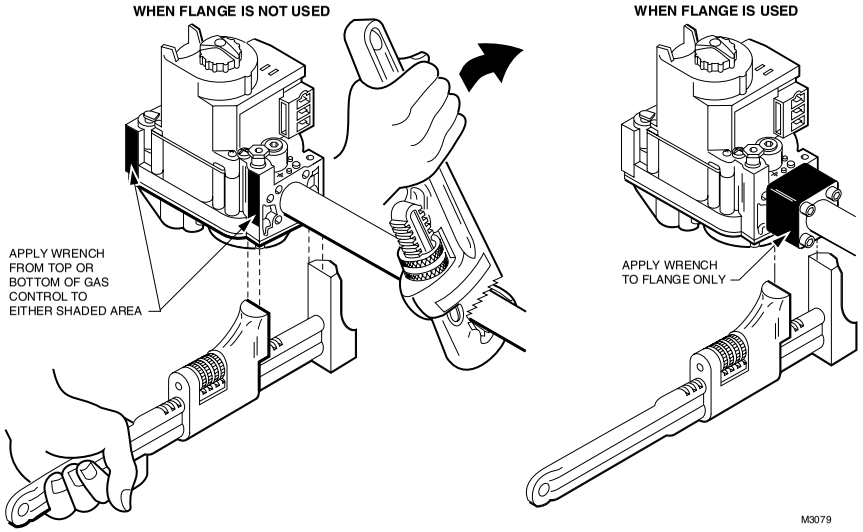

Fig. 5. Proper use of wrench on gas control with and without flanges.

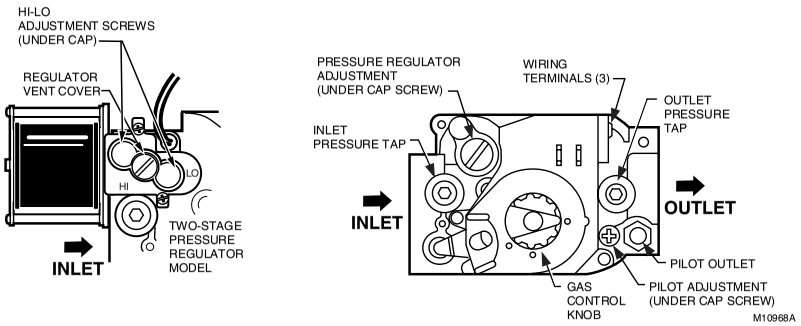

Fig. 6. Top view of gas control.

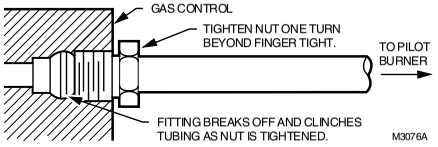

Fig. 7. Always use new compression fitting.

Wiring

Follow the wiring instructions furnished by the appliance manufacturer, if available, or use the general instructions provided below. When these instructions differ from the appliance manufacturer, follow the appliance manufacturer instructions.

All wiring must comply with applicable electrical codes and ordinances.

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

1. Check the power supply rating on the gas control and make sure it matches the available supply. Install a transformer, thermostat and other controls as required.
2. Connect control circuit to the gas control terminals. See Fig. 8.

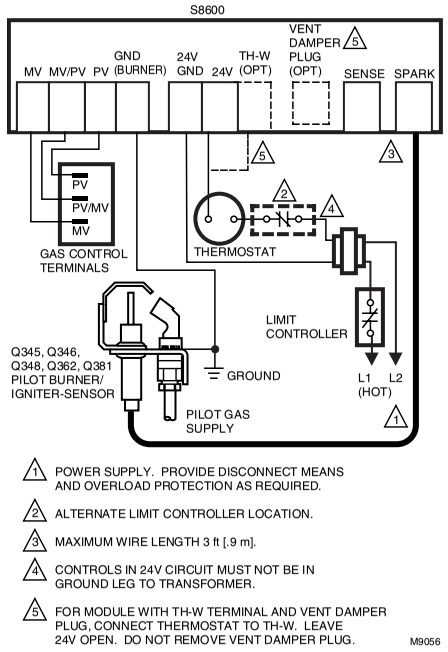

Fig. 8. Typical wiring connections for 24 volt control in intermittent ignition system with S8600.

STARTUP AND CHECKOUT

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
1. Do not force the gas control knob on the appliance. Use only your hand to turn the gas control knob. Never use any tools.
2. If the knob does not operate by hand, the control should be replaced by a qualified service technician.

Gas Control Knob Settings

Gas control knob settings are as follows:
OFF: Prevents pilot and main gas flow through the control.
ON: Permits gas to flow into the control body. Under control of the thermostat and intermittent pilot module, gas can flow to the pilot and main burners.

NOTE: Controls are shipped with the gas control knob in the ON position.

Turn On System

Rotate the gas control knob counterclockwise ↶ to ON.

Turn On Main Burner

Follow appliance manufacturer instructions or turn up thermostat to call for heat.

Perform Gas Leak Test

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
Perform Gas Leak Test every time work is done on a gas system.

IMPORTANT

Do not spray soap and water solution on the gas control. Do not use an excessive amount of soap and water solution to perform the gas leak test. These can damage the control.

Gas Leak Test

1. Paint pipe connections upstream of the gas control with rich soap and water solution. Bubbles indicate a gas leak.
2. If a leak is detected, tighten the pipe connections.
3. Light the main burner. Stand clear of the main burner while lighting to prevent injury caused from hidden leaks that could cause flashback in the appliance vestibule.
4. With the main burner in operation, paint the pipe joints (including adapters) and the control inlet and outlet with rich soap and water solution.
5. If another leak is detected, tighten the adapter screws, joints, and pipe connections.
6. Replace the part if a leak cannot be stopped.

Check and Adjust Pilot Flame

The pilot flame should envelop 3/8 to 1/2 in. (10 to 13 mm) of the tip of the igniter-sensor. See Fig. 9. If the pilot flame is small or lazy, the inlet gas pressure may be too low, or the pilot orifice may be partially clogged. Check and repair as necessary. If the pilot flame is hard and noisy, the inlet gas pressure may be too high. The gas control has a pilot adjustment mechanism to reduce the pilot flow if necessary. If pilot adjustment is necessary, proceed as follows:

1. Remove pilot adjustment cover screw. See Fig. 6.
2. The pilot adjustment is shipped at the full pilot gas flow rate. Turn the inner adjustment screw clockwise ↷ if the inlet pressure is too high. Turn the inner adjustment screw clockwise ↷ to decrease or counterclockwise ↶ to increase pilot flame.
3. Replace the cover screw after the adjustment to prevent gas leakage.

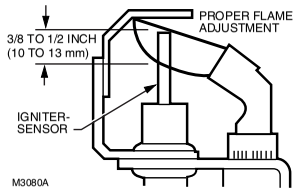

Fig. 9. Proper flame adjustment.

Check and Adjust Gas Input and Burner Ignition

IMPORTANT

1. *Do not exceed input rating stamped on appliance nameplate, or manufacturer's recommended burner orifice pressure for size orifice(s) used. Make certain primary air supply to main burner is properly adjusted for complete combustion. Follow appliance manufacturer instructions.*
2. *IF CHECKING GAS INPUT BY CLOCKING GAS METER: Make certain there is no gas flow through the meter other than to the appliance being checked. Other appliances must remain off with the pilots extinguished (or deduct their consumption from the meter reading). Convert flow rate to Btuh as described in form 70-2602, Gas Controls Handbook, and compare to Btuh input rating on appliance nameplate.*
3. *IF CHECKING GAS INPUT WITH MANOMETER: Make sure the gas control knob is in the OFF position before removing outlet pressure tap plug to connect manometer (pressure gauge). Also move the gas control knob to the OFF position when removing the gauge and replacing the plug. Before removing inlet pressure tap plug, shut off gas supply at the manual valve in the gas piping to the appliance or, for LP, at the tank. Also shut off gas supply before disconnecting manometer and replacing plug. Repeat Gas Leak Test at plug with main burner operating.*

NOTE: Check the inlet pressure before adjusting the pressure regulator.

Standard and Slow-Opening (H, K and M) Models

1. Carefully check the main burner lightoff. Make sure that the main burner lights smoothly and that all ports remain lit.
2. Check the full rate manifold pressure listed on the appliance nameplate. Gas control full rate outlet pressure should match this rating.
3. With main burner operating, check the gas control flow rate using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the control. See Fig. 6.
4. If necessary, adjust the pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.
   a. Remove the pressure regulator adjustment cap screw.
   b. Using a screwdriver, turn the inner adjustment screw (Fig. 6) clockwise ↷ to increase or counterclockwise ↶ to decrease the gas pressure to the burner.
   c. Always replace the cap screw and tighten firmly to prevent gas leakage.
5. If the desired outlet pressure or flow rate cannot be achieved by adjusting the gas control, check the gas control inlet pressure using a manometer at the inlet pressure tap of the gas control. If the inlet pressure is in the nominal range (see Tables 8A and 8B), replace the gas control. Otherwise, take the necessary steps to provide proper gas pressure to the control.

NOTE: If the burner firing rate is above 150,000 Btuh on VR8304 models (see Table 1 for VR8304 capacities), it may not be possible to deliver the desired outlet pressure. This is an application issue, not a control failure. Take whatever steps are required to correct the situation.

Step-Opening (P) Models

Step-opening models require that you check and adjust the full-rate pressure first and then check the step pressure. The step pressure is not field adjustable.

1. Carefully check the main burner lightoff. Make sure that the main burner lights smoothly and that all ports remain lit.
2. Check the full rate manifold pressure listed on the appliance nameplate. Gas control full rate outlet pressure should match this rating.
3. With main burner operating, check the gas control flow rate using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the gas control. See Fig. 6.
4. If necessary, adjust the pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.
   a. Remove the pressure regulator adjustment cap screw.

   Using a screwdriver, turn the inner adjustment screw (Fig. 6) clockwise ↷ to increase or counterclockwise ↶ to decrease the gas pressure to the burner.
   b. Always replace the cap screw and tighten firmly to prevent gas leakage.
5. If the desired outlet pressure or flow rate cannot be achieved by adjusting the gas control, check the gas control inlet pressure using a manometer at the inlet pressure tap of the control. If the inlet pressure is in the nominal range (see Tables 8A and 8B), replace the control. Otherwise, take the necessary steps to provide proper gas pressure to the control.
6. Carefully check the burner lightoff at step pressure. Make sure the burner lights smoothly and without flashback to the orifice. Make sure all ports remain lit. Cycle the burner several times, allowing at least 60 seconds between cycles for the regulator to resume the step function. Repeat after allowing the burner to cool. Readjust the full rate outlet pressure, if necessary, to improve lightoff characteristics.

Two-Stage (Q) Models

Two-stage models require that you check and adjust both high and low pressure regulator settings. Two-stage appliance operating sequences vary. Consult the appliance manufacturer instructions for the specific operating sequence and regulator adjustment procedure for the appliance in which the control is installed.

1. Set appliance to operate on high.
2. Carefully check the main burner lightoff. Make sure that the main burner lights smoothly and that all ports remain lit.
3. Check the full rate (high) manifold pressure listed on the appliance nameplate for high pressure. The gas control full rate outlet pressure should match this rating.
4. With main burner operating, check the gas control flow rate using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the gas control. See Fig. 6.
5. If necessary, adjust the high pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.
   a. Remove the pressure regulator adjustment cap (Fig. 6).
   b. Using a screwdriver, turn the inner adjustment screw for HI pressure clockwise ↷ to increase or counterclockwise ↶ to decrease the gas pressure to the burner.
6. After high pressure has been checked, check low pressure regulation. Two-stage appliance operating sequences vary. Consult the appliance manufacturers instructions for the specific operating sequence and regulator adjustment procedure for the appliance in which the control is installed and for instructions on how to prevent the control from moving to high stage while checking the low pressure regulator setting.
7. Check the low rate manifold pressure listed on the appliance nameplate. Gas control low rate outlet pressure should match this rating.
8. With main burner operating, check the gas control flow rate as before (using the meter clocking method or check pressure using a manometer connected to the outlet pressure tap on the control).
9. If necessary, adjust the low pressure regulator to match the appliance rating. See Tables 8A and 8B for factory-set nominal outlet pressure and adjustment range.
   a. Remove the pressure regulator adjustment cap (Fig. 6).

   Using a screwdriver, turn the inner adjustment screw for LO pressure clockwise ↷ to increase or counterclockwise ↶ to decrease the gas pressure to the burner.
10. Once high and low pressure have been checked and adjusted, replace pressure regulator adjustment cap. If the desired outlet pressure or flow rate cannot be achieved by adjusting the gas control, check the control inlet pressure using a manometer at the inlet pressure tap of the control. If the inlet pressure is in the nominal range (see Tables 8A and 8B), replace the gas control. Otherwise, take the necessary steps to provide proper gas pressure to the control.

Check Safety Shutdown Performance

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
Perform the safety shutdown test any time work is done on a gas system.

NOTE: Read steps 1 through 7 before starting, and compare to the safety shutdown or safety lockout tests recommended for the intermittent pilot (IP) ignition module. Where different, use the procedure recommended for the module.

1. Turn off gas supply.
2. Set thermostat or controller above room temperature to call for heat.
3. Watch for ignition spark or for glow at hot surface igniter either immediately or following prepurge. See IP module specifications.
4. Time the length of the spark operation. See the IP module specifications.
5. After the module locks out, open the manual gas cock and make sure no gas is flowing to the pilot or main burner. With modules that continue to spark until the pilot lights or the system shuts down manually, the pilot should light when the manual gas control knob is opened.
6. Set the thermostat below room temperature and wait one minute.
7. Operate system through one complete cycle to make sure all controls operate properly.

Table 8A. Pressure Regulator Specification Pressures (in. wc).

Model Type	Type of Gas	Nominal Inlet Pressure Range	Factory Set Nominal Outlet Pressure		Setting Range	
			Step	Full Rate	Step	Full Rate
Standard, Slow	NAT	5.0 to 7.0	—	3.5	—	3.0 to 5.0
	LP	12.0 to 14.0	—	10.0	—	8.0 to 12.0
Step	NAT	5.0 to 7.0	0.9	3.5	None	0.7 to 1.7
	LP	12.0 to 14.0	2.2	10.0	None	1.4 to 5.5
Two-Stage	NAT	5.0 to 7.0	—	1.7 Low 3.5 High	—	0.9 to 3.0 Low[a] 3.0 to 5.0 High
	LP	121.0 to 14.0	—	4.9 Low 10.0 High	—	3.5 to 5.5 Low 8.0 to 11.0 High

[a] Low Fire setting range for VR8304Q 1/2 in. by 1/2 in. and 1/2 in. by 3.4 in. is 1.5 to 3.0 in. wc.

Table 8B. Pressure Regulator Specification Pressures (kPa).

Model Type	Type of Gas	Nominal Inlet Pressure Range	Factory Set Nominal Outlet Pressure		Setting Range	
			Step	Full Rate	Step	Full Rate
Standard, Slow	NAT	1.2 to 1.7	—	0.9	—	0.7 to 1.2
	LP	2.9 to 3.9	—	2.5	—	2.0 to 3.0
Step	NAT	1.2 to 1.7	0.2	0.9	None	0.17 to 0.48
	LP	2.9 to 3.9	0.5	2.5	None	1.4 to 1.37
Two-stage	NAT	1.2 to 1.7	—	0.48 Low 0.9 High	—	0.22 to 0.75 Low[a] 0.75 to 1.2 High
	LP	2.9 to 3.9	—	1.2 Low 2.5 High	—	0.9 to 1.4 Low 2.0 to 2.5 High

[a] Low Fire setting range for VR8304Q 1/2 in. by 1/2 in. and 1/2 in. by 3.4 in. is 0.37 to 0.75 kPa.

Non-Regulating On-Off (U) Models

Non-regulating VR8204U Valves are designed for application in various parts of Europe where a separate, distinct, pressure regulator is required. The VR8204U is similar to the VR8204A in all other aspects and should be installed accordingly.

MAINTENANCE

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury, or death.
Do not disassemble the gas control; it contains no replaceable components. Attempted disassembly, repair, or cleaning can damage the control, resulting in gas leakage.

Regular preventive maintenance is important for applications in the commercial cooking and agricultural and industrial industries that place a heavy load on system controls because:

- In many such applications, particularly commercial cooking, the equipment operates 100,000 to 200,000 cycles per year. Such heavy cycling can wear out the gas control in one to two years.
- Exposure to water, dirt, chemicals and heat can damage the gas control and shut down the control system.

The maintenance program should include regular checkout of the control as outlined in the Startup and Checkout section, and the control system as described in the appliance manufacturer literature.

Maintenance frequency must be determined individually for each application. Some considerations are:

- Cycling frequency. Appliances that may cycle 20,000 times annually should be checked monthly.
- Intermittent use. Appliances that are used seasonally should be checked before shutdown and again before the next use.
- Consequence of unexpected shutdown. Where the cost of an unexpected shutdown would be high, the system should be checked more often.
- Dusty, wet, or corrosive environments. Since these environments can cause the gas control to deteriorate more rapidly, the system should be checked more often.

The system should be replaced if:

- It does not perform properly on checkout or troubleshooting.
- The gas control is likely to have operated for more than 200,000 cycles.
- The control is wet or looks as if it has been wet.

SERVICE

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
Do not disassemble the control; it contains no replaceable components. Attempted disassembly, repair, or cleaning can damage the gas control, resulting in gas leakage.

⚠ CAUTION

Equipment Damage.
Can burn out valve coil terminals.
Never apply a jumper across (or short) the valve coil terminals, even temporarily.

After servicing, verify proper system operation.

If Main Burner Does Not Come On With Call For Heat

1. Confirm the gas control knob is in the ON position.
2. Adjust thermostat several degrees above room temperature.
3. Using ac voltmeter, check for 24V at gas control:
   - If pilot lights, measure across MV/PV and MV.
   - If pilot does not light, measure across MV/PV and PV before safety lockout occurs.
4. If voltage is incorrect or not present, check control circuit for proper operation.
5. If 24V is present, replace gas control.

INSTRUCTIONS TO THE HOMEOWNER

⚠ WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury, or death.
Follow these warnings exactly:

1. Pilot flame is lit automatically. Do not light the pilot flame manually.
2. Before lighting the pilot burner flame, smell around the appliance for gas. Be sure to smell next to the floor because LP gas is heavier than air. If you smell gas:
   - Turn off the gas supply at the appliance service valve. On LP gas systems, turn off the gas supply at the gas tank.
   - Do not light any appliances in the house.
   - Do not touch electrical switches or use the phone.
   - Leave the building and use a neighbor's phone to call your gas supplier.
   - If you cannot reach your gas supplier, call the fire department.
3. Replace the gas control in the event of any physical damage, tampering, bent terminals, missing or broken parts, stripped threads, or evidence of exposure to heat.

IMPORTANT

Follow the operating instructions provided by the heating appliance manufacturer. The information below describes a typical control application, but the specific controls used and the procedures outlined in your appliance manufacturer instructions can differ, requiring special instructions.

STOP: Read the Warnings Above Before Proceeding.

The pilot flame is lit automatically. If the appliance does not turn on when the thermostat is set several degrees above room temperature, follow these instructions:

1. Set the thermostat to its lowest setting to reset the safety control.
2. Disconnect all electric power to the appliance.
3. Remove the burner access panel if provided on your appliance.
4. Turn the gas control knob clockwise ↷ to the OFF position.
5. Wait five minutes to clear out any unburned gas. Then if you smell gas, STOP! Follow Step 2 in the Warning above. If you do not smell gas, continue with the next step.
6. Turn the gas control knob counterclockwise ↶ to the ON position.
7. Replace the burner access panel.
8. Reconnect all electric power to the appliance.
9. Set the thermostat to the desired setting.
10. If the appliance does not turn on, turn the gas control knob to the OFF position and contact a qualified service technician for assistance.

Turning Off the Appliance

Vacation Shutdown

Set the thermostat to the desired room temperature while you are away.

Complete Shutdown

Turn off power to the appliance. Turn off the gas supply to the appliance. Turn the gas control knob to OFF. The appliance will completely shut off. Follow the procedure in the Instructions to the Homeowner section above to resume normal operation.

Honeywell

Home and Building Control
Honeywell Inc.
1985 Douglas Drive North
Golden Valley, Minnesota 55422

Home and Building Control
Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9

69-1225—4 G.R. Rev. 9-00

www.honeywell.com

Honeywell

L404A-D,F; L604A,L,M Pressuretrol® Controllers

L404 and L604 Pressuretrol® Controllers are line voltage pressure controllers that provide operating control, automatic limit protection, or manual reset limit protection for pressure systems of up to 300 psi (21.1 kg/cm^2 or 2068 kpa).

- Can be used with steam, air, non-combustible gases, or fluids non-corrosive to the pressure sensing element.
- Stainless steel diaphragm (except 300 psi [21.1 kg/cm^2 (2068 kPa)] models) also allows use with ammonia, oxygen, distilled water, and similar media.
- L404B is recommended for supervision of atomizing medium pressure in oil burner systems.
- Models are available with spst, spdt, or dpst switching and in variety of operating ranges.
- Dustproof, trouble-free mercury switches (all models except L404F, which has snap-acting switch).
- Automatic reset models have adjustable, subtractive differential (except L604M).
- Trip-free mechanism on manual reset models assures that limit function of controller cannot be defeated by jamming reset lever.
- Screw adjustments made on top of case.
- Scaleplates marked in English (psi) and Metric (kg/cm^2) units.
- L404F models available with European enclosure, British Standard Pipe Threads, ground screw, and scaleplates marked in kg/cm^2 and either psi or kPa.
- Clear plastic cover on case to observe pressure settings and switch action.
- Leveling indicator visible through cover.
- Hexagonal fitting with 1/4-18 NPT internal threads for direct mounting to 14026 Steam Trap (siphon loop).
- Surface mount is available using screws through holes (knockouts) in case backing.

CONTENTS

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60-2150-10

Specifications

TRADELINE® MODELS

TRADELINE® models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Specifications of TRADELINE® controls are the same as those of standard models except as noted below.

TRADELINE® MODELS AVAILABLE:
L604A Pressuretrol® Controllers—Available in 2 to 15, 5 to 50, 10 to 150, and 20 to 300 psi (.14 to 1.1 kg/cm^2 [14 to 103 kPa], .4 to 3.5 kg/cm^2 [34 to 345 kPa], .7 to 10.6 kg/cm^2 [69 to 1034 kPa], and 1.4 to 21.0 kg/cm^2 [138 to 2068 kPa]) .
ADDITIONAL FEATURES: TRADELINE® pack with cross-reference label.

STANDARD MODELS

MODELS: L404A-D,F and L604A,L,M Pressuretrol® Controllers. See Table 1. A 14026 Steam Trap (siphon loop) is available, except where noted in Table 1. The steam trap is necessary for boiler installations.
SWITCH(ES): Mercury switch(es) in all models except the L404F, which has a Micro Switch snap-acting switch.
PRESSURE SENSING ELEMENT: Stainless steel diaphragm (brass bellows in 300 psi [21.1 kg/cm^2, (2068 kPa)] models).
MAXIMUM AMBIENT TEMPERATURE: 150°F (66°C).
MINIMUM AMBIENT TEMPERATURE: Minus 35°F (minus 37°C); also refer to the note in the Location and Mounting section.
ADJUSTMENT MEANS: Screws on top of controller case. Scales are marked in psi and kPa.
ELECTRICAL CONNECTIONS: Internal screw terminals; hole in side of case for 1/2 in. conduit.
MOUNTING MEANS: Hexagonal fitting on diaphragm has 1/4-18 NPT internal threads for mounting on a pipe or steam trap (siphon loop). Also can be surface-mounted using screws through two holes (knockouts) in back of case.

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 (TRADELINE® model, if desired).
2. Operating range (see Table 1).
3. Model without steam trap, if desired and available (see Table 1, Note b).
4. Optional specifications, if desired (see Table 1).
5. Replacement parts, if desired.
6. Accessories, if desired.

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 Relations
   Honeywell, 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

   In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9. 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.

TABLE 1—MODELS AVAILABLE.

Model	Switching Action on Pressure Rise to Setpoint	Operating Ranges[a] psi	Operating Ranges[a] kg/cm²	Operating Ranges[a] kPa	Midscale Subtractive Differential[a] (Adjustable) psi	Midscale Subtractive Differential[a] (Adjustable) kg/cm²	Midscale Subtractive Differential[a] (Adjustable) kPa	Maximum Surge Pressure psi	Maximum Surge Pressure kg/cm²	Maximum Surge Pressure kPa
L404A	spst, breaks circuit	2 to 15[b,c] 5 to 50 10 to 150[b] 20 to 300[d]	.14 to 1.0 .35 to 3.5 .66 to 10.6 1.4 to 21.0	14 to 103 34 to 345 69 to 1034 138 to 2068	2 to 6 4 to 12 8 to 16 15 to 40	.14 to .41 .28 to.82 .56 to 1.10 1.04 to 2.76	14 to 4 127 to 83 55 to 110 103 to 276	50 85 225 500	3.5 6.0 15.8 35.2	345 586 1550 3445
L404B[i]	spst, makes circuit	2 to 15d,[c,e,f] 5 to 50 10 to 150[e,b] 20 to 300[d]	.14 to 1.1 .35 to 3.5 .66 to 10.6 1.4 to 21.0	14 to 103 24 to 345 69 to 1034 138 to 2068	2 to 6 4 to 12 8 to 16 15 to 40	.14 to .41 .28 to .82 .56 to 1.10 1.04 to 2.76	14 to 41 27 to 83 55 to 110 103 to 276	50 85 225 500	3.5 6.0 15.8 35.2	345 586 1550 3445
L404C	spst, breaks circuit	2 to 15 5 to 50 10 to 150 20 to 300[d]	.14 to 1.0 .35 to 3.5 .66 to 10.6 1.4 to 21.0	14 to 103 34 to 345 69 to 1034 138 to 2068	manual reset (fixed, subtractive differential)			50 85 225 500	3.5 6.0 15.8 35.2	345 586 1550 3445
L404D	spst, makes circuit	2 to 15 10 to 150	.14 to 1.0 .66 to 10	14 to 103 69 to 1068	manual reset[g] (fixed, subtractive differential)			50 225	3 5 15.8	345 1550
L404F	spdt snap-acting switch,[h] makes R-W, breaks R-B	2 to 15 5 to 50[i] 10 to 150 20 to 300[d]	.14 to 1.0 .35 to 3.5 .66 to 10 1.4 to21.0	14 to 103 34 to 345 69 to 1034 138 to 2068	2 to 6 6 to 14 10 to 22 20 to 50	.14 to .41 .41 to .97 .69 to 15.2 1.4 to 3.5	14 to 41 41 to 97 60 to 152 138 to 345	50 85 225 500	3.5 6.0 15.8 35.2	345 586 1550 3445
L604A	2 isolated spst circuits, or 1 spdt,[j] makes R1-W, breaks R2-B	2 to 15[c] 5 to 50 10 to 150 20 to 300[d]	.14 to 1.0 .35 to 3.5 .66 to 10 1.4 to21.0	14 to 103 34 to 345 69 to 1034 138 to 2068	2 to 6 4 to 12 8 to 16 15 to 40	.14 to .41 .28 to .82 .56 to 1.10 1.04 to 2.76	14 to 41 27 to 83 55 to 110 103 to 276	25 85 225 500	1.8 6.0 15.8 35.2	172 586 1550 3445
L604L	spdt circuit makes R-W, breaks R-B	2 to 15	.14 to 1.0	14 to 103	manual reset[g] (fixed, subtractive differential)			25	1.8	172
L604M	spdt circuit makes R-W, breaks R-B	10 to 150	.66 to 10.1	69 to 1034	fixed: 3.5 psi (24.1 kPa)			225	15.8	1550

[a] Scaleplates are marked in both psi and kg/cm².
[b] Model available with special fixed low differential. Switch rated for 0.5A at 120 Vac.
[c] L404A,B and L604A models are available with 1 to 6 psi midscale subtractive differential in 2 to 15 psi models.
[d] Brass bellows replaces stainless steel diaphragm. Not suitable for use with ammonia, oxygen, or other corrosive materials.
[e] Model available with minimum operating pressure of 1.25 psi (0.09 kg/cm² or 8.62 kPa) and minimum subtractive differential of 0.5 psi (0.035 kg/cm² or 3.45 kPa).
[f] Model available with special fixed low differential. Switch rated for 0.5A at 120 Vac.
[g] L404C,D and L604L models are designated as Manual Reset 2 controllers; the trip-free reset mechanism does not permit the controller to function as an automatic-reset device when the manual reset lever is held in the reset position. The subtractive differential is fixed at the minimum value of the adjustable differential of the L404A for each corresponding operating range.
[h] L404F only; all other models have mercury switches.
[i] Model available with sealed bell crank adjustment.
[j] Spst switches operate in unison; spdt action when jumper is installed between R1 and R2.
[k] Also recommended for supervision of atomizing medium pressure (air or steam) in an oil burner system.

SWITCH CONTACT RATING (in amperes at 50/60 Hz):

Model	Load	120 Vac	240 Vac	120 Vdc	240 Vdc
L404A	Full Load Locked Rotor Noninductive[a]	8.0 48.0 10.0	5.1 30.6 5.0	2.4 24.0 5.0	1.2 12.0 2.0
L604A,L[b]	Full Load Locked Rotor Noninductive	8.0 48.0 10.0	5.1 30.6 5.0	2.0 20.0 8.0	1.0 10.0 4.0
L604M	Full Load	1.0	0.5	1.0	0.5

[a] L404F (snap-acting) does not have non-inductive or dc ratings.
[b] L604A and L have also been tested (and listed by Underwriters Laboratories Inc.) and breaking (not making) a load with a total rating of 9.8 A full load, plus 360 VA ignition, plus 250 VA pilot duty at 120 Vac.

L404A-D,F; L604A,L,M
SPECIFICATIONS

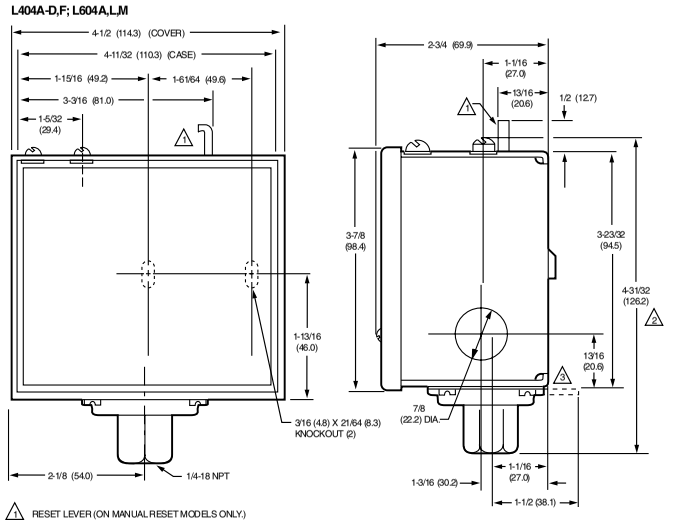
DIMENSIONS: See Fig. 1. See Fig. 2 for mounting steam trap (siphon loop).
WEIGHT: 2 IBC. (0.91 kg).
FINISH: Gray.
APPROVALS:
Underwriters Laboratories Inc. listed (L404A,B,C,D,F; L604A,L,M only): file no. MP466, vol.10; guide no. MBPR.
Canadian Standards Association certified (L404A,B,C,D,F; L604A,L only): file no. LR1620; guide no.400-E-0.

REPLACEMENT PARTS:
129178 Thermoplastic Cover.
14026 Steam Trap (siphon loop)—1/4 in. black iron pipe. Necessary for boiler installations.
ACCESSORIES:
33312B Knurled Adjustment Knob—with setscrew; fits on main scale pressure adjusting screw.
4074BWJ Limit Stop Assembly—to limit set point ranges; includes 129564 Range Stop, 107194 Range Stop Screw, and 23466 Wrench.

TABLE 2—CONVERSION TABLE (psi to kPa).

Operating Range Scale-Plate (psi)	Operating Range Equivalent (kg/cm²)	Operating Range Equivalent (kPa)	Subtractive Differential Scale-Plate (psi)	Subtractive Differential Equivalent (kg/cm²)	Subtractive Differential Equivalent (kPa)
0 to 15	0 to 10	0 to 103	—	—	—
2 to 15	.14 to1.0	14 to 103	1 to 6 2 to 6	07 to 4 .14 to .4	7 to 41 14 to 41
5 to 50	.3 to 3.5	34 to 345	4 to 12 5 to 14	.3 to .8 .4 to 1.0	28 to 83 41 to 97
5 to 150	.3 to 10.3	34 to 1034	—	—	—
10 to 150	.7 to 10.3	69 to 1034	8 to 16 10 to 22	.6 to 1.1 .7 to 1.5	55 to 110 69 to 152
20 to 300	1.4 to 20.7	138 to 2068	15 to 40 20 to 50	1.0 to 2.8 1.4 to 3.5	103 to 276 138 to 345

Fig. 1—Mounting dimensions of the L404A,B,C,D,F and L604A,L,M Pressuretrol® Controllers, in in. (mm).



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, flame safeguard control technician.
4. After installation is complete, check out product operation as provided in these instructions.

⚠ CAUTION

1. Disconnect power supply before beginning installation to prevent possible equipment damage or electrical shock.
2. When using the controller with a compressor, install a dampening device (such as a needle valve, header, or surge tank) to dampen pulsations that can damage the controller or reduce its life.

IMPORTANT:

1. *Locate the controller where the ambient temperature will not exceed 150°F (66°C).*
2. *Use pipe compound sparingly to avoid clogging the hole in the pipe or diaphragm fitting.*
3. *Do not tighten the controller by hand by holding the case.*
4. *Accurately level the controller for proper operation.*

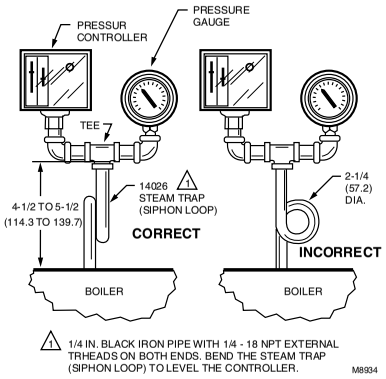
LOCATION AND MOUNTING

NOTE: For most accurate operation; add supplemental heat to installations where the temperature falls below minus 20°F (minus 29°C). Never locate the controller where the temperature falls below minus 35°F (minus 37°C), because mercury in the switch freezes at this temperature.

When used with steam boilers, always mount the controller *above the water line* in the boiler. A steam trap (siphon loop) must always be connected between the controller and the boiler (Fig. 2) to prevent boiler scale and corrosive vapors from attacking the diaphragm. The loop on the steam trap must always be perpendicular to the face of the controller. If the loop is parallel to the controller, expansion or contraction of the loop tips the controller and causes the switch to operate inaccurately.

The controller can be mounted (1) alongside the pressure gauge, (2) in a fitting on the boiler provided by the manufacturer, (3) at a remote location in case of excessive vibration, or (4) in a special mounting on a low water cutoff.

Fig. 2—Right and wrong mounting of a steam trap (siphon loop), with approximate dimensions in in. (mm).



Make all pipe connections in accordance with approved standards. Use only a small amount of pipe compound to seal the connection joints. Excess pipe compound can clog the small hole in the fitting and prevent the controller from operating properly.

To avoid leaks and damage to the case, use a parallel jaw wrench on the controller's hexagonal fitting. *Do not tighten the controller by hand by holding the case.*

Leveling

A controller with a mercury switch must be accurately leveled for proper operation. It is level when the leveling indicator (Fig. 11) hangs freely with its pointer directly over the index mark inside the back of the case. Level the controller by carefully bending the steam trap (siphon loop).

Mounting Alongside a Pressure Gauge

To mount the controller *alongside a pressure gauge* (Fig. 2), remove the gauge. In its place, install a steam trap (siphon loop) with a tee on top. Using elbows and pipe nipples, mount the controller and pressure gauge on the ends of the tee. Level the controller after installation.

Mounting on a Boiler

If it is not convenient to mount the controller alongside the pressure gauge, install a steam trap (siphon loop) *in the fitting provided* by the boiler manufacturer. If there is no fitting, mount the steam trap at a location recommended by the boiler manufacturer. Screw the controller directly to the steam trap, and level the controller.

Mounting at a Remote Location

If there is *excessive vibration* at the boiler that can adversely affect the operation of the controller, mount the controller at a remote location. All piping from the boiler must be suitable and solidly mounted. The piping must be properly pitched to drain all condensation back to the boiler. A steam trap (siphon loop) must be mounted between the remote piping and the controller. Level the controller after installation.

Supervision of Atomizing Medium Pressure (Air or Steam)—L404B

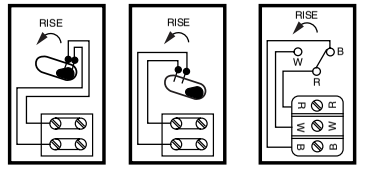
When air or steam is used as an atomizing medium in an oil burner system, authorities having jurisdiction (approval bodies and codes) often require a low limit to prevent opening the main oil valve until sufficient atomizing pressure is present, and to shut down the system when the atomizing pressure falls too low.

The L404B is recommended for this application. It makes a circuit when the pressure rises to the set point, and breaks when the pressure falls to the set point minus the differential (Fig. 10).

WIRING

1. Disconnect the power supply before beginning wiring to prevent electrical shock or equipment damage.
2. Assume all wiring complies with applicable electrical codes, ordinances, and regulations. Use NEC Class 1 (line voltage) wiring.
3. For normal installations, use moisture-resistant No. 14 wire suitable for at least 167°F (75°C) when you are using the controller with a flame safeguard primary control, or at least 194°F (90°C) when using it with a programming control.
4. For high temperature installations, use moisture-resistant No. 14 wire, selected for a temperature rating above the maximum operating temperature.
5. All models have a terminal block inside the cover (Fig. 3 and 4) and a 7/8 in. (22.2 mm) hole in one side for 1/2 in. conduit, cable, or wires. Remove the front cover by loosening the screw at the bottom of the main scale.
6. Refer to Fig. 5 through 9 for typical hookups. Follow the burner or boiler manufacturer's wiring diagram if provided .
7. Make sure the loads do not exceed the Switch Contact Ratings in the Specifications section.
8. Replace the front cover when wiring is completed.

Fig. 3—L404 terminal blocks and internal schematics.



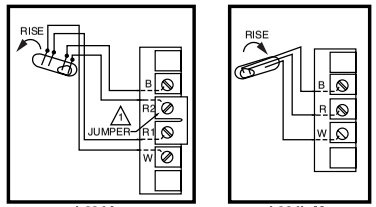
L404A,C — BREAKS ON PRESSURE RISE TO SETPOINT

L404B,D — MAKES ON PRESSURE RISE TO SETPOINT

L404F (SNAP-ACTING) — BREAKS R-B, MAKES R-W ON PRESSURE RISE TO SETPOINT

M8941

Fig. 4—L404 terminal block and internal schematic.



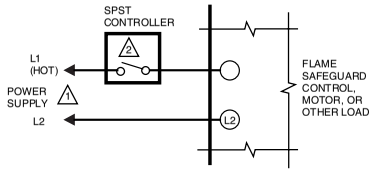
L604A
MAKES R1-W
BREAKS R2-B
ON PRESSURE RISE TO SETPOINT.

L604L,M

1 SPDT SWITCH ACTION WITH JUMPER INSTALLED; OTHERWISE, TWO ISOLATED SPST SWITCHES.

M8935

Fig. 5—L404 used as a limit or as an operating controller.

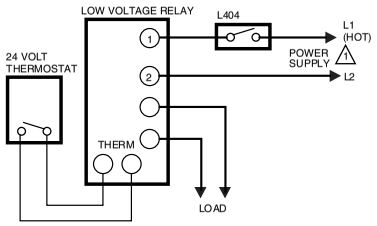


1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 HIGH LIMIT—L404A OR C BREAKS WHEN PRESSURE RISES TO SETPOINT.
LOW LIMIT—L404B BREAKS WHEN PRESSURE FALLS TO SETPOINT MINUS DIFFERENTIAL.
OPERATING CONTROLLER—L404A BREAKS WHEN PRESSURE RISES TO SETPOINT, AND MAKES AGAIN WHEN PRESSURE FALLS TO SETPOINT MINUS DIFFERENTIAL.

M8936

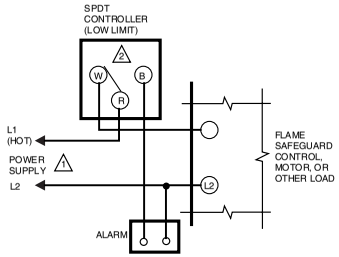
Fig. 6—L404 with a low voltage relay.



1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

M8940

Fig. 7—L404F, L604A (jumper installed) used as a high limit, with an alarm circuit.

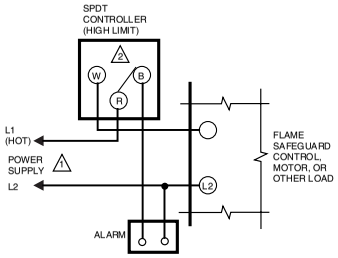


1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 BREAKS R TO W AND MAKES R TO B WHEN PRESSURE FALLS TO SETPOINT MINUS DIFFERENTIAL.

M8937

Fig. 8—L404F, L604A (with jumper installed) or L604M, used as a low limit, with an alarm circuit.

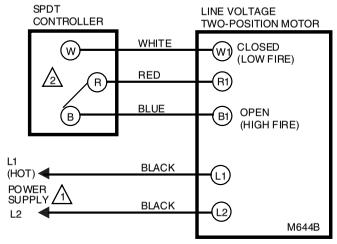


1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 BREAKS R TO B AND MAKES R TO W WHEN PRESSURE RISES TO SETPOINT.

M8938

Fig. 9—L404F, or L604 with jumper installed, controlling an M644B motor.



1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 BREAKS R TO B AND MAKES R TO W WHEN PRESSURE RISES TO SETPOINT.

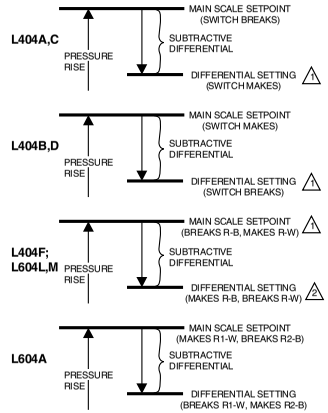
M8939

Setting and Checkout

SETTING

In all models, the differential is subtractive from the main scale set point. The upper operating point is determined by the main scale set point, while the lower operating point is determined by the main scale setting less the differential setting. The L404F and L604A (with jumper installed), L,M have spdt switching action. Operating points are shown in Fig. 10.

Fig. 10—L404 and L604 operating points.



1 L404C,D AND L604L MANUAL RESET MODELS HAVE A SMALL, FIXED DIFFERENTIAL. THEY CAN BE MANUALLY RESET WHEN THE PRESSURE FALLS TO THE MAIN SCALE SETPOINT MINUS THE DIFFERENTIAL.

2 L604M HAS A SMALL, FIXED DIFFERENTIAL OF 3.5 PSI (0.25 kg/cm²) OR 24.1 kPa.)

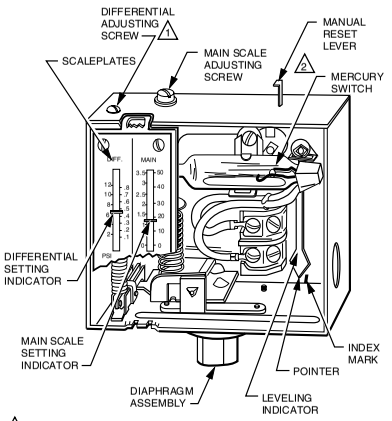
M8942

Adjust the main scale set point for the desired operating pressure by turning the main scale adjusting screw (Fig. 11) on the top of the case until the main scale setting indicator is at the desired value. On an L404A,B,F with a 5 to 150 psi (.3 to 10.3 kg/cm^2 [34 to 1034 kPa]) operating range, or an L604A, adjust the differential setting by turning the differential adjusting screw (Fig. 11) until the differential setting indicator is at the desired value. L404C,D and L604L are manual reset models: see the next paragraph. The L604M has a fixed differential. The scaleplates are marked psi and kg/cm^2.

Trip-Free Manual Reset Feature (L404C,D and L604L only)

The L404C breaks, the L404D makes, and the L604L makes R-W and breaks R-B when the pressure rises to the main scale setpoint. They will not automatically return to their former positions. To reset one of these controllers, wait until the pressure falls to the set point minus the differential (Fig. 10). Then depress the manual reset lever (Fig. 11) and release it. The controller will not be reset until you release the manual reset lever. This prevents the controller from becoming an automatic-reset device if the reset lever is stuck, held in, or tied down.

Fig. 11—Setting a Pressuretrol® Controller.



1 ADJUSTABLE DIFFERENTIAL ON THE L404A,B,F; L404L WITH A 5 TO 150 PSI (0.34 TO 10.3 kg/cm^2 [34 TO 134 kPa] OPERATING RANGE; AND L604A MODELS ONLY.

2 TRIP-FREE MANUAL RESET LEVER ON THE L404C,D AND L604L MODELS ONLY.

M8943

CHECKOUT

After the controller has is installed, wired, and set, test it with the system in operation. First allow the system to stabilize. Then observe the operation of the controller while raising and lowering its setpoint. Pressure should increase when the setpoint is raised and decrease when the set point is lowered.

Also check the make and break points of the controller. If they do not agree with a separate, accurately calibrated pressure gauge, a slight adjustment of the scaleplate(s) may be necessary.

Use accurate pressure testing equipment when checking out the controller. Do not rely on inexpensive gauges. The controllers are carefully calibrated at the factory.

Boiler Installation

If the controller is being used on a boiler installation, test it as follows:

1. Note the boiler pressure by checking the boiler pressure gauge. (To perform this test properly, the boiler should have a pressure reading near the middle of the controller's main scale range.)
2. Turn the main scale adjusting screw (Fig. 11) until the main scale setting indicator on the controller corresponds to the boiler pressure gauge reading.
3. The L404A or C should break the control circuit(s) automatically when the boiler pressure gauge reading equals or slightly exceeds the controller setting.

The L404B or D should make the circuit under the same circumstances.

The L404F; L604L,M should make the R-W circuit and break the R-B circuit under the same circumstances.

The L604A should make the R1-W circuit and break the R2-B circuit under the same circumstances.

4. If the controller is operating properly, turn the main scale adjusting screw (Fig. 11) until the main scale setting indicator is at the desired set point.

If a Controller Seems to Operate Improperly

If the controller is suspected of operating improperly, it may be further checked as follows (Fig. 12):

1. Disconnect all power to the controller, loosen the cover screw, and remove the cover.
2. Disconnect the wires from the controller.
3. Connect an ohmmeter between the switch terminals.
4. Lower the set point of the controller (simulating a pressure increase) through a range greater than the differential. The switch should either make or break, depending on the model of the controller. (An L404A or C should break, an L404B or D should make, an L404F; L604L,M should break R-B and make R-W, and an L604A should break R2-B and make R1-W.) If it makes, the ohmmeter reads zero; if it breaks, the ohmmeter reads infinity.
5. Raise the set point of the controller (simulating a pressure decrease) through a range greater than the differential. The switch should break or make, just the opposite of its action in step 4 (except for the L404C,D and L604L manual reset models).

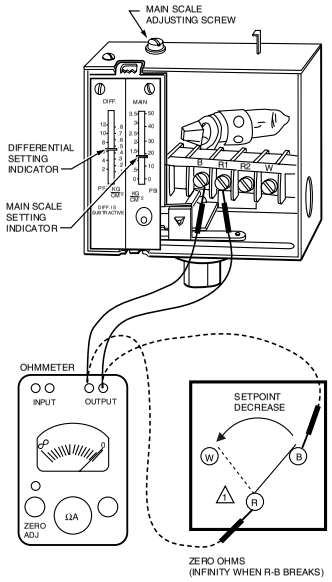
NOTE: An approximation of the differential can be made by observing the change in set point required for a resistance change from zero to infinity.

6. If the controller operates improperly, replace it.
7. When the controller is operating properly, reconnect the wires to the terminal block, replace the cover and tighten the cover screw, and reconnect the power.

CAUTION

Do not put the system into service until you have satisfactorily completed all applicable tests described in this Checkout section, in the Checkout section of the applicable instructions for the flame safeguard control, and any others required by the burner and boiler manufacturers.

Fig. 12—Checking controller operation using an ohmmeter.



1 AN L604, WITH JUMPER INSTALLED BETWEEN R1 AND R2, IS SHOWN; AN L404F OPERATES SIMILARLY (SPDT SWITCHING). AN L404A, B, C OR D HAS ONLY TWO TERMINALS (SPST SWITCHING); AN L404A OR C BREAKS AND L404B OR D MAKES WHEN THE SETPOINT IS DECREASED FAR ENOUGH.

M8944

Service Information

CALIBRATION

The controller was carefully calibrated during manufacturing and should not require recalibration. Most calibration errors are caused by improper leveling. The controller should be level when the pointer on the leveling indicator is directly over the index mark (Fig. 11). In some cases, the leveling indicator may not be accurate enough. The pointer may be over the index mark, but the controller still may not be operating within the tolerance of its scale setting. In this case, carefully bend the steam trap (siphon loop) until the controller switches properly.

MAINTENANCE

The cover of the controller should be in place at all times to protect the internal components from dirt, dust, and physical damage. Routine maintenance should consist of occasional inspection and blowing or brushing away any accumulated dirt and dust. To ensure proper functioning of the controller at all times, perform an operational check of the entire system during routine maintenance checks.

Honeywell

Home and Building Control
Honeywell Inc.
1985 Douglas Drive North
Golden Valley, MN 55422

Home and Building Control
Honeywell Limited—Honeywell Limitée
740 Ellesmere Road
Scarborough, Ontario
M1P 2V9

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S8610A,B,F,H AND S8670D
INTERMITTENT PILOT MODULE

APPLICATION

These ignition modules provide ignition sequence, flame monitoring, and safety shutoff for intermittent pilot central furnaces and heating appliances. S8610 and S8670 models include a connector that converts the existing ignition cable from a stud terminal receptacle to a 1/4 inch female quick-connect. S8610 and S8670 provide up to 1.0 A pilot and 2.0 A main valve current rating. Minimum ambient temperature rating is -40° F [-40° C]. Maximum ambient rating is +175° F [+79° C] for S8610, S8670 used with 1.0 A or less main valve. Maximum ambient rating for S8610, S8670 used with 1.0 to 2.0 A main valve is +165° F [+74° C]. See Table 1 for a summary of other differences between models.

TABLE 1—INTERMITTENT PILOT IGNITION MODULES.

MODEL	IGNITER-SENSOR TYPE	TYPE OF GAS	PREPURGE TIMING	100 PERCENT SHUTOFF	LOCKOUT TIMING	IGNITION SEQUENCE[a]
S8610A	Separate	Natural	None	No	No	Spark on until pilot lightoff or manual shutoff; pilot valve open until manual shutdown.
S8610F	Combination					
S8610B	Separate	Natural or LP	None	Yes, at lockout	15 or 90 sec. max., as ordered	Spark on until pilot lightoff or lockout; pilot valve closes on lockout.
S8610H	Combination					
S8670D	Combination	Natural or LP	45 sec.	Yes, at lockout	15 or 90 sec. max., as ordered	Ignition trial follows prepurge; spark on until pilot lightoff or lockout; pilot valve closes on lockout.

[a]If established flame is lost, all models restart ignition trial.

PLANNING THE INSTALLATION

Intermittent pilot systems are used on a wide variety of central heating equipment and on heating appliances such as commercial cookers, agricultural equipment, industrial heating equipment, and pool heaters. Some of these applications may make heavy demands on the controls, either because of frequent cycling or because of moisture, corrosive chemicals, dust, or excessive heat in the environment. In these situations, special steps may be required to prevent nuisance shutdowns and premature control failure. These applications require Honeywell Residential and Building Controls Engineering review; contact your Honeywell Sales Representative for assistance.

FREQUENT CYCLING

These controls are designed for use on space heating appliances that typically cycle 3 to 4 times an hour during the heating season and not at all during the cooling season. In an application with significantly greater cycling rates and closer to year-round use, we recommend monthly checkout because the controls may wear out more quickly.

WATER OR STEAM CLEANING

Once a module or gas control has been wet, it may operate unreliably and must be replaced. If the appliance is likely to be cleaned with water or steam, the controls and associated wiring should be covered so water or steam flow cannot reach them. The controls should be high enough above the bottom of the cabinet so they will not be subject to flooding or splashing during normal cleaning procedures. If necessary, shield the controls to protect them from splashing water. A NEMA 4 enclosure is recommended for the ignition module; see the Electronic Ignition Service Manual, form 70-6604.

HIGH HUMIDITY OR DRIPPING WATER

Over time, dripping water or high ambient humidity can create unwanted electrical paths on the module circuit board, causing the module to fail. *Never* install an appliance where water can drip on the controls.

In addition, high ambient humidity can cause the gas control to corrode, and finally to fail.

Where the appliance may be installed in a humid atmosphere, make sure air circulation around the module and gas control is adequate to prevent condensation. It's also important to regularly check out the system. A NEMA 4 enclosure may be needed; see the Electronic Ignition Service Manual, form 70-6604.

CORROSIVE CHEMICALS

Corrosive chemicals can also attack the module and gas control and eventually cause a failure. Where chemicals may be used routinely for cleaning, make sure the cleaning solution cannot reach the controls. Where chemicals are likely to be suspended in air, as in some industrial and agricultural applications, protect the ignition module from exposure with a NEMA 4 enclosure; see the Electronic Ignition Service Manual, form 70-6604.

DUST OR GREASE ACCUMULATION

Heavy accumulation of dust or grease may cause the controls to malfunction. Where dust or grease may be a problem, provide covers for the module and the gas control that will limit environmental contamination. A NEMA 4 enclosure is recommended for the ignition module; see the Electronic Ignition Service Manual, form 70-6604.

HEAT

The controls can be damaged by excessively high temperatures. Make sure the maximum ambient temperature at the control locations will not exceed the rating of the control. If the appliance normally operates at very high temperatures, insulation, shielding, and air circulation may be necessary to protect the controls. Proper insulation or shielding should be provided by the appliance manufacturer; make sure adequate air circulation is maintained when the appliance is installed.

INSTALLATION

WHEN INSTALLING THIS IGNITION SYSTEM...

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

WARNING

FIRE OR EXPLOSION HAZARD
MAY CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH

1. **The ignition module can malfunction if it gets wet, leading to accumulation of explosive gas.**
   - **Never install where water can flood, drip, or condense on module.**
   - **Never try to use a module that has been wet—replace it.**
2. **Liquefied petroleum (LP) gas is heavier than air and will not vent upward naturally.**
   - **Do not light pilot or operate electric switches, lights, or appliances until you are sure the appliance area is free of gas.**

CAUTION

1. Disconnect power supply before beginning wiring to prevent electrical shock or equipment damage.
2. If a new gas control is to be installed, turn off gas supply before starting installation. Conduct Gas Leak Test according to gas control manufacturer's instructions after the gas control is installed.
3. If module must be mounted near moisture or water, provide suitable waterproof enclosure.

PERFORM PREINSTALLATION SAFETY INSPECTION

The preinstallation checks described in ANSI Standard Z21.71 on page 21 *must* be done before the replacement module is installed. If a condition which could result in unsafe operation is detected, the appliance should be shut off and the owner advised of the unsafe condition. Any potentially unsafe condition must be corrected before proceeding with the installation.

Maintenance Requirements in Severe Environments

Regular preventive maintenance is important in any application, but especially so in commercial cooking, agricultural, and industrial applications because:

- In many such applications, particularly commercial cooking, the equipment operates 100,000-200,000 cycles per year. Such heavy cycling can wear out the gas control in one to two years. A normal forced air furnace, for which the controls were originally intended, typically operates less than 20,000 cycles per year.
- Exposure to water, dirt, chemicals, and heat can damage the module or the gas control and shut down the control system. A NEMA 4 enclosure can reduce exposure to environmental contaminants. See Electronic Ignition Service Manual, form 70-6604.

The maintenance program should include regular checkout of the system as outlined under Checkout, page 13.

WARNING

FIRE OR EXPLOSION HAZARD
MAY CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH
Do not attempt to disassemble or clean the module. Improper reassembly and cleaning may cause unreliable operation.

Maintenance frequency must be determined individually for each application. Some considerations are:

- *Cycling frequency.* Appliances that may cycle more than 20,000 times annually should be checked monthly.
- *Intermittent use.* Appliances that are used seasonally should be checked before shutdown and again before the next use.
- *Consequence of unexpected shutdown.* Where the cost of an unexpected shutdown would be high, the system should be checked more often.
- *Dusty, wet, or corrosive environment.* Since these environments can cause the controls to deteriorate more rapidly, the system should be checked more often.

Any control should be replaced if it does not perform properly on checkout or troubleshooting. In addition, replace any module if it is wet or looks like it has ever been wet. Protective enclosures as outlined under "Planning the Installation" are recommended regardless of checkout frequency.

MOUNT IGNITION MODULE

Select a location close enough to the burner to allow a short (3 ft. [0.9 m] max.), direct cable route to the igniter. Ambient temperature at the module must be within the range listed under APPLICATION, page 1. The module must be protected from water, moisture, corrosive chemicals, and excessive dust and grease.

We recommend mounting the module with the terminals down to protect them from dripping water and dust. It can also be mounted with the terminals on either side. DO NOT MOUNT with terminals pointing up. Refer to Fig. 1 for mounting recommendations. Fasten securely with four No. 6-32 machine or No. 8 sheetmetal screws (S8610 and S8670 mounting hole pattern is the same as the S86 and S89 mounting hole pattern).

Form Number 69-0523

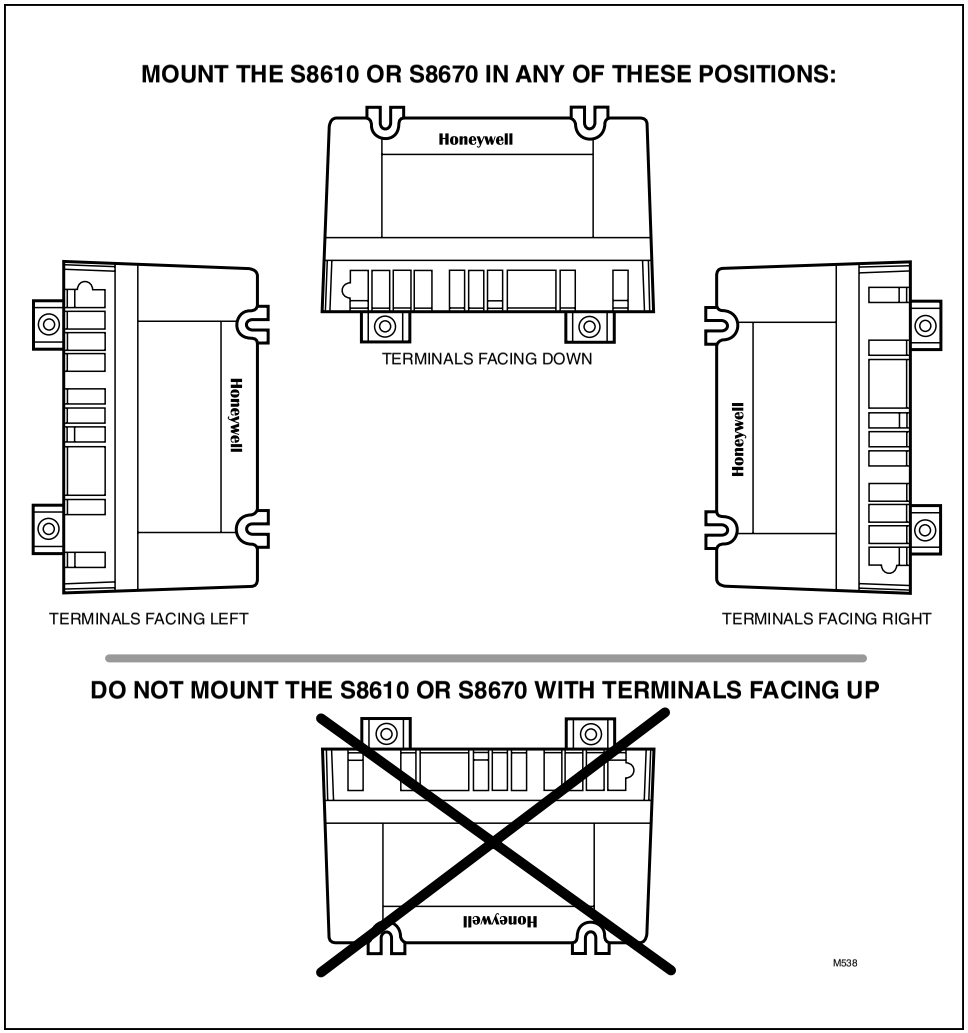


FIG. 1—IGNITION MODULE MOUNTING RECOMMENDATIONS.

MOUNT THE SYSTEM CONTROLS

Mount any required controls, such as the gas control, spark igniter, flame sensor, thermostat, limit, and transformer according to manufacturer's instructions.

WIRE THE SYSTEM

CAUTION

1. Check the wiring diagram furnished by the appliance manufacturer, if available, for circuits differing from the wiring hookups shown. Carefully follow any special instructions affecting the general procedures outlined below.
2. Disconnect the power supply before making wiring connections to prevent electrical shock or equipment damage.

IMPORTANT

1. As shown in the wiring diagrams, a common ground is required on:
   a. The pilot burner mounting bracket, and
   b. The GND(BURNER) terminal on the ignition module. Failure to use the GND(BURNER) terminal may result in intermittent loss of spark and/or loss of flame current sensitivity.
2. Make sure the transformer has adequate VA. The ignition module requires at least 0.2 A at 24 Vac. Add the current draws of all other devices in the control circuit, including the pilot and main valves in the gas control, and multiply by 24 to determine the total VA requirement of these components. Add this total to 4.8 VA (for the ignition module). The result is the minimum transformer VA rating. Use a Class II transformer if replacement is required.

Connect Ignition Cable

Use Honeywell ignition cable or construct an ignition cable that conforms to suitable national standards such as Underwriters Laboratories Inc. See Tables 2 and 3.

NOTE: When using an S8610 or S8670 to replace an S86, use the enclosed adapter to convert the S86 ignition cable to an S8610 ignition cable. Then, install adapter and cable to the S8610 ignition module.

TABLE 2—HONEYWELL PREASSEMBLED IGNITION CABLES (UL STYLE 3257).

CABLE PART NUMBER	LENGTH	MODULE END	IGNITER END
394800-30	30 in.	1/4 in. quick connect, insulated	Rajah connector receptacle, 90 deg. rubber boot
394801-30	30 in.	1/4 in. quick connect, insulated	Rajah connector receptacle, straight rubber boot

TABLE 3—RECOMMENDED IGNITION CABLE FOR FIELD ASSEMBLY.

CABLE TYPE	VOLTAGE RATING (rms)	TEMPERATURE RATING C	TEMPERATURE RATING F
UL Style 3217	10,000	150	302
UL Style 3257	10,000	250	484

Cable must be no longer than 36 in. [0.9 m]. To construct a cable, fit one end of ignition cable with 1/4 in. diameter Rajah connector receptacle and the other with a 1/4 in. female quick-connect. Protect both ends with insulated boots.

NOTE: The cable must not run in continuous contact with a metal surface or spark voltage will be greatly reduced. Use ceramic or plastic standoff insulators as required.

To install:

1. Connect one end of the cable to the male quick connect SPARK terminal on the ignition module.

2. Connect the other end of the cable to the igniter or igniter-sensor stud on the pilot burner/igniter-sensor.

Connect Vent Damper

The D80B Vent Damper can be used with all ignition modules, although the Molex plug provided on some modules simplifies wiring connections when used with the D80D Plug-In Vent Damper. *Once a module with vent damper plug has powered a vent damper circuit, it cannot be used in a gas system without a vent damper*. A non-replaceable fuse in the module blows on initial power-up. Once this fuse has blown, the module won't work unless the vent damper is connected.

To connect the plug-in model to D80D:

1. Remove the plug from the terminal strip on the ignition module case and discard.

2. Using the wiring harness supplied, insert the matching pin plug into receptacle on case and other end to vent damper.

To connect the D80B, follow the wiring diagrams supplied with the vent damper or see Fig. 8 for typical connections.

Connect Ignition Module

1. Connect remaining system components to the ignition module terminals as shown in the appropriate wiring diagram, Figs. 2 through 11.

   - Fig. 2 is a basic circuit for a heating only atmospheric burner with S8610F,H or S8670D.
   - Fig. 3 shows S8610F,H with vent damper plug in a heating only atmospheric burner system with D80D Vent Damper. *Never* use a vent damper in an LP gas system or in a fan-assisted combustion system.
   - Figs. 4 and 5 show S8610A,B with separate sensor and igniter, with and without the D80D Vent Damper.
   - Figs. 6 through 11 show S8610F,H and S8670D in a variety of systems with alternate connections for modules with vent damper plug. Remember, however, that a vent damper should not be used in an fan-assisted combustion system or an LP gas system and that the vent damper plug must not be removed except to connect the module to a D80D with the plug-in cable. S8610A,B can be substituted in these drawings by simply connecting the igniter and sensor as shown in Figs. 4 and 5.

2. Refer to heating appliance manufacturer's instructions for wiring auxiliary controls.

3. Adjust thermostat heat anticipator to match system current draw. The current draw equals the total current required for the ignition module (0.2 A) plus the gas control and any other auxiliary equipment in the control circuit.

Connect Gas Control

Use No. 18 gauge solid or stranded wire. Use 1/4 in. female quick-connects for module connections. Connect to gas control terminals as shown in wiring diagrams, using terminals appropriate to the gas control.

Ground Control System

The igniter, flame sensor, and ignition module must share a common ground with the main burner. Use thermoplastic insulated wire with a minimum rating of 105° C [221° F] for the ground wire; asbestos insulation is not acceptable. If necessary, use a shield to protect the wire from radiant heat generated by the burner. Connect the ground wire as follows:

1. Fit one end of the ground wire with a female 1/4 in. quick-connect terminal and connect it to the male quick-connect GND(BURNER) terminal on the ignition module.

2. Strip the other end of the wire and fasten it under the igniter bracket mounting screw. If necessary, use a shield to protect the ground wire from radiant heat.

3. The burner serves as the common grounding area. If there is not good metal-to-metal contact between the burner and ground, run a lead from the burner to ground.

NOTE: "Earth" ground is not required.

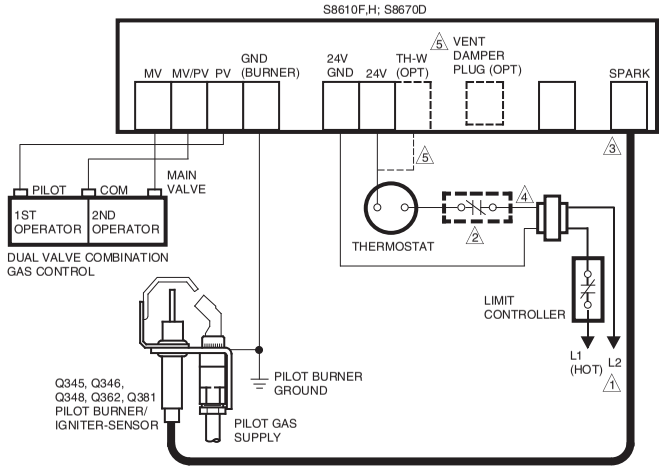
REPLACING MODULE WITH TH-R, TH-W TERMINALS

On modules that do not have a vent damper plug, the thermostat must be connected between the transformer and the 24V terminal on the module. To change out a module with TH-R, TH-W terminals:

1. Remove the wires from the 25V(2) and TH-R terminals on the old module. Connect these two wires with a solderless connector.
2. Tag and remove the remaining wires from the old module.
3. Remove the old module and mount the new one in the same location.
4. Reconnect the remaining wires as shown in Table 4.
5. Increase the thermostat anticipator setting by 0.2 A.

TABLE 4—TERMINAL CROSS REFERENCE.

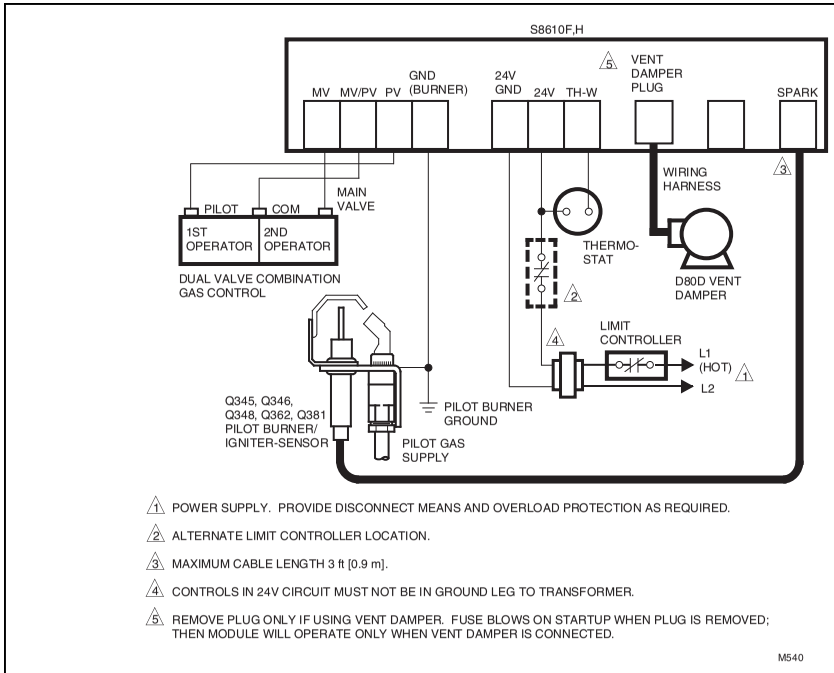
TERMINAL ON OLD MODULE:	TERMINAL ON NEW MODULE:
25 V (1)	24 V (GND)
TH-W	24 V
MV	MV
MV/PV	MV/PV
PV	PV
GND (Burner)	GND (Burner)



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. ALTERNATE LIMIT CONTROLLER LOCATION.
3. MAXIMUM CABLE LENGTH 3 ft [0.9 m].
4. CONTROLS IN 24V CIRCUIT MUST NOT BE IN GROUND LEG TO TRANSFORMER.
5. FOR MODULE WITH TH-W TERMINAL AND VENT DAMPER PLUG, CONNECT THERMOSTAT TO TH-W. LEAVE 24V OPEN. DO NOT REMOVE VENT DAMPER PLUG.

M539

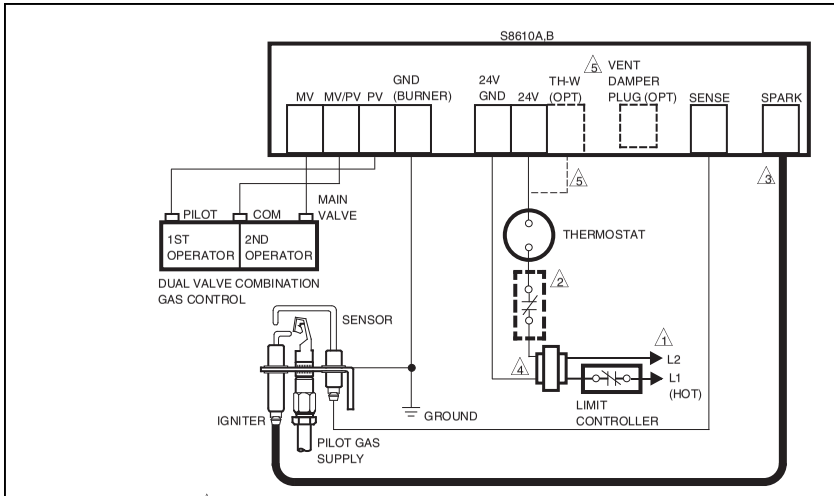
Fig. 2—S8610F,H; S8670D in a heating system with an atmospheric burner.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. ALTERNATE LIMIT CONTROLLER LOCATION.
3. MAXIMUM CABLE LENGTH 3 ft [0.9 m].
4. CONTROLS IN 24V CIRCUIT MUST NOT BE IN GROUND LEG TO TRANSFORMER.
5. REMOVE PLUG ONLY IF USING VENT DAMPER. FUSE BLOWS ON STARTUP WHEN PLUG IS REMOVED; THEN MODULE WILL OPERATE ONLY WHEN VENT DAMPER IS CONNECTED.

M540

Fig. 3—S8610F,H with a vent damper plug in a heating system with an atmospheric burner and a D80D Vent Damper.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. ALTERNATE LIMIT CONTROLLER LOCATION.
3. MAXIMUM CABLE LENGTH 3 ft [0.9 m].
4. CONTROLS IN 24V CIRCUIT MUST NOT BE IN GROUND LEG TO TRANSFORMER.
5. FOR MODULE WITH TH-W TERMINAL AND VENT DAMPER PLUG, CONNECT THERMOSTAT TO TH-W. LEAVE 24V OPEN. DO NOT REMOVE VENT DAMPER PLUG.

M541

Fig. 4—S8610A,B in a heating system with an atmospheric burner.

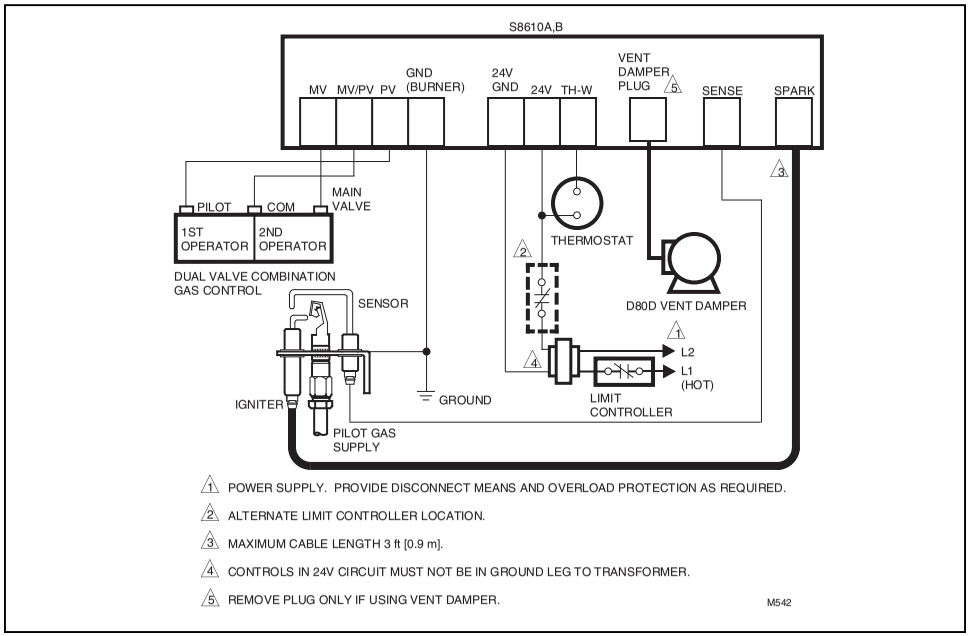


Fig. 5—S8610A,B with vent damper plug in an atmospheric burner heating system with a D80D Vent Damper.

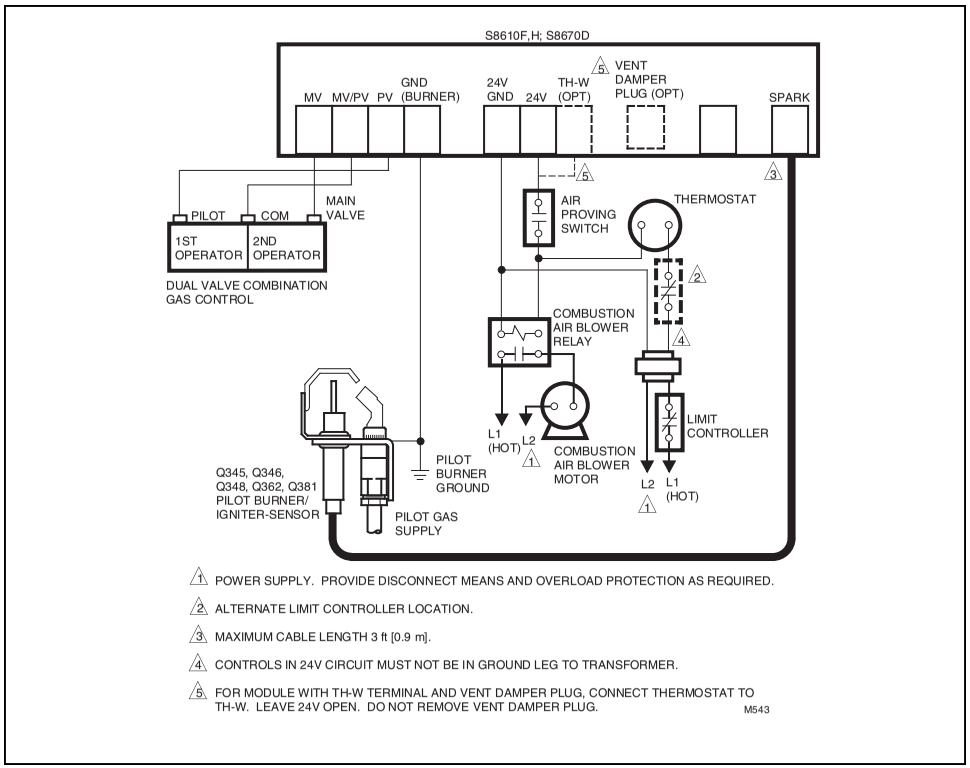


Fig. 6—S8610F,H; S8670D in a heating system with power-assisted combustion.

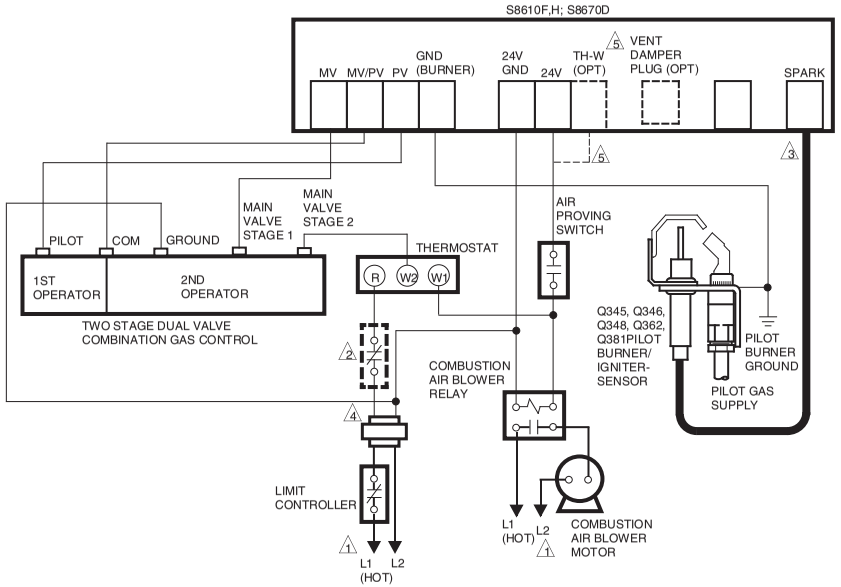
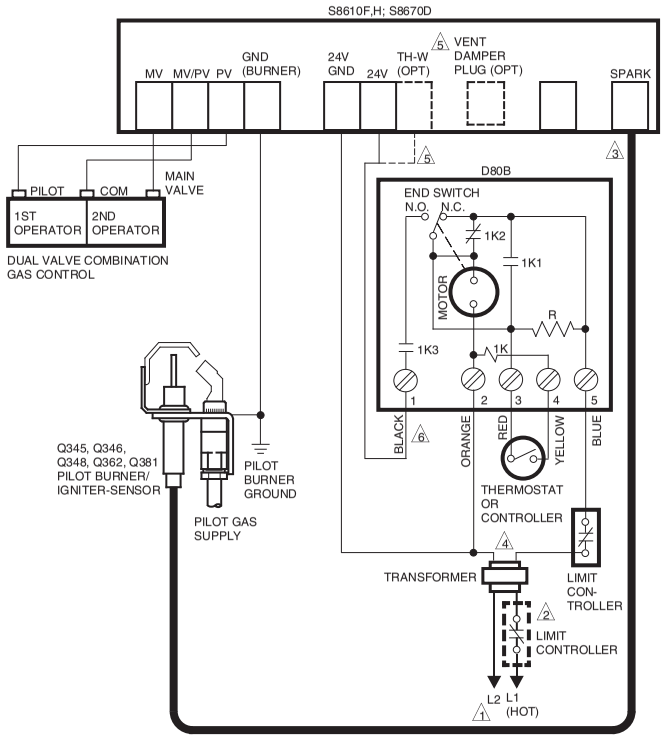


Fig. 7—S8610F,H; S8670D in a heating system with a two-stage gas control and power-assisted combustion.



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

2 ALTERNATE LIMIT CONTROLLER LOCATION.

3 MAXIMUM CABLE LENGTH 3 ft [0.9 m].

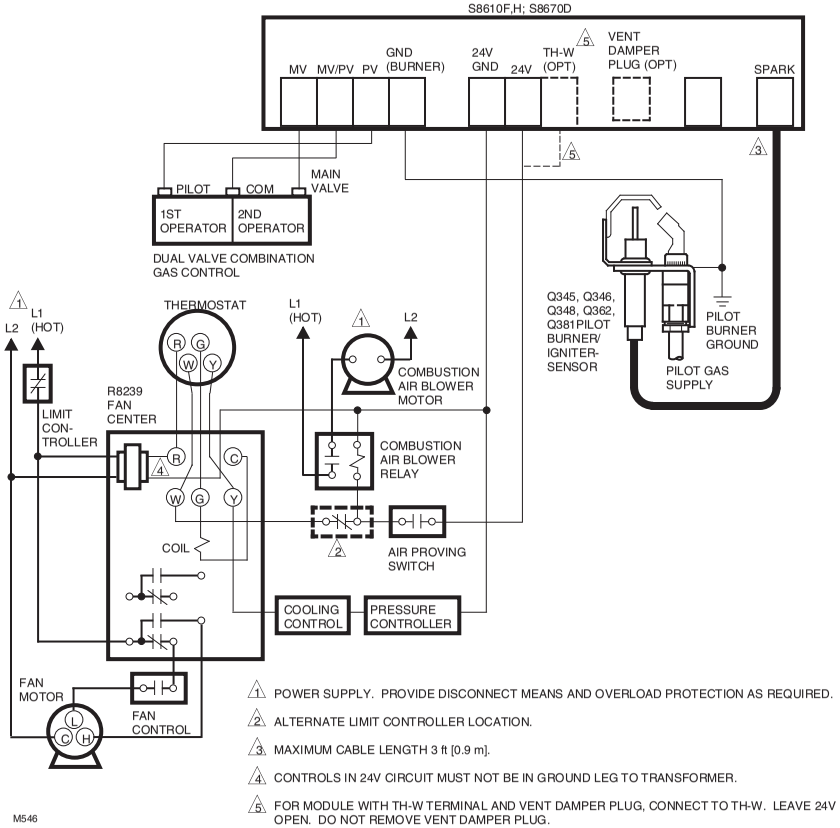
4 CONTROLS IN 24V CIRCUIT MUST NOT BE IN GROUND LEG TO TRANSFORMER.

5 FOR MODULE WITH TH-W TERMINAL AND VENT DAMPER PLUG, CONNECT TO TH-W. LEAVE 24V OPEN. DO NOT REMOVE VENT DAMPER PLUG.

6 COLORS REFER TOTHE D80B WIRE HARNESS, IF USED.

M545

Fig. 8—S8610F,H; S8670D in a heating system with an atmospheric burner and a D80B Vent Damper.



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

2 ALTERNATE LIMIT CONTROLLER LOCATION.

3 MAXIMUM CABLE LENGTH 3 ft [0.9 m].

4 CONTROLS IN 24V CIRCUIT MUST NOT BE IN GROUND LEG TO TRANSFORMER.

5 FOR MODULE WITH TH-W TERMINAL AND VENT DAMPER PLUG, CONNECT TO TH-W. LEAVE 24V OPEN. DO NOT REMOVE VENT DAMPER PLUG.

M546

Fig. 9—S8610F,H; S8670D in a heating-cooling system with power-assisted combustion.

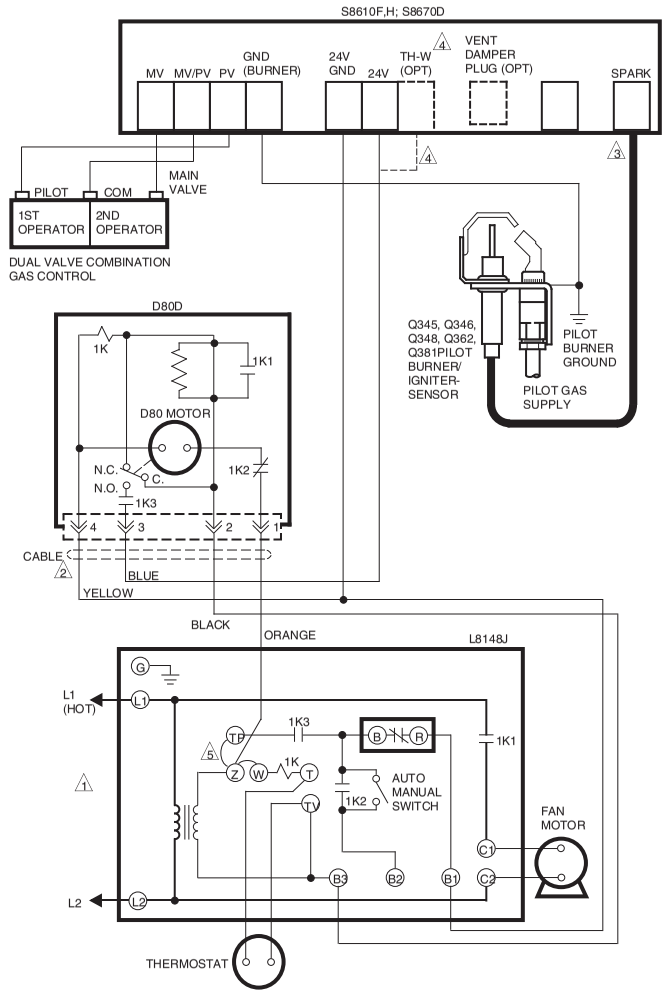


Fig. 10—S8610F, H; S8670D in a hydronic heating system with a D80D Vent Damper.

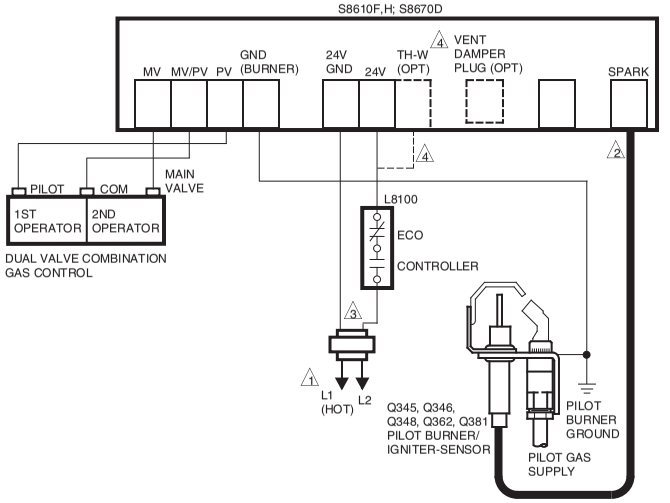


Fig. 11—S8610F,H; S8670D in a commercial water heater control system.

CHECKOUT

Check out the gas control system:

- At initial installation of the appliance.
- As part of regular maintenance procedures. Maintenance intervals are determined by the application. See PLANNING THE INSTALLATION, page 1, for more information.
- As the first step in troubleshooting.
- Any time work is done on the system.

WARNING

FIRE OR EXPLOSION HAZARD
MAY CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH

1. **If you smell gas or suspect a gas leak, turn off gas at manual service valve and evacuate the building. Do not try to light any appliance, do not touch any electrical switch or telephone in the building until you are sure no spilled gas remains.**
2. **Gas leak test must be done as described in Steps 1 and 5 below on initial installation and any time work is done involving the gas piping.**

STEP 1: Perform Visual Inspection.
☐ With power off, make sure all wiring connections are clean and tight.
☐ Turn on power to appliance and ignition module.
☐ Open manual shutoff valves in the gas line to the appliance.
☐ Do gas leak test ahead of gas control if piping has been disturbed.

GAS LEAK TEST: Paint gas control gasket edges and all pipe connections downstream of gas control, including pilot tubing connections, with rich soap and water solution. Bubbles indicate gas leaks. Tighten joints and screws or replace component to stop gas leak. Recheck with soap and water solution.

STEP 2: Review Normal Operating Sequence and Module Specifications.
☐ See OPERATION, page 13, and APPLICATION, page 1.

STEP 3: Reset the Module.
☐ Turn the thermostat to its lowest setting.
☐ Wait one minute.
As you do Steps 4 and 5, watch for points where operation deviates from normal. Refer to Troubleshooting Chart to correct problem.

STEP 4: Check Safety Shutoff Operation.
This step applies to lockout and continuous retry modules only.
☐ Turn gas supply off.
☐ Set thermostat or controller above room temperature to call for heat.
☐ Watch for spark at pilot burner either immediately or following prepurge. See device label.
☐ Time spark from start to shutoff. See device label.
Ignition sequence should start again followed by shutoff after 90 seconds maximum.
☐ Open manual gas control knob and make sure no gas is flowing to pilot or main burner.
☐ Set thermostat below room temperature and wait one minute before continuing.

STEP 5: Check Normal Operation.
☐ Set thermostat or controller above room temperature to call for heat.
☐ Make sure pilot lights smoothly when gas reaches the pilot burner.
☐ Make sure main burner lights smoothly without flashback.
☐ Make sure burner operates smoothly without floating, lifting, or flame rollout to the furnace vestibule or heat buildup in the vestibule.
☐ If gas line has been disturbed, complete gas leak test.

GAS LEAK TEST: Paint gas control gasket edges and all pipe connections downstream of gas control, including pilot tubing connections, with rich soap and water solution. Bubbles indicate gas leaks. Tighten joints and screws or replace component to stop gas leak. Recheck with soap and water.

☐ Turn thermostat or controller below room temperature. Make sure main burner and pilot flames go out.

OPERATION

Module operation can be conveniently divided into two phases for S8610 and three for S8670. The phases are:

- Prepurge (S8670 only)
- Trial for ignition (all models)
- Main burner operation (all models)

Figs. 12 and 13 summarize the normal operating sequences of the modules.

PREPURGE (S8670 ONLY)

On proof of airflow, the air proving switch closes and energizes the S8670. When the module is used in an atmospheric system, the call for heat energizes the module.

In either case, the module first initiates a 45 second. delay to allow system prepurge. After prepurge, the module starts the pilot ignition sequence.

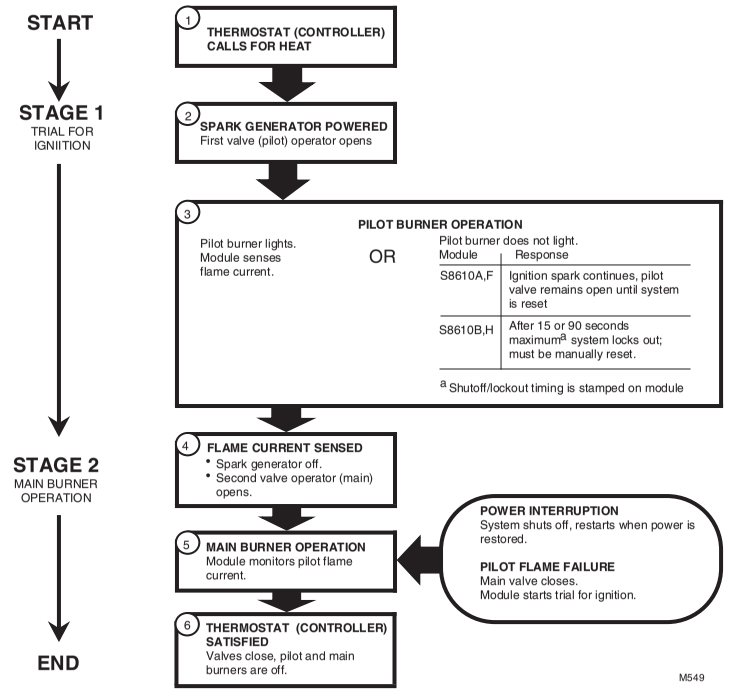


Fig. 12—S8610 normal operating sequence.

TRIAL FOR IGNITION

Pilot Ignition

Following prepurge timing (S8670), or on the call for heat (S8610), the module energizes the first main valve operator. The first main valve opens, which allows gas to flow to the pilot burner. At the same time, the electronic spark generator in the module produces an over 10,000 volt spark pulse output. The voltage generates a spark at the igniter (S8610A,B) or igniter-sensor (S8610F,H; S8670) that lights the pilot.

If the pilot does not light, or the pilot flame current is not at least 1.0 μA and steady, the module will not energize the second (main) valve and the main burner will not light. S8610A,F will continue to spark as long as the thermostat calls for heat, or until the pilot lights.

Safety Lockout (S8610B,H; S8670D)

These modules provide 100 percent shutoff and safety lockout. A timer in these models starts timing the moment the trial for ignition starts. Ignition spark continues only until the timed trial for ignition period ends. Then the module goes into safety lockout. Lockout de-energizes the first main valve operator and closes the first main (pilot) valve in the gas control, stopping pilot gas flow. The control system must be reset by setting the thermostat below room temperature for one minute or by turning off power to the module for one minute.

MAIN BURNER OPERATION

When the pilot flame is established, a flame rectification circuit is completed between the sensor and burner ground. The flame sensing circuit in the module detects the flame current, shuts off the spark generator, and energizes the second main valve operator. The second main valve opens and gas flows to the main burner, where it is ignited by the pilot burner. On lockout models, the flame current also holds the safety lockout timer in the reset (normal) operating condition.

When the call for heat ends, both valve operators are de-energized, and both valves in the gas control close.

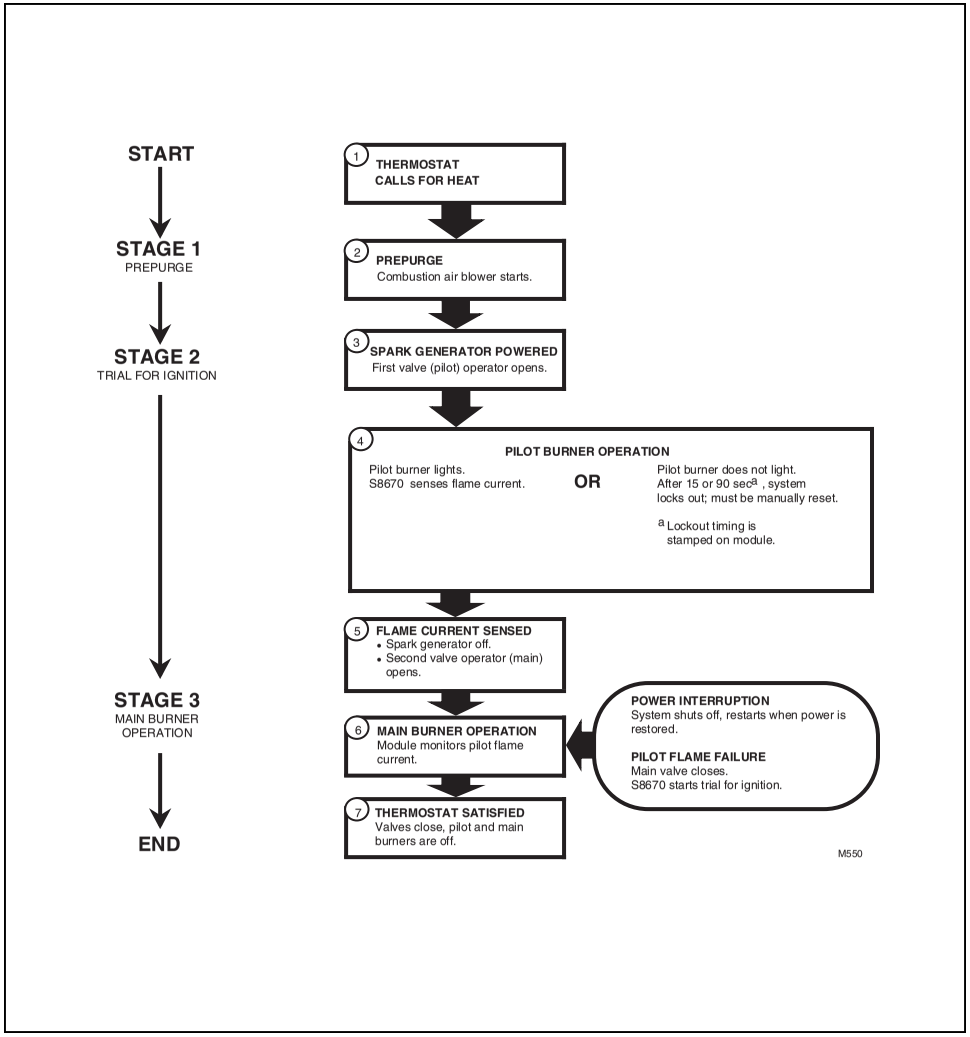


Fig. 13—S8670 normal operating sequence.

TROUBLESHOOTING

IMPORTANT

1. The following service procedures are provided as a general guide. Follow appliance manufacturer's service instructions if available.
2. On lockout and retry models, meter readings between gas control and ignition module must be taken within the trial for ignition period. Once the ignition module shuts off, lockout models must be reset by setting the thermostat down for at least one minute before continuing. On retry models, wait for retry or reset at the thermostat.
3. If any component does not function properly, make sure it is correctly installed and wired before replacing it.
4. The ignition module cannot be repaired. If it malfunctions, it must be replaced.
5. Only trained, experienced service technicians should service intermittent pilot systems.

Perform the checkout on page 12 as the first step in troubleshooting. Then check the appropriate troubleshooting guide (Fig. 15 or 16) and the schematic diagram (Fig . 17 or 18) to pinpoint the cause of the problem. If troubleshooting indicates an ignition problem, see Ignition System Checks below to isolate and correct the problem.

Following troubleshooting, perform the checkout procedure (page 12) again to be sure system is operating normally.

IGNITION SYSTEM CHECKS

STEP 1: Check ignition cable.

Make sure:

☐ Ignition cable does not run in contact with any metal surfaces.

☐ Ignition cable is no more than 36 inches [0.9 meters] long.

☐ Connections to the ignition module and to the igniter or igniter-sensor are clean and tight.

☐ Ignition cable provides good electrical continuity.

STEP 2: Check ignition system grounding. *Nuisance shutdowns are often caused by a poor or erratic ground.*

☐ A common ground, usually supplied by the pilot burner bracket, is required for the module and the pilot burner/igniter-sensor.

- Check for good metal-to-metal contact between the pilot burner bracket and the main burner.
- Check the ground lead from the GND(BURNER) terminal on the module to the pilot burner. Make sure connections are clean and tight. If the wire is damaged or deteriorated, replace it with No. 14 through No.18 gauge, moisture-resistant, thermoplastic insulated wire with 105° C [221° F] minimum rating.
  - — Check the ceramic flame rod insulator for cracks or evidence of exposure to extreme heat, which can permit leakage to ground. Replace pilot burner/igniter-sensor and provide shield if necessary.
  - — If flame rod or bracket are bent out of position, restore to correct position.

STEP 3: Check spark ignition circuit. *You will need a short jumper wire made from ignition cable or other heavily insulated wire.*

☐ Close the manual gas valve.

☐ Disconnect the ignition cable at the SPARK terminal on the module.

WARNING

When performing the following steps, do not touch stripped end of jumper or SPARK terminal. The ignition circuit generates over 10,000 volts and electrical shock can result.

☐ Energize the module and immediately touch one end of the jumper firmly to the GND terminal on the module. Move the free end of the jumper slowly toward the SPARK terminal until a spark is established.

☐ Pull the jumper slowly away from the terminal and note the length of the gap when sparking stops. Check table below.

ARC LENGTH	ACTION
No arc or arc less than 1/8 inch [3 mm]	Check external fuse, if provided. Verify power at module input terminal. Replace module if fuse and power okay.
Arc 1/8 inch [3 mm] or longer.	Voltage output is okay.

STEP 4: Check pilot and main burner lightoff.

☐ Set the thermostat to call for heat.

☐ Watch the pilot burner during the ignition sequence. See if:

- Ignition spark continues after the pilot is lit.
- The pilot lights and the spark stops, but main burner does not light.
- *S8610B,H; S8670D only:* The pilot lights, the spark stops and main burner lights, but the system shuts down.

☐ If so, ensure adequate flame current as follows.

- Turn off furnace at circuit breaker or fuse box.
- Clean the flame rod with emery cloth.

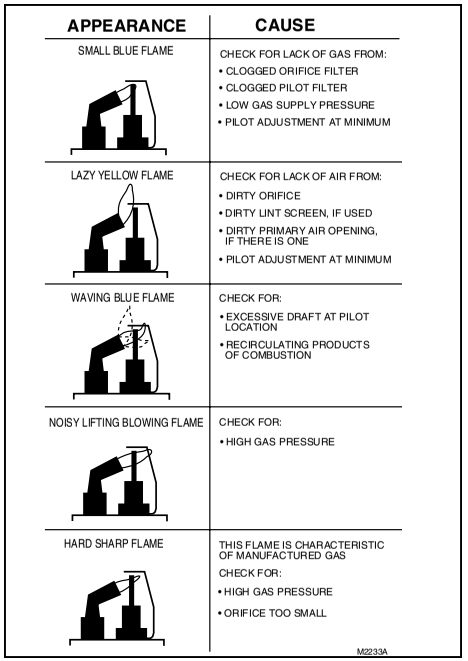


Fig. 14—Examples of unsatisfactory pilot flames.

- Make sure electrical connections are clean and tight. Replace damaged wire with moisture-resistant No. 18 wire rated for continuous duty up to 105° C [221° F].
- Check for cracked ceramic insulator, which can cause short to ground, and replace igniter-sensor if necessary.
- At the gas control, disconnect main valve wire from the TH or MV terminal.
- Turn on power and set thermostat to call for heat. The pilot should light but the main burner will remain off because the main valve actuator is disconnected.
- Check the pilot flame. Make sure it is blue, steady and envelops 3/8 to 1/2 inch [10 to 13 mm] of the flame rod. See Fig. 14 for possible flame problems and their causes.
- If necessary, adjust pilot flame by turning the pilot adjustment screw on the gas control clockwise ↷ to decrease or counterclockwise ↶ to increase pilot flame. Following adjustment, always replace pilot adjustment cover screw and tighten firmly to assure proper gas control operation.
- Set thermostat below room temperature to end call for heat.

☐ Recheck ignition sequence as follows.

- Reconnect main valve wire.
- Set thermostat to call for heat.
- Watch ignition sequence at burner.
- If spark still doesn't stop after pilot lights, replace ignition module.
- If main burner doesn't light or if main burner lights but system locks out, check module, ground wire, and gas control as described in appropriate troubleshooting chart, Fig. 15 or 16.

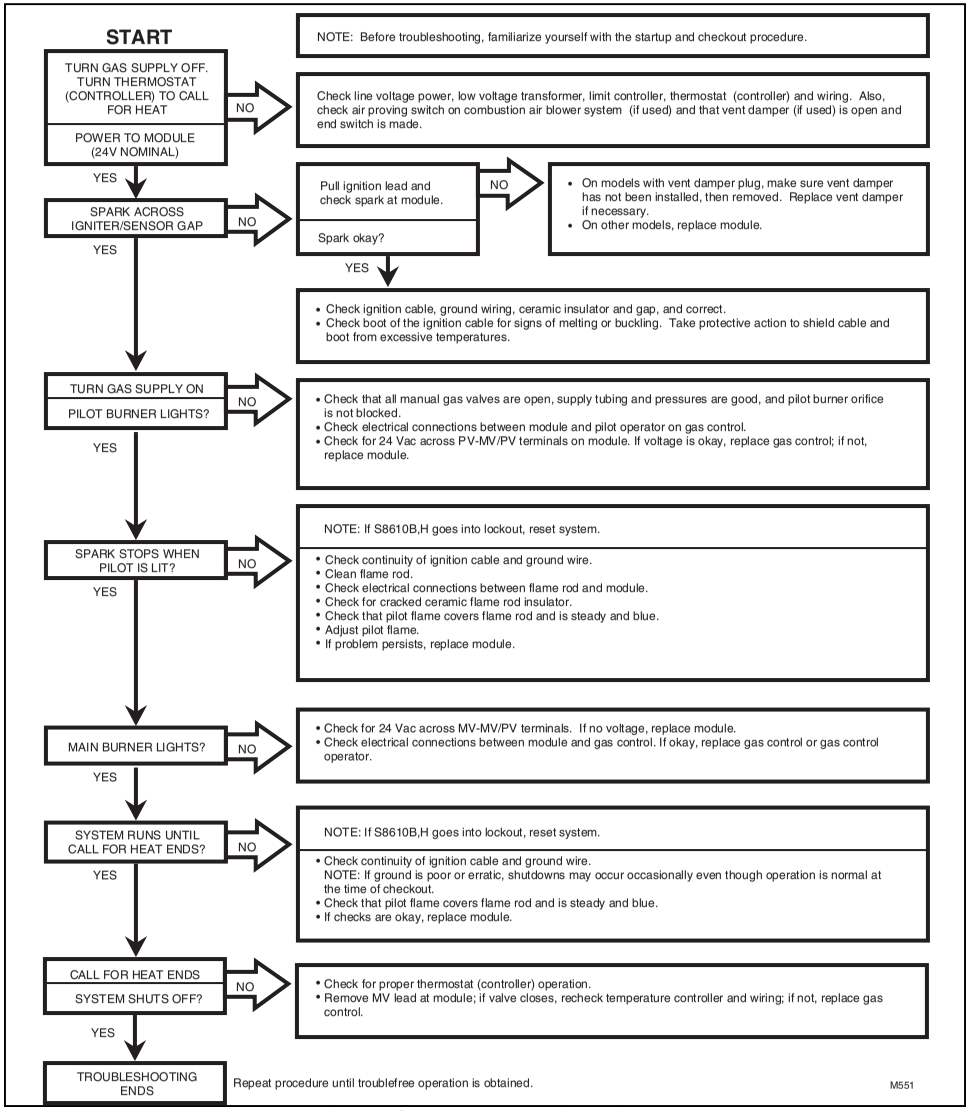


Fig. 15—S8610 troubleshooting guide.

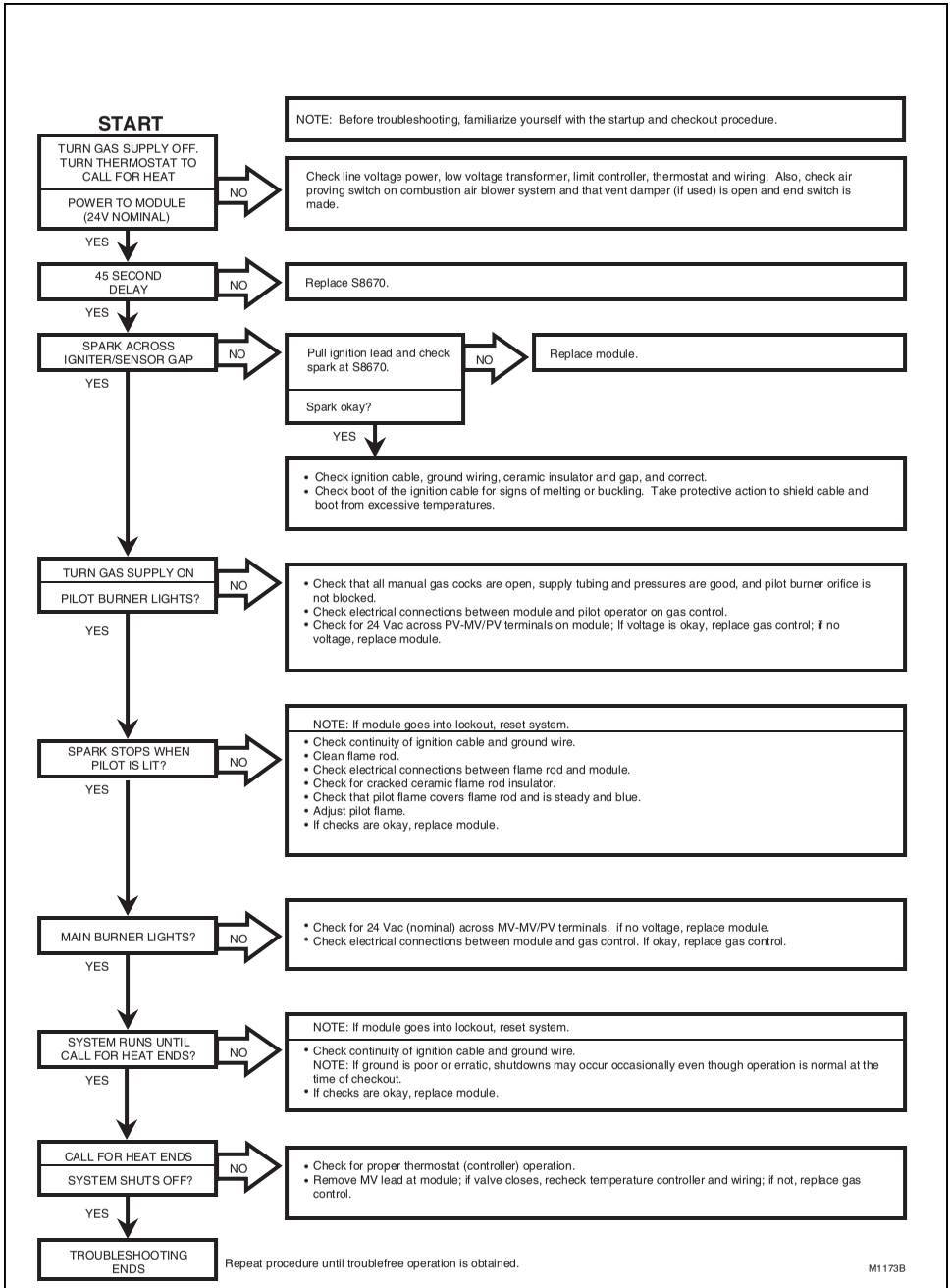


Fig. 16—S8670 troubleshooting guide.

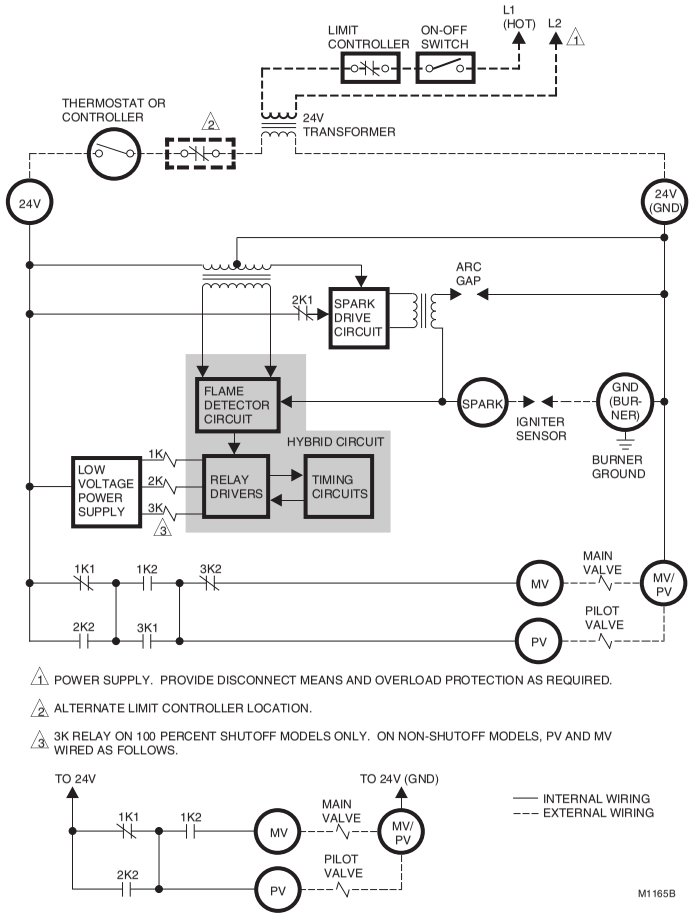


Fig. 17—Representative schematic for S8610F,H. See Fig. 1 for hookup. S8670 is similar except the timing circuit includes a purge timer. See Fig. 6 for hookup.

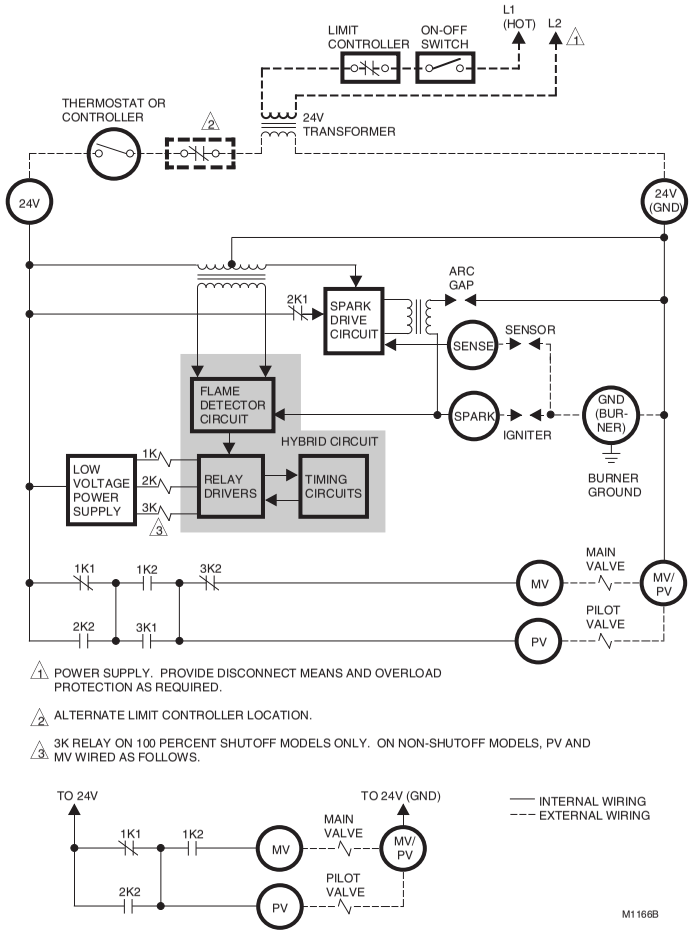


Fig. 18—Representative schematic for S8610A,B. See Fig. 3 for hookup.

EXHIBIT A

RECOMMENDED PROCEDURE FOR SAFETY INSPECTION OF AN EXISTING APPLIANCE INSTALLATION AS A PRELIMINARY STEP TO APPLYING AN AUTOMATIC INTERMITTENT PILOT SYSTEM

The following procedure is intended as a guide to aid in determining that an appliance is properly installed and is in a safe condition for continuing use.

This procedure is predicated on central furnace and boiler installations equipped with an atmospheric gas burner(s) and not of the direct vent type. It should be recognized that generalized test procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary to determine safe operation of the equipment.

a. This procedure should be performed prior to any attempt at modification of the appliance or the installation.

b. If it is determined there is a condition which could result in unsafe operation, the appliance should be shut off and the owner advised of the unsafe condition.

The following steps should be followed in making the safety inspection:

1. Conduct a Gas Leakage Test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.

2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restrictions, leakage or corrosion or other deficiencies which could cause an unsafe condition.

3. Shut off all gas to the appliance and shut off any other fuel-burning appliance within the same room. Use the shutoff valve in the shutoff valve in the supply line to each appliance.

4. Inspect burners and crossovers for blockage and corrosion.

5. Applicable only to warm air heating appliances. Inspect heat exchangers for cracks, openings or excessive corrosion.

6. Applicable only to boilers. Inspect for evidence of water or combustion product leaks.

7. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliance is located and other spaces of the building. Turn on clothes dryers. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers. If, after completing steps 7 through 12, it is believed sufficient combustion air is not available, refer to 1.3.4 of the National Fuel Gas Code (Z223.1) for guidance.

8. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

9. a. Determine that the pilot is burning properly and that main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner.

b. Determine manifold pressure in order to match input after the new control is installed.

a. Visually determine that main burner gas is burning properly; i.e., no floating, lifting or flashback. Adjust the primary air shutter(s) as required.
b. If appliance is equipped with high and low flame control or flame modulation, check for proper main burner operation at low flame.

11. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use a draft gauge, the flame of a match or candle, or smoke from a cigarette, cigar or pipe.

12. Return doors, windows, exhaust fans, fireplace dampers and all other fuel-burning appliances to their previous conditions of use.

13. Applicable only to warm air heating appliances. Check both limit controller and fan controller for proper operation. Limit controller operation can be checked by temporarily disconnecting the electrical supply to the blower motor and determining that the limit control acts to shut off the main burner gas.

14. Applicable only to boilers:
a. Determine that the circulating water pumps are in operating condition.
b. Test low water cutoffs, automatic feed controls, pressure and temperature limit controls and relief valves in accordance with the manufacturer's recommendations and instructions to determine they are in operating condition.

EXHIBIT A OF ANSI STANDARD Z21.71 FOR AUTOMATIC INTERMITTENT PILOT IGNITION SYSTEMS FOR FIELD INSTALLATION

EXHIBIT B

PROCEDURE FOR INSTALLING AUTOMATIC INTERMITTENT PILOT SYSTEMS

Prior to beginning this procedure, a preliminary examination of the appliance and the automatic intermittent pilot system should be made to determine that the automatic intermittent pilot system can be properly applied to the appliance.

This procedure is intended as a guide to aid in safely installing a listed automatic intermittent pilot system on an existing listed appliance equipped with an atmospheric gas burner(s) and not of the direct vent type.

This procedure is based on the assumption that the history of the specific installation has been one of safe and satisfactory operation.

This procedure is predicated on central furnace and boiler installations, and it should be recognized that generalized procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary to determine safe operation of the equipment.

The following steps should be followed in making the modifications:

1. Perform a safety inspection of the existing appliance installation. See Exhibit A for a recommended procedure for such a safety inspection.

2. Shut off all gas and electricity to the appliance. To shut off gas, use the shutoff valve in the supply line to the appliance. Do not use the shutoff valve which is provided as part of a combination control.

3. Install the automatic intermittent pilot system in strict accordance with the manufacturer's installation instructions.

4. Turn on all gas and electricity to the appliance.

5. Determine that the appliance transformer has adequate capacity by following the steps outlined below:
a. Compute the approximate current draw by adding the current draw of the automatic intermittent pilot system to (1) the current draw of the associated valving, and (2) the current draw of any relays or other devices operated by the transformer.
b. Multiply the total current draw as computed above by 24 V to determine the total VA (volt-ampere) required.
c. The total VA (volt-ampere) required should be equal to or less than the VA rating of the transformer.
d. If the total VA (volt-ampere) required is greater than the VA rating of the transformer, the transformer must be replaced with a Class 2 transformer of adequate rating.

6. Check the heat anticipator in the comfort thermostat to determine if it is properly adjusted to the current draw of the control system. Follow the thermostat manufacturer's instructions.

7. Make certain wiring connections are tight and wires are positioned and secured so they will not be able to contact high temperature locations.

8. Conduct a Gas Leakage Test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.

9. a. Adjust the thermostat to its highest temperature setting, and test manifold pressure and adjust the pressure regulator to match original input as required (refer to Exhibit A, step 9b).
b. Visually determine that main burner is burning properly; i.e., no floating, lifting or flashback. Adjust the primary air shutter(s) as required.

10. If the appliance is equipped with high and low flame control or flame modulation, check for proper main burner operation at both high and low flame.

11. Determine that the pilot is igniting and burning properly and that main burner ignition is satisfactory by interrupting and re-establishing the electrical supply to the appliance in any convenient manner. Make this determination with the appliance burner both cold and hot. Perform this step as many times as is necessary to satisfy yourself that the automatic intermittent pilot system is operating properly.

12. Test the pilot safety device (1) to determine if it is operating properly, and (2) for turndown characteristics according to the manufacturer's installation instructions. No adjustments should be made other than those recommended by the system manufacturer.

13. Sequence the appliance through at least three operating cycles.

14. Applicable only to furnaces. Check both the limit controller and the fan controller for proper operation. Limit control operation can be checked by blocking the circulating air inlet or temporarily disconnecting the electrical supply to the blower motor and determining that the limit controller acts to shut off the main burner gas.

15. Applicable only to boilers.
a. Determine that the circulating water pumps are in operating condition.
b. Test low water cutoffs, automatic feed water controls, pressure and temperature limit controllers and relief valves in accordance with the manufacturer's recommendation to determine they are in operating condition.

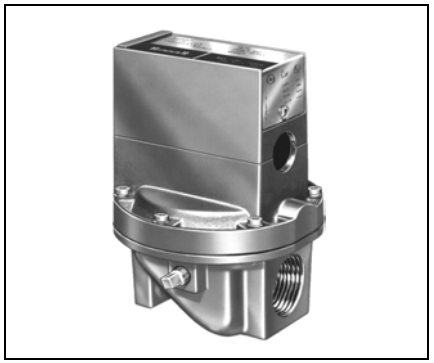
16. Add the labels (see 1.6.1-n and -o) on the appliance.

EXHIBIT B OF ANSI STANDARD Z21.71 FOR AUTOMATIC INTERMITTENT PILOT IGNITION SYSTEMS FOR FIELD INSTALLATION.

Honeywell

V48A,F,J; V88A,J Diaphragm Gas Valves

SPECIFICATION DATA



APPLICATION

The V48 and V88 are solenoid-operated diaphragm valves suitable for LP (Liquefied Petroleum), natural, and manufactured gases. They are normally used on atmospheric boilers, commercial water heaters, and rooftop heaters.

FEATURES

- **Line voltage, 2-wire thermostat or controller used with a V48; V88 used with 24V thermostat.**
- **Valves provide slow opening and fast closing.**
- **Two second maximum closing time.**
- **V48J, V88J rated for 150°F (66°C) ambient temperature.**
- **V48F rated for 5 psi (lb. per sq. in.) (34.5 kPa). V48A and V88A rated for either 1/2 or 1 psi (3.4 or 6.9 kPa), depending on model. V48J and V88J rated for 1 psi (6.9 kPa).**
- **One model for natural and LP gases.**
- **Wide range of sizes and capacities.**
- **Firm closing; diaphragm is both weight and spring loaded.**
- **Valve closes on power failure; recommended for final shutoff service.**
- **Adjustable or fixed bleed orifices available for installation by OEM.**
- **Valve position indicator on 1-1/4 in. V48A2227 and 2 in. V48F1103 Valves.**

SPECIFICATIONS

Models:
V48A (120 Vac) or V88A (24 Vac) solenoid operated diaphragm valves for 1/2 or 1 psi (3.4 or 6.9 kPa) maximum operating pressure.
V48F (120 Vac) solenoid operated diaphragm valve for 5 psi (34.5 kPa) maximum operating pressure.
V48J (120 Vac) or V88J (24 Vac) solenoid operated diaphragm valves for 1 psi (6.9 kPa) operating pressure and 150°F (66°C) maximum ambient temperature.

Type of Gas: Suitable for liquefied petroleum (LP), natural, manufactured, and sulfur-bearing gases.

Valve Capacity: See table in Fig. 2.

Valve Pattern: Straight-through, non-offset.

Valve Body Material: Die-cast aluminum.

Pilot Tapping (see Table 1 for thread type):
3/4 through 1-1/2 inch valves: 1/8-27 NPT or 1/8-28 BSP.PI.
2 through 3 inch valves: 1/4-18 NPT.

Bleed Tapping (see Table 2 for thread type): 1/8-27 NPT or 1/8-28 BSP.PI.

Valve Opening Time:
Five seconds maximum at 2 oz/in.^{2} (0.86 kPa) pressure. Adjustable bleed valve assembly or fixed bleed orifices available for longer opening time (NPT threads only; see Accessories).

65-0053-1

Valve Closing Time (on power failure; measured at 2 oz/in.^{2} (0.86 kPa) pressure): 2 seconds maximum.

Maximum Operating Pressure: See Table 2.

Power Consumption (maximum): 9 watts or 15 VA.

Ambient Temperature Rating:
V48A,F and V88A: 32°F to 125°F (0°C to 52°C).
V48J and V88J: 32°F to 150°F (0°C to 66°C).

Maximum Fluid Temperature:
V48A,F; V88A: 125°F (52°C).
V48J; V88J: 150°F (66°C).

Thermostat Heat Anticipator Setting: For 60 Hz V88, set at 0.6A; for 50Hz set at 0.65A.

Dimensions: See Fig. 1.

Weight: See Table 1.

Table 1. Valve Weight.

Pipe Size (in.)	lb	kg
3/4	2-1/2	1.13
1	3	1.36
1-1/4	3-1/2	1.59
1-1/2	4	1.81
2	9	4.08
2-1/2	8-1/2	3.86
3	9-1/2	4.31

Approvals: (60 Hz models only):
Underwriters Laboratories Inc. Listed: File No. MH1639; Guide No. YIOZ.
CSA 158158-2500005576 (Z21.21-CSA 6.5).

NOTE: All models rated at 50 Hz and all models with BSP.PI threads are not CSA Design Certified.

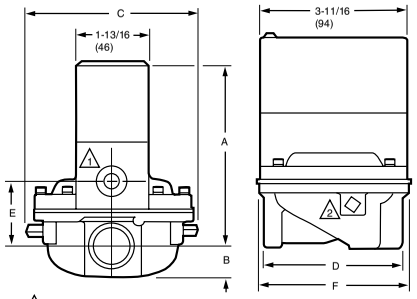
Optional Feature: Valve position indicator is available on 1-1/4 in. V48A2227 and 2 in. V48F1103.

Replacement Coil Assemblies:[a]
116930: 24V, 60 Hz V88A
116931: 120V, 60 Hz V48A.
116932: 220V, 50 Hz V48A
116932: 240V, 60 Hz V48A
118888: 24V, 60 Hz V88J
139937: 120V, 60 Hz V48J
[a] These V48/V88 bonnet assemblies and solenoid operators are not compatible with old style valve bodies.

Table 2. Models Available.

Model	Voltage and Frequency	Maximum Operating Pressure		Pipe Size (in.)	Thread Type[a]
		psi	kPa		
V48A	100V, 50 Hz	1/2	3.4	1, 1-1/4, 1-1/2	BSP.PI
		1	6.9	2	
	120V, 60 Hz	1/2	3.4	3/4, 1, 1-1/4, 1-1/2	NPT
		1	6.9	1, 1-1/4, 1-1/2, 2, 2-1/2, 3	
	220V, 50 Hz			1, 1-1/4, 1-1/2, 2, 3	BSP.PI
	240V, 50 Hz			2	NPT
V48F	120V, 60 Hz	5	34.5	2	
V48J	120V, 60 Hz	1	6.9	3/4, 1, 1-1/4, 1-1/2, 2	
	110V, 50 Hz				
V88A	24V, 60 Hz	1/2	3.4	3/4, 1, 1-1/4, 1-1/2	
		1	6.9	3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3	
V88J	24V, 60 Hz		6.9	1, 1-1/4	

[a] A valve position indicator is on 1-1/4 in. V48A2227 and 2 in. V48F1103 Valves. BSP.PI—British Standard Parallel Internal Threads; NPT—American Standard Taper Pipe Threads.



VALVE SIZE (IN.)	APPROXIMATE DIMENSIONS											
	A		B		C		D		E		F	
	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM
3/4	4-11/16	119.1	3/4	19.1	4-5/8	117.5	3-1/2	88.9	1-5/8	41.3	3-13/16	96.8
1	5-1/16	128.6	1	25.4	5	127.0	3-11/16	93.7	2-1/16	52.4	4-5/16	109.5
1-1/4	5-9/16	141.3	1-1/4	31.8	5-7/8	149.2	5-5/16	134.9	2-3/8	60.3	5-5/16	134.9
1-1/2	5-9/16	141.3	1-1/4	31.8	5-7/8	149.2	5-5/16	134.9	2-3/8	60.3	5-5/16	134.9
2	6-15/16	176.2	2-1/4	57.2	9-1/2	241.3	8-3/8	212.7	3-9/16	90.5	5-5/16	236.5
2-1/2	6-15/16	176.2	2-1/4	57.2	9-1/2	241.3	8-3/8	212.7	3-9/16	90.5	9-5/16	236.5
3	6-15/16	176.2	2-1/4	57.2	9-1/2	241.3	8-3/8	212.7	3-9/16	90.5	9-5/16	236.5

1 BLEED TAPPING: 1/8-27 NPT, OR 1/8-28 BSP, PL.

2 PILOT TAPING (2): 1/8-27 NPT FOR 3/4 THROUGH 1-1/2 IN. SIZES, 1/4-18 NPT FOR 2 THROUGH 3 IN. SIZES; OR 1/8-28 BSP. PL FOR 1 THROUGH 1-1/2 IN. SIZES, 1/4-19 BSP,PL FOR 2 THROUGH 3 IN SIZES.

M8487

Fig. 1. Mounting dimensions of V48A,F,J and V88A,J Diaphragm Gas Valves in in. (mm).

Table 3. Extending Valve Opening Time[a] By Adding a Bleed Orifice.

Valve Size (in.)	Valve Opening Time (seconds)		
	No Orifice	Orifice No. 122160, 0.018 in. (0.46 mm)	Orifice No. 124674, 0.011 in. (0.28 mm)
1	1	2	3
1-1/4	1	5	6
1-1/2	1	5	6
2	4	15	32
2-1/2	4	23	37
3	5	24	37

[a] Time to reach 80% gas flow at fully open position. Inlet pressure; 4.2 in. wc (1.05 kPa) for 1 to 2 in. valves; 5 in. wc (1.25 kPa) for 2-1/2 and 3 in. valves. Pressure drop across valves at fully open position. 0.2 in. wc (0.05 kPa) for 1 to 2 in. valves; 1 in. wc (0.25 kPa) for 2-1/2 and 3 in. valves.

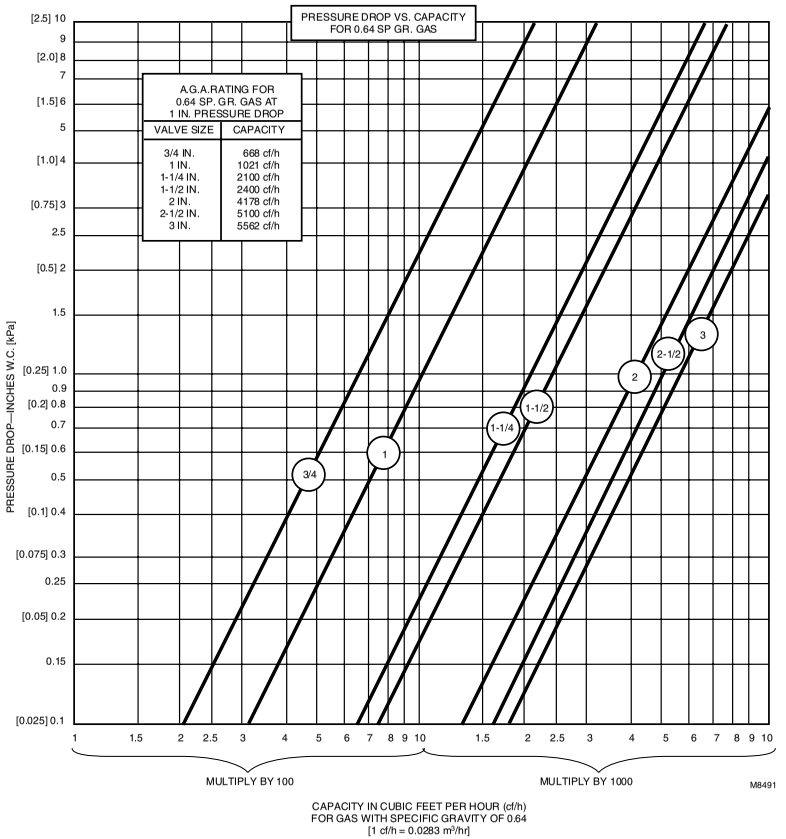


Fig. 2. Pressure drop vs. capacity chart for sizing gas valves.

Honeywell

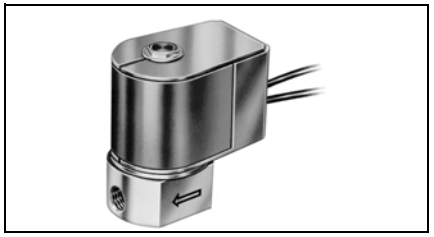
Automation and Control Solutions
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422

Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9

Honeywell

V4046C, V8046C Magnetic Valves

SPECIFICATION DATA



APPLICATION

The V4046C and V8046C Magnetic (solenoid) Valves provide On-Off control of natural or LP gas flow for pilot burners in commercial and industrial applications.

FEATURES

- **Normally closed valves which open immediately when energized.**
- **V4046C is for line voltage applications; V8046C is for 24 Vac applications.**
- **Provides on-off control of manufactured, Liquefied Petroleum (LP), and natural gases with high sulfur content.**
- **Used with pilot burners in industrial applications.**
- **All models close in one second (maximum) on power failure.**
- **Heavily loaded spring plunger maintains valve seating when the coil is de-energized, permitting the valve to be mounted in any position.**
- **Valve may be pipe-mounted or mounted on bracket support furnished by the installer.**
- **Powerhead assembly can be rotated 360 angular degrees.**
- **Solenoid coil is field-replaceable without removing the valve body from the piping connection.**

SPECIFICATIONS

Models: See Table 1.

Types of Gas: Suitable for all domestic gases including high sulfur content LP gas.

Valve Material: Aluminum.

Valve Pattern: Straight-through.

Pipe Size: See Fig. 1.

Dimensions: See Fig. 2.

Valve Action on Power Failure: All models close in one second maximum.

Mounting:
Can be mounted in any position. Mounts directly in pipe line or on a support bracket. See Fig. 2 for tapped holes provided in bottom of valve body. Conduit outlet on powerhead can be rotated through 360 degrees with respect to valve body.

Wiring Connection: Two 36-in. (915 mm) leadwires; 1/2 in. conduit bushing.

Ambient Temperature Range: -40°F to +125°F (-40°C to +54°C).

Approvals:
Underwriters Laboratories, Inc. Listed: File NO. MH1639, V3, S3; Guide No. YIOZ; V4046C, V8046C for gas.
Factory Mutual Listed: V4046C, V8046C for gas.
CSA 158158-250000605.8, Guide Numbers C3371-03, 83. (60 Hz models only).

Replacement Parts: Coil assemblies include coil, leadwire, insulator and bobbin. See Table 3.

Table 1. Model Specifications.

Model	Pipe Size (in.)	Thread	Pressure Rating[a]		Gas Flow		Gas Heat Capacity[a]	Operation Energized	Voltages (60 Hz)
			psi	kPa	cfh[b]	m/hr	btuh[c]		
V4046C	1/8	1/8 - 27 NPT	10	69	20	0.57	20,000	Opens Immediately	120
	1/4 Small Body	1/4 - 18 NPT			20	0.57	20,000		120
	1/4 Large Body	1/4 - 18 NPT			55	1.56	55.000		120
	3/8	3/8 - 18 NPT			67	1.90	67,700		120
	3/8	3/8 - 18 NPT			67	1.90	67,700		208
V8046C	1/8	1/8 - 27 NPT			20	0.57	20,000		24
	1/4 Small Body	1/4 - 18 NPT			20	0.57	20,000		24
	1/4 Large Body	1/4 - 18 NPT			55	1.56	55,000		24
	3/8	3/8 - 18 NPT			67	1.90	67,700		24

[a] 1/2 psi in CSA rating.

[b] See body sizes, Fig. 2. 55 cfh (1.56 cmh) is for large body valve with 1/4-18 NPT threads; 67 cfh (1.90 cmh) is for large body valve with 3/8-18 NPT threads.

[c] Natural gas, 1000 btu/cu ft measured at one inch pressure drop, 0.64 specific gravity. See Gas Capacity Conversion Factors.

Table 2. Coil VA Ratings.

Model	24 Vac, 60 Hz	120 Vac, 60 Hz	208 Vac, 60 Hz
V4046C	—	13.8	13.7
V8046C	14.1	—	—

Table 3. Coil Assemblies for V4046C, V8046C Valves.

Part Number	Used On
116671A	V4046C; 120 Vac, 60 Hz
116782A	V4046C; 208 Vac, 60 Hz
11668A	V8046C; 24 Vac, 60 Hz

Gas Valve Sizing

1. Check the burner nameplate for:
   a. the type of gas used, and
   b. the gas flow capacity. The capacity will be listed in British thermal units per hour (Btuh)) or in cubic feet per hour (cfh).
2. Contact the local gas utility for information regarding:
   a. the specific gravity (sp gr) and
   b. the Btu per cubic foot (Btucf) for the type of gas used.
3. Find the capacity in cfh. If the capacity is listed in Btu, convert to cfh using the following formula:

$$\text{Capacity in cfh} = \frac{\text{Btuh (burner nameplate)}}{\text{Btu/cu ft (gas utility)}}$$

4. For gases with specific gravity other than 0.64, multiply the burner cfh using the proper conversion factor in Table 4.

Table 4. Gas Conversion Factors.

Type of Gas	sp gr (average)	Multiply cfh by
Manufactured	0.60	0.968
Mixed	0.70	1.046
LP-Propane	1.53	1.546
LP-Butane	1.98	1.759

5. Use the corrected burner capacity in cfh when determining the gas valve size in Fig. 1.
6. Determine the maximum pressure drop to be taken across the valve. If pressure drop is not in pounds per square inch (psi), multiply the value in known pressure units by the conversion factor.
7. Plot the capacity (cfh) vs. pressure drop (psi) in Fig. 1 to find the proper valve size.

NOTE: Use the corrected cfh for gas other than 0.64 sp gr.

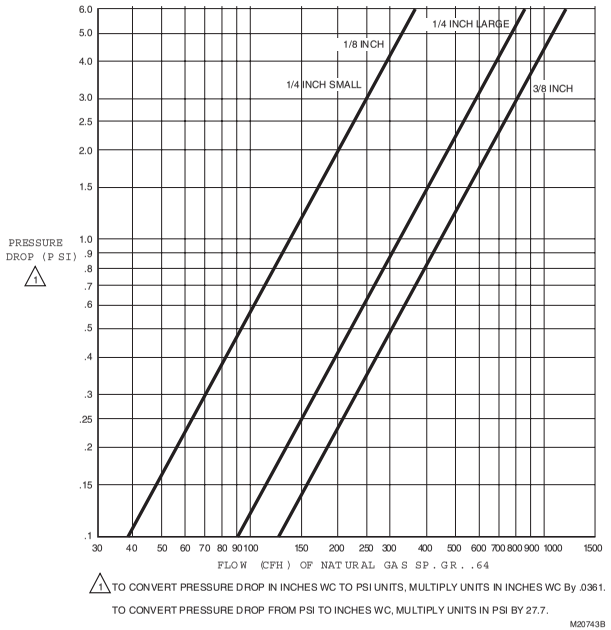
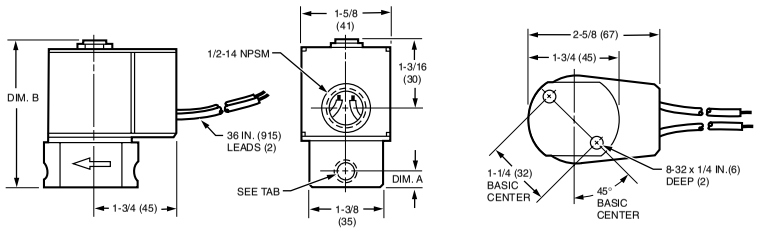


Fig. 1. Pressure drop (psi) vs.flow capacity (cfh) on V4046C, V8046C gas valves only.

Dimensions. See Fig. 2.



MODEL	BODY SIZE	THREAD SIZE	DIM. A		DIM. B	
			IN	MM	IN	MM
V4046C, V8046C	SMALL	1/8-27 NPT	5/16	8	2-3/4	70
	SMALL	1/4-18 NPT	3/8	10	3	76
	LARGE	1/4-18 NPT	1/2	13	3-1/4	83
	LARGE	3/8-18 NPT	1/2	13	3-1/4	83

Fig. 2. V4046C, V8046C approximate dimensions in in. (mm).

V4046C, V8046C MAGNETIC VALVES

Honeywell

Automation and Control Solutions
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422

Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9

65-0068—1 G.R. Rev. 09-02

Honeywell

L4008A,B,E,L; L6008A,G,H Aquastat® Controllers

INSTALLATION INSTRUCTIONS

APPLICATION

These remote bulb (see Fig. 7), immersion type (see Fig. 1) controllers operate in response to temperature changes in hydronic heating systems and other heated liquids.

Electrical Ratings:
Switch ratings are shown on the inside cover of each device. The electrical requirements on controlled equipment must not exceed this rating.

- L4008A—breaks the burner circuit on a rise in water temperature. It is normally used as a limit controller. When used as an operating controller or low limit, a separate high limit control must be used.
- L4008B—makes a control circuit on a rise in water temperature. It is normally used as a circulator controller to prevent circulator operation until boiler water temperature is at or above the control setting.
- L4008E—breaks the burner circuit and locks out on a rise in water temperature. It is used as a high limit controller where manual reset is desirable.
- L4008L—is used as a 2-stage Aquastat® controller.
- L6008A—makes the burner circuit on a drop in water temperature. It is normally used as a circulator and low limit cooling controller.

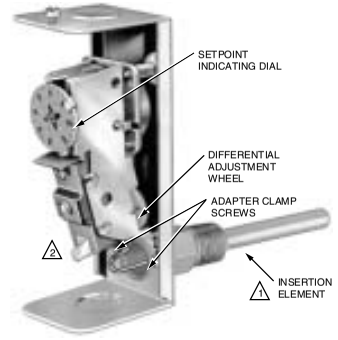


Fig. 1. Internal view.

- L6008G—is used as a 2-stage Aquastat® controller to cycle 2-stage gas valve.
- L6008H—is used as a low fire Aquastat® controller.

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

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.

Depending on model and installation requirements, install the temperature sensing bulb either in an immersion well (see Fig. 2) that extends into the boiler or tank, or directly immerse the temperature sensing bulb in the liquid. For installations not using a well, secure the bulb with a bulb compression fitting (see Fig. 3), or a capillary compression fitting (see Fig. 4). Order the well or the fitting separately.

The boiler manufacturer generally provides a tapping for inserting the Aquastat® controller sensing element. Locate this tapping in a representative point where typical water temperature can be measured. Never locate the bulb or protecting immersion well close to a hot or cold water inlet or steam coil. Install the bulb in the supply line of an indirect water heater, in the indirect water heater itself, or in the feed riser about 6 in. (152 mm) above the boiler. If the riser is valved, install the bulb between the boiler and the valve.

95-5971-2

The Aquastat® controller can be remotely mounted—either vertically on a wall or panel, or directly on the boiler, tank, or vessel.

If the system is filled, drain the system to a point below the boiler tapping, or to wherever the sensing bulb is to be installed.

Mounting the Case

1. Remove the cover and fasten the case to the wall or panel using the three mounting holes in the back of the case.
2. When mounting the remote bulb, if desirable, route the tubing to run through any of the other three corner notches in the case. Be careful not to kink or bend tubing sharply. Be sure bends have at least 1 in. (25.4 mm) radius.

Installing Remote Bulb with Immersion Well

Fit well, if used, to sensing bulb snugly for good thermal response. Insert bulb until it rests against the bottom of the well; then hold it there while tightening the tubing clamp.

1. Screw the well into the boiler, tank or pipe tapping.
2. Insert the bulb into the well, pushing the tubing until the bulb bottoms in the well.
3. Attach the retainer clamp to the end of the well spud. Loosen the draw nut and spread the jaws of the clamp with the screwdriver if necessary.
4. With the retainer clamp attached to the well spud (be sure jaws of clamp hook over ridge at end of the spud, as shown in Fig. 2, points A). Adjust tubing to fit through retainer clamp groove, as shown at point B.
5. Tighten the draw nut so the retainer clamp is firmly attached to the well spud and the tubing is held by the clamp.

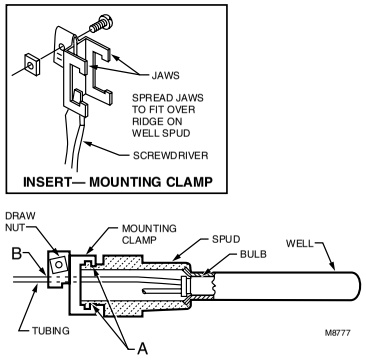


Fig. 2. Immersion well fitting.

IMPORTANT
Do not secure draw nut so tightly that retainer clamp could cut or collapse tubing.

Mounting with Bulb Compression Fitting

1. Screw the fitting into the boiler or pipe tapping.
2. Slide sealing washer onto the bulb.
3. Insert the bulb into the fitting until bulb bottoms.
4. Slide split sleeve into fitting.
5. Place clamps A and B on assembly so that sleeve is drawn into fitting when screws are tightened.

   NOTE: Make sure that the nub on clamp A engages space between sleeve and clamp.

6. Tighten clamp screws evenly.

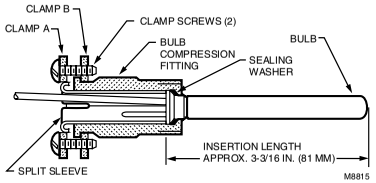


Fig. 3. Bulb compression fitting.

Mounting with Capillary Compression Fitting

1. Screw fitting into the boiler or pipe tapping.
2. Place packing nut on tubing.
3. Slide bulb completely through fitting.
4. Place composition disc and 4 slotted brass washers on tubing in the order shown in Fig. 4. Turn brass washers so that slots are 180 degrees to each other.
5. Slide seal assembly into fitting and tighten packing nut.

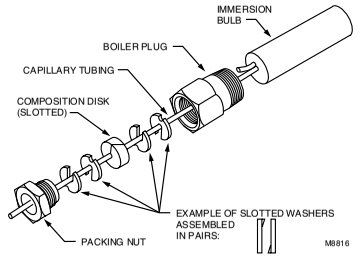


Fig. 4. Capillary compression fitting.

WIRING

All wiring must agree with applicable codes and ordinances and regulations in such matters as wire size, type of insulation, and enclosure. The controllers are provided with conduit knockouts in the top and bottom of case.

Refer to Fig. 5 or 6 for a typical connection diagram.

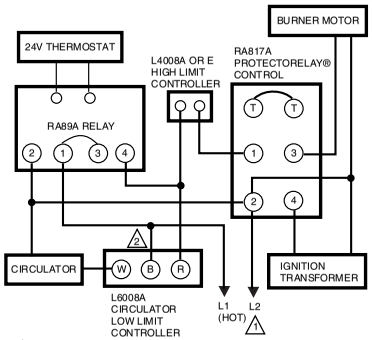


Fig. 5. Typical oil-fired hydronic heating system with domestic hot water.

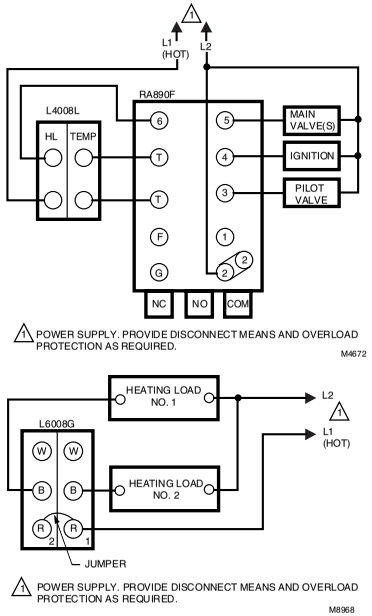


Fig. 6. Typical oil burner installation using L4008L or L6008G.

SETTING

Control Point:
Insert a screwdriver in the slotted head visible through the cover, and turn the indicating dial to the control point. Temperature settings should be according to boiler manufacturer's recommendations.

Differential (on adjustable differential models):
Remove cover and move the differential adjustment wheel (Fig. 1 or 7) to a point on the scale corresponding to the desired differential. Replace cover.

Manual Reset (L4008E):
After boiler water temperature has dropped to a point below the high limit setting, less differential, the reset button at the front of the case must be pushed before the burner can operate.

ADJUSTMENTS

Adjusting Differential

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, see Fig. 7, until the desired reading is aligned with the V notch in the frame. The wheel provides as adjustment from 5° to 30°F (3° to 17°C). Replace the cover on the Aquastat® controller.

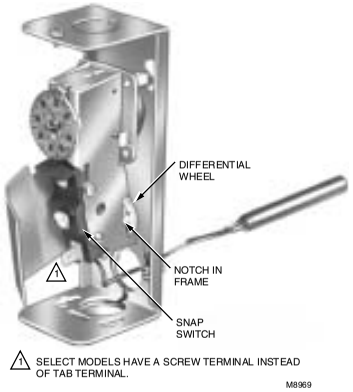


Fig. 7. Adjusting the differential.

Adjust the 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.

L4008A,B,E,L; L6008A,G,H REMOTE BULB AQUASTAT® CONTROLLERS

Adjusting L6008G Interstage Differential

The L6008G Controller has an adjustable interstage differential. The setpoint adjustment knob determines the temperature at which the right switch operates. The left switch can be adjusted to operate from 3° to 10°F (1.7° to 5.6°C) above the point of operation of the right switch. The Interstage differential is adjusted by turning the star wheel with a narrow screwdriver inserted into the rectangular hole in the chassis. See Fig. 8

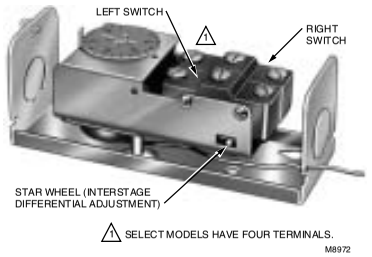


Fig. 8. Interstage differential adjustment on an L4008L or L6008G.

CHECKOUT

⚠ WARNING
CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.
This product is intended for use only in systems with a pressure relief valve.

Check to be sure the Aquastat® controller is properly installed and adjusted. Put the system into operation and observe the action of the control through several cycles to make sure that it provides proper control of the system as described in the Operation section. Make any additional adjustments necessary to assure comfort requirements.

Honeywell

Home and Building Control
Honeywell Inc.
1985 Douglas Drive North
Golden Valley, MN 55422

Home and Building Control
Honeywell Limited-Honeywell Limitée
740 Ellesmere Road
Scarborough, Ontario
M1P 2V9

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95-5971—2 J.H. Rev. 9-95 Printed in U.S.A

Honeywell

V9055A,D Modulating Fluid Power Gas Valve Actuator

PRODUCT DATA

APPLICATION

The V9055 Gas Valve Actuator in combination with a V5055, VE5000[a] or V5097 Gas Valve provides modulating control of the gas supply to commercial and industrial burners.

FEATURES

- **Actuator opens the valve to the low-fire position when energized. Actuator then modulates to meet firing rate controller (Series 90) demand.**
- **Actuator is equipped with an integral shaft that may be used to drive a combustion air damper in unison with the gas valve.**
- **The V5055 or V5097 Gas Valve includes a yellow SHUT indicator. The actuator includes a red OPEN indicator. The indicators provide constant visual indication of valve position.**
- **Actuator can be used with all VE5000[a], V5055 or V5097 Valve models; however, the V5055B or V5097B with characterized guide is recommended for optimum control and low-fire repeatability.**
- **Ambient temperature range for 60 Hz models is -40°F to 125°F (-40°C to 53°C). Ambient temperature range for 50 Hz and 50/60 Hz models is -10°F to 125°F (-23°C to 52°C).**
- **Auxiliary 1/2 hp rated switch is available for field installation.**
- **Integral damper shaft provides a maximum of 20 lb (9 kg) of force.**
- **Valve and actuator may be mounted in any position.**
- **Model is available with NEMA 4 (weatherproof) enclosure.**
- **V9055D/V5055C,E and V9055D/V5097C,E combinations available with proof-of-closure switch and two valve seals (valve seal overtravel interlock) to meet specific code/standard/insurer requirements.**
- **Field addable adapter available for 4-20 dc mA control of actuator.**
- **When replacing a V9034 Actuator with a V9055, the V5034 Valve body must also be replaced with a V5055 or V5097 Gas Valve.**

[a] VE5000 is a European manufactured and approved valve for European use only.

Contents

60-2311-7

SPECIFICATIONS

Models:
V9055A: Modulating Fluid Power Gas Valve Actuator.
V9055D: Modulating Fluid Power Gas Valve Actuator with proof-of-closure switch.

Low-Fire Adjustment: 0.14 inch to 0.65 inch (with respect to V5055/V5097B Valve) valve stem travel. Refer to form 70-8311 for valve flow (capacity) curves.

Table 1. Pressure Ratings of Actuator-Valve Combinations.

Valve	Actuator	
	V9055[a]	V9055D[a] (use with V5055C,E)
V5055B/V5097B 3/4 to 3 in.	5 psi (35 kPa) diff.; 15 psi (105 kPa) closeoff.	—
V5055B 4 in.	3 psi (21 kPa) diff.; 15 psi (105 kPa) closeoff	—
V5055A,C/V5097A,C 3/4 to 3 in.	5 psi (35 kPa) diff.; 15 psi (105 kPa) closeoff.	5 psi (35 kPa) diff.; 15 psi (105 kPa) closeoff.
V5055A,C 4 in.	3 psi (21 kPa) diff.; 15 psi (105 kPa) closeoff.	3 psi (21 kPa) diff.; 15 psi (105 kPa) closeoff.
V5055D,E/V5097D,E 3/4 to 1-1/2 in.	5 psi (35 kPa) diff.; 75 psi (525 kPa) closeoff.	5 psi (35 kPa) diff.; 75 psi (525 kPa) closeoff.
V5055D,E/V5097D,E 2, 2-1/2, 3 in.	5 psi (35 kPa) diff.; 45 psi (315 kPa) closeoff.	5 psi (35 kPa) diff.; 45 psi (315 kPa) closeoff.

[a] The low-fire flow of the V5055/V5097A,C,D and E Valves will differ from those of the V5055/V5097B. Check the valve flow curves in form 70-8311 and match the low-fire adjustment to the burner design and application.

Table 2. Electrical Ratings.

Voltage/ Frequency	Opening		Holding	
	Watts	VA	Watts	VA
120/60	60	122	20	32
100-50/60	57/46	100/81	25/20	36/31
220/50	68	141	20	32
240/50	88	194	19	36

Table 3. Auxiliary and Proof-of-Closure Switch Ratings: 1/2 hp[a].

	120V	240V
Full Load	9.8A	4.9A
Locked Rotor	58.8A	29.4A

[a] Maximum total connected power to both switches (if used) is 1800 VA.

Opening Time:
50 Hz models: 32 seconds (nominal).
60 Hz models: 26 seconds (nominal).

Closing Time: 1 second (maximum)

Damper Arm Rating (damper drives one direction only):
Standard Models: 20 lb. maximum at 2-11/16 in. radius at 20°F to 125°F and 5 lb at -40°F to 20°F (9 kg maximum at 68 mm radius at -7°C to 66°C and 2.3 kg at -40°C to -7°C).
Model with Damper Shaft Return Spring: 10 lb maximum at 2-11/16 in. radius at 20°F to 125°F and 5 lb at -40°F to 20°F (4.5 kg at 68 mm radius at -7°C to 66°C and 2.3 kg at -40°C to -7°C).

Damper Shaft: Shaft is 3/8 in. (9.5 mm) for use with 7616BR Damper Arm. Models available with damper shaft return spring.

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.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

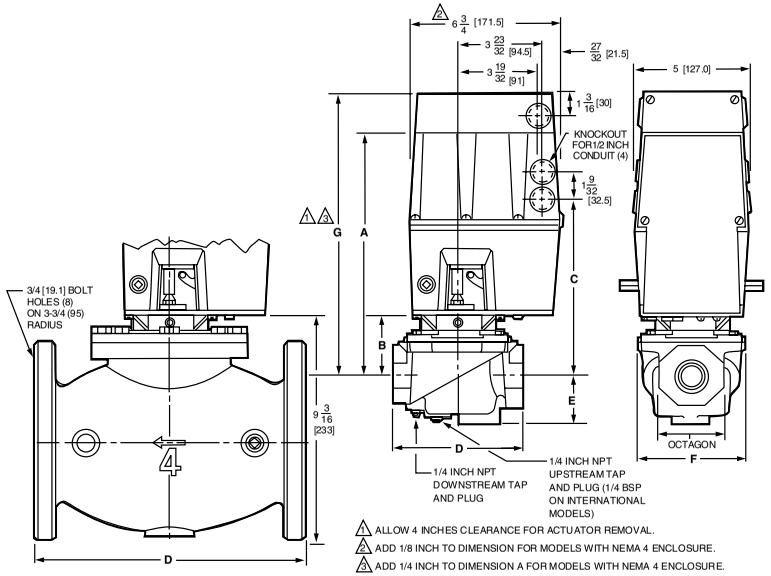
1. Your local Home and Building Control Sales Office (check white pages of your phone directory).
2. Home and Building Control Customer Relations
   Honeywell, 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386 (800) 328-5111

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.
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.

Ambient Temperature Rating:
-40°F to 125°F (-40°C to 52°C) for 60 Hz models, and -10°F to 125°F (-23°C to 52°C) for 50 Hz and 50/60 Hz models.

Mounting Means: Actuator attaches directly to valve with two setscrews. Valve and actuator can be mounted in any position.

Installation Dimensions: See Fig. 1.



VALVE SIZE	DIM A		DIM B		DIM C		DIM D		DIM E		DIM F		DIM G		OCTAGON	
INCH	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM
3/4	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-3/4	146.1	2-1/4	57.2	4-13/16	122.2	13-1/8	333.4	2-13/16	71.4
1	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-3/4	146.1	2-1/4	57.2	4-13/16	122.2	13-1/8	333.4	2-13/16	71.4
1-1/4	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-3/4	146.1	2-1/4	57.2	4-13/16	122.2	13-1/8	333.4	2-13/16	71.4
1-1/2	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-3/4	146.1	2-1/4	57.2	4-13/16	122.2	13-1/8	333.4	2-13/16	71.4
2	11-1/4	285.8	2-7/8	73.0	8-5/16	211.1	8-3/8	212.7	2-3/4	69.9	7-19/32	192.9	13-1/4	336.5	3-1/2	88.9
2-1/2	11-3/4	298.5	3-3/8	85.7	8-13/16	223.8	9-1/4	235.0	2-3/4	69.9	7-19/32	192.9	13-3/4	349.3	4-1/2	114.3
3	11-3/4	298.5	3-3/8	85.7	8-13/16	223.8	9-1/4	235.0	2-3/4	69.9	7-19/32	192.9	13-3/4	349.3	4-1/2	114.3
4	14-1/8	358.8	5-13/16	147.6	11-7/32	285.0	12-1/2	317.5	4-5/8	117.5	—	—	16-3/16	411.0	—	—

M7321

Fig. 1. V9055/V5055 dimensions in in. (mm).

NEMA 4 Enclosure: Model available.

Table 4. V9055/V5097 dimensions in in. (mm)

Valve Size[a] (in.)		Dim. A		Dim. B		Dim. C		Dim. D[b]		Dim. E		Dim. F		Dim. G	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
Small Body	3/4	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-5/8	142.9	2-1/2	63.5	4-13/16	122.2	13-3/16	335
	1	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-5/8	142.0	2-1/2	63.5	4-13/16	122.2	13-3/16	335
	1-1/4	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-5/8	142.9	2-1/2	63.5	4-13/16	122.2	13-3/16	335
	1-1/2	11-1/8	282.6	2-3/4	69.9	8-3/16	208.0	5-5/8	142.9	2-1/2	63.5	4-13/16	122.2	13-3/16	336
	2	11-1/8	282.6	2-7/8	73.0	8-3/16	208.0	5-5/8	142.9	2-1/2	63.5	7-19/32	192.9	13-3/16	335.0
Large Body	2	11-3/4	298.5	3-3/8	85.7	8-3/8	212.7	9-7/16	239.7	4	101.5	7-19/32	192.9	13-3/8	339.7
	2-1/2	11-3/4	298.5	3-3/8	85.7	8-3/8	212.7	9-7/16	239.7	4	101.5	7-19/32	192.9	13-3/8	339.7
	3	11-3/4	298.5	3-3/8	85.7	8-3/8	212.7	9-7/16	239.7	4	101.5	7-19/32	192.9	13-3/8	339.7

[a] Valve size using accessory pipe adapter fitting.

[b] Without flanges.

Approvals:
Underwriters Laboratories Inc. Listed: File No. MN1639, Guide No. YI0Z.
Factory Mutual Approved: Report Nos. 20835 and 24061
International Approval Services (IAS), a joint venture of AGA and (CGA): Design Certified.
Industrial Risk Insurers: Acceptable.

Accessories:
133568 Auxiliary Switch.
7616BR Crank Arm.
135796 Wrench.
133569 Proof-of-closure Switch Bag Assembly. Must be used with V5055C or E.
Q5055A1001 Adapter Assembly—Adapts ITT General V710 Gas Valve to accept Honeywell Gas Valve Actuators. Replaces ITT AH8 Gas Valve Actuator.
203422C Adapter Board—Used to control V9055 Actuator with 4-20 dc mA input.

INSTALLATION

⚠ WARNING

Electrical Shock Hazard.
Can cause serious injury, death or equipment damage.

1. Disconnect power before connecting wiring.
2. Assure that wiring complies with applicable electrical codes and ordinances.
3. Be sure that power supply is the same as that stamped on the nameplate of the device.
4. Be sure only a trained, experienced, flame safeguard control serviceman installs or services this device.
5. Assure that loads connected to the auxiliary switch, if used, do not exceed the ratings given in the Specifications section.

IMPORTANT

1. *Do not attempt to use the V9055 with one of the adapters that connects the V4055 Actuator to the older V5034 Valves. The adapter is for use with the V4055 only. The V9055 cannot be used with a V5034 Valve. When replacing a V9034 Actuator with a V9055, the V5034 Valve must be replaced with a V5055/V5097 Gas Valve.*
2. *Connect terminals R, W, and B only to Series 90 proportioning controller. Do not apply any voltage to these terminals.*
3. *Avoid mounting actuator upside down if water is likely to drip on it. In this position, water can become trapped in the electronics compartment.*

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 instruction 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 product operation as provided in these instructions.

Valve Installation

The actuator is mounted directly on the V5055/V5097 Valve after the valve is installed in the gas supply line. Refer to the instructions packed with the V5055/V5097 Valve for details of installation. When installing the valve, be sure that:

1. Sufficient clearance is left for installation and service of the actuator.
2. Ambient temperatures at the valve location will remain within the rated ambient range.
3. The position of the valve permits hookup to the damper if one is controlled.

IMPORTANT:

When a damper crank arm is used with a NEMA 4 actuator that is exposed to ice or sleet, a suitable shield must be installed to prevent ice or sleet buildup.

Install Accessory Switches (If Needed)

An spdt switch may be installed to operate an auxiliary load of up to 1/2 hp. The switch may be adjusted to operate at any point in the valve stroke. A proof-of-closure switch may also be installed. The proof-of-closure switch must be used with the V5055 C,E/V5097C,E (two seals) Valve to provide valve seal overtravel interlock.

The spdt proof-of-closure switch is installed to make or break a circuit when the valve is in the closed position. The switch is not adjustable.

NOTE: Mark the actuator or valve to indicate any changes made.

To install the switches, proceed as follows:

1. Remove the actuator faceplate (two screws).
2. Remove the silver-colored barrier to expose the actuator stem.
3. Insert the auxiliary switch in the position indicated in Fig. 3. Fasten with two screws through the actuator base.
4. Insert the proof-of-closure switch in the position shown in Fig. 3. The proof-of-closure switch mounts against the side of the actuator housing. The mounting holes are spaced to mount the switch only in the correct position. Fasten with two screws through the actuator base.
5. If only one switch is used, install the narrow barrier included with the switch in the unused space.
6. Mount the actuator before making wiring connections and adjustments to the switch.

Mount and Adjust Damper Crank Arm

IMPORTANT:

When a damper crank arm is used with a NEMA 4 actuator that is exposed to ice or sleet, a suitable shield must be installed to prevent ice or sleet buildup.

The crank arm provides a maximum travel of 2-5/16 in. (59 mm). For complete installation information, refer to the instructions packed with the 7616BR Crank Arm.

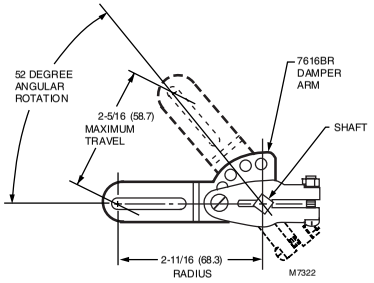


Fig. 2. Crank Arm Operation.

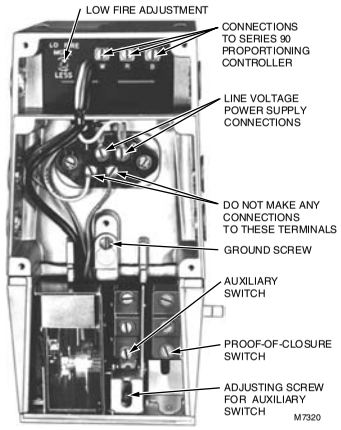


Fig. 3. Internal components and connections in V9055.

WIRING

⚠ WARNING

Electrical Shock Hazard.
Can cause serious injury, death or equipment damage.
To prevent electrical shock or equipment damage disconnect power supply before wiring.

All wiring must agree with applicable electrical codes and ordinances.
Connect power supply to terminals 1 and 2 on the terminal strip. Do not make any connections to the unmarked terminals shown in Fig. 3.

NOTE: When replacing a V9034, remove the 24 volt transformer because V9055 has a built-in transformer. When replacing a V9034 Actuator with a V9055, replace the V5034 Gas Valve with a V5055/V5097 Valve.

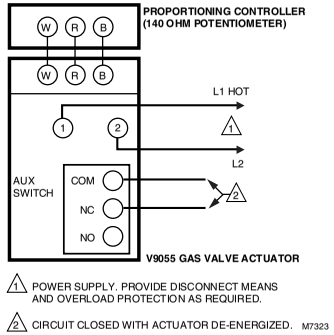


Fig. 4. Wiring for V9055 Modulating Gas Valve Actuator.

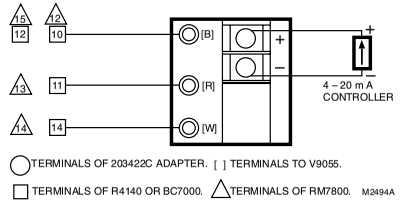


Fig. 5. Hookup of V9055 for firing rate control with a 4-20 mA input.

203422C—V9055 Adapter (For 4-20 mA Input) Installation

The 203422C Adapter Board allows the V9055 Modulating Fluid Power Gas Valve Actuator to be controlled with a 4-20 dc mA input. The adapter mounts in the wiring compartment and provides screw terminals for field wiring.

1. Remove the screws from terminals R,B and W on the V9055 Actuator.
2. Position the adapter board to the R, B and W terminals and install and tighten three screws (four screws provided in bag assembly) to the R, B, and W terminals.
3. Connect field wiring from 4-20 mA controller to the + and - terminals on the 203422C adapter board Be sure to observe polarity.

⚠ CAUTION

Equipment Damage Hazard.
Incorrect wiring can damage the controller or adapter board.
Be sure to observe polarity from the controller to the 203422C Adapter Board.

4. Reconnect power.
5. With manual shutoff gas valve Closed, apply power to the V9055 and check its operations with the 4-20 mA temperature controller by manually incrementing and decrementing the output; 4 mA input will drive the V9055 to low-fire position; 20 mA drives to high-fire. Assure V9055 completes a full stroke.
6. Turn manual shutoff gas valve to the open position and test the remainder of the system for proper operation.
7. If the V9055 is being used for firing rate control, connect system according to the drawing in Fig. 5.
8. Sequence the burner through a normal startup.

⚠ CAUTION

Equipment Damage Hazard.
Improper wiring can cause equipment damage or danger to personnel.
Label all wires prior to disconnection when servicing valves. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

ADJUSTMENTS

IMPORTANT:

When using the V9055D with the V5055/V5097C or E (two seals) Valves, match low-fire minimum adjustment to the burner and the application. Too low of an adjustment could result in loss of burner flame. Also plan to check this low-fire adjustment at periodic maintenance intervals.

Adjust Low-Fire Setting

The low-fire setting is adjustable from approximately 0.14 to 0.65 inch valve stem travel (with respect to V5055B/V5097B Gas Valve). The low-fire adjustment is factory-set at the maximum position (approximately 50 percent of full gas flow capacity). Refer to form 70-8311 for valve flow (capacity)

curves. Check to be sure the low-fire setting is at maximum (fully clockwise) before starting the adjustment procedure. To adjust:

1. Remove the lead to the V9055 terminal R. Jumper terminal R to W. This will prevent the actuator from going to the high-fire position.
2. Using a Phillips screwdriver, turn the low-fire adjusting screw to the desired low-fire position. Do not push inward on screw.
3. Shut down the burner, and then restart. Repeat several times to be sure the low-fire setting is suitable for correct burner lightoff.
4. Turn off power supply. Remove R-W jumper, and reconnect the lead to terminal R on the V9055.

Adust the Auxiliary Switch (if used)

The auxiliary switch is adjustable throughout the stroke of the actuator. With the switch installed in the actuator, turn the adjusting screw (Fig. 3) clockwise ↷ to cause the switch to operate earlier in the stroke and counterclockwise ↶ to operate later in the stroke.

OPERATION

To function as intended, the V9055 must be connected to a properly sized valve. The proper sized V5055/V5097B Gas Valve with characterized guide is recommended for optimum control and low-fire repeatability. Too large of a valve will not properly modulate the gas flow. When the actuator is energized, it will drive at least to the adjusted low-fire position. The distance it will open beyond this low-fire position depends on the demands of the modulating controller.

When the controller calls for no heat, the actuator will modulate the valve to the low-fire position. When power to the actuator is interrupted, the valve will completely close.

Fig. 6 shows the V9055 in a typical flame safeguard control system.

CHECKOUT AND SERVICE

Checkout

IMPORTANT

Only a trained, experienced flame safeguard control technician should service or repair this control.

After the valve installation is complete, cycle the valve a few times with the manual fuel shutoff cock closed before testing the system in actual operation.

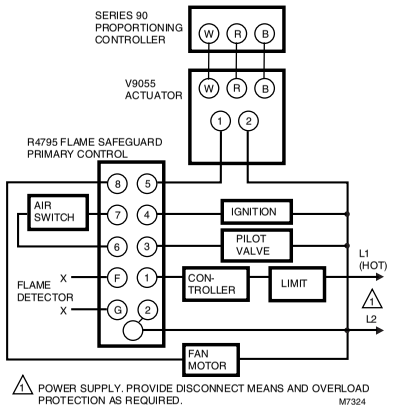


Fig. 6. V9055 connected to R4795 in typical application.

Service

The actuator is not field repairable except for replacing the auxiliary switch. See Install Accessory Switches section for the procedure.

Do not disassemble the valve actuator. Perform the following checks before removing and replacing the V9055 Gas Valve Actuator.

1. With manual gas valve closed, energize the V9055 and check for voltage on terminals 1 and 2. Actuator should modulate to the low-fire position.

⚠ CAUTION

Equipment Damage Hazard.
Improper wiring can damage the equipment and cause injury to personnel.
Label all wires prior to disconnection when servicing valves. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

2. Disconnect the leads from the modulating controller (terminals W,R, and B). Connect a manual potentiometer, color-to-color, to terminals W, R, and B on the actuator. With the valve energized, use the potentiometer to open and close the actuator. It should run from the low-fire position and to the fully open position.

If the actuator itself has failed, return it to the factory for repair.

Honeywell

Home and Building Control
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422

Home and Building Control
Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9

Series 26/26H – Low Water Cutoff

- Meets CSD1 Requirements
- Non Powered Contacts
- Time Delays Available
- LED Monitoring
- U.L. "Limit Control"
- Snap-Thru Standoff Mounting
- Compact Size
- Power Outage Feature
- CSA Approved

Designed for boiler low-water cutoff protection. A snap-through standoff mounting device is available for Series 26 units. Optional Power Outage feature resets after nuisance outages. Optional reset button is used when device has been deactivated because of low water condition. Reset is functional only if water has returned to normal level. Built-in 3 second time delay, 6 second delay available.

Specifications

Contact Design	1 N.O. & 1 N.C. (1 form C)
Contact Rating (120, 240 VAC)[1]	10 amp Resistive 1/3 hp
Mode of Operation	Direct
Sensitivity	0-26K ohm, factory set
Primary Voltage	120 VAC, 240 VAC[2], 24 VAC, 208/240 VAC (+10%/-15%) 50/60 Hz
Secondary Voltage	12 VAC, 1.5 mA
Temperature	-40°F to 150°F
Approvals	U.L. 353, U.L. 508 File # MP1430, CSA
Terminal Style	Spade connection
Options	Time Delays, Power Outage, Retrofit Plate

Notes:
1. For applications requiring higher contact ratings, request information on 26P (16 amp contact rated).
2. 240 volt is not U.L.

How to Order

Use the **Bold** characters from the chart below to construct a product code.

26 X X X X X X XX

Series
26 **26H**

Sensitivity
A – 4.7K **D**** – 50K
B – 10K **E**** – 100K
C – 26K

Supply Voltage
1 – 120 VAC **2** – 240 VAC **3** – 24 VAC **8** – 208/240 VAC

Standoff Style*
A – 1/16" Panel **C** – Screw mount
B – 1/8" Panel **D** – Retrofit

Enclosure
0 – None **1** – NEMA 1 **4** – NEMA 4

Optional Character*

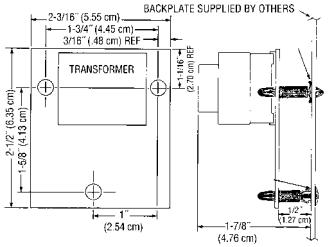
Time Delay (decreasing level)
03 – 3 seconds **06** – 6 seconds

*See page E-29 for descriptions. – Standard part numbers
**26H only

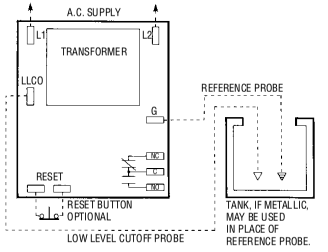
Applications

- Low-Water Cutoff
- Point Level
- Valve Control
- Single-Level Service
- Alarms
- Pump Control

Dimensions



Wiring



CONDUCTIVITY

Form 260
Sheet P/N 100203-1
Rev. H

Warrick® Series 26 Controls

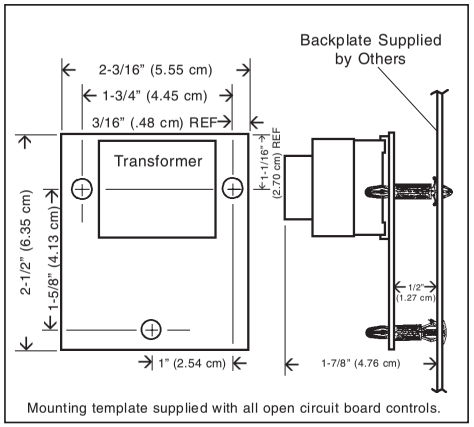
Installation and Operation Bulletin

This bulletin should be used by experienced personnel as a guide to the installation of Series 26 controls. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors Inc., or its local representative if further information is required.

Specifications

Control Design: Open circuit board design
Contact Design: SPDT (1 form C): one normally open (N.O.) and one normally closed (N.C.), non-powered contacts.
Contact Ratings: 10A @ 120 or 240 VAC resistive (120°F), 1 A @ 120, 240 VAC resistive (150°F), 1/3 H.P. @ 120, 240 VAC (120°F)
Contact Life: Mechanical: 5 million operations.
Electrical: 100,000 operations minimum at rated load.
Supply Voltage: 120, 240 or 24 VAC models:
+10% - 15%, 50/60 Hz. 208/240 Model: 187 Vmin to 255 Vmax. VAC 50/60 Hz
Supply Current: Relay energized 4.4 VA.
Secondary Circuit: 12 VAC RMS voltage on probes, 1.5 milli-amp current.
Sensitivity: Models operate from 4.7K to 26K maximum specific resistance
Temperature: -40 to 150° F. ambient.
Terminals: Probe connections 3/16" spade: Line and power connections 1/4" space
Time Delays: Standard - LLCO probe, 3 seconds on lowering level
Listing: UL limit control recognition (353). 240 and 208/240 volt units are not U.L. limit control recognized.

Dimensions



Mounting template supplied with all open circuit board controls.

Notes

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

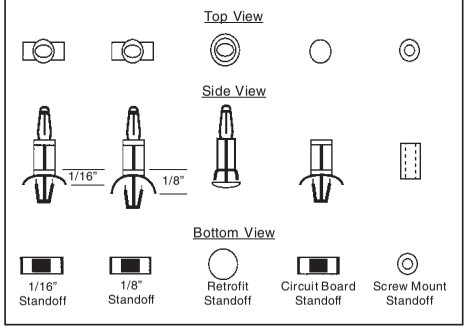
If retrofit stand-off is to be used, thru-holes to be drilled in back plate should be .250" Dia.

Installation

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

Standoffs

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

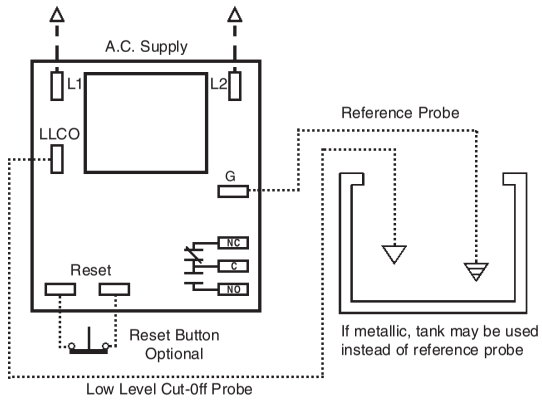


Sensitivities vs Maximum Probe Wire Distance*

SENSITIVITY CHARACTER	SENSITIVITY (KOHMS)	DISTANCE (FT)
A	4.7	900
B	10	600
C	26	250

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

Wiring Diagram



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

MANUAL RESET (Normally closed pushbutton installed across reset terminals) When the liquid rises to the electrode on terminal LLCO, the control will remain de-energized until the pushbutton is depressed. The control will then energize, (LED will be lit) changing the state of the contacts. The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to their original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

MANUAL RESET OPTIONAL POWER OUTAGE FEATURE (Normally closed pushbutton across reset terminals) Control will ignore power loss to control. With liquid above electrode on terminal LLCO, a power outage will cause the control to de-energize, but will automatically energize upon return of power. However, loss of liquid will cause control to de-energize and remain so until liquid again rises to electrode and pushbutton is depressed.

26 X X X – X – XX – XX

- **Time Delay:** 3 seconds standard up to 6 seconds
- **Optional Character:** See optional character chart below
- **Enclosure:** 0- None, 1- NEMA 1, 4- NEMA 4, 7- NEMA 7, 12- NEMA 12
- **Stand off Style:** A- 1/16 Panel, B- 1/8 Panel, C- Screw Mount, D- Retrofit
- **Voltage:** 1- 120 VAC, 2- 240 VAC, 3- 24 VAC, *8 = 208/240 VAC
- **Sensitivity:** A- 4.7K, B- 10K, C- 26K

* 187 Vmin to 255 Vmax VAC

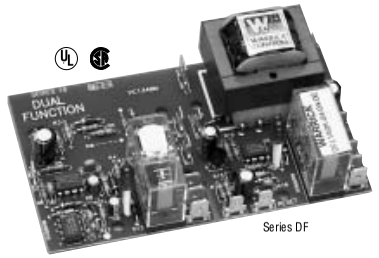
Optional Character Chart

	N.C. Pushbutton	Power Outage	Retrofit Plate
C	X		
E		X	
F	X	X	
N		X	X
P	X	X	X
R			X

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

Series DF – Dual Function Controls

- Solid State Reliability
- Compact Size
- Meets CSD1 Requirements
- CSA Approved
- U.L. "Limit Control"
- Spade Terminals for Easy Wiring
- Manual Reset (optional)
- Power Outage Feature (optional)
- U.L. "Motor Control"



Series DF

Dual function Series DF models are designed to control two independent level functions, one single-level control operation and one differential-level operation.

Optional Power Outage feature resets after nuisance outages. Optional Reset Button is used when device has been deactivated due to low water condition. Reset is activated only after water has returned to normal level. This control is ideal in applications on boilers, food service equipment, and chemical delivery systems.

Specifications

Contact Design	1 N.O. & 1 N.C. (1 form C) extra function
Contact Rating (120, 240 VAC)	10 amp Resistive 1/3 hp
Mode of Operation	H/L Direct/Inverse, LLCO – factory set
Sensitivity	0-26K ohm, factory set
Primary Voltage	120 VAC, 240 VAC[1], 24 VAC (+10%/-15%) 50/60 Hz
Secondary Voltage	12 VAC
Temperature	-40°F to 150°F
Approvals	U.L. 508 File # MP1430, U.L. 353 File # E44426, CSA
Terminal Style	Spade connection
Options	Time Delays, Manual Reset, Power Outage, Retrofit Plate

Notes:
1. 240 VAC unit does not carry U.L. Limit Control recognition.

How to Order

Use the **Bold** characters from the chart below to construct a product code.

DF X X X X X X XX XX XX

- Series: **DF**
- Mode of Operation: Direct **A** – 4.7K, **B** – 10K, **C** – 26K; Inverse **K** – 4.7K, **L** – 10K, **M** – 26K
- Supply Voltage: **1** – 120 VAC **2** – 240 VAC **3** – 24 VAC **8** – 208/240 VAC
- Standoff Style*: **A** – 1/16" Panel **B** – 1/8" Panel **C** – Screw mount **D** – Retrofit
- Enclosure: **0** – None **1** – NEMA 1 **4** – NEMA 4
- Optional Character*
- Time Delay (increasing level) H/L function: **01-20** – seconds
- Time Delay (decreasing level) H/L function: **01-20** – seconds
- Time Delay (decreasing level) LLCO function only: **03** – 3 seconds **06** – 6 seconds

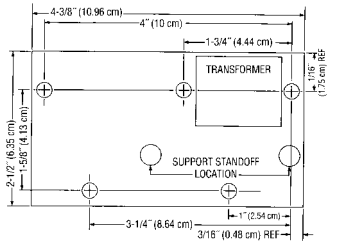
*See page E-29 for descriptions. – Standard part numbers

CONDUCTIVITY

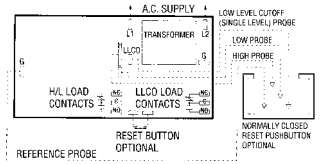
Applications

- Dual Function
- Single-Level Service
- Differential Service
- Feedwater Control / Low-Water Cutoff
- High Level / Low Level
- Pump Down / High Level

Dimensions



Wiring



Note: For single level service, use "H" and "G" connections.

Form 222B
Sheet P/N 100205-1
Rev. D

Warrick® Dual Function Controls

Installation and Operation Bulletin

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

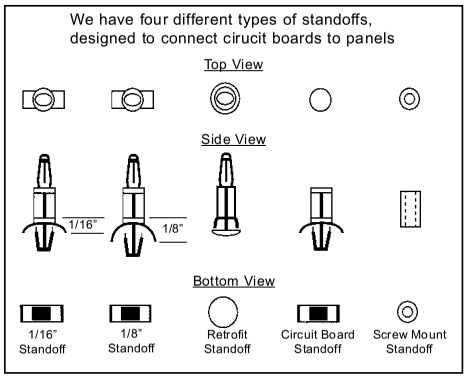
Specifications

Control Design: Open circuit board design
Contact Design: SPDT (1 form C): one normally open (N.O.) and one normally closed (N.C.), non powered contacts for limit control and SPDT (1 form C): one normally open (N.O.) and one normally closed (N.C.), non powered contacts for level control
Contact Ratings: 10A @ 120, 208/240, 240 VAC resistive (120°F), 1A @ 120, 208/240,240 resistive (150°F), 1/3 Hp @ 120, 208/240, 240 VAC
Contact Life: Mechanical - 5 million operations Electrical - 100,000 operations minimum at rated load
Supply Voltage: 120, 240, or 24 VAC models, +10%, -15%, 50/60 Hz. 208/240 Model: 187V Min to 255V Max, VAC 50/60 Hz
Power Consumption: 120, 208/240, 240, or 24 VAC both relays energized - 4.4 VA.
Secondary Circuit: 12 VAC RMS voltage on probes, 1.5 milli-amp current.
Sensitivity: Models operate from 0-26K ohms maximum specific resistance (factory set)
Temperature: -40° to 150° F ambient
Terminals: Probe connections 3/16" male quick connects, Line and Power connections 1/4" male quick connects
Time Delays: Standard, 0.5 seconds rising level, LLCO probe, 3 seconds lowering level.
Listings: Entire control carries U.L. motor controller recognition (UL 508) and U.L. Limit control recognition (UL 353). 208/240 and 240 VAC models carry only motor controller recognition (UL 508)

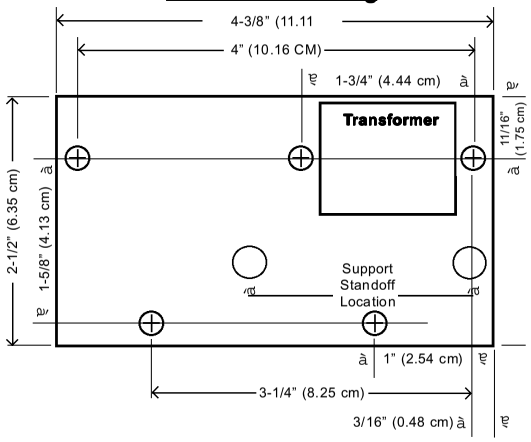
Installation

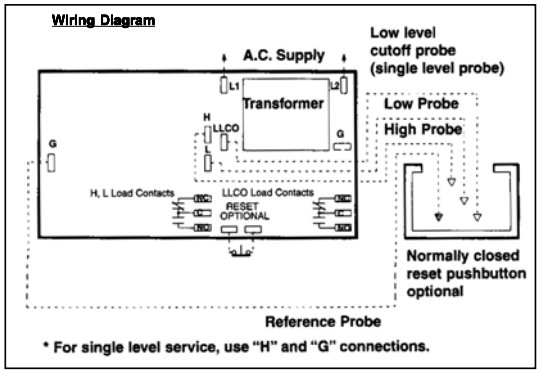
1. Drill five .187 holes in customer supplied back plate using stick on template supplied with control. Standard standoffs are designed for back plate thickness of 0.062 (1/16"). Standoffs are available for back plates of 0.125 (1/8") nominal thickness. If retrofit plate standoffs are used, drill 5 (five) 0.250 dia. Holes in proper locations.
2. Install five standoffs into back plate. Install two support standoffs into circuit board. Snap circuit board onto standoffs. See sketch for proper installation. Install control in an appropriate enclosure.
3. Wire control per wiring diagram, following N.E.C. and local codes. Use appropriately sized spade terminals.

Standoffs



Dimensional Drawing





Operation

DIRECT MODE BOTH FUNCTIONS

LLCO Function: When the liquid rises to the electrode on terminal LLCO, the relay associated with terminal LLCO energizes, changing state of the load contacts. (LED will be lit). The relay remains energized until the liquid level recedes below electrode on terminal LLCO. The associated relay then de-energizes, (LED will not be lit) returning load contacts to original state. Unless otherwise specified, there is a three-second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

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

INVERSE MODE

LLCO Function: LLCO always functions in direct mode only see above for operation.
H-L Function: Associated relay energizes with power, (LED will be lit) changing the state of the load contacts. When the liquid rises to the electrode on terminal H, the relay de-energizes, returning load contacts to shelf state. (LED will not be lit). The associated relay remains de-energized until the liquid level recedes below electrode on terminal L. The relay then energizes.

Optional

Optional Manual Reset (Normally closed pushbutton across reset terminals. Pushbutton ordered separately): Manual reset only applies to the function associated with terminal LLCO. When the liquid rises to the electrode on terminal LLCO, the control will remain de-energized (load contacts in original state) until the pushbutton is depressed. The control will then energize, (LED will be lit) changing the state of the contacts. The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will go off) returning load contacts to their original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes.

Manual Reset with optional Power Outage Feature: Reset (Normally closed pushbutton across reset terminals. Pushbutton ordered separately) Control will ignore power loss to control. With liquid in contact with electrode on terminal LLCO, a power outage of less than 250 m sec. Will cause the control to de-energize, but will automatically energize upon return of power. However, loss of liquid will cause control to de-energize and remain so until liquid again rises to electrode and pushbutton is depressed.

Time Delays associated with terminals H and L : With time delay on increasing level, the liquid must be in contact with the high electrode for the full duration of the time delay before control will operate. With delay on decreasing level, the liquid must be below the low electrode for the full duration of the time delay before control will operate. In single level service, terminals 3 and 4 must be jumpered together to achieve time delays on both increasing and decreasing levels or just decreasing level.

Time Delays associated with terminal LLCO: 3 Second time delay on decreasing level is standard. A 6 second time delay can be specified and would act in the same manner as listed above.

DFXXXXX XX XX XX

- **Time Delay** (Decreasing Level) LLCO level function 3 sec standard, 6 sec available.
- **Time Delay** (Decreasing Level) H - L function 1-20 sec.
- **Time Delay** (Increasing Level) H - L function 1-20 sec
- **Optional Character**: See chart
- **Enclosure**: **0**- none, **1**- NEMA 1, **4**- NEMA 4, **7**- NEMA 7, **12**- NEMA 12
- **Standoff Style:** **A**- 1/16" panel, **B**- 1/8" panel, **C**- screw mount, **D**- retrofit
- **Supply Voltage:** 1- 120 VAC, 2- 240 VAC, 3- 24 VAC, 8- 208/240 VAC
- **Mode/Sensitivity:** H/L, LLCO Direct **A**- 4.7K, **B**- 10K, **C**- 26K--- H/L, Inverse **K**- 4.7K, **L**- 10K, **M**- 26K

Optional Character Chart

	Reset Function	N.C. Pushbutton	Power Outage	Retrofit Plate
D	x			
G	x	x	x	
J	x	x	x	x
K	x		x	
L	x		x	x
R				x
S	x	x		
T	x	x		x
W	x			x

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

Series 3E – Pipe Thread Attachment
Series 3N – Flat Surface Mounting

- Up to 7 Probes
- Threaded Attachment (3E)
- CSA Approved
- FM Approved (3E)
- Flat Mounting (3N)
- Available in Various Body Metals
- U.L. Recognized (3E)

Series 3E fittings are cast metal, pressure-tight assemblies capable of handling 1-7 probes. Attachment to vessels is accomplished with external pipe threading. 3E Fittings require the use of 3R rigid or 3W wire suspended electrodes.

Series 3N fittings accommodate 1-3 probes operating at atmospheric pressure. The assembly mounts on a flat surface atop open tanks or closed vessels. 3N Fittings require the use of 3R rigid or 3W wire suspended electrodes.

Series 3E

Specifications

Type of Connection	
Series 3E	Threaded
Series 3N	Bracket
Probes	
Series 3E	1 thru 7
Series 3N	1 thru 3
Terminal Housing	Die cast aluminum, epoxy coated
Body Material	
Series 3E	Cast iron, red brass, 316 stainless steel
Series 3N	PVC, red brass, 316 stainless steel
Pressure/Temperature	
Series 3E	125 psig @ 353°F (cast iron); 250 psig @ 406°F (brass, 316 s.s.)
Series 3N	0 psig @ 150°F (PVC); 0 psig @ 500°F (brass, 316 s.s.)
Approvals	
Series 3E	U.L. File # MP2489, Vol. 1, Sec. 2; CSA; FM
Series 3N	CSA File # LR11644

Dimensions

Series	No. of Probes	Attachment to Vessel	Conduit Boss Thread Size	Terminal Housing Size (W˝ x D˝ x H˝)
3E	1	1˝ NPT	1/2˝ NPT	2-1/4 x 2-1/4 x 2-1/4
	2	2˝ NPT	1/2˝ NPT	3-1/4 x 3-1/4 x 2-3/8
	3	2˝ NPT	1/2˝ NPT	3-1/4 x 3-1/4 x 2-3/8
	4	2-1/2˝ NPT	1/2˝ NPT	3-1/4 x 3-1/4 x 2-3/8
	5	3˝ NPT	3/4˝ NPT	4 x 4 x 2-1/2
	6	3˝ NPT	3/4˝ NPT	4 x 4 x 2-1/2
	7	3˝ NPT	3/4˝ NPT	4 x 4 x 2-1/2
3N	1	2-1/4˝ square flat pad, 1-1/2˝ dia. hole in top of vessel secured with #10 machine screws at the corners of a 1-1/2˝ square	1/2˝ NPT	2-1/4 x 2-1/4 x 2-1/4
	2		1/2˝ NPT	3-1/4 x 3-1/4 x 2-3/8
	3		1/2˝ NPT	3-1/4 x 3-1/4 x 2-3/8

Applications

- Open Tanks
- Closed Vessels
- Water
- Diluted Corrosive Liquids

How to Order

Use the **Bold** characters from the chart below to construct a product code.

3E X X

Series
3E **3N**

Number of Probes[1]
1 – One
2 – Two
3 – Three
4 – Four
5 – Five
6 – Six
7 – Seven

Body Material
A – Cast Iron (3E)
PVC (3N)
B – Red Brass
C – 316 Stainless Steel

– Standard part numbers

Note:
1. 3N features up to three probes only.

CONDUCTIVITY

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

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.

Printed in Germany • Röser Druck • Edition 01.01 • Nr. 226 359

GAO A2 SPDT pressure switch that 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.

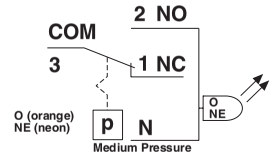
GMH A2 SPDT pressure switch that requires no auxiliary power. The GMH A2 is suitable for making and/or breaking a circuit when the set point is exceeded. A tripped switch is indicated by a neon light after set point is exceeded. **Manual reset** is required to reset the switch.

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

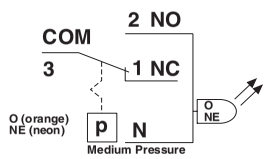
Specifications

Max. operating pressure	GAO A2-4-2,3,5,6 GMH and GML A2-4-4,6 GAO, GMH and GML A2-4-8	7 PSI (500mbar) 7 PSI (500mbar) 14 PSI (1000 mbar)
Pressure connection	O ring flange connection on underside of pressure switch	
Temperature range GAO, GMH and GML GAO, GMH and GML A2 -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. min. 24 V max. 240 V DC min. 24 V max. 48 V	
Nominal current	Silver (Ag) contact ratings AC 10A resistive @ 120 Vac AC 8A inductive @ 120 Vac DC min. 20 mA @ 24 Vdc DC max. 1 A @ 48 Vdc	Gold (Au) contact ratings DC min. 5 mA @ 5 Vdc DC max. 10m A @ 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, or as pressure falls, vertical diaphragm position.	

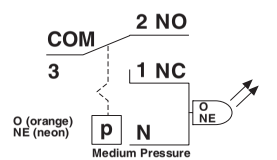
GAO switching function (upper)
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



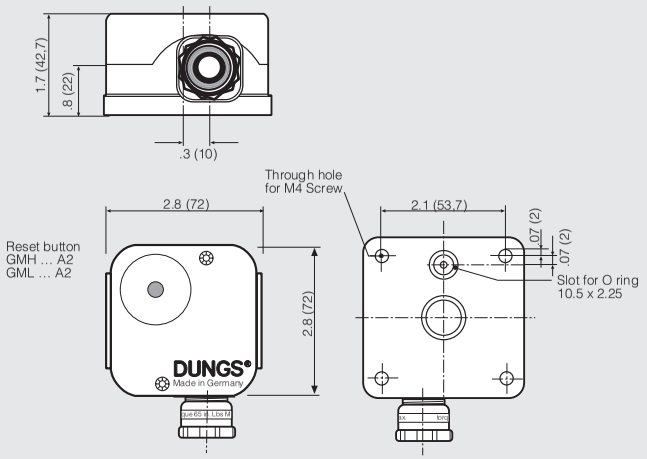
GMH switching function
As pressure rises
2 NO closes, 1 NC opens
Neon light ON, tripped.



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

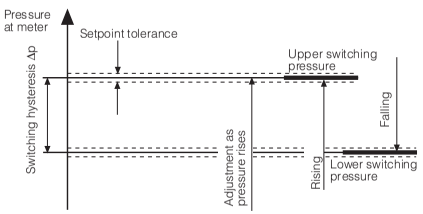


Dimensions inch(mm)
GAO, GMH, GML ...A2



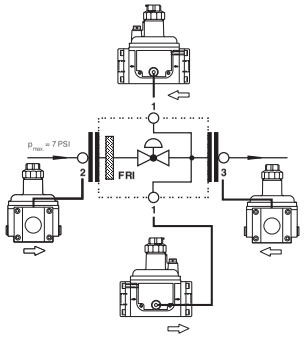
Adapters / replacement parts / Accessories	Order No.	For equipment	Notes
A2 Mounting Kit (included)	D226 188	GAO, GMH, & GML	M4 Screw, 10.5 x 2.25 O-ring
DMV Port 3 Adapter (DMV side mount for high pressure switch)	D214 975	DMV- D(LE)701 - 703/6	NPT 1/2“ - NPT 2“
Replacement Cover	D223 798	GAO, GMH, & 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 A2 (For use with D210318)	D219 659	GAO	N/A
Electrical Plug for A2 (For use with D210318)	D227 664	GMH & GML	N/A
Din Connector for A2 (For use with D210659 & D227 664)	D210 318	GAO, GMH, & GML	N/A

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



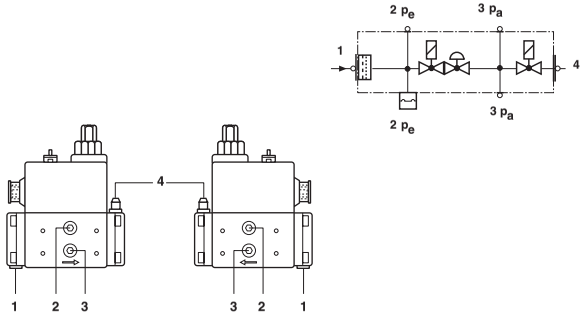
A2 mounting options
FRI gas pressure regulator

Pressure tap	mounting possible...
1	yes
2	yes
3	yes



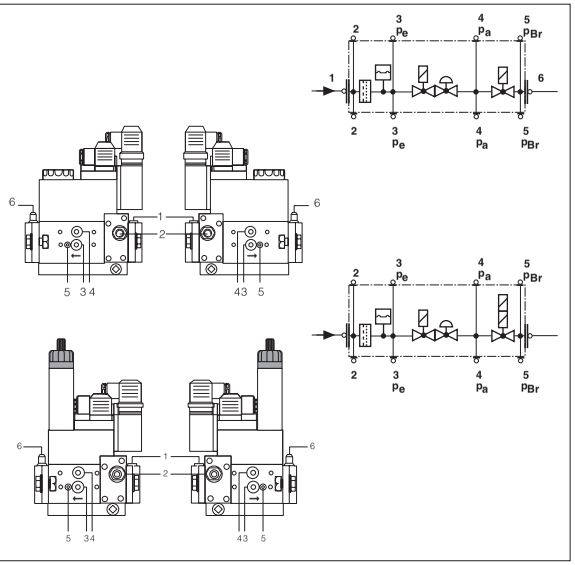
A2 mounting options
MB 053-403 GasMultiBloc

Pressure tap	mounting possible...
1	yes, with #D221 630
2	yes
3	yes
4	yes, with #D221 630



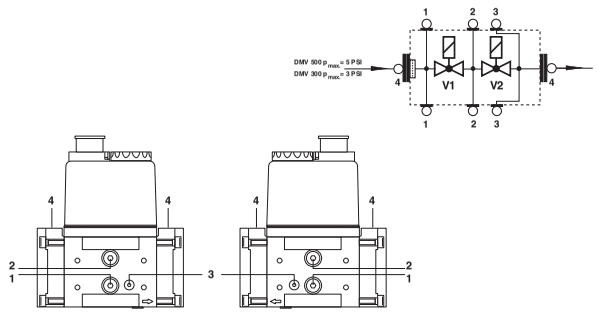
A2 mounting options
MB-D GasMultiBloc; MB-Z 405-412

Pressure tap	mounting possible...
1	no
2	no
3	yes
4	yes
5	yes, with #D214 975
6	yes, with #D221 630



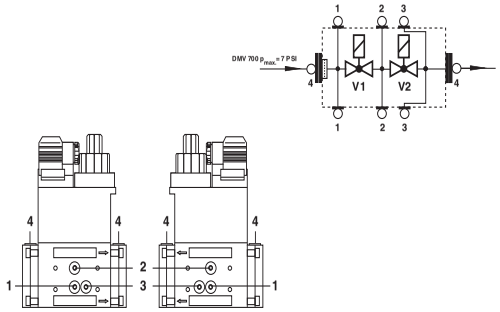
A2 mounting options
DMV 300/500 Dual modular valve

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



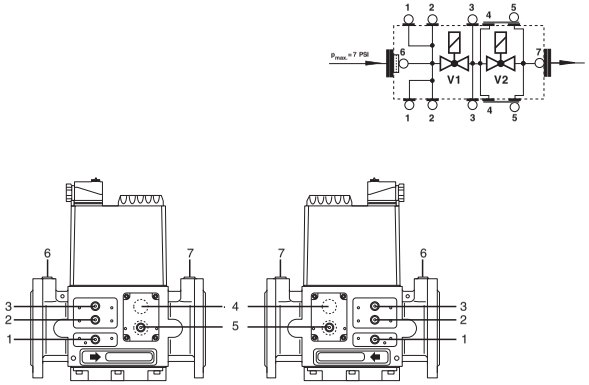
A2 mounting options
DMV 701-703/6 Dual modular valve

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	GW ... A2 mounting possible...
1	yes
2	yes
3	yes
4	no
5	yes
6	G 1/4 (525, yes)
7	G 1/4 (525, yes)



Pressure switch

GAO A2
GMH A2
GML A2

DUNGS®

Technical data

Type	Version	Order No.	Setting range In. W.C	Switching hysteresis Δp In. W.C (calabrated 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“	--

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

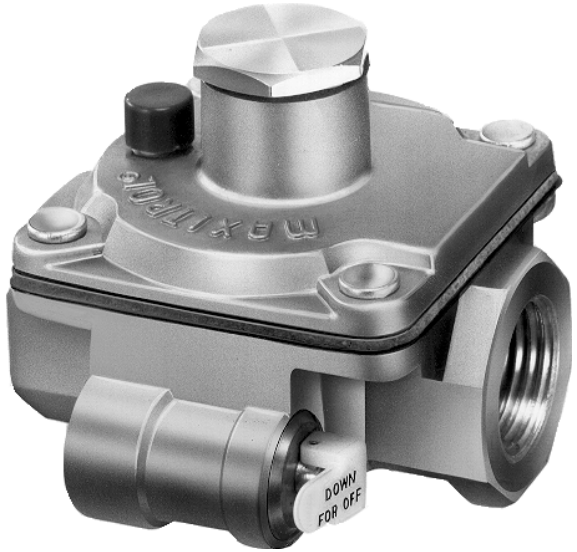
Karl Dungs Inc.
524 Apollo Drive Suite 10
Lino Lakes, MN 55014, U.S.A.
Phone 651 792-8912
Fax 651 792-8919
e-mail info@karldungsusa.com
Internet http://www.dungs.com/usa

Karl Dungs GmbH & Co.
P.O. Box 12 29
D-73602 Schorndorf, Germany
Phone +49 (0)7181-804-0
Fax +49 (0)7181-804-166
e-mail info@dungs.com
Internet http://www.dungs.com

BULLETIN MS-2032 - 8/00

Gas Appliance Pressure Regulators

Rubber Seat Poppet Models



MAXITROL company®

RV/CV Series— RV12, RV20, RV47, RV48, and CV47

These rubber seat poppet type regulators are designed primarily for main burner and pilot load applications where precise control of tiny flows is an essential operating requirement. ® certified (.15 CFH).

Housings are of high strength aluminum die castings. All models have been tested for multi-poise mounting and may be installed in any plane or angle without restriction. Other than normal upright position will result in slight difference of outlet pressure. They may be used with natural, manufactured, mixed, LP, or LP gas-air mixture.

Models having the letters A, C, D, E, F, L, M, MK, N, R, SR, S, T, or a combination of any of these suffix letters, indicates the design modifications described below:

A — short stack – limited spring adjustment (RV47 & CV47).

C — convertible regulators – preset to deliver outlet pressures for either NAT or LP gases (RV20, RV47, RV48, and CV47)
D — integral ball check limiting device that permits normal opening and restricts closing cycle (RV47 and CV47)
E — excessive pressure rated
F — factory-set, fixed/non-adujustable regulator
F6— 3/8" tube inverted flare
I — left side integral manual valve – outlet faces main inlet (CV47)
L — an integral vent limiting orifice as the breather hole
L3— 1/8" outlet tube loxit (RV12)
L4— 1/2" outlet tube loxit (RV 47)
L6— 3/8" outlet tube loxit (RV20)

MAXIMUM INLET PRESSURE:
RV12, RV20, RV47, RV47A,
RV48 & CV47, CV47A . . . . . 1/2 psi (34 mbar)
RV20L . . . . . 2 psi (140 mbar)

EMERGENCY EXPOSURE LIMITS:
RV12, RV20, RV47, RV47A, RV48
& CV47, CV47A . . . . . 2.5 psi (172 mbar)

AMBIENT TEMPERATURE LIMITS:
RV12LT & RV20LT . . . . . –40° to 275°F (–40° to 135°C)
RV48T . . . . . 32° to 275°F (0° to 135°C)
RV20L . . . . . –40° to 225°F (–40° to 107°C)
RV20C, RV47, RV47A, RV47C, RV48, RV48C &
CV47, CV47A, CV47C. . . . . 32° to 225°F (0° to 107°C)

GASES: Natural, maufactured, mixed, liquified petroleum or LP gas-air mixture.
MOUNTING: Other than normal upright position will result in slight difference of outlet pressure — mount with flow direction as marked on bottom casting.
NOTE: All Maxitrol gas appliances pressure regulators should be installed and operated in accordance with Maxitrol's "Safety Warning" Bulletin. Different models have American Gas Association, German D.V.G.W., European EN-88, Canadian Gas Association, and Australian Gas Association certifications.

M — B.S.P. - PL parallel thread – conforms to ISO 7-1, where pressure tight joints are made on the threads.
MK— B.S.P. - TR taper thread – conforms to ISO 7-1, where pressure tight joints are made on the threads.
N — main burner only – includes internal by-pass orifice to prevent lockup (RV20, RV47, RV48 & CV47).
R — right side integral manual valve – outlet faces main outlet (CV47).
SR— side tap – right side 1/8" N.P.T. (RV20 & RV47).
S — side tap – left side 1/8" N.P.T. (RV20, RV47 & CV47).
T — model variation for operating at higher ambient temperatures to 275°F (135°C), (RV48, RV20, & RV12).

The CV47 can best be described as an RV47 with an extra regulated outlet. This outlet contains an integral manual valve, and is located on the valve body's side.

The short stack models have an adjustment range of less than 2" w.c. (5 mbar). These models are advantageous where installation must be made in limited space.

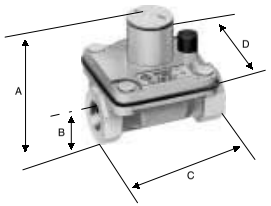
Convertible regulators are designed to delver either of two fixed outlet pressures, for natural or LP gases. RV 20C 4" to 10" w.c. RV47C & CV47C 4", 5" or 6" to 10" or 11" w.c. RV48C 5" to 10" w.c.

The RV48 model may be used with either a 12A04 ball check device, or a 12A06 fixed orifice vent limiting device.

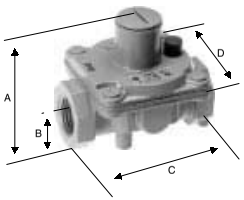
Maxitrol rubber seat poppet models offer the ultimate in design features and performance capabilities to meet specific appliance or utility requirements.

Specifications

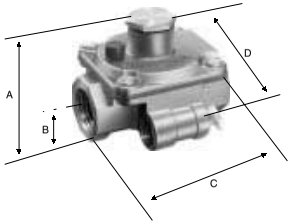
RV12



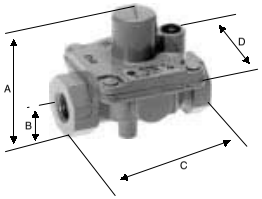
RV47, 47A



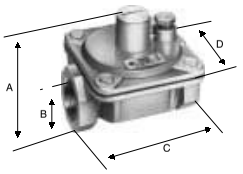
CV47, 47A



RV20



RV48



*Dimensions are maximums and are to be used only as an aid in designing clearance for the valve. Actual production dimensions may vary somewhat from those shown.

DIMENSIONS*: inches (milimeters)

Model	Vent Tap	Swing Radius	Call-Outs A	B	C	D
RV12	None (Integral)	1-3/8 (35)	1-11/16 (43)	3/8 (10)	1-11/16 (43)	1-3/8 (35)
RV20	A 5/16-24	1-5/8 (41)	2-1/8 (54)	1/2 (13)	2-3/8 (61)	1-3/4 (45)
RV47 CV47	B None (Integral)	1-7/8 (48)	2-1/2 (64)	5/8 (16)	2-15/16 (75)	2-1/4 (57)
RV47A CV47A	B None (Integral)	1-5/8 (41)	2-1/4 (57)	5/8 (16)	2-15/16 (75)	2-1/4 (57)
RV48	C 1/8" NPT	2 (51)	2-3/4 (70)	3/4 (19)	3-3/8 (86)	3 (76)

A For 1/8" tube connector
B Order with "D" or "L" suffix
C Can be supplied with 12A04 or 12A06 vent limiting device

SPRING SELECTION CHART — inches water column (millibars)

Model	Standard Spring	Other Springs Available										
RV12	2.8" to 5.2" (6.9 to 13)	1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	—	—	6.0-10 (15-25)	8.0-12 (20-30)	—
RV20	2.8" to 5.2" (6.9 to 13)	1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	—	—	6.0-10 (15-25)	8.0-12 (20-30)	9-12 (22.5-30)
CV47 RV47	2.8" to 5.2" (6.9 to 13)	1.0-3.5 (2.5-8.8)	—	—	3.8-4.3 (9.5-10.8)	4.0-8.0 (10-20)	4.7-5.3 (11.8-13.3)	—	5.6-6.4 (14-16)	6.0-10 (15-25)	8.0-12 (20-30)	9.7-11.3 (24.2-28.3)
RV48	3.0" to 6.0" (7.5 to 15)	1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	5.0-12 (12.5-30)	—	6.0-10 (15-25)	—	—

CAPACITY CHART — expressed in Btu/h (cubic meters/h) — 0.64 sp gr gas

Model	Pipe Size	Pressure Drop @ 0.3" w.c. or (.7mb)	Range of Regulations: Main Burner	Range of Regulations: M.B. and Pilot	Individual Load: Fixed Orifice	Individual Load: Ball Check Devices
RV12	1/8" x 1/8"* 3/16"Lox x 3/16"Lox	14,800 (.42) 8,800 (.25)	30,000 (.85)	25,000 (.71) 15,000 (.43)	20,000 (.56) 15,000 (.43)	—
RV20	1/4" x 1/4" 3/8" x 3/8"*	30,000 (.85)	65,000 (1.84)	50,000 (1.4)	30,000 (.85)	—
RV20C	1/4" x 1/4" 3/8" x 3/8"	30,000 (.85)	75,000 (2.11)	50,000 (1.4)	15,000 (.42)	—
CV47 RV47	3/8" x 3/8" 1/2 x 1/2"*	55,000 (1.5) 60,000 (1.7)	125,000 (3.5)	90,000 (2.5)	40,000 (1.1)	90,000 (2.5)
CV47A & C RV47A & C	3/8" x 3/8" 1/2" x 1/2"	55,000 (1.5) 60,000 (1.7)	125,000 (3.5)	125,000 (3.5)	40,000 (1.1)	125,000 (3.5)
RV48	1/2" x 1/2" 3/4" x 3/4"	130,000 (3.7) 150,000 (4.2)	230,000 (6.5) 250,000 (7.1)	230,000 (6.5) 250,000 (7.1)	40,000 (1.1)	160,000 (4.5)
RV48C	1/2" x 1/2" 3/4" x 3/4"	130,000 (3.7) 150,000 (4.2)	400,000 (11.3)	275,000 Nat (7.0) 250,000 LP (2.8)	40,000 (1.1)	160,000 (4.5)

NOTE: Minimum main burner regulation capacity for all models (except "N") is 150 Btu/h (.0042 m^3/h).
* Available as loxit connection.

HOW TO CALCULATE PRESSURE DROP AT VARIOUS FLOW RATES FROM CAPACITY CHART:

FORMULA: $P2 = P1 \times (Q2/Q1)^2$

P2 = Pressure drop at desired flow rate.
P1 = Known pressure drop (in this case 0.3" w.c.).
Q2 = Desired flow rate.
Q1 = Known flow rate at 0.3" w.c. (see chart).

SELECTING A REGULATOR WITH SUFFICIENT CAPACITY:

A. Check Capacity Chart insuring regulator has ample range of regulation and individual load capacities (for use with pilot) for the application.
B. Know minimum encountered inlet pressure.
MINIMUM INLET PRESSURE MINUS "P2" MUST BE GREATER THAN DESIRED OUTLET PRESSURE.
Solve for "P2 using above formula.
EXAMPLE: 1/2"NPT regulator required for main burner and pilot.
Desired maximum flow rate = 150,000 Btu/h.
Maximum individual load = 150,000 Btu/h.
Minimum inlet pressure = 7.0" w.c.
Required outlet pressure = 5.0" w.c.
Using the Capacity Chart shows the RV48 is the only regulator satisfying the requirements in "A".
$P2 = 0.3" \text{ w.c.} \times (150{,}000/130{,}000)^2 = 0.4"$ w.c.
7.0" w.c. — 0.4" w.c. = 6.6" w.c.
6.6" w.c. is greater than the required Po of 5.0" w.c.
THE RV48 (non "L" fixed orifice), VENTED OR W/12A04 BALL CHECK DEVICE, IS THE CORRECT REGULATOR FOR THIS APPLICATION.

MAXITROL company®

www.maxitrol.com

Maxitrol Company
23555 Telegraph Rd., P.O. Box 2230
Southfield, MI 48037-2230 U.S.A.
248.356.1400 • Fax 248.356.0829

European Representatives
Industriestrasse 1 48308 Senden, Germany
49.2597.9632.0 • Fax 49.2597.9632.99
Warnstedter Strasse 3 06502 Thale, Germany
49.3947.400.0 • Fax 49.3947.400.200

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)

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www.maxitrol.com

Maxitrol Company
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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.

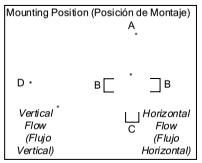
9. **Un regulador MAXITROL deberá usarse** dentro del rango de temperatura y no deberá excederse la presión máxima de entrada que se muestra en la tabla siguiente y deberá estar en la posición indicada de montaje. Los reguladores MAXITROL pueden usarse con todo tipo de gases combustibles.

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

Gas Appliance Pressure Regulators

Straight-Thru-Flow Design

RV52, RV53, RV61, RV81, RV91, RV111, and RV131

1/2", 3/4", 1", 1¼", 1½", 2", 2½", 3" & 4"

design certified

Maximum Pressure

CSA Rated (except RV131) ..... 1/2 psi (35 mbar)
Maxitrol Tested*
RV52 & RV53 ..... 1/2 psi (35 mbar)
RV61, RV81, RV91, & RV111 ..... 1 psi (70 mbar)
RV131 ..... 2 psi (140 mbar)
* Do not use if inlet pressure is more than 10 times desired outlet pressure

EMERGENCY EXPOSURE LIMITS (Maxitrol Tested)

RV52 & RV53 ..... 3 psi (210 mbar)
RV61, RV81, RV91 & RV111 ..... 5 psi (350 mbar)
RV131 ..... 15 psi (1050 mbar)

GAS CONTAINMENT EXPOSURE LIMITS*

RV 52 & RV53..... 15 psi (1050 mbar)
RV61, RV81, RV91, RV111,
& RV131 ..... 25 psi (1750 mbar)
* Please note that internal damage may occur when exposed to these pressures.

AMBIENT TEMPERATURE LIMITS

RV52, RV53, RV61, RV81,
RV91 & RV111 ..... -40° to 205° F (-40° to 96° C)
RV131 ..... -40 to 125° F (-40 to 52° C)

GASES: Natural, manufactured, mixed, liquefied petroleum, or LP gas-air mixture.

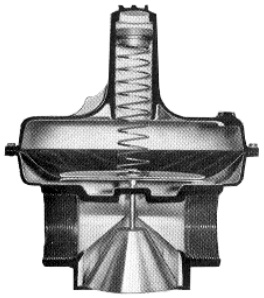
S-T-F Series

MAXITROL® company

Straight-Thru-Flow Design

RV series

RV52, RV53, RV61, RV81, RV91, RV111, and RV131



FEATURES

- Greater accuracy—higher pressure drop capacity
- Outlet pressures available to 42" w.c.
- Available in full range of pipe sizes from 1/2" to 4"
- All models tapped with NPT vent bosses
- CSA Design Certified (except RV131)

BENEFITS

- Unique conical valve design fills need of combining good regulation with high capacity in low to intermediate pressure range
- Allows more pressure drop to be assigned to piping and valves—permits reduction in manifold size
- Provides accurate, sensitive regulation at inlet pressures as low as 3" w.c.
- RV131 only, provides bonus benefits of high capacity and good performance at pressures of 1 psi or higher
- Ease of installation and replacement

All models except RV131 are CSA design certified for 1/2 psi rated pressure under the ANSI standard for gas pressure regulators; and CSA listed to certify compliance with nationally published safety, construction, and performance standards.

They are main burner only, non-lockup type. They should not be used as a line gas pressure regulator ahead of low pressure controls. Use only where downstream controls can operate at line pressure. Refer to other Maxitrol sales bulletins for proper types.

The RV52, RV53, & RV61 are suitable for multipoise mounting. The RV81, RV91, RV111, & RV131 are recommended for normal horizontal position only.

Maxitrol's original Straight-Thru-Flow design meets your needs for high capacities at low inlet pressures. The basic difference between S-T-F design and other type regulators lies in the conical valve. The cone principal permits gas to flow straight through the regulator without changing directions. Frictional flow resistance is reduced, resulting in greater capacity.

The improved flow pattern provides accurate sensitive regulation at extremely low pressure differentials. The ability of the regulator to handle large capacity appliances with limited supply pressure offers a definite advantage to designers of commercial and industrial gas-fired equipment. Models up to the three inch pipe size have high strength pressure cast aluminum housings. The RV131 four inch model is of cast iron and steel construction. RV61, RV81, RV91, RV111, & RV131 internal conical valves are coated with Teflon® for long life. Diaphragm material is cut from the finest synthetic coated fabrics available. All other parts are carefully specified corrosion-resistant or plated material.

Pipe sizes of 1/2", 3/4", 1", 1-1/4", 1-1/2", 2", 2-1/2", 3", and 4" are available. Models through the 3" size are threaded, the 4" RV131 is flanged.

At the emergency exposure limits, there may be no regulation, but all models will contain gas. They will suffer no internal damage and will resume regulation when normal pressure is restored.

Straight-Thru-Flow appliance regulators are intended for use with all fuel gases, and may also be used with air or other noncorrosive gases within their pressure limits.

Typical applications include all types of residential, commercial and industrial gas-fired appliances and equipment used on low pressure gas supply. See Maxitrol's "Spring Selection Chart" for part numbers, color and size of springs.

Teflon is a registered trademark of DuPont Corporation.

NOTE: All Maxitrol appliance regulators should be installed in accordance with Maxitrol's "Safety Warning" bulletin.

Capacities and Pressure Drop

CAPACITIES—expressed in CFH (m³/h)—0.64 sp gr gas

Model Number and Pipe Size		CSA MAX	Pressure Drop (inches w.c. (mbar))												
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	2	3	4
RV52	1/2 x 1/2 3/4 x 3/4	450 (12.7)	151 (4.2)	214 (6.1)	262 (7.4)	302 (8.5)	338 (9.5)	370 (10.5)	400 (11.3)	427 (12.1)	453 (12.8)	478 (13.5)	676 (19.1)	828 (23.4)	956 (27.1)
RV53	3/4 x 3/4 1 x 1	710 (20.1)	217 (6.1)	306 (8.6)	375 (10.6)	433 (12.2)	484 (13.7)	530 (15)	573 (16.2)	612 (17.3)	650 (18.4)	684 (19.3)	968 (27.4)	1185 (33.5)	1369 (38.7)
RV61	1 x 1 1-1/4 x 1-1/4	1100 (31.1)	379 (10.7)	536 (15.1)	675 (19.1)	759 (21.5)	848 (24)	929 (26.3)	1004 (28.4)	1073 (30.4)	1138 (32.2)	1200 (34.0)	1742 (49.3)	2134 (60.4)	2464 (69.8)
RV81	1-1/4 x 1-1/4 1-1/2 x 1-1/2	2500 (70.8)	780 (22.1)	1102 (31.2)	1350 (38.2)	1559 (44.1)	1743 (49.5)	1909 (54)	2062 (58.4)	2204 (62.4)	2339 (66.2)	2465 (69.8)	3485 (98.7)	4269 (120)	4929 (139)
RV91	2 x 2 2-1/2 x 2-1/2	3275 (92.7)	1212 (34.3)	1714 (48.5)	2100 (59.4)	2424 (68.6)	2711 (76.7)	2969 (84.1)	3208 (90.8)	3429 (97.1)	3637 (103)	3834 (108)	5422 (153)	6640 (188)	7668 (217)
RV111	2-1/2 x 2-1/2 3 x 3	7500 (212)	2742 (78)	3878 (110)	4750 (134)	5485 (155)	6132 (175)	6718 (190)	7256 (205)	7757 (219)	8227 (233)	8572 (243)	12134 (343)	14862 (420)	17161 (486)
RV131	4 x 4	–	4734 (134)	6695 (190)	8200 (232)	9468 (268)	10586 (300)	11595 (328)	12525 (354)	13390 (380)	14202 (402)	14971 (424)	21172 (600)	25930 (734)	29942 (848)

Sizing Instructions

In order to select the proper size regulator, you must know the available inlet pressure, desired outlet pressure, and the required maximum flow rate.

Example No. 1—To select a regulator of ample capacity to handle flow.

KNOWN:
Pipe size 2-1/2", flow rate 8,000 CFH (0.64 sp gr), inlet pressure 9" w.c., desired outlet pressure 5" w.c.

SOLUTION:

1. Determine differential pressure available:
   Inlet pressure 9" w.c.
   Subtract outlet pressure - 5" w.c.
   Available differential pressure 4" w.c.
2. When determining capacity Maxitrol recommends that the pressure drop not exceed 1/2 of available differential pressure (1/2 of 4" w.c. = 2" w.c.).
3. Check Capacity Chart to determine which regulator has a pressure drop of 2" w.c. or less at a flow rate of 8,000 CFH.
4. The RV111 meets these standards with a flow rate of 12,134 CFH for the 2-1/2" pipe size at 2" w.c. pressure drop. The 2-1/2" RV91 flows 5422 CFH at 2" w.c. pressure drop. Therefore, the RV111—2-1/2" is the correct regulator to use.

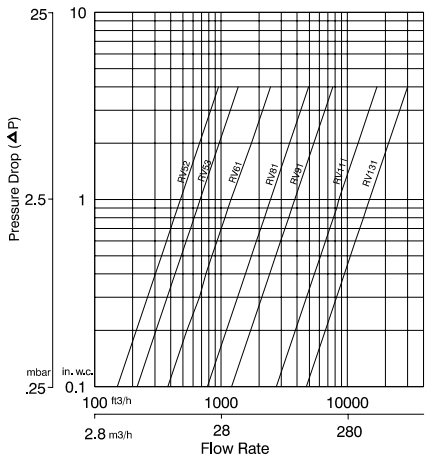
Example No. 2—To determine maximum recommended operating outlet pressure.

KNOWN:
Pipe size 4", flow rate 21,000 CFH, inlet pressure 10" w.c.

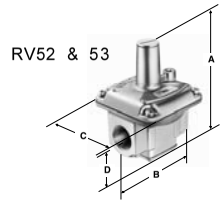
SOLUTION:

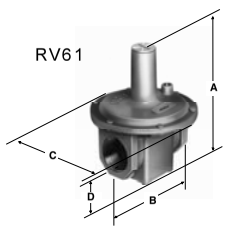
1. Check capacity Chart above for 4" regulator, RV131.
2. Note that at a flow rate of 21,172 CFH the pressure drop is 2" w.c.
3. Multiply this by two to obtain recommended differential pressure (4" w.c.).
4. Subtract 4" differential pressure from 10" w.c. inlet pressure to obtain maximum recommended outlet pressure setting of 6" w.c.

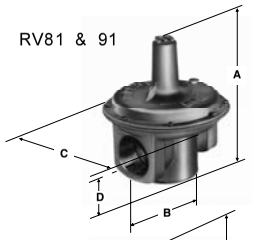
Pressure Drop Chart



Dimensions and Spring Ranges



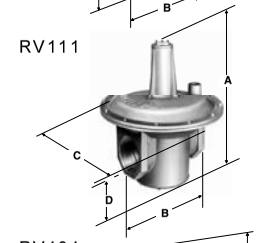


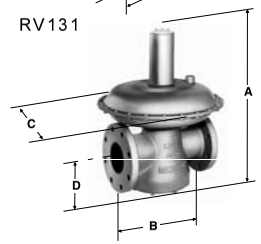


DIMENSIONS*—inches (millimeters)

Model & Illustration Number	Vent Tap	Swing Radius	Call-Outs			
			A	B	C	D
RV52	1/8" NPT	3.6 (91)	4.9 (124)	3.2 (81)	3.25 (83)	1.25 (32)
RV53	1/8" NPT	3.9 (99)	5.2 (132)	3.75 (95)	3.9 (99)	1.3 (33)
RV61	1/8" NPT	4.8 (122)	6.4 (164)	4.4 (111)	5.4 (138)	1.6 (41)
RV81	3/8" NPT	6.4 (162)	8.4 (213)	6 (153)	7 (178)	2 (51)
RV91 2" pipe	1/2" NPT	8.5 (216)	10.8 (275)	6.5 (165)	9.1 (232)	2.3 (60)
RV91 2.5" pipe	1/4" NPT	8.3 (212)	10.5 (267)	7.1 (181)	9.1 (232)	2.4 (62)
RV111	3/4" NPT	11.5 (284)	15.1 (373)	9 (229)	13.4 (324)	3.5 (89)
RV131	3/4" NPT	18.2 (462)	23.25 (590)	13.9 (353)	18 (458)	5.1 (129)

** Dimensions are to be used only as an aid in designing clearance for the valve. Actual production dimensions may vary somewhat from those shown.*





SPRING SELECTION CHART—inches w.c. (mbar)

Model Number	CSA Certified Springs			Other Springs Available							
RV52	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	--	--	--	--
RV53	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	--	--	--	--
RV61	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	--	--	10-22 (25-55)	--	--
RV81	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	--	--
RV91	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	--	--
RV111	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	--	--
RV131	3 to 6 (7.5-15)	--	5-12 (12.5-30)	--	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	--	10-22 (25-55)	15-30 (38-75)	20-42 (50-105)

NOTE: The area within the heavy line indicates CSA certified springs.

MAXITROL® company

www.maxitrol.com

Maxitrol Company
23555 Telegraph Rd., P.O. Box 2230
Southfield, MI 48037-2230 U.S.A.
248.356.1400 • Fax 248.356.0829

European Representatives
Warnstedter Strasse 3 06502 Thale, Germany
49.3947.400.0 • Fax 49.3947.400.200
Industriestrasse 1 48308 Senden, Germany
49.2597.9632.0 • Fax 49.2597.9632.99

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
23555 Telegraph Rd., P.O. Box 2230
Southfield, MI 48037-2230 U.S.A.
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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.

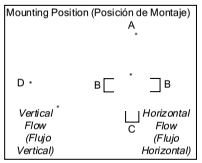
9. **Un regulador MAXITROL deberá usarse** dentro del rango de temperatura y no deberá excederse la presión máxima de entrada que se muestra en la tabla siguiente y deberá estar en la posición indicada de montaje. Los reguladores MAXITROL pueden usarse con todo tipo de gases combustibles.

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] (Posicióńde 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

Installation & Maintenance
Instructions MM-221(C)

McDonnell & Miller

ITT Industries

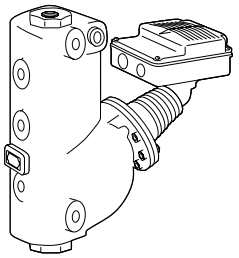
Model 157-RBP-MD

(Mercury Switch)

Model 157S-RBP-MD

(Snap Switch)

Low Water Cut-Off/Pump Controller



Model 157-RBP-MD
Model 157S-RBP-MD

Applications:

For bi-level pump control applications such as multiple boiler level operation.

⚠ WARNING

- **Before using this product read and understand instructions.**
- **Save these instructions for future reference**
- **All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.**
- **To prevent serious burns, the boiler must be cooled to 80˚F (27˚C) and the pressure must be 0 psi (0 bar) before servicing.**
- **To prevent electrical shock, turn off the electrical power before making electrical connections.**
- **This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls before leaving the site.**
- **We recommend that secondary (redundant) Low Water Cut-Off controls be installed on all steam boilers with heat input greater than 400,000 BTU/hour or operating above 15 psi of steam pressure. At least two controls should be connected in series with the burner control circuit to provide safety redundancy protection should the boiler experience a low water condition. Moreover, at each annual outage, the low water cut-offs should be dismantled, inspected, cleaned, and checked for proper calibration and performance.**
- **To prevent serious personal injury from steam blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.**
- **To prevent a fire, do not use this low water cut-off to switch currents over 7.4A, 1/3 Hp at 120 VAC or 3.7A, 1/3 Hp at 240 VAC, unless a starter or relay is used in conjunction with it.**

Failure to follow this warning could cause property damage, personal injury or death.

OPERATION

Maximum Pressure: 150 psi (10.5 kg/cm^2)

Electrical Ratings
Float Control

Voltage	Pump or Motorized Valve Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Motor Horsepower	
Voltage	Amps
120 VAC	1/3
240 VAC	1/3

Probe Control

Voltage	Pump or Motorized Valve Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Probe Sensitivity:
- 4,000 ohms

Probe Input Power
- 120 volts

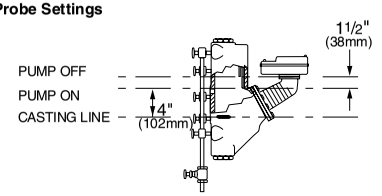
Settings and Differential Pressures:

* Values are ± 1/8" (3.2mm).

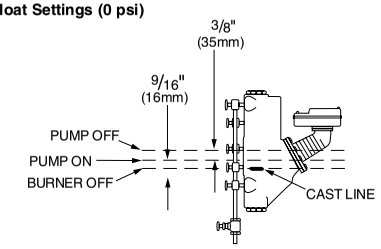
157-RBP-MD/157S-RBP-MD

Pressure	Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
Probes Any Pressure	Pump Off	5 1/2 (140)	1 1/2 (38)
	Pump On	4 (102)	
Float 0 psi (0 kg/cm^2)	Pump Off	15/16 (24)	3/8 (16)
	Pump On	9/16 (14)	
	Burner Off	0	N/A
Float 150 psi (10.5 kg/cm^2)	Pump Off	1 7/16 (37)	3/4 (19)
	Pump On	11/16 (17)	
	Burner Off	-3/8 (-16)	N/A

Probe Settings



Float Settings (0 psi)



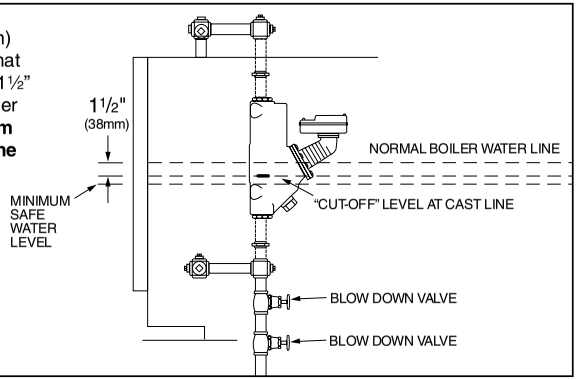
INSTALLATION –

TOOLS NEEDED:
Two (2) pipe wrenches, one (1) flathead screw driver, and pipe sealing compound.

IMPORTANT: Follow the boiler manufacturer's instructions along with all applicable codes and ordinances for piping, blow down valve and water gauge glass requirements.

STEP 1 - Determine the Elevation at Which the Low Water Cut-Off/Pump Controller Must be Installed

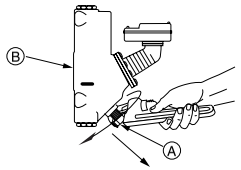
Size the steam (top) and water (bottom) horizontal equalizing pipe lengths so that the horizontal cast line on the body is 1½" (38mm) **below** the boiler's **normal** water level, **but not lower than the minimum safe water level, as determined by the boiler manufacturer.**



STEP 2 - Installing the Low Water Cut-Off

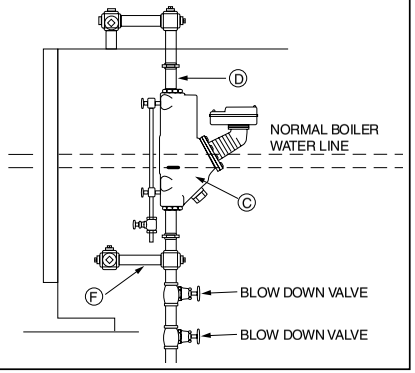
a. Using a pipe wrench, unscrew the plastic float blocking plug (A) from the float block tapping of the low water cut-off body (B).

Install pipe plug (provided) to seal port.



b. Mount and pipe the low water cut-off (C) on a vertical equalizing pipe (D) at the required elevation level, as determined in Step 1.

Install full ported blow down valves directly below the lower cross of the water equalizing pipe (F).



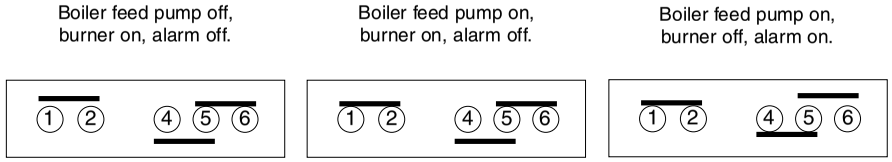
STEP 3 - Electrical Wiring

⚠ WARNING

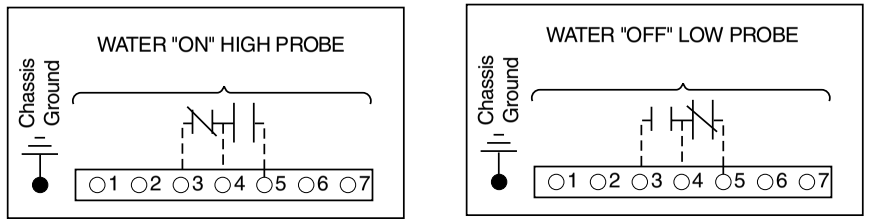
- **To prevent electrical shock, turn off the electrical power before making electrical connections.**
- **This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.**
- **Boiler manufacturer schematics should always be followed. In the event that the boiler manufacturer's schematic does not exist, or is not available from the boiler manufacturer, refer to the schematics provided in this document.**

Failure to follow this warning could cause electrical shock, an explosion and/or a fire, which could result in property damage, personal injury or death.

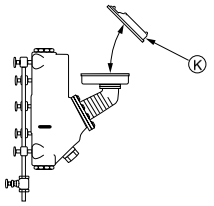
Switch Operation - Float Control



Switch Operation - Probe Control



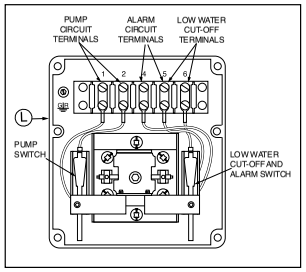
a. Using a flathead screwdriver, remove the junction box cover (K) by unscrewing the four (4) cover screws.



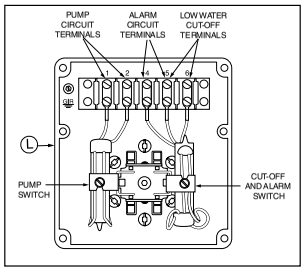
b. Following the appropriate wiring diagram, (refer to page 6) based on your application requirements, and using BX armored cable or Thinwall electrical metal tubing connector fittings, make electrical connections to the junction box (L).

IMPORTANT: There must be a minimum space of 1/2" (13mm) between connector fittings and electrical live metal parts.

Snap Switches (Series 150S)



Mercury Switches (Series 150)



- Mount **Control Box** in a suitable location near the boiler's main electrical panel.

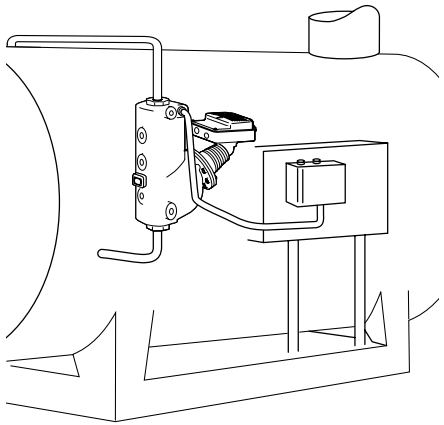
NOTE
Boiler sight glass must be visible from location of Control Box and must be within 25 feet of Control Body.

- Install electrical conduit between **Probe Housing** and **Control Box.**

NOTE
Wire must be 18 AWG stranded with glass braided silicone jacket (UL 3071) suitable for high temperature (200˚C) service.

NOTE
Refer to and follow local codes and standards when selecting conduit and electrical fittings. Wires from Probe Housing and Control Box must be in their own conduit. If they are run in conduit with other wires, there may be interference that can affect the performance of the control.

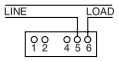
- Pull three (3) wires through conduit.



WIRING DIAGRAMS

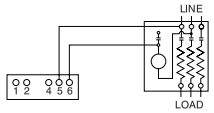
Low Water Cut-Off Only

1. Main Line Switch - For burner circuits within the switch's electrical rating.



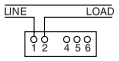
OR

2. Pilot Switch - To holding coil of a starter when the burner circuit exceeds the switch's electrical rating.



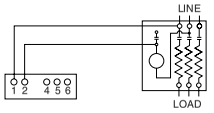
Pump Control Only

1. Main Line Switch - For pump motors within the switch's electrical rating.



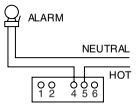
OR

2. Pilot Switch-To holding coil of a starter when the pump circuit exceeds the switch's electrical rating.



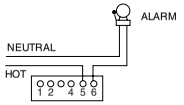
Alarm Circuit Only

1. Low Water Alarm



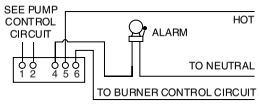
OR

2. High Water Alarm



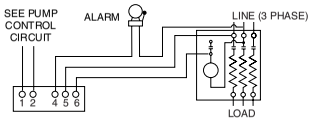
Combination Pump Control, Low Water Cut-Off and Alarm

1. Main Line Switch - For burner circuits within the switch's electrical rating.

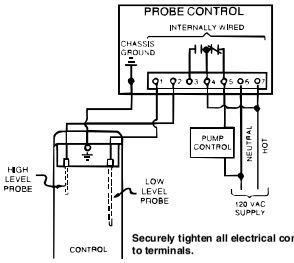


OR

2. Pilot Switch-To holding coil of a starter when the burner circuit exceeds the switch's electrical rating.



ELECTRONIC PROBES:



Securely tighten all electrical conductors to terminals.

STEP 4 - Testing

This control is factory calibrated for specific level settings as shown on page 2 in the "Operation" section. The following testing procedure is only meant to serve as a verification of proper operating sequence.

IMPORTANT: Follow the boiler manufacturer's start-up and operating instructions along with all applicable codes and ordinances.

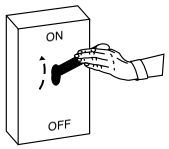
Standby Range Operation:

a. Turn on the electric power to the boiler. The pump should go on and the burner must remain off.

⚠ WARNING

If the burner comes on, immediately turn the boiler off and make the necessary corrections.

Failure to follow this warning could cause an explosion or fire and result in property damage, personal injury or death.

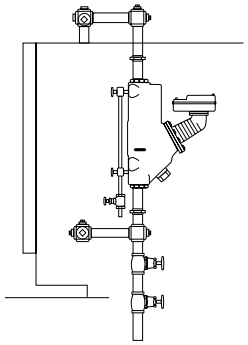


b. The boiler should begin to fill with water. As the water level rises in the sight glass, the burner should turn on and then the pump should turn off.
If the burner does not turn on or pump turn off at appropriate levels, immediately turn off the boiler and make the necessary corrections.

⚠ CAUTION

To prevent serious personal injury from steam pipe blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.

Failure to follow this caution could cause personal injury.



c. Blow down the control when the water in the boiler is at its normal level and the burner is on. **Slowly** open the upper then the lower blow-down valves and observe the water level fall in the sight glass. Close the valves (lower first then upper) after verifying that the pump contacts have closed and the burner shuts off. If this does not happen, immediately shut off the boiler, correct the problem and retest.

INSTALLATION COMPLETE

MAINTENANCE

SCHEDULE:

Blow down control as follows when boiler is in operation.
- **Daily if operating pressure is above 15 psi.**
- **Weekly if operating pressure is below 15 psi.**

NOTE
More frequent blow-down may be necessary due to dirty boiler water and/or local codes.

Disassemble and inspect annually.
- **Remove sediment or debris from float chamber.**
- **Inspect and clean probes.** Use a non-abrasive cloth to clean probes.

NOTE
The probes may need to be inspected and cleaned more frequently on systems with high raw water make-up. This includes systems with no condensate return or untreated boiler water.

Replace head mechanism every 5 years. More frequent replacement may be required when severe conditions exist such as rapid switch cycling, surging water levels and use of water treatment chemicals.

Replacement parts are available from your local authorized McDonnell & Miller Distributor. The use of parts or components other than those manufactured by McDonnell & Miller will void all warranties and may affect the units compliance with listing or regulating agencies.

BLOW DOWN PROCEDURE:

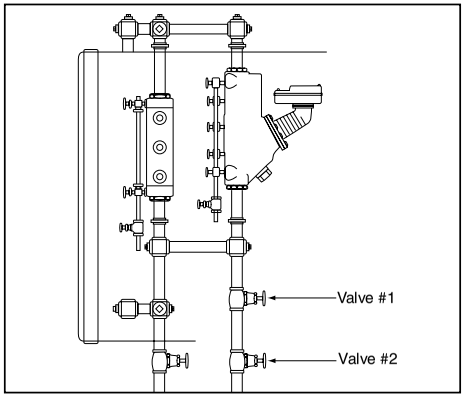
⚠ CAUTION

To prevent serious personal injury from steam pipe blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.

Failure to follow this caution could cause personal injury.

Blow down the control when the water in the boiler is at its normal level and the burner is on.
NOTE: Refer to page 2 for switch operating points.
- Open upper valve (#1).
- Slowly open the lower valve (#2).
- Water level in the sight glass should lower.
- As the water level in the sight glass lowers, the pump should turn on.
- As water continues to lower in the sight glass, the burner should turn off.
- Slowly close the lower valve (#2).
- Close the upper valve (#1).
- The water level in the sight glass should rise, first turning on the burner and then turning off the pump.

NOTE: On manual reset models, the reset button will need to be pressed after the water level has been restored before the burner will operate.



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3500 N. Spaulding Avenue
Chicago, Illinois 60618
tel: 773 267-1600
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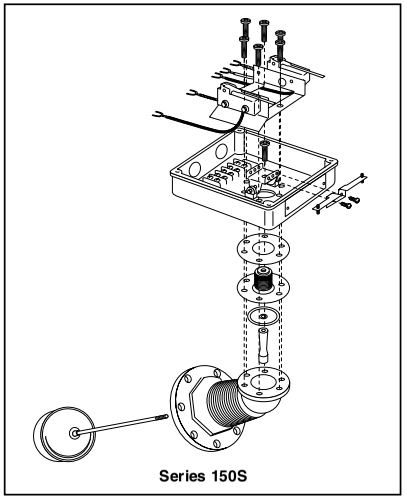
Replacement Instructions
MM-711

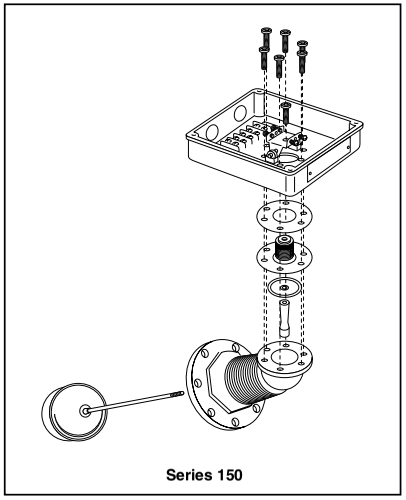
McDonnell & Miller

ITT Industries

Series 150, 150S, 157, 157S
Bellows Replacement

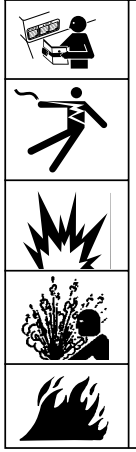


Series 150S



Series 150

⚠ WARNING

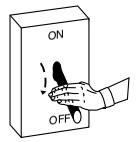


- **Before using product, read and understand instructions.**
- **Save these instructions for future reference.**
- **All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.**
- **To prevent electrical shock, turn off the electrical power before making electrical connections.**
- **To prevent serious burns release all pressure and let boiler cool down to 80˚F (27˚C).**
- **Drain water level down below the float bowl chamber before taking the head mechanism out of the body.**

Failure to follow this warning could cause property damage, personal injury or death.

STEP 1 - Preparation

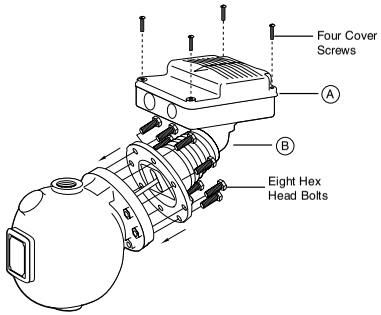
a. To prevent electrical shock turn off all electrical power to the boiler.
CAUTION: There may be more than one source of power to the boiler.



b. Release all pressure from the boiler and let it cool down to 80˚F (27˚C). Drain the water level down below the float chamber.

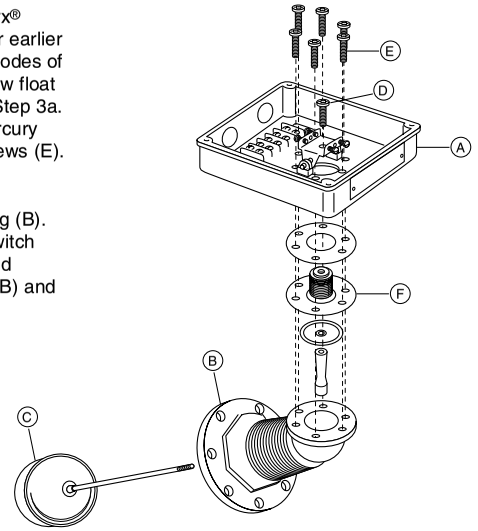
c. Remove the four screws that hold the cover on the switch housing (A) and remove the cover. Mark all electrical supply wires so they can be returned to the proper terminals. Remove the wires and conduit connections from switch housing (A).

d. Remove eight hex head bolts holding head mechanism (B) to float chamber. Carefully remove head mechanism (B) from float chamber and place in a vise.



e. Holding float (C) firmly, unscrew Allen® or Torx® fastener (D). (Units with date codes of E99 or earlier will have Allen® head fasteners. Those with codes of F99 or later will have Torx® fastener). Unscrew float and float rod (C). For snap switch units see Step 3a. For mercury switch units remove the two mercury switches. Remove six (6) Allen® or Torx® screws (E).

f. Remove switch housing (A) from head casting (B). The bellows assembly (F) may stick to the switch housing (A). Remove bellow assembly (F) and clean gasket surfaces on both head casting (B) and switch housing (A).



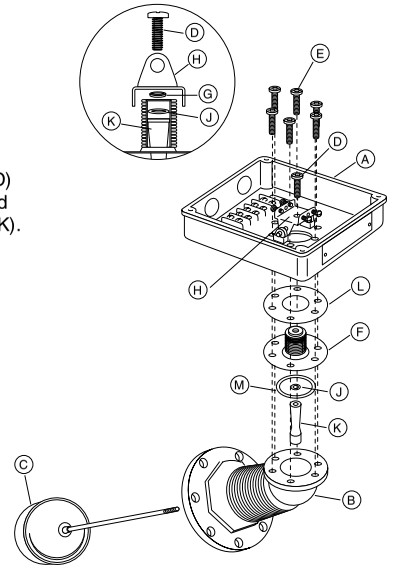
STEP 2 - Changing the Bellows for Mercury Switch Units (For Snap Switch See STEP 3)

a. NOTE: On units that have Allen® head screws they should be replaced with Torx® screws (furnished).

b. Take the new bellow assembly (F) and disassemble it noting the order of the parts. Put sealing washer (J) on top of float arm (K) and insert into inside of bellows (F). Place gasket (L) over bellows (F). Insert this assembly into switch housing (A) and bracket (H). If the screw (D) was an Allen® screw, the spacer washer (G) will have to be put in the top hole of bracket (H). Take Torx® screw (D) (furnished) and insert it into hole on top of bracket (H) and spacer washer (G) (if needed) and screw into float arm (K). Hand tighten only.

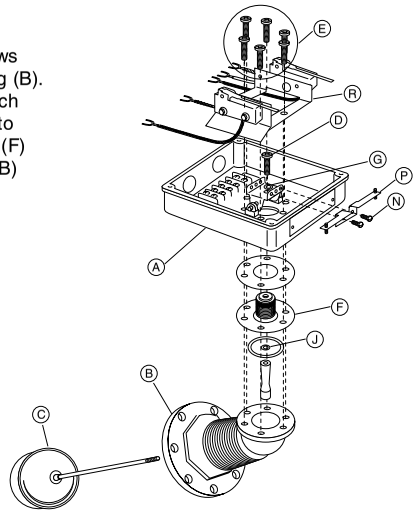
c. Make sure tapped hole on float arm (K) is facing the correct way, so the float and float rod (C) can be screwed into it when bellows assembly is assembled on the head casting. Place gasket (M) on casting (B). Center the gasket and place the bellows assembly (F) and switch housing (A) on head casting (B). Insert and tighten six (6) Torx® screws (E) to 125 in. lbs. (14 N•m).

d. Screw float and float rod (C) into float arm (K) and hand tighten. Center the float rod in the float rod guide (not shown) and tighten Torx screw (D) to 125 in. lbs. (14 N•m). Make sure you hold the float in place while tightening screw (D). Move the float up and down, making sure there is no binding and that the float rod is still centered.



Step 3 - Changing the Bellows for Snap Switch Units

a. Clean out sealant and remove two (2) screws (N) and bracket (P). Remove (6) Allen® or Torx® screws (E). Remove switch housing (A) from head casting (B). The switch bracket (R) will come out with the switch housing (A). The bellows assembly (F) may stick to the switch housing (A). Remove bellow assembly (F) and clean gasket surfaces on both head casting (B) and switch housing (A).



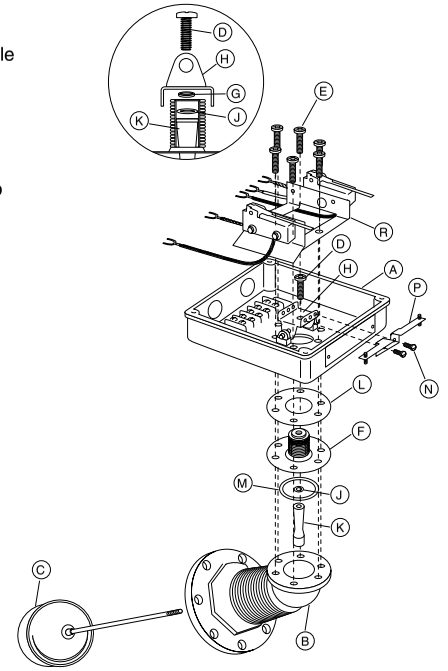
Step 3 - Changing the Bellows for Snap Switch Units (cont'd)

b. NOTE: On units that have Allen® head screws they will be replaced with Torx® screws (furnished).

c. Take the new bellows assembly (F) and disassemble it noting the order of parts. Put sealing washer (J) on top of float arm (K) and insert into inside of bellows (F). Place gasket (L) over bellows (F). Insert this assembly into switch housing (A) and bracket (H). If the screw (D) was an Allen® screw, the spacer washer (G) will have to be put in the top hole of bracket (H). Take Torx® screw (D) (furnished) and insert it into hole on top of bracket (H) and spacer washer (G) (if needed) and screw into float arm (K). Hand tighten only.

d. Make sure the tapped hole on float arm (K) is facing the correct way, so the float and float rod (C) can be screwed into it when bellows assembly is assembled on the head casting. Place gasket (M) on head casting (B). Center the gasket and place the bellows assembly (F) and the switch housing (A) on head casting (B). Insert and tighten the six (6) Torx® screws (E) to 125 in. lbs. (14N•m). Make sure that two (2) of the screws capture the switch bracket (R).

e. Screw float and float rod (C) into float arm (K) and hand tighten. Center the float rod in the float rod guide (not shown) and tighten Torx® screw (D) to 125 in. lbs. (14N•m). Make sure you hold the float in place while tightening screw (D). Move the float up and down, making sure there is no binding and that the float rod is still centered. Install bracket (P) using screws (N), tighten to 40 in. lbs. (4.5 N•m).



STEP 4 - Assembling the Head to the Body and Test for Proper Operation

a. Clean the gasket surface on head casting (B) and the body casting. Using a new gasket (furnished) mount the head mechanism to the body casting. Tighten the eight (8) bolts to 18 ft. lbs. (24N•m). Reattach conduit connectors and connect wires to the proper terminals. Turn on electrical power to the boiler.

b. Run the unit through several cycles of operation, noting the operating points. On the snap switch controls it may be necessary to readjust the switches. If this is necessary follow the enclosed instructions. (See attached for reference only, MM-235).

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Wiring connections for a Series 150E/157E when used as a replacement for a Series 150/157 (mercury) or 150S/157S (snap) switch unit.

NOTE

Read and follow installation instructions included with 150E/157E control.

A. Connect **'Hot'** (L1) wire from power supply to Terminal **'H'**.

B. Connect **'Neutral'** (L2) wire from power supply to Terminal 'N'.

NOTE: *Power wires connected to Terminals 'H' and 'N' on 150E should be from the boiler's control transformer connections which are usually designated 'L1' and 'L2'. The 150E **SHOULD NOT** be powered as part of any operating or safety circuit.*

C. Remove wire from Terminal **'1'** and connect to Terminal **'PCOM'.**

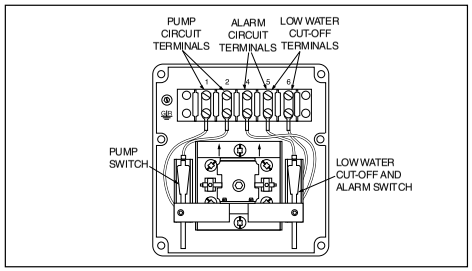
D. Remove wire from Terminal **'2'** and connect to Terminal **'PNO'.**

E. Remove wire from Terminal **'4'** and connect to Terminal **'BNO'.**

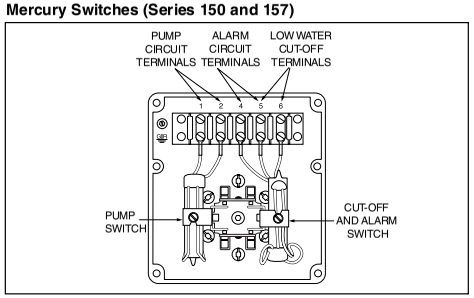
F. Remove wire from Terminal **'5'** and connect to Terminal **'BCOM'.**

G. Remove wire from Terminal **'6'** and connect to Terminal **'BNO'.**

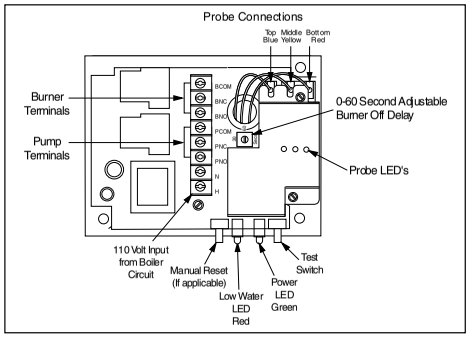
Snap Switches (Series 150S and 157S)



Mercury Switches (Series 150 and 157)



Electronic Relays (Series 150E and 157E)



3500 N. Spaulding Avenue
Chicago, Illinois 60618
tel: 773 267-1600
fax: 773 267-0991
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Series 6000 and Models 6933, 6934, 6935

ASME Section I and VIII, Steam, 'V' and 'UV', ASME Section VIII, Air/Gas 'UV' National Board Certified. Models 6933, 6934, and 6935 are ASME Section IV, 'Steam', 'HV' National Board Certified

tyco

KUNKLE

Features

- **O-ring seats available** for exceptional leak-free performance, reduced maintenance cost, multiple cycles with tight shutoff, improved seating integrity.
- **Wide hex on valve nozzle** provides wrenching service clearance for easy installation.
- **Dual control rings offer easy adjustability** for precise opening with minimum preopen or simmer and exact blowdown control.
- **Pivot between disc and spring** corrects misalignment and compensates for spring side thrust.
- **Grooved piston model disc** reduces sliding area and friction.

Model Descriptions

Model 6010: Side outlet. Full nozzle design with bronze/brass trim. Available with O-ring seats. For exceptional leak-free performance.

Model 6021: Same as Model 6010 with Teflon® (PFA) disc insert. For exceptional leak-free performance (use on steam only).

Model 6030: Same as Model 6010 except SS trim (nozzle and disc). Available with O-ring seats for exceptional leak-free performance.

Model 6182: Top outlet. Full nozzle design with bronze/brass trim. O-ring seat available for exceptional leak-free performance.

Model 6121: Same as Model 6182 with Teflon® (PFA) disc insert. For exceptional non-leak performance (use on steam only).

Model 6130: Same as Model 6182 except SS trim (nozzle and disc). O-ring seat available for exceptional leak-free performance.

Model 6186: Top outlet. Full nozzle design with bronze/brass trim. 150 psig [10.3 barg] maximum set pressure. Replaces Model 86 (original equipment only).

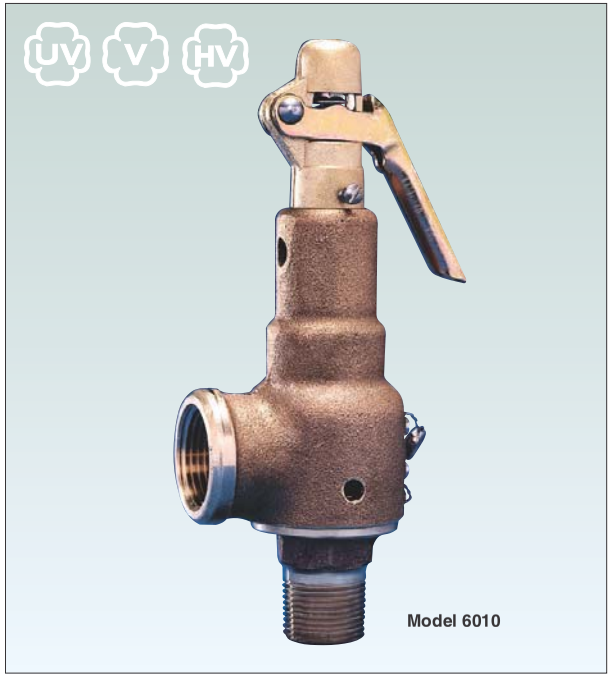
Model 6283: Over-sized side outlet. Full nozzle design bronze/brass trim.

Model 6221: Same as Model 6283 with Teflon® (PFA) disc insert. For exceptional leak-free performance (use on steam only).

Model 6230: Same as Model 6283 except SS trim (nozzle and disc).

Model 6933: Same as Model 6010 except certified for ASME code Section IV. Low pressure steam heating boilers set at 15 psig [1.0 barg] only.

Model 6934: Same as Model 6021 except certified for ASME code Section IV. Low pressure steam heating boilers set at 15 psig [1.0 barg] only.



Model 6010

Model 6935: Same as Model 6030 except certified for ASME code Section IV. Low pressure steam heating boilers set at 15 psig [1.0 barg] only.

Applications

- Steam Boilers and Generators.
- Air/Gas Compressors - reciprocating or rotary - portable or stationary, intercoolers and aftercoolers.
- Pressure Vessels - containing steam, air or non-hazardous gas. Including tanks, receivers, sterilizers and autoclaves.
- Pressure Reducing Stations - protection of the discharge or low pressure side of system.

Pressure and Temperature Limits

Models 6010, 6021, 6182, 6283, 6221
Steam Service
3 to 250 psig [0.2 to 17.2 barg]
-60° to 406°F [-51° to 208°C]

Air/Gas Service
3 to 300 psig [0.2 to 20.7 barg]
-60° to 406°F [-51° to 208°C]

Models 6030, 6130, 6230
Steam and Air/Gas Service
3 to 300 psig [0.2 to 20.7 barg]
-60° to 425°F [-51° to 218°C]

Note

1. Resilient seats determine temperature range. (see page 11)

Total Flow Control Solutions

Kunkle Safety and Relief Products

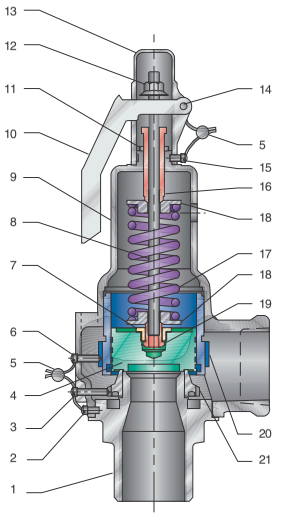
Series 6000 and Models 6933, 6934, 6935

Parts and Materials

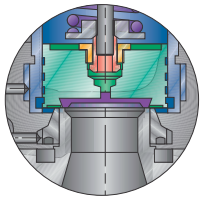
Models 6010, 6021, 6030, 6221, 6230, 6283, 6933, 6934 and 6935			
No.	**Part Name**	**Materials 6010, 6021, 6221, 6283, 6933, 6934**	**Materials 6030, 6230, 6935**
1	Nozzle	Bronze	SS
2	Body Set Screw	SS	SS
3	Warn Ring Set Screw	SS	SS
4	Disc	B21 Alloy 485,	SS
5	Wire and Seal	SS Wire and Lead seal	SS/Lead
6	Guide Set Screw	SS	SS
7	Retainer Nut	Brass, B16	Brass
8	Stem	SS, A582-416	SS
9	Body	Bronze	Bronze
10	Lever	Steel	Steel
11	Jam Nut	Brass, B16	Brass
12	Lift Nut	Steel	Steel
13	Cap	Brass	Brass
14	Lever Pin	Steel	Steel
15	Cap Set Screw	SS, Commercial 18-8	SS
16	Compression Screw	Brass, B16	Brass
17	Spring	SS	SS
18	Spring Step	Brass, B16	Brass
19	Stem Retainer	Brass, B16	Brass
20	Guide	Brass/Bronze	Brass/Bronze
21	Warn Ring	Brass/Bronze	Brass/Bronze
22	Seat[1]	1, 2	1, 2

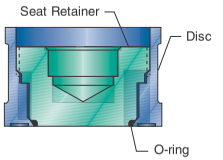
Note

1. Models 6021, 6121, 6221 and 6934 Teflon®, optional O-ring seat available for all others except Models 6933 and 6935.



Model 6010


Model 6021



Model 6010V (Optional Soft Seat)

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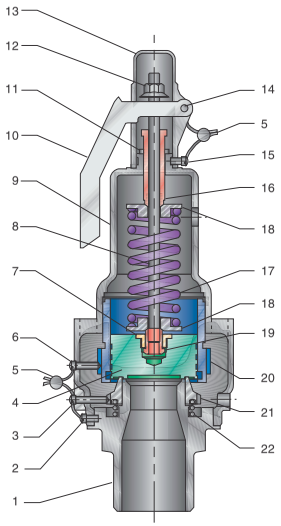
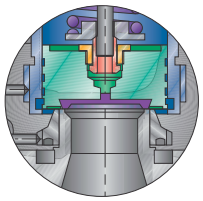
Series 6000 and Models 6933, 6934, 6935

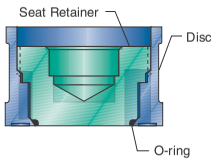
Parts and Materials



Models 6130, 6182 and 6186



Model 6121



Model 6010V (Optional Soft Seat)

Models 6121, 6130, 6182 and 6186

No.	Part Name	6121, 6182, 6186	6130
1	Nozzle	Bronze	SS
2	Body Screw	Steel	Steel
3	Warn Ring Set Screw	Steel	Steel
4	Disc	Brass, B21 Alloy 485	SS
5	Wire and Seal	SS Wire and Lead seal	SS Wire and Lead seal
6	Guide Set Screw	Steel	Steel
7	Retainer Nut	Brass, B16	Brass, B16
8	Stem	SS	SS
9	Body	Bronze, B584 Alloy 84400	Bronze, B584 Alloy 84400
10	Lever	Steel	Steel
11	Jam Nut	Brass	Brass
12	Lift Nut	Steel	Steel
13	Cap	Brass	Brass
14	Rivet	Steel	Steel
15	Cap Screw	Steel	Steel
16	Compression Screw	Brass	Brass
17	Spring	SS, A313-631	SS, A313-631
18	Spring Step	Brass, B16	Brass, B16
19	Stem Retainer	Brass, B16	Brass, B16
20	Guide	Brass/Bronze	Brass/Bronze
21	Warn Ring	Brass/Bronze	Brass/Bronze
22	Warn Ring Spring[1]	SS	SS
23	Seat[2]	[2]	[2]

Notes

1. Item 22 available as an option.
2. Item 23 is Teflon® for Model 6121. Viton® O-ring seat available on Models 6182, 6186, and 6130.

Kunkle Safety and Relief Products

Series 6000 and Models 6933, 6934, 6935

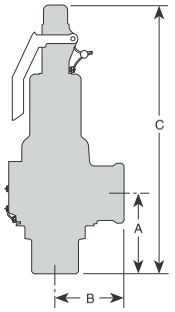
Series 6000 and Models 6933-6935 ASME Section I and VIII, Steam, ASME Section VIII, Air/Gas National Board Certified. Models 6933-6935 are ASME Section IV, 'Steam,' National Board Certified

Specifications

Model Number[1]	Orifice	Connections ANSI Standard Inlet in	Inlet [mm]	Outlet in	Outlet [mm]	Valve Dimensions in [mm] A	A	B	B	C	C	Approximate Weight lb	Weight [kg]
60**DC#	D	1/2	[12.7]	3/4	[19.0]	2 1/8	[54]	1 5/8	[41]	6 1/2	[165]	1 1/2	[0.7]
60**DD#[2]	D	3/4	[19.0]	3/4	[19.0]	2 1/8	[54]	1 5/8	[41]	6 1/2	[165]	1 3/4	[0.8]
61**DC#	D	1/2	[12.7]	—		—		—		6 1/2	[165]	1 1/4	[0.6]
60**ED#	E	3/4	[19.0]	1	[25.4]	2 3/8	[60]	1 3/4	[44]	7 1/2	[191]	2 1/2	[1.1]
60**EE#[2]	E	1	[25.4]	1	[25.4]	2 1/2	[64]	1 3/4	[44]	7 5/8	[194]	2 3/4	[1.2]
61**ED#	E	3/4	[19.0]	—		—		—		7 1/2	[191]	2 1/4	[1.0]
62**ED#	E	3/4	[19.0]	1 1/4	[31.75]	2 7/8	[73]	1 3/4	[44]	7 1/2	[191]	2 3/4	[1.2]
60**FE#	F	1	[25.4]	1 1/4	[31.8]	2 5/8	[67]	2	[51]	8 1/2	[216]	3 1/2	[1.6]
60**FF#[2]	F	1 1/4	[31.8]	1 1/4	[31.8]	2 7/8	[73]	2	[51]	8 3/4	[222]	3 3/4	[1.7]
61**FE#	F	1	[25.4]	—		—		—		8 1/2	[222]	3 1/4	[1.5]
62**FE#	F	1	[25.4]	1 1/2	[38.0]	2 7/8	[73]	2	[51]	8 1/2	[222]	3 3/4	[1.7]
60**GF#	G	1 1/4	[31.8]	1 1/2	[38.0]	3 1/8	[79]	2 3/8	[60]	9 5/8	[244]	5 1/2	[2.5]
60**GG#[2]	G	1 1/2	[38.0]	1 1/2	[38.0]	3 3/8	[86]	2 3/8	[60]	10	[254]	5 3/4	[2.6]
61**GF#	G	1 1/4	[31.8]	—		—		—		9 5/8	[244]	5	[2.3]
62**GF#	G	1 1/4	[31.8]	2	[51.0]	3 3/8	[86]	2 1/4	[57]	9 5/8	[244]	5 3/4	[2.6]
60**HG#	H	1 1/2	[38.0]	2	[51.0]	3 5/8	[92]	2 3/4	[70]	10 5/8	[270]	7 3/4	[3.5]
60**HH#[2]	H	2	[51.0]	2	[51.0]	4 1/8	[105]	2 3/4	[70]	11 1/8	[283]	8	[3.6]
61**HG#	H	1 1/2	[38.0]	—		—		—		10 5/8	[270]	7 1/4	[3.3]
62**HG#	H	1 1/2	[38.0]	2 1/2	[64.0]	3 7/8	[98]	3	[76]	10 5/8	[270]	8	[3.6]
60**JH#	J	2	[51.0]	2 1/2	[64.0]	4 1/4	[108]	3 3/8	[86]	13 5/8	[346]	15 1/2	[7.0]
60**JJ#[2]	J	2 1/2	[64.0]	2 1/2	[64.0]	4 1/2	[114]	3 3/8	[86]	14	[356]	15 3/4	[7.2]
61**JH#	J	2	[51.0]	—		—		—		13 5/8	[346]	15	[6.8]
62**JH#	J	2	[51.0]	3	[76.0]	4 5/8	[117]	3 3/8	[86]	13 5/8	[345]	15 1/2	[7.0]

Notes

1. Replace asterisks with desired model number. Replace # with desired seat material.
2. Model 6030 available only 1/2 x 3/4-inch [12.7 x 19 mm], 3/4 x 1-inch [19 x 25.4 mm], 1 x 1 1/4-inch [25.4 x 31.8 mm], 1 1/4 x 1 1/2-inch [31.8 x 38 mm], 1 1/2 x 2-inch [38 x 51 mm] and 2 x 2 1/2-inch [51 x 64 mm].
3. Models 6933, 6934 and 6935 have same dimensions as Model 6010.



Series 6000 and Models 6933, 6934, 6935

Service Recommendations for Resilient Seat/Seal Materials

Seat/Seal Materials	Service Recommendation
Viton® A (-10 to 406°F) [-23 to 208°C]	Air and Gas
Ethylene Propylene (-70 to 400°F) [-57 to 205°C]	Steam

ASME Section I and VIII, Steam, ASME Section VIII, Air/Gas National Board Certified. Models 6930, 6933, 6935 ASME Section IV, National Board Certified

Model Number/Order Guide

Model Number Position	1	2	3	4	5	6	7	7	8	9	10	11	12	13	14	15
Example	6	0	1	0	H	G	M	0	1	—	A	M	0	1	5	0

Model

6010	6130	6230
6021	6186	6933
6030	6283	6934
6182	6221	6935
6121		

Orifice

D	G
E	H
F	J

Inlet Size

C - 1/2-inch [12.7]	G - 1 1/2-inch [38.1]
D - 3/4-inch [19.0]	H - 2-inch [50.8]
E - 1-inch [25.4]	J - 2 1/2-inch [63.5]
F - 1 1/4-inch [31.8]	

Seat Material

M - Metal
E - EPR
V - Viton®

Variation (01 through 99)

01 - Plain lever
02 - Plain lever with vibration dampener
03 - Plain lever with gag
60 - BSP Threads

Design Revision

Indicates non-interchangeable revision. Dash (-) if original design.

Valve Service

A - Steam ASME Section I
K - Air/Gas ASME Section VIII
L - Steam ASME Section VIII
G - Steam ASME Section IV (Models 6933, 6934, 6935 only)
P - Steam, Non-code
N - Air, Non-code

Spring Material

M - SS

Set Pressure

0015 - 15 psig [1.0 barg] only for Models 6933, 6934, 6935

Kunkle Safety and Relief Products

Facility Phone: 828-669-3700

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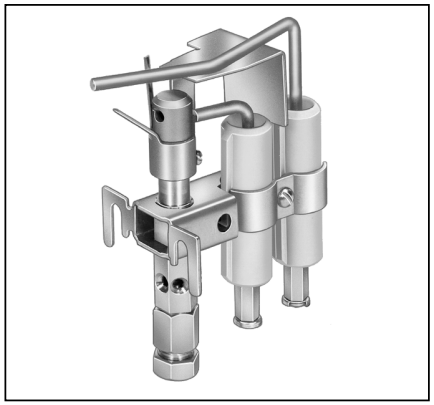
Honeywell

Q179A,B
Gas Pilot Burner Assemblies

PRODUCT DATA



GENERAL

Q179A,B Gas Pilot Burner Assemblies use the flame rectification principle to prove the flame. Q179A,B are used in conjunction with a suitable electronic flame safeguard control on industrial or commercial gas and gas pilot ignited oil burners.

FEATURES

- **Q179A is a gas pilot assembly with a flame electrode (rod) and ignition electrode, making it suitable for applications requiring an interrupted or intermittent electrically ignited gas pilot burner.**
- **Q179B has only the flame electrode and is suitable for use in continuous pilot applications.**
- **Primary aerated type burner is equipped with stainless steel fins that provide the proper flame rod area to ground area ratio for maximum flame signal and flame stabilization.**
- **Stainless steel electrode(s) are mounted in ceramic insulators, which permit electrode adjustment.**
- **Rajah connectors facilitate disconnecting.**
- **Bracket permits side or end mounting.**

CONTENTS

60-2032-3

SPECIFICATIONS

Model Number:
Q179A—Gas pilot assembly with ignition and flame electrodes. Use with intermittent or interrupted ignition. Ignition electrode is for use with 6,000V grounded secondary-ignition transformer.
Q179B—Gas pilot assembly with flame electrode (rod) only. Use with continuous pilot.

Burner:
Primary aerated. Stainless steel fins provide proper flame contact area to ground area. Flame electrode and ground bracket are furnished with each tip. Available tips are illustrated in Fig. 1, and listed in Table 1.

Mounting Means:
Bracket has holes for side mounting and two lugs for end mounting.

Type of Gas:
Natural; for LP gas, order LP orifice separately (see Accessories).

Gas Consumption:
Approximately two cu ft/hr.

Electrodes:
Stainless steel, maximum temperature 1750°F (954°C).

Electrode Insulator(s):
Ceramic.

Electrical Connector:
Rajah connector (both male and female supplied).

Approvals:
Underwriters Laboratories Inc. listed, File No. MP268;
Industrial Risk Insurers acceptable;
CSA certified, Master File No. LR-95329-1;
Factory Mutual approved;
American Gas Association certified, No. G140.401.

Mounting Dimensions:
See Fig. 2.

Maximum Temperature:
See Fig. 3.

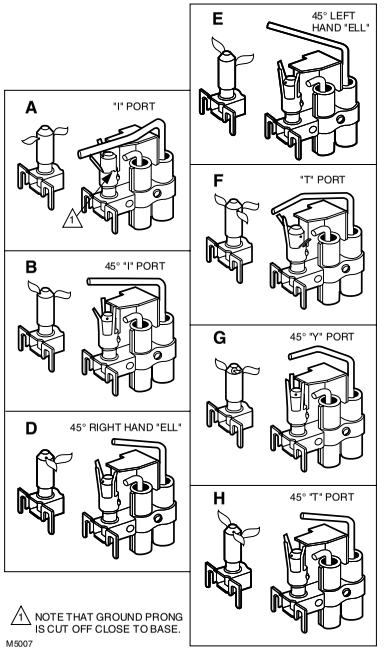


Fig. 1. Pilot tip assembly styles.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® Wholesaler or your Distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number, or specify:

1. Order number.
2. Burner tip.
3. Thermocouple, collar, and bracket, if desired, for Q179B.
4. High temperature cable, if required.

If you have additional questions, need further information, or would like to comment on our products or services, please wrt ite or phone:

1. Your local Honeywell Home and Building Controls Sales Office (check white pages of phone directory).
2. Home and Building Control Customer Relations
   Honeywell, 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9. 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.

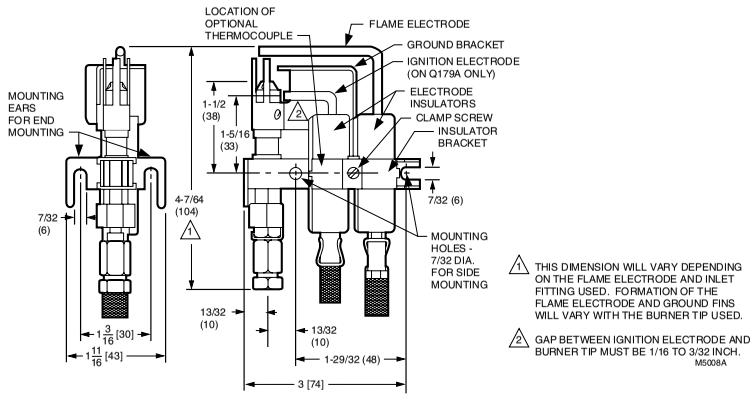


Fig. 2. Approximate mounting dimensions in in. (mm) and arrangement of parts.

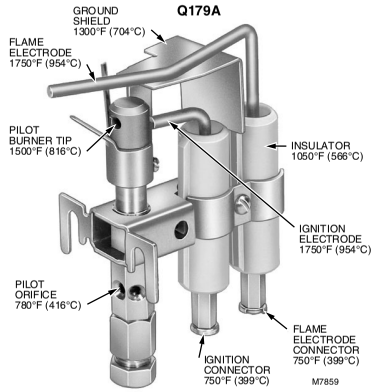


Fig. 3. Component maximum temperature ratings.

Inlet Fittings:
1/4 inch compression coupling factory-installed on all models.

Replacement Parts (See Table 1):
37356 Rajah Connector—for ignition electrode.
104312 Rajah Connector—for flame electrode.
133445A Ignition Electrode and Insulator Assembly.

Accessories:
High temperature (higher than 125°F [52°C]) cable:
Flame Rod Leadwire—part no. R1298020 (specify length) rated at 400°F (204°C).
Ignition Leadwire—part no. R1061012 (specify length), rated at 350°F (177°C).
High Tension Cable—part no. R1239001 (specify length), rated at 220°F (104°C).

Table 1. Additional Q179A,B Replacement Parts

Assembly Tip Style	Tip	Ground and Ground Shield[a]	Orifice		Flame Rod and Insulator Assembly
			Natural Gas	LP Gas	
I	105063A	102464A	395390-25[b]	395390-13[c]	133448A
45°I	105064A	102464B	395390-25[b]		133450A
45°RH	105066A	120464D	395390-25[b]		133452A
45°LH	105067A	102464D	395390-25[b]		133444A
T	105068A	102464F	395390-28[d]		133451A
45°Y	105069A	102464C	395390-28[d]		133446A
45°T	105070A	102464H	395390-28[d]		133452A
Large I	121831A	102464A	395390-25[b]		133448A

[a] On some ground areas, one or more prongs were intentionally removed at the factory.
[b] Orifice 0.025 in. (0.635 mm) diameter.
[c] Orifice 0.0130 in. (0.330 mm) diameter (order separately).
[d] Orifice 0.028 in. (0.711 mm) diameter.

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, flame safeguard control technician.
4. After installation is complete, check out product operation as provided in these instructions.

Follow instructions provided by burner manufacturer if available. If no instructions are furnished, use the following recommendations.

Mounting

The Q179 has two mounting ears at the burner and two mounting holes in the bracket (see Fig. 2). If the mounting holes in the bracket are used, it may be necessary to break off one of the mounting ears so that the bracket fits flush with the burner.

All models are supplied with a factory-installed 1/4 inch compression coupling inlet fitting. When a fitting is used, remove the compression nut and install the new fitting.

Gas Pressure Regulation

Use a pressure regulator in the line supplying the Q179 pilot. Adjust the regulator for a maximum inlet gas pressure of eight inches water column. The minimum inlet gas pressure must be two inches water column to assure reliable lightoff of the main flame.

Install the Q179A,B

Install the pilot assembly so the pilot flame has full contact with the gas stream from the main burner heads or jets.

Mount the flame electrode just inside the junction of the main and pilot flame to prove both flames. Mount the pilot so that it fires in the same direction as the draft at the mounting point, rather than where the draft is at right angles to flame travel. Keep the pilot burner below or behind the main burner so that the burner frame and refractory will help protect the pilot from radiant heat. Locating the pilot in the secondary air stream will also provide considerable cooling. The primary air adjustment must be accessible and outside the high temperature area.

Do Not Install the Q179A,B—

— Where ambient temperatures exceed those specified in Fig. 3.
— Where excessive draft turbulence can deflect the pilot flame away from the main burner or flame electrode.
— Where the ignition electrode is within arcing distance of any metal other than the pilot burner head.
— Where the flame electrode contacts any metal part of the installation.
— Where the flame electrode is closer than one inch from a radiant refractory.

Wiring

⚠ CAUTION
Disconnect power supply to prevent electrical shock and equipment damage. More than one disconnect may be involved. Wiring must conform to local codes and ordinances.

Rajah connectors are furnished for making connections to the ignition and flame electrodes. The ignition electrode (A models only) takes a receptacle connector. The flame electrode (both A and B models) takes a plug connector and has a snap-action spring terminal.

Use high tension wire, of a type found acceptable by a nationally recognized testing agency, for the wiring to the ignition electrode (Q179A). High tension wires should be rated electrically equivalent to type GTO-10 and should have temperature and humidity characteristics adequate for the

application. If the ignition lead is exposed to temperatures above 125°F (52°C), use Honeywell R1061012 Ignition Cable rated at 350°F (177°C) or equivalent. For ignition installations in a contaminated environment, use Honeywell R1239001 High Tension Cable rated at 220°F (104°C) or equivalent.

For wiring between the F terminal of the relay and the flame electrode, use wire with moisture-resistant insulation. Number 14 single-conductor TW wire is adequate however, those portions of the leadwire exposed to temperatures over 125°F (52°C) should also be heat resistant. For both heat and moisture-resistant applications, use part no. R1298020 Flame Rod Leadwire rated at 400°F (204°C) continuous duty or equivalent.

Run a ground wire from the pilot burner to the relay to assure a continuous, unchanging ground.

For detailed wiring diagrams, see the Instructions packed with the flame safeguard control.

CHECKOUT

⚠ CAUTION

Check to ensure the main valve opens only when the pilot flame is strong enough to ignite the main burner. Perform the pilot turn-down test as described in the Honeywell Flame Safeguard Control instructions.

The proper pilot burner orifice must be selected for the gas being used (natural, LP gas) so that the pilot burns with a medium hard flame. This type of flame provides the maximum flame signal.

The flame safeguard control relay will chatter if excess secondary air velocity or a severe draft condition causes the pilot flame to make intermittent contact with the flame electrode (rod) or grounding bracket.

The performance of the pilot assembly can be determined by measuring the flame signal developed with the pilot operating. The flame signal (current/voltage) measurement requires the use of an appropriate volt-ohmmeter.

Most existing Honeywell Flame Safeguard Controls incorporate a flame current jack in the control plug-in amplifier or in the control itself. The flame current measurement can be made with a Honeywell W136A Test Meter, which has a 0 to 25 microampere dc scale (see Fig. 4). With the W136A selector switch positioned to the 0 to 25 microampere scale, connect the meter leads to the two ends of the meter connector plug, positive (red, +) to positive, negative (black, -) to negative. The Meter Connector Plug part no. 196146 is provided with the W136A Meter. If a W136A Meter or connector plug is not available, a dc ammeter with a 0 to 25 microampere scale can be wired in series with the F lead of the flame detector circuit. A minimum flame current of 2.0 microamperes is considered acceptable.

The Honeywell BCS 7700 and 7800 SERIES Flame Safeguard Control flame signals are measured in dc volts. A 20,000 volt/ohm meter with a 0 to 5 or 10 Vdc scale is recommended for measuring the flame signal of BCS 7700 controls while a one megohm/volt meter is recommended for 7800 SERIES controls. The flame signal voltages are measured as illustrated in Fig. 5 and 6.

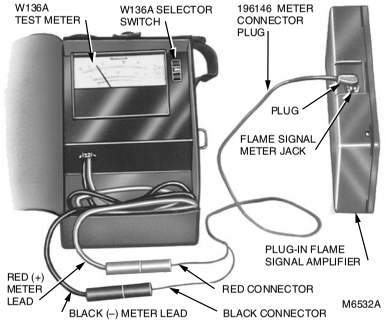
The minimum acceptable flame signal voltage for the BCS 7700 controls is 2.2 Vdc (maximum expected is 4.98 Vdc).

The minimum acceptable flame signal voltage for the 7800 SERIES controls is 1.25 Vdc (maximum expected is 5.0 Vdc).

If the flame signal is less than the minimum acceptable for the Honeywell Flame Safeguard Control used, adjust the flame electrode (rod) to increase the flame signal to at least the minimum acceptable level by loosening the clamp screw and turning the electrode (rod) slightly to the right or left as required. After the flame electrode (rod) is adjusted, check the gap between the ignition electrode and burner tip (Q179A). The gap must be between 1/16 and 3/32 inch.

Perform the pilot turndown test as described in the Flame Safeguard Control Instructions to ensure the pilot flame is adequate to ignite the main burner.

Fig. 4. Measuring microamp flame signal.



Pilot Turndown Test

If the flame rod is used to prove a pilot flame before the main fuel valve(s) can be opened, perform a pilot turndown test. Follow the procedures in the Instructions for the appropriate flame safeguard control, and in the burner manufacturer's instructions.

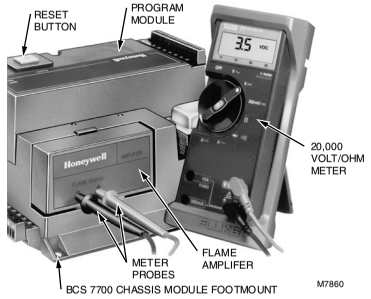


Fig. 5. Measuring BCS 7700 Control flame signal voltage.

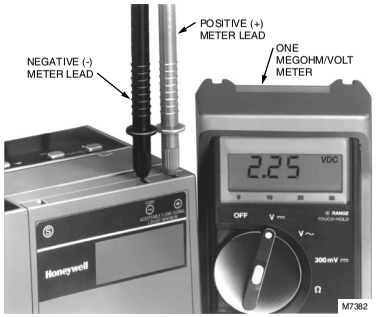


Fig. 6. Measuring 7800 SERIES Control flame signal voltage.

INSTRUCTIONS FOR TUBE REMOVAL & REPLACEMENT

TOOLS NEEDED

Socket for removing head plate nuts

Current Boiler Size	Socket Size
100-750	1-1/16" socket
850-5000	1-1/4" socket
5550-9500	1-5/16" socket
10,000 + larger	1-1/16" socket
Steam Models	
5-40 HP	7/8" socket
50-70 HP	1-1/16" socket

Small pinch bar to pry head plate loose
Small sledge hammer (appx. 4#)
1" chisel 8" to 10" long
Tube cutting tool
1" Socket for square end of tube cutting tool (if used)
12" OAL ratchet for use with tube cutting tool or expander
Extension handle for leverage
Tube expander/roller-3/4" socket
Large drill motor for expanding/rolling of tubes
Test pump (if required)

MATERIAL REQUIRED

2 - Replacement Head Gaskets
Boiler Tubes:
SA178 Grade A 2" Dia - 0.95" Wall
By Boiler Req. Length

PROCEDURE

Apply WD-40 or similar oil on the studs before removing nuts.

Remove the head plate nuts.

Remove the head plates & gaskets.

Open the combustion chamber (fire box) door.

Remove or cover the burner heads (we feel that it is better to remove & clean the burner heads at this time for proper maintenance of your boiler).

U.L. Listed

Gaskets, tube rollers (expanders) & tube cutters are available for sale or rental from the factory. Please call the parts department for details.

A.S.M.E.

NOTE: DO NOT REMOVE THE FOUR "CORNER" TUBES AS THEY ARE NEEDED TO HOLD THE SHAPE OF THE BOILER.

1. Begin by cutting the bottom row of boiler tubes.
2. Cut all other tubes from both ends of the boiler. The tubes will fall into the fire box. Do not damage the burner/gas orifices.
3. Using a dull chisel and sledge hammer, crimp down the flared end of the tube that is left in the tube sheet after cutting.
4. Using the same chisel and hammer, knock the remaining piece of tube into the fire box.
5. After removing the tube ends, clean all tube sheet holes with a grinding stone using caution not to remove too much surface or cause holes to become out of round.
6. Install four tubes into the tube sheet nearest to the remaining four corner tubes and roll (expand) those tubes using your expanding tool, socket and drill motor. Now remove the four "corner" tubes, & tube ends and clean the tube holes as per the above instructions.
7. The remaining tubes can now be installed into the tube sheet at this time.
8. Use a flat ended nail on one end to hold the tube and keep them from spinning while rolling.
9. Lightly grease the inside of the tube before rolling for lubrication of the roller (expander).
10. Expand (roll) all tubes.
11. After expanding wipe inside of tube to remove excess grease.
12. Clean inside of header and head plate.
13. Replace magnesium anode rods (if included with boiler).
14. Install new gaskets (no gasket compound is needed).
15. Install head plates and nuts.
16. Using a 12" OAL ratchet and socket, tighten the head plate nuts.
17. Refill boiler with water.
18. **Pump boiler pressure not to exceed relief valve pressure.**
19. Using a flash light, look into the fire box area and check tubes for leaks.
20. If leaks are found, drain boiler and follow above procedure to re-expand tubes(it is not necessary to remove leaking tube, only to re-roll).
21. Continue procedure until leaks are stopped.

Gaskets, tube rollers (expanders) & tube cutters are available for sale or rental from the factory. Please call the parts department for details.

AJAX BOILER INC.
2701 SOUTH HARBOR BLVD. • SANTA ANA, CA 92704
PHONE: (714) 437-9050 • FAX: (714) 437-9060
http://www.aboilerinc.com • EMAIL: Info@aboilerinc.com

YOUR LOCAL REPRESENTATIVE IS:

N O T I C E

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

W A R N I N G

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

AJAX BOILER INC.
2701 S. Harbor Blvd. • Santa Ana, CA 92704
714.437.9050 • Fax 714.437-9060
www.ajaxboiler.com
mail@ajaxboiler.com

SO # _____

Serial No. _____

Model No. _____

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